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Risk Factors of Sudden Sensorineural Hearing Loss in Armenia:

A Case-Control Study

Professional Publication Framework

By:

Lusine Mamikonyan, MD, MPH (c)

Advising Team:

Ani Movsisyan, Dphil (PhD), MSc, MPH

Anahit Demirchyan, MD, MPH

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List of Abbreviations

CI	Confidence interval
ESR	Erythrocyte sedimentation rate
HSV-1	Herpes simplex virus type 1
HSV-2	Herpes simplex virus type 2
IRB	Institutional review board
MnD	Meniere's disease
MS	Multiple sclerosis
NSAID	Non-steroidal anti-inflammatory drugs
OR	Odds ratio
SAD	Systemic autoimmune diseases
SARS-Cov-2	Severe acute respiratory syndrome coronavirus 2
SD	Standard deviation
SSNHL	Sudden sensorineural hearing loss
USA	United States of America

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Abstract

Introduction: Sudden sensorineural hearing loss (SSNHL), also defined as sudden deafness, is a sudden loss of hearing which develops over a 72-hour period. The global incidence of SSNHL was reported to be 5-20 cases per 100,000 per year. However, the true incidence might be higher than this. Although various potential risk factors have been proposed, the exact cause of SSNHL remains unclear in most cases, highlighting the importance of investigating its risk factors. To our knowledge, no studies have been conducted in Armenia to determine the predictors of SSNHL among the adult population.
Aim: The aim of this study was to identify potential risk factors of sudden sensorineural hearing loss in Armenia.
Methods: A case-control study was designed to explore the risk factors of SSNHL. The study setting was the audiology department of Erebuni medical center, which provides major audiological services throughout Armenia. The study population were people aged between 18 and 70 years who checked their hearing at Erebuni medical center between 2021 and 2023. Cases were those diagnosed with SSNHL, while controls were patients diagnosed with a conductive type of hearing loss or no hearing impairment. Medical record review was conducted from pure tone audiometry journals, and surveys were carried out using telephone interviews. The study instrument was developed based on a literature review and pretested before the interviews. The questionnaire had seven domains: sociodemographic factors, comorbidities, infectious risk factors, ototoxic drugs, other risk factors, behavioral factors, and socioeconomic factors. Statistical analysis involved descriptive, simple and multiple logistic regression analyses. The Institutional Review Board of the American University of Armenia approved the study.
Results: The study was conducted among 162 participants (81 cases and 81 controls) with a 3.6% refusal rate among cases and 16.5% among controls. The study found that people smoking at the time of the hearing test had 2.68 (95% CI: 1.16-6.17) times higher odds of experiencing SSNHL. Elevated blood cholesterol level was associated with 2.70 (95% CI: 1.06-6.93) times higher odds of developing SSNHL. The observed effect ranges for diabetes and frequent usage of pain relievers included no-effect value (one), possibly due to the small sample size, but for both, a clear direction was towards the large effect (aOR=3.78; 95% CI: 0.94-15.19; aOR=2.48; CI: 0.86-7.20; respectively).
Conclusion: The study identified three major determinants associated with a higher risk of SSNHL in Armenia. The findings are mainly consistent with the previous studies. The results highlight the importance of preventive measures such as implementing smoking prevention and cessation programs, monitoring blood cholesterol and glucose levels among the population groups at higher risk for hyperlipidemia and hyperglycemia, and educating patients on effectively controlling cholesterol and glucose levels in case of hypercholesterolemia and hyperglycemia.

Introduction

Background

Sudden sensorineural hearing loss (SSNHL), also defined as sudden deafness, is a sudden loss of hearing, mostly in one ear, which develops over a 72-hour period.[1] It is diagnosed in the presence of 30 dB or more sensorineural hearing loss across at least three consecutive frequencies.[1] Damage to the inner ear, particularly the cochlea, or to the neural pathways starting from the retrocochlear region to the brain, can result in sensorineural hearing loss.[2] The hearing loss is associated with tinnitus (ringing in the ears), vertigo, nausea, and vomiting.[1,3] People discover their hearing loss in the morning upon waking up or attempting to use their affected ear.[1] This disorder requires urgent medical attention since the timely treatment is associated with a better prognosis, though the association is not quite strong.[4] The low incidence and the wide range of reported spontaneous recovery rate (31-65%) hamper the evaluation of the treatment effectiveness.[4,5] However, early diagnosis (less than a week) and treatment can improve the outcomes.[4,6] It is recommended to immediately start high-dose oral steroid therapy within the first two weeks.[5,7] According to a study, the recovery rate is around 50% if starting the treatment within the first month of the disease onset and as low as 25% in case the treatment is started after the first month.[8]

Epidemiology

The global incidence of SSNHL was reported to be 5-20 cases per 100,000 per year.[9] The annual incidence of SSNHL was 27 per 100,000 people in the USA between 2006 and 2007.[10] However, the true incidence might be higher than the estimated ones since people with spontaneous and quick recovery may not seek medical attention.[6] According to other studies, this

figure can be 160 per 100,000 population.[11] There is an increase in the incidence with older age; 11 per 100,000 people among the population younger than 18 are affected, while the figure is 77 per 100,000 among people 65 years and older.[10] The incidence rate steadily increases with age among those aged from 18 to 65 years.[10] Currently, the age of onset has a declining tendency, with the higher rates of younger people being affected.[12] Males are slightly more susceptible to this disease, with a male-to-female ratio of 1.07:1.[10] The male predominance is more prominent among patients older than 65, with a greater ratio of 1.30:1.[10]

Risk Factors

In most cases, the exact etiology of SSNHL remains unclear; thus, it is diagnosed as idiopathic, highlighting the importance of investigating its risk factors.[3] Currently, about a hundred potential etiological factors have been proposed.[13] All these more or less well understood risk factors are grouped into several categories; cardio-vascular or hematologic, sociodemographic, behavioral, infectious, autoimmune, neoplastic, otologic, traumatic, and ototoxic.[1,3,6,14–16]

Cardiovascular or hematologic risk factors

A large number of risk factors of cardiovascular and hematologic diseases are associated with SSNHL, according to several meta-analyses and case-control studies. [14,17–19] Various vascular and hematologic pathologies, such as endothelial damage, thromboembolic disorders, increased plasma viscosity, and many others can reduce the blood supply of the cochlea by affecting the labyrinthine artery.[14,18] The cochlear microcirculation is composed of a terminal capillary bed and lacks collateral vessels for restoring blood supply during ischemic conditions, making it susceptible to vascular impairment.[17,19] Additionally, cochlear hair cells require high oxygen levels due to their high metabolic activity rate; thus, they are vulnerable to minimal

ischemia and hypoxia.[17] Hence, even brief episodes of vascular obstruction and reduced blood flow in this region can result in clinical manifestations, such as temporary or permanent hearing damage.[17,19]

Diabetes is a metabolic disorder that can impair the microcirculation of cochlear structures leading to hearing damage.[20] According to a case-control study, the odds of diabetes is two times higher among people diagnosed with SSNHL compared to controls.[17] High blood pressure is another potential risk factor for this disease. Based on a systematic review and meta-analysis of SSNHL in adults, 13.6% of patients with SSNHL had hypertension, while only 0.5% of the general population suffered from hypertension.[14] Stroke is another acute cardiovascular event that might be related to hearing loss.[21] A cohort study in Taiwan identified a twofold increase in SSNHL incidence among stroke patients compared to non-stroke patients.[21] Changes in lipid profile can also cause microcirculatory disturbance in the cochlea.[22,23] The prevalence of hypercholesterolemia among idiopathic SSNHL patients is 35-40%.[6] Different types of coagulopathies may also increase the risk of SSNHL.[18,19,24] Despite the findings of these studies, the link between SSNHL and cardiovascular risk factors still needs thorough exploration.[25]

Sociodemographic risk factors

As mentioned above, the incidence of SSNHL increases with age.[10] However, since the true incidence is still not fully identified, some inconsistencies exist relating to the age of the disease onset.[6] According to one of the sources, the incidence peaks between 50 and 60 years of age.[6] According to other articles, people from mid-forties to mid-fifties are the most susceptible to sudden hearing loss.[26,27] Males are marginally more likely to suffer from SSNHL.[10] Although, this difference is not identified in some literature.[6,26,27] A Taiwanese study of 31,258 SSNHL patients reported a mean age of 50.30 (SD 16.70), 53.5% diagnosed males, and 46.5% females.[28]

A cross-sectional survey conducted in China among 866 SSNHL patients reported a mean age of 37.3 years and 44.0% of male patients.[12] Additionally, it identified that 83.6% of participants were employed and 82.2% were married.[12] Another study in Iran revealed that hearing loss is associated with insufficient education and income.[29]

Behavioral risk factors

Smoking, alcohol consumption, dietary habits, exposure to environmental noise, and insomnia have also been linked to SSNHL.[3,12,14,17,30–33] Smoking and alcohol can increase the probability of labyrinthine artery atherosclerosis and microthrombus formation; thus, impairing the blood supply to the inner ear.[34] A retrospective cohort study conducted in Korea presented an association between SSNHL and insomnia.[33] The previously mentioned Chinese cross-sectional study reported that 16.9% of SSNHL patients had a previous history of noise exposure.[12] Eating light-colored fresh vegetables was revealed to be protective against the risk of SSNHL (OR=0.48; 95% CI: 0.24-0.96 p=0.04).[17]

Infectious risk factors

Various studies have demonstrated possible link between viral infections and SSNHL.[35] According to a systematic review, about 12.8 % of this disorder can be attributed to infectious diseases.[1] There are three possible mechanisms that viral infection can lead to hearing loss; direct damage to the cochlear nerve or its fluid spaces, reactivation of some latent viruses inside the inner ear, and indirect damage of the inner ear by triggering an immune response.[35] Mumps, rubella, measles, influenza-B, herpes simplex viruses (HSV-1 and HSV-2), and Lassa virus may impair hearing by direct invasion of the cochlea.[6,35] Reactivation of different latent viruses such as varicella-zoster virus, Epstein-Barr virus, and cytomegalovirus located in the inner ear may have an etiological link to SSNHL[35]. In adults who have been exposed to these viruses during

their childhood, sudden deafness can be explained by reactivation of latent viruses.[35] The third mechanism proposes that viruses such as Lassa virus can damage hearing by inducing an antibody response against inner ear antigens.[35] Evidence suggests that severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is a potential risk factor for SSNHL with an unknown mechanism.[36] Group A *Streptococcus*, *Treponema pallidum* (syphilis), *Borrelia burgdorferi* (Lyme disease), and *Toxoplasma gondii* are other non-viral infections that can cause hearing damage.[1]

Autoimmune risk factors

Immune-mediated inflammation is another proposed theory of SSNHL etiology.[37] On average, 45.7 % of patients diagnosed with sudden deafness have an increased erythrocyte sedimentation rate (ENR), which is one of the non-specific inflammatory markers.[6] Different mechanisms can injure the inner ear, such as an autoantibody response against antigen, complement system activation, and direct damage by cytotoxic T cells.[38] High levels of autoantibodies against phospholipids and anti-endothelial cell autoantibodies, which are elevated during systemic autoimmune diseases (SAD), have been detected among SNHLL patients.[37] Systemic lupus erythematosus, Susac syndrome, antiphospholipid syndrome, polyarteritis nodosa, Wegener's granulomatosis, Sjogren syndrome, rheumatoid arthritis, Cogan syndrome, sarcoidosis, Behcet syndrome are the most common SADs associated with SNHL.[38] Even though the exact pathophysiology of immune damage is still unclear, the clinical benefits of corticosteroids and immunosuppressants during SSNHL favor this theory.[38]

Ototoxic drugs

Ototoxicity or cellular degeneration of the cochlea is a possible side effect of platinum-based chemotherapeutic agents (cisplatin), antibiotics (aminoglycosides, macrolides), anti-

inflammatory medication (NSAID, aspirin), loop diuretics, antimalarials and quinines.[2,39–41] Hearing loss due to these medications can happen at any point of treatment or after intake, leading to gradual or sudden hearing loss.[39] However, this relation is better studied for age-related hearing loss.[40,41]

The exact mechanism of long-term ototoxicity of these medications is not well known.[40] The toxicity of aminoglycosides is considered to be through elevating the levels of free radical formation, which results in hair cell death by damaging cochlear mitochondria, while cisplatin targets the spiral ganglion cells, outer hair cells, and the stria vascularis.[40] High doses of anti-inflammatory medication alter the function of outer hair cells by decreasing the blood supply to the cochlea.[40] Loop diuretics are thought to impair the function of the stria vascularis as well.[40]

Neurological disorders

Potential causes of SSNHL related to neurological origin include multiple sclerosis (MS), migraine, and pontine ischemia.[6] Multiple sclerosis is a demyelinating brain stem disease that mainly affects the optic nerve.[42] Nonetheless, as a part of the auditory tract, the vestibulocochlear nerve can also be involved, and SSNHL can be its clinical manifestation.[42] About 4 - 10% of MS patients experience sudden deafness during remission and relapse.[43]

Currently, a growing body of evidence suggests a possible link between migraine and SSNHL.[44–46] One retrospective cohort study demonstrated that the risk of developing SSNHL among migraine patients was 1.8 times higher than that of matched non-migraine controls.[45] According to another cohort study, the cumulative incidence of inner ear disorders among migraine patients was 12.2%[46]. In comparison, it was only 5.5% among matched controls, and the adjusted hazard ratio for SSNHL was 1.22 (95% CI, 0.53-2.83) among the migraine cohort compared to controls.[46]

Thyroid diseases

SSNHL can be one among many clinical manifestations of thyroid disorders, which are endocrine diseases characterized by altered serum thyroid hormone levels, either hypothyroidism or hyperthyroidism.[47] The prevalence of thyroid dysfunction among SSNHL patients varies from 1% to 15%.[6] A nationwide case-control study in Taiwan revealed that hypothyroidism among patients older than 50 and hyperthyroidism among women are risk factors for SSNHL.[47]

Osteoporosis

Osteoporosis is a systemic skeletal condition that leads to a decrease in bone mass, bone fragility, and susceptibility to fractures.[48] Various studies have proposed a possible association between osteoporosis and SSNHL.[48] Based on a retrospective study, patients diagnosed with osteoporosis had an incidence rate of 10.43 per 10 000 person-years of SSNHL, while this rate was only 5.93 per 10 000 person-years for the control group.[48]

Neoplasia

About 1% of SSNHL can be a clinical manifestation of retrocochlear disease.[49] Vestibular schwannoma (VS) is one of the most common retrocochlear disorders that can be linked to sudden deafness.[49] SSNHL can be found among 12-26% of VS patients.[50] Sudden deafness can also be a rare clinical presentation of sphenoid wing meningiomas.[51]

Family history

SSNHL is a multifactorial disorder; both genetic and environmental factors play a role in its etiology.[52] Various studies aimed to identify a possible link between the disease and heritable factors.[53] According to a retrospective study, 33.6 % of patients diagnosed with SSNHL had a positive family history.[54]

Other otological diseases

Based on a meta-analysis of various studies, approximately 5% of SSNHL can be caused by other otological disorders such as Meniere's disease (MnD), otosclerosis, fluctuating hearing loss, and enlarged vestibular aqueduct.[6] MnD is a common disorder that can initially manifest as sudden deafness.[55]

Trauma

Traumatic events may account for 4% of the incidence of SSNHL.[6] Inner ear structures are quite vulnerable to cochlear trauma; its membranes can easily be ruptured, which clinically will be presented as sudden deafness.[6] Trauma leading to hearing impairment is classified into temporal bone fracture, barotrauma, acoustic trauma, and otological surgical trauma.[6,56] Acoustic trauma is defined as hearing loss as a result of excessive noise.[57] It is more common in a military environment and can lead to both sensorineural and conductive hearing loss.[58]

Situation in Armenia

There is little data about the prevalence of SSNHL in Armenia. Only one study examining therapeutic effect, reported 98 patients diagnosed with SSNHL in only one of the hospitals in Armenia (Astghik medical center) between 2015 and 2019.[59] According to communications with specialists, SSNHL is diagnosed based on the results of pure tone audiometry. The majority of large hospitals in Yerevan are equipped with an audiometer. However, some healthcare facilities in regions lack this equipment. Therefore, patients with a possible diagnosis of SSNHL are referred to Yerevan. After the diagnosis is made, steroid therapy is immediately started.

Study Rationale

SSNHL is an otological emergency; thus, delayed diagnosis and treatment might have detrimental effects leading to permanent hearing loss.[60] Given the unknown but possibly high incidence rate of SSNHL in Armenia, and the importance of its prevention or timely intervention, studies are needed to identify potentially modifiable risk factors and the population groups at high risk for the disease.

Study Aim

The aim of this study was to identify potential risk factors of sudden sensorineural hearing loss in Armenia, such as sociodemographic and behavioral factors, comorbidities, infectious diseases, ototoxic drugs, other otological diseases, family history, trauma, etc.

The research question was the following:

- What are the common risk factors of sudden sensorineural hearing loss among the adult population of Armenia?

Methods

Study Design

A case-control study was conducted to investigate the risk factors of SSNHL. This design has several advantages for this study, such as it enables exploring multiple risk factors, can be applied in case of rare diseases, requires fewer resources, and can be conducted within a short timeframe. The study duration was about six months.

Study Setting

The data was collected from the audiological department of Erebuni medical center that is one of the major audiological service providers throughout Armenia. The hospital was selected based on the student investigator's convenience and data availability.

Study Participants

The study population comprised people who underwent pure tone audiometry at Erebuni medical center between 2021 and 2023. Cases were those diagnosed with SSNHL, while controls were among patients not diagnosed with SSNHL, who also underwent pure tone audiometry at the same facility at the same period. Controls were diagnosed with a conductive type of hearing loss or had no hearing impairment. The inclusion criterion was patient's age between 18 and 70 years. The lower limit of 18 years was chosen for ethical reasons to include only legal adults, while the upper limit was chosen to exclude people with age-related hearing loss. People diagnosed with a mixed type of hearing loss or age-related hearing loss, not speaking Armenian, and those with profound bilateral hearing loss that hinders the telephone interview, were excluded.

Sample Size Calculation

The formula for two proportions was used to calculate the sample size with a 0.05 level of significance and 0.8 power. According to a case-control study of SSNHL in adults, 15.6% of patients with SSNHL had diabetes, while only 9.5% of the general population suffered from diabetes.[17] Only 5.6% of the population is diagnosed with diabetes in Armenia[61]. The study aimed to detect a 15% difference among cases and controls with 80% study power and 95% confidence level. Based on the calculations, 158 participants (79 in each group) were needed. The relatively large difference of 15% was taken for feasibility reasons, as SSNHL is a rare disease and identifying a considerably larger number of cases (e.g., 148, if 10% difference would

be taken) would not be feasible for this study. However, the intention was to target a higher-than-calculated sample size if more cases were identified.

$$n = \frac{(z_{1-\alpha/2}\sqrt{2\underline{p}(1-\underline{p})} + z_{1-\beta}\sqrt{p_1(1-p_1)+p_2(1-p_2)})^2}{(p_1-p_2)^2} \quad \underline{p} = \frac{p_1+p_2}{2} \quad n =$$

$$\frac{(1.96\sqrt{2*0.131(1-0.131)} + 0.842\sqrt{0.056(1-0.056)+0.206(1-0.206)})^2}{(0.056-0.206)^2} = 78{,}256 \approx 79$$

$z_{1-\alpha/2}$= 1.96

$z_{1-\beta}$ = 0.842

$p_1\ (exposure\ among\ controls) = 0.056$

$p_2\ (exposure\ among\ case) = 0.15 + 0.056 = 0.206$

$$\underline{p} = \frac{0.056 + 0.206}{2} = 0.131$$

Data Collection

After obtaining permission from the study hospital, participants were identified from the pure tone audiometry journals, which served as the sampling frame. These records contained information about patients' age, type of hearing loss (sensorineural, conductive, and mixed), degree of hearing loss (mild, moderate, severe, and profound), date of the diagnosis, and contact number. The records included all individuals who underwent audiometry at the hospital starting from 2021 to the present (Appendix 1). Hearing thresholds for air conduction were assessed at 125, 250, 500, 1000, 2000, 4000, and 8000 dB. Hearing thresholds for bone conduction were assessed at 250, 500, 1000, 2000, 4000, and 8000 Hz. Masking was applied whenever it was necessary. For calculating the hearing threshold, 5 dB ascending steps were used.

The student investigator and the audiometry nurse conducted a medical record review at the hospital from these audiometry journals. The above-mentioned information was extracted from these records at the hospital and was recorded in the medical record review form (Appendix 2). Information on participant's ID, name, contact number, case/control status and interview dates were separately reported in the Journal (Appendix 3). The student investigator, who is also an ENT physician and a previous staff member of the department, and the nurse determined the case and control status of the participants. Cases and controls were selected from the same source. Census was applied for the cases, as the disease is rare. For each case, the controls were the next patients who had a hearing test in the audiometry journal. For each case, three controls were selected because of the expected high rate of non-response among controls (based on previous studies conducted at Turpanjian College of Health Sciences).

Participants were contacted first by the hospital staff (the audiometry nurse), asking whether the hospital could share their contact information with the researcher. Only after this, the student investigator contacted the participants for potential participation. Then, after presenting the consent form (Appendix 4), obtaining oral consent, and assessing the eligibility criteria, the student investigator arranged and conducted telephone interviews. There was one interview with each respondent, and it lasted 15-20 minutes. Participants faced no difficulties related to hearing since patients with severe bilateral hearing loss were excluded from the study.

The nurse kept a separate Journal form (Appendix 5), which included the participant's ID number, name, contact information, case/control status, and information related to the phone call; and she used a phone script (Appendix 6) for contacting a potential participant first time. The nurse and the student each made three attempts to recruit participants. The response rate was

calculated based on the nurse's Journal form. The data was collected from March 7 to April 16, 2023.

Study Instrument

The study instrument was a questionnaire (Appendix 7) developed based on the literature review.[1,3,6,13–17] The questionnaire consisted of seven domains (sociodemographic factors, comorbidities, infectious risk factors, ototoxic drugs, other risk factors, behavioral factors, and socioeconomic factors). The categorized list of items included in the questionnaire is presented below:

1. *Sociodemographic factors:* patient's age, gender, residency (marzes), residential status (city, village), nationality, family size, education, employment status, and marital status.
2. *Comorbidities:* cardiovascular and hematological disorders and their risk factors (hypertension, diabetes mellitus, hypercholesterolemia, hypercoagulation disorders, stroke, myocardial infarction, anemia, ad thromboembolic disease), systemic autoimmune diseases, neurologic diseases, thyroid diseases, neoplasia, and osteoporosis.
3. *Infectious risk factors:* viral (Herpes Zoster, measles, mumps, COVID-19) and non-viral (Group A Streptococcus and toxoplasmosis).
4. *Ototoxic drugs:* antibiotics (gentamicin, streptomycin, rifampicin, azithromycin, and erythromycin), pain relievers (NSAID), and diuretics.
5. *Other risk factors:* family history of hearing loss, trauma (temporal bone fracture, barotrauma, acoustic trauma, and otological surgical trauma), other otological diseases (Meniere's disease (MD), otosclerosis, fluctuating hearing loss, and vestibular schwannoma), and self-perceived health status.

6. *Behavioral factors:* smoking and drinking habits, working in a noisy environment, listening to loud music, and using headphones.
7. *Socioeconomic factors:* general standard of living, housing condition, and average monthly spending of the family.

The questionnaire was pretested among four cases and three controls before its application in the study. According to their feedback, several changes were made.

Study Variables

The presence or absence of sudden sensorineural hearing loss among people aged between 18 and 70 years was the dependent variable. The diagnosis was confirmed based on the results of audiometry and patient's report.

The independent variables were the potential risk factors; sociodemographic characteristics (age, gender, residency, residential status, nationality, family size, education, employment status, and marital status), comorbidities (cardiovascular and hematological disorders, systemic autoimmune diseases, neurologic diseases, endocrine disorders, neoplasia, and osteoporosis), infections (viral and non-viral), ototoxic drugs (antibiotics, pain-relievers, and diuretics), other possible risk factors (family history of hearing loss, trauma, other otological diseases, and self-perceived health status), behavioral factors (smoking and drinking habits, working in a noisy environment, listening to loud music, and using headphones), and socioeconomic factors (general standard of living, housing condition, and average monthly spending of the family). The majority of variables were dichotomous. Dummy variables were created for those variables (marital status, duration of working in a noisy environment) having

more than two categories. Continuous variables were treated as such after checking the linearity of their association with the outcome on the logistic scale.

Statistical Analysis

The data analysis was performed using IBM SPSS software. Descriptive statistics were used for presenting characteristics (age, gender, degree of hearing loss, proportions of risk factors, etc.) among cases and controls. Percentages and proportions were used to describe categorical variables, while means and standard deviations were used to summarize continuous variables. The chi-square test was used for comparing categorical variables between cases and controls, and the t-test was used for continuous variables' comparison.

Simple logistic regression was run between each potential risk factor and the outcome. Each variable associated with the outcome during the simple logistic regression analysis with a p-value less than 0.25 was further used for building the multiple logistic regression model (62).[62] After subsequent elimination of variables that lost their statistical significance when controlling for other variables, a model of predictors of SSNHL was built. The model that achieved the best possible fit and the highest possible Nagelkerke R Square value while containing variables with p-values below 0.1 was selected as the final. A higher than usual p-value was selected for keeping the variables in the model, considering the small sample size and possibly limited power of the study to capture important predictors of the outcome. The Hosmer-Lemeshow goodness of fit test was used to test the model fit.

Ethical Considerations

The study was approved by the Institutional Review Board of the American University of Armenia. Permission to get access to audiological records and patients' contacts was obtained

from the heads of the audiology departments. A hospital staff member first contacted participants. The student investigator contacted them only after they agreed to participate in the study. Before the start of the telephone interview, oral consent (Appendix 4) was obtained from the participants. The participants were informed about the aim of the study, who was conducting it, why they were selected, how their contacts were obtained, and how much time it would require them to participate in the survey. The details of complete confidentiality and the right to withdraw at any time during the interview process were assured. Each participant was given an ID number. They were also informed that their participation or withdrawal does not harm or directly benefit them.

Results

Response Rate

It was intended to recruit 79 participants in each group. Based on the audiometry journals, 104 potential cases, and 108 eligible controls were identified at Erebuni medical center between January 2021 and April 2023. However, 20 participants from cases didn't meet the eligibility criteria or couldn't be contacted, while 11 subjects from controls couldn't be contacted. Out of 84 contacted cases, the survey was conducted among 81 participants, and three patients refused to take part. Out of 97 contacted controls, 81 participants agreed to complete the interview, and 16 refused to take part. Thus, the refusal rate was 16.5% among controls and only 3.6% among cases. The study had a 75.0% response rate among controls and 77.9% among cases. The overall response rate of the study was 76.4%. An average of 1.3 attempts were made to contact each respondent who completed the questionnaire (1.4 among cases and 1.3 among controls).

Descriptive Statistics

Based on the medical records, out of 81 cases, 53.1% (n=43) suffered from mild, 40.7% (n=33) from moderate, and 6.2% (n=5) from severe hearing loss. SSNHL affected right ear of 64.2% (n=52) of cases, left ear of 30.9% (n=25), and the damage was bilateral in 4.9% (n=5) of cases. The cases sought medical attention, on average, 6.95 days after the onset of hearing impairment. Among controls, 42.0% (n=34) had normal hearing, and 58.0% (n=47) were diagnosed with conductive hearing loss. The degree of conductive hearing loss among 68.1% (n=32) of controls was mild, 29.8% (n=14) was moderate, and 2.1% (n=1) was severe. Left-sided hearing loss was observed among 36.2% (n=17) of the controls, 21.3% (n=10) had right-sided decreased hearing, and 42.6% (n=20) had both-sided. The main reason for controls to visit an audiologist was hearing loss for 37.0% (n=30), ear pain for 42.0% (n=34), tinnitus for 18.5% (n=15), and the requirement of employer for 2.5% (n=2).

The descriptive statistics of participants' characteristics on sociodemographic factors, comorbidities, infectious risk factors, previous use of ototoxic drugs, behavioral, socioeconomic, and other factors are displayed separately for the cases and controls and the total study sample in Tables 1a-f.

The mean age of cases during the hearing test was 43.62 (SD 11.20), ranging from 18 to 66, and 41.43 (SD 13.92), ranging from 18 to 69, for controls. The number of females slightly exceeded the number of males in both groups: 51.9% (n=42) for cases and 55.6% (n=45) for controls. All of the participants were Armenian. No statistically significant differences were observed between cases and controls with regards to sociodemographic and socioeconomic characteristics.

Self-perceived health was significantly lower among cases ($p<0.01$, Table 1-a). SSNHL cases had a significantly higher prevalence of hypertension (35.8% versus 19.8% $p<0.05$, Table 1-b), diabetes (13.6% versus 3.7% $p<0.05$, Table 1-b), and high level of blood cholesterol (25.9% versus 9.9% $p<0.05$, Table 1-b). A statistically significant difference was observed between cases and controls related to their smoking status at the time of their hearing test (27.2% versus 13.6% $p=0.05$, Table 1-f). Several marginally significant differences were detected between cases and controls, such as higher average level of education among controls, previous history of acoustic trauma among cases, and longer duration of working in a noisy environment among cases ($0.05<p<0.10$). Of the 6.2% (n=5) cases who reported positive family history of SSNHL, two had a father who suffered from the same disease, one mother, one sibling, and one grandparent. Meanwhile, only one of the controls reported that his/her father was previously diagnosed with SSNHL. Of the 6.2% (n=5) of cases who had a traumatic experience before the hearing loss, three suffered from acoustic nerve trauma, one barotrauma, and one temporal bone fracture. The participants who had ever been a smoker or smoked at the time of the hearing test were all males. Nobody in the sample suffered from Toxoplasmosis. Of the ototoxic medication use the participants were inquired about, nobody in the sample used Gentamicin, Streptomycin, Rifampicin, and Erythromycin during the inquired period.

Simple Logistic Regression Analysis

The results of simple logistic regression analyses that provide crude associations between each independent variable and the outcome of SSNHL are depicted in Table 2. Higher education was associated with lower odds of developing SSNHL with a crude OR of 0.52 (95% CI: 0.28-0.98). Cases rated their self-perceived health status as worse compared to controls with a crude OR of 2.65 (95% CI: 1.37-5.14). The presence of comorbidities such as hypertension, diabetes,

hypercholesterolemia, and blood coagulation disorders was associated with higher odds of having SSNHL (OR=2.27; 95% CI: 1.11-4.61; OR=4.09; 95% CI: 1.10-15.25; OR=3.19; 95% CI: 1.32-7.72; and OR=3.03; 95% CI: 0.92-9.94, respectively). The crude OR of the association between smoking at the time of the hearing test and the disease was 2.37 (95% CI: 1.06-5.29), demonstrating higher chances of SSNHL among smokers. People who often used pain relievers had 2.39 times the odds of being diagnosed with SSNHL as compared to people who didn't frequently take pain relievers; the observed effect range was suggestive of a weak negative to a moderately positive association between pain reliever usage and SSNHL (95% CI: 0.86-6.64). The odds of SSNHL was higher among participants exposed to occupational noise for more than four years compared with people who never worked in a noisy environment (OR=3.07; 95% CI: 1.05-9.02). An extremely wide confidence interval was observed for the presence of the family history variable (OR=5.26; 95% CI: 0.60-46.09), which may be explained by the low prevalence of the positive family history in the sample (3.7%; n=6).

Multiple Logistic Regression Analysis

Table 3 presents the results of multiple logistic regression analysis. According to the Hosmer-Lemeshow goodness of fit test, the model had a good fit (p=0.959). Nagelkerke R Square value was 0.147. The final model identifying adjusted associations between SSNHL status and independent risk factors included the following variables: smoking at the time of the hearing test (aOR=2.68; 95% CI: 1.16-6.17), having a high level of blood cholesterol at the time of the hearing loss (aOR=2.70; 95% CI: 1.06-6.93), being diagnosed with diabetes before the hearing impairment (aOR=3.78; 95% CI: 0.94-15.19), and frequently taking pain relievers (aOR=2.48; 95% CI: 0.86-7.20).

Based on the study, smoking at the time of the hearing test was associated with 2.68 times higher odds of developing SSNHL. The odds of being diagnosed with SSNHL among patients with elevated blood cholesterol levels was 2.70 times the odds of experiencing SSNHL among participants with normal blood cholesterol levels. Diabetic patients had 3.78 times higher chance of suffering from SSNHL; the observed effect range was suggestive of a weak negative to a strong positive association between diabetes and SSNHL (95% CI: 0.94-15.19). Participants with frequent pain relievers usage were 2.48 times more likely to develop SSNHL; the observed effect range suggested a weak negative to a moderately positive association between regular use of pain relievers and SSNHL (95% CI: 0.86-7.20).

Discussion

Main Findings

To our knowledge, this is the first study conducted in Armenia to determine the predictors of SSNHL among the adult population. On average, the participants visited an audiologist and checked their hearing after 6.95 days of the disease onset. According to the literature, starting the treatment within less than a week is associated with a better outcome[4,6]; hence, delated treatment was not a major concern in this study. Another case-control study reported an average duration of 8.07 days between the onset of hearing loss and treatment.[34] The result of our study about the smoking to be a possible risk factor of SSNHL is consistent with other studies.[14,30–32] Smoking is a cardiovascular risk factor that causes circulatory alterations in the inner ear, which is susceptible to decreased blood supply.[14] According to a systematic review and meta-analysis by Lin et al., heavy smoking along with alcohol consumption significantly increases the risk of SSNHL.[14] The study found a pooled odds ratio of 1.3 (95% CI: 1.12-1.61) for heavy smoking.[14] A cross-sectional study conducted in Japan designed to explore the

relationship between behavioral risk factors of cardiovascular diseases and idiopathic SSNHL identified that the proportion of current smokers was significantly higher among SSNHL patients in comparison to controls from the National Health and Nutrition Survey in Japan.[31] However, there are contradictory data in the literature on this matter.[3,34,63,64] Another systematic review and meta-analysis based on 24 studies reported no significant effect of smoking on SSNHL.[63]

According to this research, being diagnosed with hypercholesterolemia was associated with significantly higher odds of developing SSNHL. Hypercholesterolemia is a cardiovascular risk factor that impairs the blood supply to the inner ear; thus, supporting the vascular hypothesis of SSNHL.[55] This finding is in agreement with the literature.[17,19,22,23,30,63,65–67] The aforementioned systematic review and meta-analysis of 22,620 SSNHL patients and 54,946 matched controls revealed that cases had significantly higher levels of total cholesterol compared to controls, along with a significantly higher prevalence of diabetes and hypertension.[63] An elevated standard mean difference of cholesterol level of 11.09 mg/dL (95% CI: 3.51-18.67; p=0.004) was observed among SSNHL patients.[63] Another systematic review and meta-analysis (102,292 patients) also reported a significant positive association between increased cholesterol level and SSNHL (OR=2.09; 95% CI: 1.52-2.87). According to this study, hypertriglyceridemia also significantly increases the risk of SSNHL (OR=1.54; 95% CI: 1.18-2.02).[66] There are a number of case-control studies conducted in different countries, such as Italy, Iraq, China, and Korea that detected significant differences in lipid profiles among cases and controls.[17,19,22,30,66,67] Another study indicated a significant correlation between higher cholesterol concentration in blood and poorer outcome of hearing recovery after SSNHL, irrelevant to treatment.[23] However, as with the association between smoking and SSNHL, our findings of higher chance of SSNHL

among those with hypercholesterolemia contradict with several other case-control studies.[15,32,34,64]

This study identified diabetes as another determinant of sudden deafness. This finding is in line with the literature.[17,63] The mechanism is similar to other cardio-vascular factors, which cause microcirculatory and hemodynamic disorders in the cochlea.[20] The observed effect range for diabetes and usage of pain relievers included no-effect value (one), possibly due to the small sample size, but a clear direction was towards the large effect.

Literature suggests inconsistent data related to the ototoxic effect of anti-inflammatory medications. A systematic review of 92,532 participants demonstrated varying data related to the impact of NSAIDs on hearing health.[68] However, according to another study, frequent use of NSAIDs, aspirin, and acetaminophen can increase the chances of hearing loss.[69] However, as mentioned above, the effects of ototoxic medication are well-understood for chronic hearing loss (40, 41).[40,41] Another possible explanation of our finding could be the frequent use of pain relievers among those suffering from migraine, which is a potential risk factor for SSNHL and can mediate the association between medication use and sudden deafness[44–46], but was not measured directly during the study. The participants were asked if they had a neurological disorder in general, but not specifically - migraine.

During this study, we tried to investigate the role of several well-known risk factors of SSNHL, but we could not identify significant associations between many of these factors and the outcome. Although our study identified considerably higher prevalence of hypertension, coagulation disorders, and thyroid diseases among cases compared to controls, the differences did not reach statistical significance. However, a potential explanation for this lack of significance could be the small sample size and resulting limited power of the study. Differences

in the reported prevalence of other comorbidities (stroke, myocardial infarction, thromboembolic events, systemic autoimmune diseases, neoplasia, and osteoporosis) might not be captured by this study as a result of their low overall prevalence in the population. However, still, these conditions were more frequent among cases. Other determinants, such as the family history of SSNHL, previous craniocerebral or auditory traumas, prolonged working duration in a noisy environment, and regular listening to loud music were also more common among cases; however, the differences were insignificant.

Strengths of the Study

This is the first known study to explore the possible risk factors of sudden sensorineural hearing loss in Armenia. Selecting cases and controls from the same source could minimize the selection bias. The selection of participants started with patients that have been diagnosed recently; therefore, recall bias was reduced. The diagnosis of the type and degree of hearing loss was based on medical records, which reduced instrumentation and misclassification biases.

Limitations of the Study

The study has several limitations as well. The small sample size and potentially low power of the study are serious limitations; as a result, several well-known risk factors might not have been detected. The sample size to detect a 15% difference was chosen for feasibility reasons. The "ideal" sample size, aiming to find a 10% difference in line with literature, should be 296 participants (148 cases and 148 controls). Even though the diagnosis of sensorineural hearing loss was based on medical records, the final group assignment was made after the patients' confirmation of the sudden nature of hearing loss. All the risk factors were self-reported, which might have introduced some inaccuracy. Given the nature of data collection, social desirability could have also been an issue when answering sensitive questions such as

smoking, alcohol use, previous diseases, etc. Including different degrees of hearing loss in the study was another limitation, since there might be a link between exposure to potential risk factors and the degree of hearing loss. Generalizability could have been a threat to external validity as this was a one-hospital-based study, and people living in regions might refer to their local hospitals for audiological assessment. However, audiometry is mainly conducted in tertiary care facilities and is lacking in most region-based health care centers.

Recommendations

According to this study, smoking at the time of hearing loss, elevated blood cholesterol level and diabetes significantly increase the risk of SSNHL among adults in Armenia. Smoking prevention and cessation programs among the population should be prioritized. Monitoring blood cholesterol and glucose levels should be encouraged among the population groups at higher risk for hyperlipidemia and hyperglycemia. After identifying lipid profile disorders and hyperglycemia, primary health care physicians, cardiologists, and endocrinologists need to educate patients on properly controlling their cholesterol and glucose levels with diet and medication.

Larger-scale studies of SSNHL risk factors are warranted for future research, as a bigger sample size and higher power will enable to capture other important determinants of the outcome that this study failed to reveal. In addition, including other hospitals can strengthen the study and increase the generalizability of the findings.

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Tables

Table 1-a Distribution of sociodemographic and socioeconomic factors between cases with SSNHL and controls in Erebuni hospital, Armenia, 2023

Characteristics	Case (n=81)	Control (n=81)	p-value	Total sample (n=162)
Age during survey in years, mean (SD)	44.60 (11.15)	42.54 (13.85)	0.298	43.57 (12.58)
Age during the hearing test in years, mean (SD)	43.62 (11.20)	41.43 (13.92)	0.273	42.52 (12.64)
Gender, % (n)			0.753	
Male	48.1 (39)	44.4 (36)		46.3 (75)
Female	51.9 (42)	55.6 (45)		53.7 (87)
Region, % (n)			0.684	
Aragatsotn	6.2 (5)	3.7 (3)		4.9 (8)
Ararat	9.9 (8)	7.4 (6)		8.6 (14)
Armavir	11.1 (9)	7.4 (6)		9.3 (15)
Gegharkunik	3.7 (3)	6.2 (5)		4.9 (8)
Kotayk	9.9 (8)	8.6 (7)		9.3 (15)
Lori	3.7 (3)	6.2 (5)		4.9 (8)
Shirak	4.9 (4)	2.5 (2)		3.7 (6)
Syunik	6.2 (5)	2.5 (2)		4.3 (7)
Tavush	2.5 (2)	4.9 (4)		3.7 (6)
Vayots Dzor	6.2 (5)	3.7 (3)		4.9 (8)
Artsakh	0.0 (0)	2.5 (2)		1.2 (2)
Yerevan	35.8 (29)	44.4 (36)		40.1 (65)
Residence, % (n)			0.865	
City/town	67.9 (55)	70.4 (57)		69.1 (112)
Village	32.1 (26)	29.6 (24)		30.9 (50)
Family size, mean (SD)	4.43 (1.64)	4.52 (1.66)	0.739	4.48 (1.65)
Education, % (n)			0.059	
Less than university	58.0 (47)	42.0 (21)		50.0 (81)
University/more	42.0 (34)	58.0 (47)		50.0 (81)
Employment status, % (n)			0.563	
Employed	55.6 (45)	55.6 (45)		55.6 (90)
Unemployed/student	27.2 (22)	33.3 (27)		30.2 (49)
Retired	6.2 (5)	2.5 (2)		4.3 (7)
	11.1 (9)	8.6 (7)		9.9 (16)

Characteristics	Case (n=81)	Control (n=81)	p-value	Total sample (n=162)
Self-employed/seasonal migrant worker/farmer				
Marital status, % (n)			0.189	
Single	11.4 (9)	21.0 (17)		16.3 (26)
Married	79.7 (63)	74.1 (60)		76.9 (123)
Divorced/ widow	8.9 (7)	4.9 (4)		6.9 (11)
Standard of living, % (n)			0.711	
Substantially or little below average	17.3 (14)	16.0 (13)		16.7 (27)
Average	50.6 (41)	45.7 (37)		48.1 (78)
Substantially or littler above average	32.1 (26)	38.3 (31)		35.2 (57)
Satisfaction with housing condition, % (n)			0.567	
Very dissatisfied /dissatisfied	2.5 (2)	3.7 (3)		3.1 (5)
Neither dissatisfied nor satisfied	22.2 (18)	16.0 (13)		19.1 (31)
Satisfied/ very satisfied	75.3 (61)	80.2 (65)		77.8 (126)
Family expenditure, % (n)			0.291	
Less than 250000 AMD	50.0 (25)	36.5 (19)		43.1 (44)
From 250001 - 500000 AMD	38.0 (19)	42.3 (22)		40.2 (41)
Above 500000 AMD	12.0 (6)	21.2 (11)		16.7 (17)

Table 1-b. Distribution of comorbidities between cases with SSNHL and controls in Erebuni hospital, Armenia, 2023

Characteristics	Case (n=81)	Control (n=81)	p-value	Total sample (n=162)
Hypertension, % (n)	35.8 (29)	19.8 (16)	0.035	27.8 (45)
Medication, % (n)	69.0 (20)	87.5 (14)		75.6 (34)
Duration in years, mean (SD)	3.76 (3.18)	5.00 (4.55)		4.20 (3.72)
Diabetes, % (n)	13.6 (11)	3.7 (3)	0.047	8.6 (14)
Medication, % (n)	72.7 (8)	66.7 (2)		71.4 (10)
Duration in years, mean (SD)	2.55 (2.07)	3.67 (2.89)		2.79 (2.19)
Thyroid disease, % (n)	18.5 (15)	12.3 (10)	0.385	15.4 (25)
Name, % (n)				
Hypothyroidism	93.3 (14)	90.0 (9)		92.0 (23)
Hyperthyroidism	6.7 (1)	10.0 (1)		8.0 (2)
Duration in years, mean (SD)	7.87 (8.43)	3.90 (2.13)		6.28 (6.87)
High blood cholesterol, % (n)	25.9 (21)	9.9 (8)	0.013	17.9 (29)
Medication, % (n)	52.4 (11)	62.5 (5)		55.2 (16)
Duration in years, mean (SD)	2.38 (1.96)	2.63 (2.20)		2.45 (1.99)
Blood coagulation disorder, % (n)	13.6 (11)	4.9 (4)	0.101	9.3 (15)
Name, % (n)				
Hypocoagulation	45.5 (5)	50.0 (2)		46.7 (7)
Hypercoagulation	54.5 (6)	50.0 (2)		53.3 (8)
Duration in years, mean (SD)	7.82 (10.88)	10.25 (16.50)		8.47 (12.01)
Thromboembolic event, % (n)	1.2 (1)	0.0 (0)	1.000	0.6 (1)
Name, % (n)				
Unknown	100 (1)	0.0 (0)		0.6 (1)
Time passed in years, mean (SD)	3.00 (-)	-		3.00 (-)
Stroke, % (n)	2.5 (2)	0.0 (0)	0.497	1.2 (2)
Name, % (n)				
Ischemic	100 (2)	0.0 (0)		100 (2)
Hemorrhagic	0.0 (0)	0.0 (0)		0.0
Time passed in years, mean (SD)	7.50 (3.54)	-		7.50 (3.54)
Myocardial infarction, % (n)	2.5 (2)	0.0 (0)	0.497	1.2 (2)
Time passed in years, mean (SD)	10.50 (13.44)	-		10.50 (13.44)
Anemia, % (n)	3.7 (3)	4.9 (4)	1.000	4.3 (7)
Duration in years, mean (SD)	3.33 (2.31)	5.50 (5.17)		4.57 (4.08)

Characteristics	Case (n=81)	Control (n=81)	p-value	Total sample (n=162)
Systemic autoimmune disease, % (n)	3.7 (3)	2.5 (2)	1.000	3.1 (5)
Name, % (n)				
Rheumatoid arthritis	66.7 (2)	50.0 (1)		60.0 (3)
Mediterranean fever	33.3 (1)	0.0 (0)		20.0 (1)
Vitiligo	0.0 (0)	50.9 (1)		20.0 (1)
Duration in years, mean (SD)	10.50 (8.66)	6.00 (5.66)		9.00 (7.54)
Neurological disease, % (n)	3.7 (3)	7.4 (6)	0.495	5.6 (9)
Name, % (n)				
Neurosis	66.7 (2)	33.3 (2)		44.4 (4)
Cerebral atrophy	0.0 (0)	16.7 (1)		11.1 (1)
Depression	0.0 (0)	16.7 (1)		11.1 (1)
Epilepsy	0.0 (0)	16.7 (1)		11.1 (1)
Migraine	33.3 (1)	16.7 (1)		22.2 (2)
Duration in years, mean (SD)	4.00 (2.65)	12.83 (16.53)		9.89 (13.86)
Neoplasia, % (n)	7.4 (6)	4.9 (4)	0.746	6.2 (10)
Name, % (n)				
Breast cancer	16.7 (1)	25.0 (1)		20.0 (2)
Cervical cancer	33.3 (2)	0.0 (0)		20.0 (2)
Hypophyseal tumor	0.0 (0)	50.0 (2)		20.0 (2)
Myoma	16.7 (1)	0.0 (0)		10.0 (1)
Thyroid cancer	16.7 (1)	25.0 (1)		20.0 (2)
Vestibular Schwannoma	16.7 (1)	0.0 (0)		10.0 (1)
Time passed in years, mean (SD)	5.83 (5.49)	2.75 (2.87)	0.338	4.60 (4.70)
Osteoporosis, % (n)	7.4 (6)	3.7 (3)	0.495	5.6 (9)
Duration in years, mean (SD)	3.00 (3.52)	2.33 (1.16)		2.78 (2.86)

Table 1-c. Distribution of infectious risk factors between cases with SSNHL and controls in Erebuni hospital, Armenia, 2023

Characteristics	Case (n=81)	Control (n=81)	p-value	Total sample (n=162)
Herpes zoster, % (n)	0.0 (0)	1.2 (1)	1.000	0.6 (1)
Time passed in months, mean (SD)	-	12.00 (-)		12.00 (-)
Measles, % (n)	29.6 (24)	23.5 (19)	0.447	26.5 (43)
Time passed in years, mean (SD)	44.21 (9.75)	43.68 (10.81)		43.98 (10.11)
Mumps, % (n)	21.0 (17)	21.0 (17)	1.000	21.0 (34)
Time passed in years, mean (SD)	38.56 (10.04)	38.12 (11.10)		38.34 (10.41)
COVID-19, % (n)	11.1 (9)	9.9 (8)	1.000	10.5 (17)
Time passed in months, mean (SD)	6.40 (4.70)	7.88 (4.73)		7.06 (4.63)
Group A Streptococcus, % (n) *(within last month)*	3.7 (3)	4.9 (4)	1.000	4.3 (7)

Table 1-d. Distribution of ototoxic drugs use between cases with SSNHL and controls in Erebuni hospital, Armenia, 2023

Characteristics	Case (n=81)	Control (n=81)	p-value	Total sample (n=162)
Azithromycin, % (n)	3.7 (3)	3.7 (3)	1.000	3.7 (6)
Pain relievers, % (n)	16.0 (13)	7.4 (6)	0.141	11.7 (19)
Diuretics, % (n)	7.4 (6)	2.5 (2)	0.277	4.9 (8)

Table 1-e. Distribution of other risk factors between cases with SSNHL and controls in Erebuni hospital, Armenia, 2023

Characteristics	Case (n=81)	Control (n=81)	p-value	Total sample (n=162)
Family history, % (n)	6.2 (5)	1.2 (1)	0.210	3.7 (6)
Trauma, % (n)	6.2(5)	0.0 (0)	0.059	3.1 (5)
Ear disease, % (n)	2.5 (2)	1.2 (1)	1.000	1.9 (3)
Self-perceived health, % (n)			0.005	
Excellent/very good/good	51.9 (42)	74.1 (60)		63.0 (102)
Fair/poor	48.1 (39)	25.9 (21)		37.0 (60)

Table 1-f. Distribution of behavioral factors between cases with SSNHL and controls in Erebuni hospital, Armenia, 2023

Characteristics	Case (n=81)	Control (n=81)	p-value	Total sample (n=162)
Ever been a smoker, % (n)	34.6 (28)	24.7 (20)	0.228	29.6 (48)
Smoking at the time of hearing test, % (n)	27.2 (22)	13.6 (11)	0.050	20.4 (33)
Years smoked, mean (SD)	5.63 (9.01)	4.86 (10.34)	0.616	5.25 (9.68)
Alcohol usage, % (n)			0.488	
Never	42.0 (34)	40.7 (33)		41.4 (67)
Less than 3 drinks per month	30.9 (25)	37.0 (30)		34.0 (55)
1-3 drinks per week	16.0 (13)	17.3 (14)		16.7 (27)
4 drinks or more per week	11.1 (9)	4.9 (4)		8.0 (13)
Binge drinking, % (n)	0.0 (0)	0.0 (0)	-	0.0 (0)
Working in a noisy environment, % (n)	23.5 (19)	16.0 (13)	0.324	19.8 (32)
Duration, % (n)			0.073	
Never	76.5 (62)	84.0 (68)		80.2 (130)
Less than 4 years	6.2 (5)	9.9 (8)		8.0 (13)
4 years and more	17.3 (14)	6.2 (5)		11.7 (19)
Headphone use, % (n)	22.2 (18)	24.7 (20)	0.427	23.5 (38)
Duration, % (n)				
Never	77.8 (63)	75.3 (61)	0.823	76.5 (124)
Less than 30 minutes	3.7 (3)	7.4 (6)		5.6 (9)
Between 30 minutes to 1 hour	9.9 (8)	7.4 (6)		8.6 (14)
Between 1 hour and 3 hours	6.2 (5)	6.2 (5)		6.2 (10)
More than 4 hours	2.5 (2)	3.7 (3)		3.1 (5)
Headphone type, % (n)				
In-ear	100 (18)	85.0 (17)	0.232	92.1 (35)
Over-ear	0.0 (0)	15.0 (3)		7.9 (3)
Listening to loud music, % (n)	11.1 (9)	6.2 (5)	0.403	8.6 (14)
Duration, % (n)			0.487	
Never	88.9 (72)	93.8 (76)		
Less than 30 minutes	4.9 (4)	2.5 (2)		3.7 (6)
Between 30 minutes to 1 hour	4.9 (4)	2.5 (2)		3.7 (6)
Between 1 hour and 3 hours	1.2 (1)	0.0 (0)		0.6 (1)
More than 4 hours	0.0 (0)	1.2 (1)		0.6 (1)

Table 2. Odds ratios and confidence intervals from simple logistic regression analysis of risk factors of SSNHL in Erebuni hospital, Armeina, 2023

Characteristics	OR	95 CI	p-value
Higher education[1]	0.52	0.28-0.98	0.042
Marital status			
Single	0.30	0.07-1.32	0.111
Married	0.60	0.17-2.15	0.434
Divorced/ widow	1		
Fair/poor self-perceived health	2.65	1.37-5.14	0.004
Hypertension	2.27	1.11-4.61	0.024
Diabetes	4.09	1.10-15.25	0.036
High blood cholesterol	3.19	1.32-7.72	0.010
Blood coagulation disorder	3.03	0.92-9.94	0.068
Pain relievers	2.39	0.86-6.64	0.095
Family history	5.26	0.60-46.09	0.134
Ever been a smoker	1.61	0.82-3.19	0.170
Smoking at the time of hearing test	2.37	1.06-5.29	0.035
Duration of working in a noisy environment			
Never	1		
Less than 4 years	0.69	0.21-2.21	0.527
4 years and more	3.07	1.05-9.02	0.041

[1] University/more

Table 3. Logistic regression model of risk factors of SSNHL in Erebuni hospital, Armeina, 2023

Characteristics	aOR	95 CI	p-value
Diabetes	3.78	0.94-15.19	0.061
Elevated blood cholesterol	2.70	1.06-6.93	0.038
Smoking at the time of hearing test	2.68	1.16-6.17	0.021
Usage of pain relievers	2.48	0.86-7.20	0.094
Hosmer-Lemeshow goodness-of-fit test p-value=0.959 **Nagelkerke R-squared - 0.147**			

Appendices

Appendix 1. Information Obtained from the Medical Records

Patient ID#

Age:

Patient sex:

- Male
- Female

Data of audiometry:

Hearing loss:

- Type
    - Sensorineural
    - Conductive
    - Mixed
- Degree
    - Mild
    - Moderate
    - Severe
    - Profound
- Side of affected ear
    - Left
    - Right
    - Both

Appendix 2. Medical Record Review Form

ID	Age (y.)	Gender	Case/ Control	Type of hearing loss	Degree of hearing loss	Side of affected ear	Date of Audiometry (dd/mm/yy)

Result Codes (RC)

Gender
1. Male
2. Female

Case/Control
1. Case
2. Control

Type of hearing loss
1. Normal hearing
2. Sensorineural
3. Conductive
4. Mixed

Degree of hearing loss
1. Normal hearing
2. Mild
3. Moderate
4. Severe

Side of affected ear
1. Normal hearing
2. Left
3. Right
4. Both

ID
1 _ _ _ (four digit ID for cases starting with 1)
2 _ _ _ (four digit ID for controls starting with 2)

Appendix 3. Journal Form for the Student Investigator

Journal Form

ID	Name (first name and last name)	Age (y.)	Gender	Telephone number	Case/ Control	Survey Date (dd/mm/yy)	Att1	Att2	Att3

Result Codes (RC)

1. Completed interview
2. Refusal
3. No response/ wrong contact
4. Postponed interview
5. Died
6. Unable to participate
   6.1 Because of hearing loss
7. Incomplete interview
8. Doesn't know Armenian
9. Chronic hearing loss
10. Not eligible for other reason
11. Other _____

Gender
1. Male
2. Female

Case/Control
1. Case
2. Control

ID
1 _ _ _ (four digit ID for cases starting with 1)
2 _ _ _ (four digit ID for controls starting with 2)

Appendix 4. Informed Consent Form

Հայաստանի ամերիկյան համալսարան
Թրփանճեան առողջապահական գիտությունների ֆակուլտետ
Գիտահետազոտական էթիկայի թիվ 1 հանձնաժողով
Իրազեկ համաձայնության ձև

Բարև Ձեզ: Իմ անունը Լուսինե Մամիկոնյան է: Ես քիթ-կոկորդ-ականջաբան եմ, ես նաև Հայաստանի ամերիկյան համալսարանի Թրփանճեան առողջապահական գիտությունների ֆակուլտետի մագիստրատուրայի ավարտական կուրսի ուսանող եմ: Մենք ավարտական աշխատանքի շրջանակներում անցկացնում ենք հարցում, որպեսզի բացահայտենք հանկարծակի սենսոնևրալ ծանրալսության զարգացման հետ կապված ռիսկի գործոնները Հայաստանում:

Հետազոտությունն իրականացվում է հետազոտության նախապայմաններին համապատասխանող 158 մասնակիցների շրջանում, ովքեր ստուգել են իրենց լսողությունը Էրեբունի բժշկական կենտրոնում 2020 - 2023 թթ. ընկած ժամանակահատվածում: Դուք հրավիրված եք մասնակցելու այս հարցմանը, քանի որ դուք ստուգել եք Ձեր լսողությունը Էրեբունի բժշկական կենտրոնում, որտեղից էլ վերցվել են Ձեր կոնտակտային տվյալները, և բուժքույրը ստացել է Ձեր թույլտվությունը կապվելու համար: Ձեր մասնակցությունն այս նախագծին կսահմանափակվի միայն այս հեռախոսային հարցազրույցով, որը կտևի 15-20 րոպե: Հարցաթերթիկը ներառում է հարցեր մի շարք հնարավոր ռիսկային գործոնների մասին, ինչպիսիք են նախկին հիվանդությունները, վարակները և վարքագծային գործոնները, որոնց հետ դուք կարող եք առնչված լինել՝ նախքան լսողության թեստ անցնելը:

Ձեր մասնակցությունն այս հարցմանը լիովին կամավոր է: Դուք իրավունք ունեք համաձայնել կամ հրաժարվել մասնակցությունից: Կարող եք հրաժարվել պատասխանել ցանկացած հարցի, որը Ձեզ դուր չի գալիս, կամ դադարեցնել հարցազրույցը ցանկացած պահի: Այս հարցմանը Ձեր մասնակցությունը կամ դրանից հրաժարվելը որևէ վտանգ չի ներկայացնում Էրեբունի բժշկական կենտրոնում Ձեր հետագա բուժման համար: Մասնակցելով այս հետազոտությանը՝ դուք որևէ ուղղակի շահ չեք ստանա, սակայն Ձեր անկեղծ պատասխանները վճռորոշ կլինեն հանկարծակի ծանրալսության առաջացման ռիսկային գործոններն ավելի լավ հասկանալու համար, ինչը հետագայում կարող է նպաստել ավելի արդյունավետ կանխարգելիչ միջոցառումներ մշակելուն:

Այս հարցումը լիովին գաղտնի է: Ձեր կողմից տրամադրված տեղեկությունները և բժշկական տվյալները հասանելի կլինեն միայն մեր հետազոտական թիմին: Ձեր անձնական տվյալները գաղտնի կպահվեն անվտանգ

վայրում (կողպեքի տակ) և հետազոտության ավարտից վեց ամիս անց կոչնչացվեն: Հետազոտության վերջնական զեկույցը կներառի միայն բոլոր հարցաթերթիկների տվյալների ամփոփ նկարագիրը:

Այս հետազոտության հետ կապված հավելյալ հարցեր ունենալու դեպքում կարող եք կապվել Հայաստանի ամերիկյան համալսարանի Թրփանճեան առողջապահական գիտությունների ֆակուլտետի ավագ գիտաշխատող, հետազոտական թիմի անդամ Անահիտ Դեմիրճյանի հետ, հետևյալ հեռախոսահամարով՝ +374 60 612 562: Եթե զգաք, որ այս հետազոտության շրջանակներում որևէ կերպ վիրավորել են Ձեզ հարցազրույցի ընթացքում կամ Ձեզ հետ ճիշտ չեն վարվել, կարող եք դիմել Հայաստանի ամերիկյան համալսարանի գիտահետազոտական էթիկայի հանձնաժողովի համակարգող Վարդուհի Հայրումյանին՝ հետևյալ հեռախոսահամարով. +374 60 612 561: Ծրագրի գլխավոր հետազոտող է հանդիսանում Թրփանճեան առողջապահական գիտությունների ֆակուլտետի հրավիրյալ դասախոս Անի Մովսիսյանը:

Համաձա՞յն եք մասնակցել հարցազրույցին: (Այո կամ Ոչ)

Շնորհակալությու՛ն: Կարո՞ղ ենք սկսել:

American University of Armenia
Turpanjian College of Health Sciences
Institutional Review Board #1
Informed Consent Form

Hello, my name is Lusine Mamikonyan. I am an ear, nose, and throat physician, and I am a graduate student of the Master of Public Health program at the Turpanjian College of Health Sciences at the American University of Armenia. We are conducting a survey as part of a master thesis project to assess risk factors associated with sudden sensorineural hearing loss in Armenia.

The research is being conducted among 158 eligible participants who checked their hearing at Erebuni medical center between 2020 and 2023. You are invited to participate in this survey since you underwent a hearing test at Erebuni medical center, from where your contact information was obtained, and the nurse received your permission to be contacted by me. Your participation in this project will include only this telephone interview and should take 15 - 20 minutes. The questionnaire involves a group of potential risk factors such as previous diseases, infections, and behavioral factors that you might have been exposed to before the hearing test.

Your participation in this survey is completely voluntary. You have the right to agree or refuse to participate. You may skip any question you feel uncomfortable with or stop the interview anytime. Participation in this survey or refusal entails no risk to your future attendance at Erebuni medical center. You will not receive any direct benefits by participating in this study, but your honest answers will be crucial for better understanding the risk factors of sudden deafness, which later can help in developing better prevention measures.

The survey is completely confidential. Only our research team will have access to the information provided by you and the data extracted from the medical records. The journal form that contains data on your identity, and contact information, will not be revealed, will be kept in a secure location (under a lock), and will be destroyed six months after the completion of the study. The final report will only include the summary of the data from all questionnaires.

If you have any questions about the study or your participation, you can contact the co-investigator of this study and the Research Assistant Professor of the College of Health Sciences at the American University of Armenia, Dr. Anahit Demirchyan at +374 60 612 562. If you think you have been hurt by joining the study or feel you have not been treated fairly, you should contact Ms. Varduhi Hayrumyan, the Human Protections Administrator of the Institutional Review Board of the American University of Armenia: +374 60 612 561. The principal investigator of the study is Dr. Ani Movsisyan, a Visiting Assistant Professor at the College of Health Sciences.

Do you agree to participate? (YES or NO)

Thank you. If yes, shall we continue?

Appendix 5. Journal Form for the Nurse

ID	Name (first name and last name)	Telephone number	Case/ Control	Phone Call Date (dd/mm/yy)	Att1	Att2	Att3

Result Codes (RC)

1. Agreed to participate
2. Refusal
3. No response/ wrong contact
4. Postponed the call
5. Died
6. Unable to participate
   6.1 Because of hearing loss
7. Doesn't know Armenian
8. Other _____

Case/Control

1. Case
2. Control

ID

1 _ _ _ (four digit ID for cases starting with 1)

2 _ _ _ (four digit ID for controls starting with 2)

Appendix 6. Phone Script for the Nurse

Բուժքրոջ հեռախոսազրույցի սցենարը

Բարև Ձեզ: Իմ անունն Արմինե է: Ես Էրեբունի բժշկական կենտրոնի աուդիոմետրիայի բուժքույրն եմ: Այժմ Հայաստանի ամերիկյան համալսարանի Թրփանճեան առողջապահական գիտությունների ֆակուլտետի մագիստրատուրայի ուսանողի ավարտական աշխատանքի շրջանակներում անցկացվում է մի հարցում, որի նպատակն է բացահայտել հանկարծակի սենսոնևրալ ծանրալսության զարգացման հետ կապված ռիսկի գործոնները Հայաստանում:

Հետազոտությունն իրականացվում է հետազոտության նախապայմաններին համապատասխանող մասնակիցների շրջանում, ովքեր ստուգել են իրենց լսողությունը Էրեբունի բժշկական կենտրոնում 2020 - 2023 թթ. ընկած ժամանակահատվածում: Դուք հրավիրված եք մասնակցելու այս հարցմանը, քանի որ դուք ստուգել եք Ձեր լսողությունը Էրեբունի բժշկական կենտրոնում, որտեղից էլ վերցվել են Ձեր կոնտակտային տվյալները: Եթե դեմ չեք, կարո՞ղ եմ Ձեր թույլտվությամբ, Ձեր կոնտակտային տվյալները փոխանցել հետազոտողին, ով հետագայում կկապվի Ձեզ հետ, կտրամադրի հետազոտության հետ կապված ավելի մանրամասն տեղեկություններ և ըստ Ձեր համաձայնության պարագայում կանցկացնի հարցումը:

Կարո՞ղ եմ Ձեր կոնտակտային տվյալները տրամադրել հետազոտողին: (Այո կամ Ոչ)

Շնորհակալությու՛ն:

Phone Script for the Nurse

Hello, my name is Armine. I am an audiometry nurse at Erebuni medical center. In the scope of a master thesis project of the Master Public Health program at the Turpanjian College of Health Sciences at the American University of Armenia, research is being conducted to assess risk factors associated with sudden sensorineural hearing loss in Armenia.

The research is being carried out among patients who checked their hearing at Erebuni medical center between 2020 and 2023. You are invited to participate in this survey since you underwent a hearing test at Erebuni medical center, from where your contact information was obtained. If you don't mind, can I, with your permission, transfer your contact information to the researcher, who will contact you later, provide more detailed information related to the study, and, with your consent, conduct a survey?

Can I provide your contact information to the researcher? (YES or NO)

Thank you.

Appendix 7. Questionnaire for telephone interview

Interview date: ___/___/___
dd mm yy

Interview start time: ___:___
hour min

ID __ __ __ (Patient ID)

1. Screening questions

1.1 Did you check your hearing at Erebuni medical center in the last two years?	1. Yes 2. No *(thank the respondent and complete the interview)*
1.2 What was the main reason for checking your hearing?	1 Hearing loss 2 Ear pain (Go to Q2.1) 3 Employment (Go to Q2.1) 4 Driving license (Go to Q2.1) 5 Ringing in ears (Go to Q2.1) 6 Other _____ (specify) (Go to Q2.1)
1.3 How did your hearing loss start? *(only for cases)*	1. Suddenly (within hours or a few days) 2. Gradually *(thank the respondent and complete the interview)* 3. Don't know *(thank the respondent and complete the interview)*
1.4 How many days later after noticing hearing loss did you have your hearing checked *(if don't remember, record an estimate) (only for cases)*?	_____ (number of days)

2. Sociodemographic factors

2.1 How old are you?	_____ (years)
2.2 What is your gender *(clarify if cannot be determined by voice or records)*?	1. Male 2. Female
2.3 In what marz/region of Armenia do you live?	1. Aragatsotn 2. Ararat 3. Armavir 4. Gegharkunik 5. Kotayk 6. Lori 7. Shirak 8. Syunik 9. Tavush 10. Vayots Dzor 11. Artsakh 12. Yerevan
2.4 Where do you reside?	1. Village 2. City/town
2.5 What is your nationality?	1. Armenian 2. Russian 3. Yezidi 4. Other _____
2.6 How many people live in your family?	_____ (people)
2.7 What is the highest level of education you have completed?	1. School (9 years or less) 2. Compete school (12 years) 3. Intermediate professional (10-13 years) 4. Institute/University 5. Master's degree/Postgraduate 6. Other _____
2.8 What is your employment status?	1. Employed 2. Student 3. Unemployed 4. Retired 5. Self-employed/seasonal migrant worker/farmer 6. Other _____

2.9 What is your marital status?	1. Single 2. Married 3. Divorced 4. Widow 5. Refuse to answer

3. Comorbidities

3. Before the hearing test have you ever been diagnosed with … *(ask for each disease)*	Yes/No	Can you name the specific disease/ Did you regularly take any medication for it before the hearing test *(ask for each disease)*?	How long (years) have you been diagnosed with the disease before the hearing test?/ How much time (years) has passed since the disease started before the hearing test *(if don't remember, record an estimate) (ask for each disease)*?
3.1 Hypertension	1.Yes 2. No (Go to Q3.2)	3.1.1 Medication: 1.Yes 2. No	3.1.2 Duration:
3.2 Diabetes	1.Yes 2. No (Go to Q3.3)	3.2.1 Medication: 1.Yes 2. No	3.2.2 Duration:
3.3 Thyroid disease	1.Yes 2. No (Go to Q3.4)	3.3.1 Name:	3.3.2 Duration:
3.4 High blood cholesterol	1.Yes 2. No (Go to Q3.5)	3.4.1 Medication: 1.Yes 2. No	3.4.2 Duration:
3.5 Blood coagulation disorder	1.Yes 2. No (Go to Q3.6)	3.5.1 Name:	3.5.2 Duration:
3.6 Thromboembolic event	1.Yes 2. No (Go to Q3.7)	3.6.1 Name:	3.6.2 Time:

3.7 Stroke	1.Yes 2. No (Go to Q3.8)	3.9.1 Name: 1. Ischemic 2. Hemorrhagic	3.7.2 Time:
3.8 Myocardial infarction	1.Yes 2. No (Go to Q3.9)		3.8.1 Time:
3.9 Anemia	1.Yes 2. No (Go to Q3.10)		3.9.1 Duration:
3.10 Systemic autoimmune disease (e.g., lupus, scleroderma, and rheumatoid arthritis)	1.Yes 2. No (Go to Q3.11)	3.10.1 Name:	3.10.2 Duration:
3.11 Neurologic disorder	1.Yes 2. No (Go to Q3.12)	3.11.1 Name:	3.11.2 Duration:
3.12 Neoplasia	1.Yes 2. No (Go to Q3.13)	3.12.1 Name:	3.12.2 Time:
3.13 Osteoporosis (bone fragility)	1.Yes 2. No (go to Q 4)		3.13.1 Duration:

4. Infectious risk factors

4. A few months (years) before the hearing test, were you diagnosed with … *(ask for each disease)*	Yes/No	How much time (years) has passed since the last episode of the disease before the hearing test (years/ months) *(if don't remember, record an estimate) (ask for each disease)*?
4.1 Herpes zoster (painful herpetic rash) (months)	1.Yes 2. No (Go to Q4.2)	4.1.1 Time: (months)
4.2 Measles (years)	1.Yes 2. No (Go to Q4.3)	4.2.1 Time: (years)
4.3 Mumps (years)	1.Yes 2. No (Go to Q4.4)	4.3.1 Time: (years)
4.4 COVID-19 (months)	1.Yes 2. No (Go to Q4.5)	4.4.1 Time: (months)

4.5 Toxoplasmosis (months)	1.Yes 2. No (Go to Q4.6)	4.5.1 Time: (months)
4.6 Group A Streptococcus (suppurative tonsillitis) *(ask within last month)*	1.Yes 2. No (Go to Q5.1)	

5. Ototoxic drugs

5.1 Did you take any of these antibiotics within one month before the hearing test?

5.1.1 Gentamicin	1.Yes 2. No
5.1.2 Streptomycin	1.Yes 2. No
5.1.3 Rifampicin	1.Yes 2. No
5.1.4 Erythromycin	1.Yes 2. No
5.1.5 Azithromycin	1.Yes 2. No

5.2 Before the hearing test, were you a frequent user of the following medications (several times a week for at least one year)?

5.2.1 Pain relievers	1.Yes 2. No
5.2.2 Diuretics	1.Yes 2. No

6. Other risk factors

<table>
<tr>
<td>6.1 Has anyone in your family ever suffered from sudden deafness (complained of sudden hearing loss that developed within a few days)?</td>
<td>1. Yes →Who was that person to you?

<table>
<tr><td>6.1.1 Mother</td><td>1.Yes 2. No</td></tr>
<tr><td>6.1.2 Father</td><td>1.Yes 2. No</td></tr>
<tr><td>6.1.3 Sibling</td><td>1.Yes 2. No</td></tr>
<tr><td>6.1.4 Grandparents</td><td>1.Yes 2. No</td></tr>
<tr><td>6.1.5 Other</td><td>_____</td></tr>
</table>

2. No (Go to Q6.2)</td>
</tr>
<tr>
<td>6.2 Have you experienced any physical traumas (including acoustic or pressure injury) within one month before the hearing test?</td>
<td>1. Yes →What type of trauma was that?

<table>
<tr><td>6.2.1 Temporal bone fracture</td><td>1.Yes 2. No</td></tr>
<tr><td>6.2.2 Barotrauma (trauma due to increased air and water pressure)</td><td>1.Yes 2. No</td></tr>
<tr><td>6.2.3 Acoustic trauma (trauma due to excessive noise)</td><td>1.Yes 2. No</td></tr>
<tr><td>6.2.4 Otological surgical trauma (ear surgery)</td><td>1.Yes 2. No</td></tr>
<tr><td>6.2.5 Other</td><td>_____</td></tr>
</table>

2. No (Go to Q6.3)</td>
</tr>
</table>

<table>
<tr><td>6.3 Before the hearing test, were you diagnosed with any other ear diseases?</td><td>1. Yes →What was the disease and how long (years) have you been diagnosed with the disease before the hearing test? (ask for each disease)

<table><tr><td>6.3.1 Meniere's disease</td><td>1.Yes 2. No</td></tr><tr><td>6.3.1.1 Duration:</td><td>____ (years)</td></tr><tr><td>6.3.2 Otosclerosis</td><td>1.Yes 2. No</td></tr><tr><td>6.3.2.1 Duration:</td><td>____ (years)</td></tr><tr><td>6.3.3 Vestibular schwannoma</td><td>1.Yes 2. No</td></tr><tr><td>6.3.3.1 Duration:</td><td>____ (years)</td></tr></table>
2. No (Go to Q6.4)</td></tr>
<tr><td>6.4 How would you describe your health in the last month?</td><td>1. Excellent
2. Very good
3. Good
4. Fair
5. Poor</td></tr>
</table>

7. Behavioral factors

7.1 Have you ever been a smoker?	1.Yes 2. No (Go to Q7.2)
7.1.1 Were you a smoker in the period before the hearing test?	1.Yes 2. No
7.1.2 Overall, how many years have you smoked regularly?	_____ (years)
7.2.1 On average, how often did you use alcohol containing drinks before the hearing test? (One drink is 1 glass of wine; can/bottle of beer; shot of liquor, whiskey or vodka, or mixed drink)	1. I didn't use 2. Less than 3 drinks per month 3. 1-3 drinks per week 4. 4-8 drinks per week 5. 9 drinks or more per week

7.2.2 Before the hearing test, was there ever a time in your life when you drank 5 or more portions of any kind of alcoholic beverage almost every day?	1.Yes 2. No
7.3 Did you work in a noisy environment before the hearing test?	1.Yes 2. No (Go to Q7.4)
7.3.1 How long did you work in a noisy environment before the hearing test?	1. Less than a year 2. 1-3 years 3. 4-6 years 4. 7-10 years 5. More than 10 years
7.4 Did you use headphones before the hearing test?	1.Yes 2. No (Go to Q7.5)
7.4.1 How much time per day did you use headphones before the hearing test?	1. Less than 30 minutes 2. Between 30 minutes to 1 hour 3. Between 1 hour and 3 hours 4. Between 4 hour and 6 hours 5. More than 6 hours
7.4.2 What type of headphones did you mostly use?	1. In-ear 2. Over-ear
7.5 Did you listen to loud music before the hearing test?	1.Yes 2. No (Go to Q8.1)
7.5.1 How much time per day did you listen to loud music before the hearing test?	1. Less than 30 minutes 2. Between 30 minutes to 1 hour 3. Between 1 hour and 3 hours 4. Between 4 hour and 6 hours 5. More than 6 hours

8. Socioeconomic factors

8.1 How would you rate your family's general standard of living?	1. Substantially below average 2. Little below average 3. Average 4. Little above average 5. Substantially above average

8.2 How satisfied are you with your housing conditions?	1. Very dissatisfied 2. Dissatisfied 3. Neither dissatisfied nor satisfied 4. Satisfied 5. Very satisfied
8.3 On average, how much money does your family spend per month?	1. Less than 100000 AMD 2. From 100000 - 250000 AMD 3. From 250001 - 500000 AMD 4. Above 500000 AMD 5. Refuse to answer

Interview end time: ___:___
hour min

Thank you!

Հարցաշար

Ամսաթիվ ___/___/___
օր ամիս տարի

Սկսման ժամ ___:___
ժամ րոպե

Մասնակցի ՏՀ __ __ __

1. Ստուգիչ հարցեր

1.1 Վերջին երկու տարվա ընթացքում «Էրեբունի» բժշկական կենտրոնում ստուգե՞լ եք Ձեր լսողությունը:	1. Այո 2. Ոչ *(շնորհակալություն հայտնեք մասնակցին և ավարտեք հարցումը)*
1.2 Ո՞րն էր Ձեր լսողությունը ստուգելու հիմնական պատճառը:	1 Լսողության կորստի 2 Ականջի ցավի (Անցնել հարց 2.1) 3 Աշխատավայր ներկայացնելու (Անցնել հարց 2.1) 4 Վարորդական իրավունքի (Անցնել հարց 2.1) 5 Ականջի խշշոց (Անցնել հարց 2.1) 6 Այլ _____ (նշեք) (Անցնել հարց 2.1)
1.3 Ինչպե՞ս սկսվեց Ձեր լսողության կորուստը *(հարցրեք միայն դեպքերին)*:	1. Հանկարծակի (մի քանի ժամվա կամ օրվա ընթացքում) 2. Աստիճանաբար *(շնորհակալություն հայտնեք մասնակցին և ավարտեք հարցումը)* 3. Չգիտեմ *(շնորհակալություն հայտնեք մասնակցին և ավարտեք հարցումը)*
1.4 Լսողության կորուստը նկատելուց քանի՞ օր անց եք ստուգել Ձեր լսողությունը *(եթե չի հիշում, հարցրեք մոտավոր թիվը) (հարցրեք միայն դեպքերին)*:	_____ (օր)

2. Սոցիալ-ժողովրդագրական տվյալներ

2.1 Քանի՞ տարեկան եք:	_____ (տարի)
2.2 Խնդրում եմ նշել Ձեր սեռը *(հարցրեք, եթե հնարավոր չէ որոշել ձայնով կամ անունով այլապես՝ նշեք)*:	1. Արական 2. Իգական
2.3 Հայաստանի ո՞ր մարզում կամ տարածաշրջանում եք բնակվում:	1. Արագածոտն 2. Արարատ 3. Արմավիր 4. Գեղարքունիք 5. Կոտայք 6. Լոռի 7. Շիրակ 8. Սյունիք 9. Տավուշ 10. Վայոց Ձոր 11. Արցախ 12. Երևան
2.4 Խնդրում եմ նշել Ձեր բնակավայրը:	1. Գյուղ 2. Քաղաք
2.5 Խնդրում եմ նշել Ձեր ազգությունը:	1. Հայ 2. Ռուս 3. Եզդի 4. Այլ _____
2.6 Քանի՞ անձից է կազմված Ձեր ընտանիքը:	_____ (մարդ)
2.7 Ո՞րն է Ձեր ստացած կրթության ամենաբարձր մակարդակը:	1. Դպրոց (9 տարի կամ պակաս) 2. Դպրոց (12 տարի) 3. Միջնակարգ մասնագիտական (10-13 տարի) 4. Համալսարան (բակալավր) 5. Մագիստրոս/հետբուհական 6. Այլ _____

2.8 Խնդրում եմ նշել Ձեր աշխատանքային կարգավիճակը:	1. Աշխատում եմ 2. Սովորում եմ 3. Չեմ աշխատում 4. Թոշակառու եմ 5. Անհատ ձեռներեց եմ / սեզոնային աշխատանքային միգրանտ / հողագործ 6. Այլ _____
2.9 Խնդրում եմ նշել Ձեր ամուսնական կարգավիճակը:	1. Չամուսնացած 2. Ամուսնացած 3. Ամուսնալուծված 4. Այրի 5. Հրաժարվում եմ պատասխանել

3. Ուղեկցող հիվանդություններ

3. Լսողությունը ստուգելուց առաջ երբևէ Ձեզ մոտ ախտորոշվե՞լ է ... *(Հարցրեք յուրաքանչյուր հիվանդության համար՝ առանձին)*	Այո/Ոչ	Կարո՞ղ եք նշել կոնկրետ հիվանդությունը: / Դուք դրա համար կանոնավոր կերպով որևէ դեղորայք ընդունու՞մ էիք՝ մինչև լսողության թեստը: *(Հարցրեք յուրաքանչյուր հիվանդության համար՝ առանձին)*	Մինչև լսողությունը ստուգելը՝ քանի՞ տարի էր, ինչ Ձեզ մոտ ախտորոշվել էր այդ հիվանդությունը: / Քանի՞ տարի է անցել հիվանդության սկզբից մինչև լսողության թեստը: *(Եթե չի հիշում, հարցրեք մոտավոր թիվը) (Հարցրեք յուրաքանչյուր հիվանդության համար առանձին)*
3.1 Զարկերակային բարձր ճնշում	1.Այո 2. Ոչ *(Անցեք հ.3.2)*	3.1.1 Դեղորայք. 1.Այո 2. Ոչ	3.1.2 Տևողությունը.
3.2 Շաքարային դիաբետ	1.Այո 2. Ոչ *(Անցեք հ.3.3)*	3.2.1 Դեղորայք. 1.Այո 2. Ոչ	3.2.2 Տևողությունը.
3.3 Վահանաձև գեղձի հիվանդություն	1.Այո 2. Ոչ *(Անցեք հ.3.4)*	3.3.1 Անվանումը.	3.3.2 Տևողությունը.

3.4 Արյան մեջ խոլեստերինի բարձր մակարդակ	1.Այո 2. Ոչ *(Անցեք հ.3.5)*	3.4.1 Դեղորայք. 1.Այո 2. Ոչ	3.4.2 Տևողությունը.
3.5 Արյան մակարդելիության խանգարում	1.Այո 2. Ոչ *(Անցեք հ.3.6)*	3.5.1 Անվանումը.	3.5.2 Տևողությունը.
3.6 Թրոմբոէմբոլիա	1.Այո 2. Ոչ *(Անցեք հ.3.7)*	3.6.1 Անվանումը.	3.6.2 Անցած ժամանակը.
3.7 Կաթված/ ինսուլտ	1.Այո 2. Ոչ *(Անցեք հ.3.8)*	3.7.1 Անվանումը. 1. Իշեմիկ 2. Հեմոռագիկ	3.7.2 Անցած ժամանակը.
3.8 Ստրամկանի ինֆարկտ	1.Այո 2. Ոչ *(Անցեք հ.3.9)*		3.8.1 Անցած ժամանակը.
3.9 Սակավարյունություն	1.Այո 2. Ոչ *(Անցեք հ.3.10)*		3.9.1 Տևողությունը.
3.10 Համակագային աուտոիմուն հիվանդություն (օր՝. գայլախտ, սկլերոդերմիա, ռևմատոիդ արթրիտ)	1.Այո 2. Ոչ *(Անցեք հ.3.11)*	3.10.1 Անվանումը.	3.10.2 Տևողությունը.
3.11 Նյարդաբանական խանգարում	1.Այո 2. Ոչ *(Անցեք հ.3.12)*	3.11.1 Անվանումը.	3.11.2 Տևողությունը.
3.12 Ուռուցք	1.Այո 2. Ոչ *(Անցեք հ.3.13)*	3.12.1 Անվանումը.	3.12.2 Անցած ժամանակը.
3.13 Օստեոպորոզ (ոսկրերի փխրունություն)	1.Այո 2. Ոչ *(Անցեք հ. 4)*		3.13.1 Տևողությունը.

4. Ինֆեկցիոն հարուցիչներ

4. Լսողությունը ստուգելուց մի քանի ամիս (տարի) առաջ Ձեզ մոտ ախտորոշվե՞լ է ... *(հարցրեք յուրաքանչյուր հիվանդության համար՝ առանձին)*	Այո/Ոչ	Քանի՞ ամիս/տարի էր անցել հիվանդության վերջին դրվագից՝ մինչև լսողության թեստը: *(Եթե չի հիշում՝ հարցրեք մոտավոր թիվը)*
4.1 Գոտևորող հերպես (դեմքի, կրծքավանդակի, մեջքի կամ որովայնի շրջանում ցավոտ հերպետիկ ցան) (ամիս)	1. Այո 2. Ոչ *(Անցեք հ. 4.2)*	4.1.1 (ամիս)
4.2 Կարմրուկ (տարի)	1. Այո 2. Ոչ *(Անցեք հ. 4.3)*	4.2.1 (տարի)
4.3 Էնդեմիկ պարոտիտ (խոզուկ) (տարի)	1. Այո 2. Ոչ *(Անցեք հ. 4.4)*	4.3.1 (տարի)
4.4 ՔՈՎԻԴ-19 (ամիս)	1. Այո 2. Ոչ *(Անցեք հ. 4.5)*	4.4.1 (ամիս)
4.5 Տոքսոպլազմոզ (ամիս)	1. Այո 2. Ոչ *(Անցեք հ. 4.6)*	4.5.1 (ամիս)
4.6 A խմբի ստրեպտոկոկ (թարախային անգինա)՝ վերջին մեկ ամսում:	1. Այո 2. Ոչ	

5. Օտոտոքսիկ դեղորայք

5.1 Այս հակաբիոտիկներից որևէ մեկն ընդունել ե՞ք լսողությունը ստուգելուն նախորդող մեկ ամսվա ընթացքում:

5.1.1 Գենտամիցին	1.Այո 2. Ոչ
5.1.2 Ստրեպտոմիցին	1.Այո 2. Ոչ
5.1.3 Ռիֆամպիցին	1.Այո 2. Ոչ
5.1.4 Էրիթրոմիցին	1.Այո 2. Ոչ
5.1.5 Ազիթրոմիցին	1.Այո 2. Ոչ

5.2 Նախքան լսողության թեստը՝ օգտագործե՞լ եք հետևյալ տիպի դեղեր՝ առնվազն շաբաթը մի քանի անգամ՝ մեկ տարվա ընթացքում:

5.2.1 Ցավազրկողներ	1.Այո 2. Ոչ
5.2.2 Միազամուղներ	1.Այո 2. Ոչ

6. Այլ գործոններ

6.1 Ձեր ընտանիքում որևէ մեկը երբևէ ունեցե՞լ է հանկարծակի խլություն (բողոքել է լսողության հանկարծակի կորստից, որը զարգացել է մի քանի օրվա ընթացքում):	1.Այո —> Խնդրում եմ նշել նրա կապը Ձեզ հետ. 6.1.1 Մայր — 1.Այո 2. Ոչ 6.1.2 Հայր — 1.Այո 2. Ոչ 6.1.3 Քույր/Եղբայր — 1.Այո 2. Ոչ 6.1.4 Տատիկ/Պապիկ — 1.Այո 2. Ոչ 6.1.5 Այլ — _____ 2. Ոչ
6.2 Լսողությունը ստուգելուց մեկ ամիս առաջ ունեցե՞լ եք որևէ տրավմա (ներառյալ բարձր ձայնով կամ ճնշմամբ պայմանավորված վնասվածք):	1.Այո —> Խնդրում եմ նշել տրավմայի տեսակը: 6.2.1 Քունքոսկրի կոտրվածք — 1.Այո 2. Ոչ 6.2.2 Բարոտրավմա (օդի/ջրի բարձր ճնշումից) — 1.Այո 2. Ոչ 6.2.3 Ակուստիկ տրավմա (բարձր ձայնից) — 1.Այո 2. Ոչ 6.2.4 Ականջի վիրահատական տրավմա — 1.Այո 2. Ոչ 6.2.5 Այլ — _____ 2. Ոչ

<table>
<tr><td>6.3 Լսողության թեստից առաջ Ձեզ մոտ ախտորոշվե՞լ է ականջի որևէ այլ հիվանդություն:</td><td>1. Այո —> Նշեք հիվանդության անվանումը և քանի՞ տարի է, ինչ Ձեզ մոտ ախտորոշվել էր այդ հիվանդությունը՝ նախքան լսողությունը ստուգելը: (Հարցրեք յուրաքանչյուր հիվանդության համար՝ առանձին)
<table>
<tr><td>6.3.1 Մենյերի հիվանդություն</td><td>1.Այո 2. Ոչ</td><td>6.3.1.1 Տևողությունը՝</td></tr>
<tr><td>6.3.2 Օտոսկլերոզ</td><td>1.Այո 2. Ոչ</td><td>6.3.1.2 Տևողությունը՝</td></tr>
<tr><td>6.3.3 Վեստիբուլար շվանոմա</td><td>1.Այո 2. Ոչ</td><td>6.3.3.1 Տևողությունը՝</td></tr>
</table>
2. Ոչ</td></tr>
<tr><td>6.4 Ինչպե՞ս կգնահատեք Ձեր առողջական վիճակը վերջին մեկ ամսվա ընթացքում:</td><td>1. Գերազանց
2. Շատ լավ
3. Լավ
4. Բավարար
5. Վատ</td></tr>
</table>

7. Վարքագծային գործոններ/ ապրելակերպ

7.1 Դուք երբևէ ծխող եղե՞լ եք:	1. Այո 2. Ոչ (Անցնել հարց 6.2)
7.1.1 Լսողությունը ստուգելուց առաջ ընկած ժամանակաշրջանում դուք ծխե՞լ եք:	1. Այո 2. Ոչ
7.1.2 Գումարային՝ քանի՞ տարի եք կանոնավորապես ծխել:	_____ (տարի)
7.2.1 Լսողությունը ստուգելուց առաջ, միջինում, որքա՞ն հաճախ եք օգտագործել ակլոհոլ պարունակող խմիչք (մեկ բաժին է համարվում մի բաժակ գինին, կամ մի շիշ գարեջուրը, մի ըմպանակ լիկյորը, վիսկին կամ օղին, կամ խառնուրդային խմիչքը)	1. Չեմ օգտագործել 2. Ամիսը մինչև 3 բաժին 3. 1-3 բաժին մեկ շաբաթում 4. 4-8 բաժին մեկ շաբաթում 5. 9 բաժին և ավելի մեկ շաբաթում

7.2.2 Լսողությունը ստուգելուց առաջ, Ձեր կյանքում երբևէ եղե՞լ է մի պահ, երբ գրեթե ամեն օր խմել եք 5 կամ ավելի բաժին ալկոհոլային խմիչք:	1. Այո 2. Ոչ
7.3 Լսողության թեստից առաջ աշխատե՞լ եք աղմկոտ միջավայրում:	1. Այո 2. Ոչ (Անցնել հարց 7.4)
7.3.1 Որքա՞ն ժամանակ եք աշխատել աղմկոտ միջավայրում:	1. 1 տարուց քիչ 2. 1-3 տարի 3. 4-6 տարի 4. 7-10 տարի 5. 10 տարուց ավելի
7.4 Լսողությունը ստուգելուց առաջ ականջակալներ օգտագործե՞լ եք:	1. Այո 2. Ոչ (Անցնել հարց 7.5)
7.4.1 Լսողության թեստից առաջ օրվա ընթացքում որքա՞ն ժամանակ եք ականջակալներ օգտագործել:	1. 30 րոպեից քիչ 2. 30 րոպեից մինչև 1 ժամ 3. 1 ժամից մինչև 3 ժամ 4. 4 ժամից մինչև 6 ժամ 5. 6 ժամից ավելի
7.4.2 Խնդրում եմ նշել առավել հաճախ օգտագործվող ականջակալների տեսակը:	1. Ականջախեցու մեջ 2. Ականջից դուրս
7.5 Լսողության թեստից առաջ կանոնավորապես լսե՞լ եք բարձր երաժշտություն:	1. Այո 2. Ոչ (Անցնել հարց 8.1)
7.5.1 Լսողության թեստից առաջ օրվա ընթացքում որքա՞ն ժամանակ եք լսել բարձր երաժշտություն:	1. 30 րոպեից քիչ 2. 30 րոպեից մինչև 1 ժամ 3. 1 ժամից մինչև 3 ժամ 4. 4 ժամից մինչև 6 ժամ 5. 6 ժամից ավելի

8. Սոցիալ-տնտեսական գործոններ

8.1 Ինչպե՞ս կգնահատեք Ձեր ընտանիքի ընդհանուր նյութական վիճակը:	1. Միջինից բավականին ցածր 2. Միջինից քիչ ցածր 3. Միջին 4. Միջինից քիչ բարձր 5. Միջինից բավականին բարձր
8.2 Որքանո՞վ եք գոհ Ձեր տան / բնակարանի պայմաններից:	1. Շատ դժգոհ 2. Դժգոհ 3. Ոչ դժգոհ, ոչ գոհ 4. Գոհ 5. Շատ գոհ
8.3 Միջինում ամսական որքա՞ն գումար է ծախսում Ձեր ընտանիքը:	1. 100,000 դրամից պակաս 2. 100,000 – 250,000 դրամ 3. 250,001 – 500,000 դրամ 4. 500,000 դրամից ավելի 5. Հրաժարվում եմ պատասխանել

Հարցազրույցի ավարտը՝ ___:___
ժամ րոպե

Շնորհակալությու՛ն: