

ORIGINAL RESEARCH

Tinnitus in immigrants attending Swedish language education classes

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Abstract

Objectives: The aim of this study was to investigate the prevalence of tinnitus in immigrants attending Swedish language education classes in comparison with data from the general population and tinnitus's relation to hearing in this specific population.

Methods: The study was based on prospectively collected data regarding hearing and health status in newcomers attending language classes. The examination consisted of pure tone audiometry, an otoscopic examination, and a study-specific questionnaire including questions from the Swedish National Health Survey. Data from the Swedish general population were retrieved from the National Health Survey. Grading of hearing according to the World Health Organization was applied.

Results: A total of 188 study participants were included in the study. Tinnitus was reported by 38% of the immigrants, and severe tinnitus was reported by 8%. Corresponding percentages from the general population were 17% and 3%. High-frequency hearing loss ($PTA_{h3} > 25$ worse ear) was found to be a significant predictor for tinnitus ($p = 0.032$, odds ratio (OR): 2.74 [95% confidence interval (CI): 1.40–5.35]). Additionally, self-reported general health significantly predicted tinnitus, with an increased risk of tinnitus relating to worse general health ($p < .001$, OR: 2.43 [95% CI: 1.66–3.57]).

Conclusion: Severe tinnitus was more than three times as common in the immigrant participants compared to the Swedish population. High-frequency hearing loss and self-reported worse general health were predictors for tinnitus.

Level of Evidence: 1b

KEYWORDS

hearing loss, migrant health, refugee health, tinnitus

1 | BACKGROUND

Health status in immigrants, compared to the native-born population in different countries, often differs, above all, in regard to mental

health. Immigrants suffer from post-traumatic stress disorders, depression, and anxiety to a higher extent than the native-born population.^{1–3} In contrast, many studies suggest that immigrants have overall better physical health than the general population, with lower

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rates of chronic medical conditions attributed to a selection of younger and healthier persons being able to endure migration.⁴ This is often denoted as the “healthy immigrant effect.”⁵

It is well-known that the prevalence of hearing loss and chronic ear conditions differ throughout the world depending on socioeconomic factors.^{6,7} Tinnitus prevalence has been studied on a population level with different prevalence figures depending on the definition, ranging between 5% and 40%.⁸ Risk factors for tinnitus are, among others, increasing age, noise exposure, smoking and hearing loss.⁹ Moreover, reported tinnitus severity is closely related to mental health and can be a symptom of depression and anxiety.¹⁰

Little is known about hearing function and tinnitus in immigrants. To our knowledge, no studies have investigated hearing levels or tinnitus in immigrants. Overall, studies on specific medical conditions in immigrants are scarce, and there is a need for more data.

In light of the sharp increase in migration of people from different countries in the last decade, it is a major challenge for receiving countries to provide ways for people to settle in society. An important part of being able to settle in a society is learning the language. Hearing function is crucial when learning a new language to socialize into new settings. Hearing loss and tinnitus can hamper the learning process and, consequently, complicate integration and the ability for employment and establishment in society.

The aim of this study was to investigate the prevalence of tinnitus in immigrants attending Swedish language education classes in comparison with data from the general population. Furthermore, we assessed tinnitus in relation to hearing and health status in this specific population.

2 | MATERIALS AND METHODS

The study is based on prospectively collected data regarding hearing and health status in newcomers who attended language classes for immigrants in Gothenburg, Sweden, in 2019.

The inclusion criteria were participants >18 years of age and who had immigrated to Sweden. The exclusion criterion was cognitive impairment.

Study subjects were invited to participate in hearing screening carried out at the school where courses in “Swedish for immigrants” were being held. At the present school, only language education for immigrants was carried out; thus, all participants in the study were attending the municipal adult education course in Swedish for immigrants. The educational curriculum was flexible and dependent on the students' previous academic status, according to national guidelines. Students with significant functional disabilities did not attend the present school. The examination consisted of pure tone audiometry, an otoscopic examination, and a study-specific questionnaire.

2.1 | Hearing screening

Hearing screening was performed by an audiologist using a mobile audiometer (AD229b Interacoustics®) and DD45 (Radioear®)

headphones according to ISO standard 8253-1:2010. The audiological examination was carried out in a classroom where sound measurements had been performed by an acoustic engineer to rule out any noise or background sounds that would interfere with the audiological measurements. Pure tone audiometry with threshold determination was carried out at 0.25, 0.5, 1, 2, 3, 4, 6, and 8 kHz (air conduction) up to a maximum of 90 dB HL. The screening threshold was set to 20 dB HL. The pure tone average (PTA₄) was calculated from 0.5, 1, 2, and 4 kHz. The pure tone average for high-frequency hearing thresholds was calculated from 4, 6, and 8 kHz (PTA_{h3}). High-frequency hearing loss was defined as a PTA_{h3} > 25 dB HL. All study subjects were examined with an otoscope prior to hearing screening. Otoscopic ear pathologies, such as perforation, cerumen, or draining ear, were noted.

Grading of hearing loss according to the World Health Organization (WHO) was applied (pure tone average, PTA₄, in the better ear) as follows: mild hearing loss was from 26 to 40 dB, moderate hearing loss was from 41 to 60 dB, and severe hearing loss was >60 dB HL.¹¹

2.2 | Study questionnaire

The study-specific questionnaire included questions regarding country of origin, years spent in Sweden, and questions from the Swedish National Health Survey regarding tinnitus, hearing-related problems, dizziness, and general health. Moreover, data regarding comorbidities, including asthma, hypertension, diabetes, allergies, and smoking, were collected. The study-specific questionnaire was translated to eight different languages by a professional language translation service, and an assistant language teacher could help with further translation if necessary.

The Swedish National Public Health Survey is a questionnaire distributed by the Public Health Agency of Sweden that investigates health, lifestyle, and living conditions among Swedish citizens. The survey comprises a random sample of 20,000 individuals between the ages of 16 and 84 and is performed annually.¹²

2.3 | Endpoints

The primary endpoint was tinnitus in immigrants according to questions from the Swedish National Public Health Survey (No; Yes, mild problems; Yes, serious problems) compared to data from the general population (2018). Secondary endpoints were hearing loss according to the WHO (PTA₄ > 25 dB for the better ear) and high-frequency hearing loss (PTA_{h3} > 25 dB).

2.4 | Statistical methods

For correlation analysis, Fisher's exact test was used to determine whether significant differences existed between the analyzed groups. Variables at baseline with $p < .05$ (age, general health, smoking,

asthma, hypertension, dizziness, high-frequency hearing loss [PTA_{h3} > 25 dB], and hearing loss [PTA₄ > 25 dB]) were included together as possible predictors in a multivariable regression performed to predict tinnitus. Stepwise logistic regression analysis using forward selection was applied. All tests were two-tailed and conducted at the 5% significance level. For comparison between the study population data and the general population data, calculations of observed/expected cases and 95% confidence intervals (CIs) were used; a *p*-value <.05 was considered significant.

2.5 | Ethics

The study was approved by the Ethical Review Board in Sweden and performed in accordance with the Declaration of Helsinki. All study subjects gave their written informed consent to participate.

3 | RESULTS

3.1 | Study group characteristics

A total of 188 study participants were included in the study. The majority of the included study subjects were women (78%). The mean age was 40 years. Sixty-six percentage of the participants were originally from Asia, more specifically, Syria (*n* = 42), Iraq (*n* = 24), and Afghanistan (*n* = 14), constituting the overall most common countries of immigration. Twenty percentage of the participants immigrated from Africa (see Table 1). Otoscope examination revealed 164 (87%) study patients with normal eardrum status. Cerumen was found in 23 (12%) study patients, of these 15 had unilateral cerumen and 8 had bilateral cerumen. Ten of the 23 patients with cerumen had hearing impairment and 13 had normal hearing. One case with secretion was noted and no cases with eardrum perforation Table 1.

3.2 | Tinnitus and hearing

Tinnitus was reported by 38% of the immigrants in the study. Severe tinnitus was reported by 8% of the study population. Men more often reported severe tinnitus; 12% of the men reported severe tinnitus, compared to 7% of women. Regarding hearing problems, 19% of the study subjects reported problems with hearing, and 2% of the study subjects reported hearing aid use (Table 2).

3.3 | Comorbidities and general health

The most commonly reported comorbidity was allergies, noted altogether by 29% of the immigrant participants. Asthma was reported by 12%, hypertension 14%, and diabetes 7%. Regarding comorbidities, no significant differences were found between the immigrant study population and general population data.

TABLE 1 Study subjects' characteristics

	<i>n</i> = 188
Age, mean (SD), median (min-max)	40 (10.7), 39 (21-67) 95% CI: 38.9-41.9
Sex <i>n</i> (%)	
Male	42 (22%)
Female	146 (78%)
Educational level, <i>n</i> (%)	
Elementary school	115 (61%)
Upper secondary school	40 (21%)
University	33 (18%)
Occupation, <i>n</i> (%)	
Employed	8 (4%)
Parental leave	4 (2%)
Student	166 (88%)
Unemployed	8 (4%)
Retired	1 (1%)
Long-term sick leave	2 (1%)
Other	14 (7%)
Country of origin: (continent) <i>n</i> (%)	
Europe	19 (10%)
Africa	37 (20%)
Asia	124 (66%)
South America	2 (1%)
North America	0 (0%)
No country given	6 (3%)
Smoking/Tobacco, <i>n</i> (%)	
Smoker	30 (16%)
Former smoker	7 (4%)
Never smoked	145 (77%)
Other tobacco use	6 (3%)
Time from immigration (year), mean ± SD (min-max)	4.4 ± 4.23 (0.0-38.0)
Eardrum status, <i>n</i> (%)	
Normal	164 (87%)
Cerumen	23 (12%)
Secretion	1 (0.5%)
Perforation	0 (0%)

Ratings of good to very good health was reported by 60% of the study subjects, whereas 10% reported poor to very poor general health (Table 3).

3.4 | Hearing outcomes

According to the results from pure tone audiometry and the WHO grading system, 86% of the immigrant participants had

normal hearing (better ear PTA₄ < 26 dB), 9% had mild hearing loss (better ear PTA₄ 26–40 dB), 3% had moderate hearing loss (better ear PTA₄ 41–60 dB), and another 3% had severe hearing loss (better ear PTA₄ > 60 dB). Thirty-seven percentage of the study population had high-frequency hearing loss. Tinnitus was reported by 10% of those with mild hearing loss, 4% of those

with moderate hearing loss, and 4% of those with severe hearing loss (Table 4).

Hearing loss was, in general, more pronounced for study subjects reporting tinnitus than for subjects not reporting tinnitus, regarding both PTA₄ ($p < .05$) and PTA_{h3} ($p < .05$), which were statistically significant (see Table 4).

TABLE 2 Tinnitus and hearing in immigrants compared to data from the general Swedish population

Tinnitus										
Age	Study population (n = 188)				Swedish population ^a				Comparison of the study population with the Swedish population	
	n	No (%)	Yes, mild problems (%)	Yes, serious problems (%)	n	No (%)	Yes, mild problems (%)	Yes, serious problems (%)	Mild problems, observed/expected cases (CI)	Serious problems, observed/expected cases (CI)
16–29	41	76	20	5	2103	83	16	1		
30–44	91	67	27	5	3018	83	15	2		
45–64	54	44	43	13	5697	74	23	4		
65–84	2	50	0	50	5782	67	28	6		
Total	188	62	30	8	16,600	80	17	3	1.69 (1.27–2.19)	3.33 (1.86–5.49)

Problems hearing										
Age	Study population (n = 188)				Swedish population ^a				Comparison of the study population with the Swedish population	
	n	No (%)	No problems (hearing aid use)	Yes	n	No (%)	No (hearing aid use) (%)	Yes (%)	Problems hearing, observed/expected cases (CI)	
16–29	41	93	2	5	2107	91	1	8		
30–44	91	79	1	20	3004	90	1	9		
45–64	54	74	4	22	5672	86	2	11		
65–84	2	100	0	0	5748	73	13	15		
Total	188	81	2	17	16,531	86	4	11	1.77 (1.24–2.45)	

Note: Observed/expected cases and 95% CI adjusted for age and sex in bold denotes $p < .05$.

^aData from the National Health Survey 2018.

TABLE 3 General health in the study population compared to the Swedish population

General health							Comparison of the study population with the Swedish population
Age	Study population (n = 188)			Swedish population ^a (n = 8926)			Poor–very poor, observed/expected cases (CI)
	n	Good–very good (%)	Poor–very poor (%)	Good–very good (%)	Poor–very poor (%)		
16–29	41	73	2	79	6		
30–44	91	67	5	79	5		
45–64	54	37	22	69	7		
65–84	2	0	50	58	8		
Total	188	59	10	72	6	1.74 (1.04–2.71)	

Note: Observed/expected cases and 95% CI in bold denotes $p < .05$.

^aData from the National Health Survey 2018.

TABLE 4 Audiometric data and hearing loss in relation to tinnitus in the study population

Pure tone audiometry (dB HL)	All (n = 187 ^a)	Tinnitus (n = 71)	No tinnitus (n = 116)	p-Value
PTA ₄ , better ear [mean ± SD, median (IQR)]	24 ± 9.7 20 (20–22.5)	26 ± 12.5 21 (20–23.8)	22 ± 7.3 20 (20–21.3)	.037
PTA ₄ , worse ear [mean ± SD, median (IQR)]	28 ± 15.7 22 (20–25)	32 ± 21.4 24 (21.3–28.8)	25 ± 9.8 21 (20–22.5)	.0015
PTA _{h3} , any ear > 25 dB, n (%)	70 (37)	39 (55)	31 (27)	<.001
PTA ₄ , any ear > 25 dB, n (%)	46 (25)	26 (37)	20 (17)	.021
Unilateral hearing loss, n (%)	20 (11)	13 (18)	7 (6)	
Bilateral hearing loss, n (%)	26 (14)	13 (18)	13 (11)	
WHO grading of hearing loss ^b				.16
Normal hearing, better ear, n (%)	161 (86)	58 (82)	103 (89)	
Mild HL, better ear, n (%)	16 (9)	7 (10)	9 (8)	
Moderate HL, better ear, n (%)	5 (3)	3 (4)	2 (2)	
Severe HL, better ear, n (%)	5 (3)	3 (4)	2 (2)	

Note: PTA₄ represents mean values for frequencies 0.5, 1, 2, and 4 kHz; PTA_{h3} represents mean values for frequencies 4, 6, and 8 kHz.

Abbreviation: WHO, World Health Organization.

^aAudiometry data are missing for one study patient.

^bGrading of hearing loss according to the WHO, TMV4 for the better ear: Normal hearing: 0–25 dB HL, mild HL: 26–40 dB HL, moderate HL: 41–60 dB HL, and severe HL: >60 dB HL.

3.5 | Regression analysis study group

In the univariable analysis, age ($p < .001$), general health ($p < .001$), and dizziness ($p < .001$) were correlated with tinnitus. Older age, worse general health, and more severe problems with dizziness related to problems with tinnitus. Furthermore, asthma and hypertension were correlated with tinnitus. More severe asthma ($p = .018$) and hypertension ($p = .0056$) were related to problems with tinnitus.

In the multivariable regression analysis that included audiometry data and significant baseline variables, high-frequency hearing (PTA_{h3} > 25 worse ear) was found to be a significant predictor for tinnitus ($p = .0032$, OR: 2.74 [95% CI: 1.40–5.35]). Additionally, self-reported general health significantly predicted tinnitus, with an increased risk of tinnitus relating to worse general health ($p < .001$, OR: 2.43 [95% CI: 1.66–3.57]).

3.6 | Results in relation to Swedish population data

Tinnitus was more common among immigrants in the study population in comparison with data from the general Swedish population when adjusted for both age and sex. In the immigrant group, 30% reported mild tinnitus symptoms, compared to 17% in the general population. For severe tinnitus, the corresponding reported prevalence was 8% in the study group compared to 3% in the general population, making it more than three times as common in the study population adjusted for age and sex [observed/expected cases (CI) 3.33 (1.86–5.49) $p < .05$] (Table 2).

Pertaining to general health, 10% of the study population reported poor–very poor general health compared to 6% in the

general population [observed/expected cases (CI) 1.74 (1.04–2.71) $p < .05$] (Table 3).

4 | DISCUSSION

It was found that severe tinnitus was more than three times as common in immigrants compared to the Swedish population in this prospective cohort study investigating prevalence and risk factors for tinnitus. Furthermore, high-frequency hearing loss and general health were found to be predictors for tinnitus in this study population.

In the literature, the prevalence of tinnitus in men and women is reported to be similar.^{13,14} However, several studies report conflicting results. In the Beaver Dam offspring study, men had a higher prevalence of tinnitus than women.¹⁵ Likewise, in this study, 12% of the men reported severe tinnitus compared to 7% of the women. A commonly suggested explanation is the differences in the prevalence of hearing loss between men and women, where men have a higher prevalence of hearing loss than women.¹⁶

The main risk factor for developing tinnitus is hearing loss.¹⁴ However, the link between hearing loss and tinnitus is complex. In this study, audiometric results showed a higher prevalence of hearing loss in persons reporting tinnitus. Above all, high-frequency hearing loss, which is a well-known risk factor for tinnitus, was related to a higher risk of tinnitus. A majority (55%) of the study patients reporting tinnitus had high-frequency hearing loss. High-frequency hearing loss is related to damage to the inner ear and is often caused by age-related or noise-induced hearing loss.¹⁵ Assumingly, noise-induced hearing loss can be more common among migrants both due to exposure to occupational noise¹⁷ and a higher risk of exposure to explosions in war zones. Because the studied population had a mean age of

40 years, age-related hearing loss was probably not a major etiological factor for the study participants' high-frequency hearing loss.

In comparison with results from other large population studies, such as the National Health and Nutrition Examination Survey (NHANES), the prevalence of hearing loss and high-frequency hearing loss was comparable, with 87% normal hearing in the present study compared to 85% in the aforementioned study for the relevant age group. For high-frequency hearing loss, the prevalence in the present study was also similar, 37% compared to 34% in the aforementioned study, NHANES.¹⁸ Hearing loss, according to audiometric results, was more often found in persons reporting tinnitus than in persons not reporting tinnitus; however, when applying the definition and grading of hearing loss suggested by the WHO,¹¹ no significant differences could be seen. This demonstrates that, depending on the research question and study aim, other definitions of hearing loss can be relevant to capture clinically important findings, such as unilateral hearing loss and disabling high-frequency hearing loss with tinnitus. Such hearing loss is not identified with the WHO grading system.

High-frequency hearing loss and general health were found to be the most important predictors for tinnitus in this study population. As previously mentioned, tinnitus often coexists with mental health problems such as depression and anxiety,^{10,19} and thus, a convergent pattern of impaired general health and tinnitus problems is expected. Several reviews of the literature regarding tinnitus and mental health have pointed out a strong correlation between tinnitus and anxiety and depression.^{20,21}

Tinnitus and hearing problems were more common in the study population than in the Swedish population, regarding both mild and severe problems. Severe tinnitus was more than three times as prevalent in immigrants compared to the Swedish population. Poor to very poor general health was more common in immigrants, in contrast to other comorbidities, such as diabetes or hypertension, where no differences were found. This could imply that the differences in general health may be attributed to differences in mental health. These results are in line with studies on health and migration in Europe that point out mental health in immigrants as an important issue²² and highlight the need for measures to improve general and mental health in migrants.

Hearing loss and tinnitus can severely hamper the ability to learn a new language. Self-reported hearing loss was more common in the study population than in the age-stratified population; however, these results must be interpreted with caution because no audiometric data for comparison were available at the population level. Learning a new language implies high demands on speech recognition ability to gain knowledge of pronunciation and the understanding of words and phrases. Tinnitus has, in several studies, been reported to interfere with speech recognition both for persons with hearing loss and normal hearing persons.^{23,24}

An extra dimension is added for non-native speaking persons with hearing loss and/or tinnitus who are particularly sensitive to background noise levels for speech recognition ability.^{25,26}

Identifying persons with hearing loss to initiate hearing aid use can facilitate language acquisition, and interventions aimed at

reducing mental distress, such as depression, anxiety, and post-traumatic stress disorder, can relieve tinnitus burdens for these persons.

4.1 | Strengths and limitations

The strengths of this study were the prospective design and the use of audiometric data together with patient-reported data using questions from the National Health Survey in Sweden. A study limitation was the lack of a validated tinnitus-specific questionnaire, which would have strengthened the results. Furthermore, because the school where the study was performed uses weekly admission of students, it is difficult to quantitatively determine the total population at the school at any given time. Hence, the nonresponse rate in the study is difficult to assess.

5 | CONCLUSION

Severe tinnitus was more than three times as common in immigrants compared to the Swedish population. High-frequency hearing loss and self-reported worse general health were predictors for tinnitus.

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CONFLICT OF INTEREST

The authors have no other funding, financial relationships, or conflicts of interest to disclose.

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