

Health Reports

Tinnitus in Canada

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Tinnitus in Canada

by Pamela L. Ramage-Morin, Rex Banks, Dany Pineault and Maha Atrach

Abstract

Background: Tinnitus, which has no cure, can be a temporary irritant or a life-altering condition. Many factors can precipitate tinnitus, including hearing loss, exposure to loud noise and other otologic causes, neurological injuries or disease, dental disorders, some medications, and certain infectious diseases. This study summarizes new tinnitus data from the Canadian Health Measures Survey (CHMS).

Data and methods: Data were collected for individuals aged 19 to 79 years (n=6,571) from 2012 through 2015 as part of the CHMS. Tinnitus is described as “the presence of hissing, buzzing, ringing, rushing or roaring sounds in your ears when there is no other sound around you.” Bothersome tinnitus refers to tinnitus affecting sleep, concentration or mood. Factors associated with tinnitus were examined using bivariate and logistic regression analyses.

Results: An estimated 37% of adult Canadians (9.2 million) had experienced tinnitus in the past year; it was bothersome for 7% of the population. Individuals aged 19 to 29 were significantly more likely to have past-year tinnitus (46%) than those aged 30 to 49 (33%) and 50 to 70 (35%). Tinnitus was associated with poor self-reported mental health, mood disorder, a weak sense of community belonging, high daily stress and poor quality sleep. People with hearing loss and tinnitus were twice as likely as those with hearing loss alone to use hearing aids, at 11% compared with 5% respectively.

Interpretation: Tinnitus is a common condition among Canadian adults. Recent exposure to loud noise may contribute to the higher prevalence of past-year tinnitus at younger ages. Canadians could benefit from greater awareness of tinnitus, prevention strategies and management options.

Keywords: Hazardous noise, audiometry, quality of life, well-being

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Tinnitus is the perception of noise without an external, sound-producing source, also described as phantom noise.¹ It is generally classified as either subjective or objective. In at least 95% of cases, tinnitus is subjective—the head or ear noises are perceivable only to the individual.² In contrast, objective tinnitus occurs when the perception of sounds is generated by sources within the body that are transmitted to the ear and can sometimes be heard by an examiner during auscultation (i.e., listening to sounds from the heart, lungs and other organs).^{1,3} The nature of the perceived noise varies from person to person but has been described as ringing, buzzing, roaring, grinding or like the noise produced by crickets or cicadas, the wind, or releasing steam.^{1,4} Pulsatile tinnitus is rhythmic, synchronous with the heartbeat.^{1,5}

The severity and persistence of tinnitus can range from a short-term occurrence of no consequence to a chronic and life-interfering condition.^{6,7} Tinnitus has been associated with anxiety and depression, insomnia, irritation, stress, and even suicide, although the latter may be a reflection of comorbid mental health problems.⁶⁻⁹

Tinnitus may be a primary condition with no known cause beyond hearing loss, or a secondary condition to factors such as exposure to loud noise and other otologic causes, neurological injuries or disease, dental disorders, some medications, or certain infectious diseases.^{1,6,7,10} Even when the circumstances triggering tinnitus can be identified, the mechanisms prolonging the condition are not clear.⁶ The pathophysiology of tinnitus is complex and not universally agreed upon.^{11,12} Most patients develop tinnitus as a symptom of hearing loss, caused by either age, noise trauma, head injury or ototoxic drugs. Hearing loss causes less external sound stimuli to reach the brain. In response, the brain undergoes neuroplastic changes in how it processes different

sound frequencies. Tinnitus is believed to be the product of maladaptive neuroplastic changes.^{1,3,11,12}

There is no cure for tinnitus; management focuses on quality of life and varies depending on factors such as severity, impact, comorbid hearing loss and individual needs.¹³ A personalized approach to treatment is recommended and may incorporate counselling, sound-based therapies (e.g., tinnitus retraining therapy), psychological therapies (e.g., cognitive behavioural therapy), and hearing loss management (e.g., hearing aids, cochlear implants).^{13,14} Medications may be prescribed for tinnitus, particularly when comorbid conditions such as depression or insomnia are present.¹³ Individuals who experience persistent, bothersome tinnitus that has the potential to negatively affect quality of life are the focus for intervention.^{6,15}

Until recently, clinicians relied on U.S. data to estimate the prevalence of tinnitus in the Canadian population. Approximately 50 million U.S. adults experienced tinnitus in the past year, and 16 million had it almost all the time or at least on a daily basis.¹⁶ Data from the 2012 to 2013 Canadian Health Measures Survey (CHMS) show that 43% of Canadians aged 16 to 79 (11.5 million) had experienced tinnitus during their lifetime and that 35% had experienced the condition within the past year.¹⁷ The release of more recent CHMS data (2014 to 2015) combined with the earlier cycle permits more in-depth analyses of past-year tinnitus in Canada. This includes estimates of bothersome tinnitus and an exploration of factors associated with the condition, specifically noise sources, chronic conditions, measures of well-being, hearing loss and hearing aid use. This information will be valuable for raising awareness about tinnitus, planning treatment and conducting future research in Canada.

What is already known on this subject?

- Tinnitus ranges in severity from a temporary inconvenience to a chronic, life-interfering condition.
- Tinnitus can be the result of hearing loss, exposure to loud noise and other otologic causes, neurological injuries or disease, dental disorders, some medications, and certain infectious diseases.
- Tinnitus becomes increasingly common at older ages.

What does this study add?

- An estimated 37% of adult Canadians (9.2 million) had experienced tinnitus in the past year; 7% had tinnitus that was bothersome, affecting aspects of their lives such as sleep, concentration and mood.
- Younger people aged 19 to 29 were more likely than those in older age groups to report past-year tinnitus.
- Use of audio devices with headphones or earbuds and exposure to amplified music and loud noise at events were more common among younger people, which is one possible explanation for the higher prevalence of tinnitus at younger ages.
- Men were more likely than women to have experienced tinnitus; however, this difference could be accounted for by their greater exposure, in general, to loud noise at work, school or leisure.
- People with tinnitus were more likely than those without the condition to report poor mental health, mood disorder, high daily stress, a weak sense of community belonging and poor quality sleep.

Methods

Data source

The CHMS is an ongoing cross-sectional survey that samples households from five regions across Canada (Atlantic, Quebec, Ontario, Prairies and British Columbia). Participants provide demographic, socioeconomic, health and lifestyle information through an in-person, computer-assisted household interview, followed by direct physical measurements collected at a mobile examination centre (MEC). The CHMS excludes full-time members of the Canadian Armed Forces; residents of the three territories, First Nations reserves and other Aboriginal settlements, and certain remote regions; and residents of institutions such as nursing homes. Altogether, these exclusions represent approximately 4% of the target population. Proxy interviews were accepted in cases of physical or intellectual impairment.

Data from cycles 3 and 4 (2012 to 2013 and 2014 to 2015) were combined for this analysis. For each cycle, data were collected from January (year 1) through December (year 2) at 16 randomly selected sites and two MECs distributed across the five regions. The combined response rate for cycles 3 and 4, household and MEC components was 52.7%. Details regarding sampling design, data collection and calculation of response rates are available in the CHMS data user guides^{18,19} and the Instructions for Combining Multiple Cycles of Canadian Health Measures Survey (CHMS) Data.²⁰ Further information on sampling frame and data collection are available at www.statcan.gc.ca.

Study sample

This study was based on a sample of 6,571 respondents (3,250 men and 3,321 women) aged 19 to 79 years. The weighted sample from cycles 3 (n=3,288) and 4 (n=3,283) represented a population of 25.9 million Canadians. For detailed descriptions of the weighting process permitting population estimates to be calculated from the sample, see the CHMS data user guides.^{18,19}

Definitions

Tinnitus was described as “the presence of hissing, buzzing, ringing, rushing or roaring sounds in [the] ears when there is no other sound around.” Respondents who had experienced tinnitus within the past year are the focus of this study. These respondents were asked whether the tinnitus bothered them by affecting their sleep, concentration or mood, for example. Those who responded “yes” were considered to have bothersome tinnitus.

Selected sources of past-year exposure to loud noise at work, school or leisure were amplified music (e.g., concert), power tools, sporting or entertainment events (e.g., hockey game), and firearms (e.g., guns). Loud noise was self-reported; it was described to respondents as a volume that required them to speak in a raised voice to be understood or to communicate with someone at arm’s length. Respondents indicated all sources that applied. This subset of all sources of loud noise was selected because there were follow-up questions about the source’s effect on tinnitus.

Respondents were questioned about their use of headphones or earbuds for listening to music, movies or other types of audio on devices such as MP3 players, iPods, cell phones, stereo systems, televisions and computers. Individuals referred to as device users responded “yes” to the following question: “In the past 12 months, have you listened to audio devices using headphones or earbuds?” Additionally, these respondents were asked, “On average, in the past 12 months, how many hours per week did you usually listen to music, movies or other types of audio using headphones or earbuds?” Users who responded zero hours and minutes, as well as those who did not specify average weekly use, were considered occasional users and retained for the estimation of mean listening hours. Mean weekly hours of use and use at loud volume in the past 12 months were estimated by age group. A “yes” response to either or both of the following questions established loud

volume: “Is the volume level usually at or above three quarters of the maximum volume?” and, “Is the volume usually so loud that someone standing an arm’s length away would have to speak in a raised voice for you to understand what they were saying?” The mean number of listening hours and loud listening hours per week were calculated for the entire population (non-listeners contributed zero hours) and for the subpopulation of listeners (occasional listeners contributed zero hours). Including occasional listeners provides a more conservative estimate of mean weekly hours than if occasional listeners had been excluded.

A dichotomous variable, created for use in the logistic regression model, grouped respondents who had been exposed to loud noise from one or more of the selected sources or used headphones or earbuds with audio devices versus adults with none of these noise exposures.

Respondents were asked about long-term (lasting or expected to last at least six months) conditions that have been diagnosed by a health professional. The chronic conditions selected for this analysis were those that have been associated with tinnitus directly or because of treatment-related medications: high blood pressure (including medication use for high blood pressure in the past month), cardiovascular disease (i.e., has heart disease, has had a heart attack, or suffers from the effects of a stroke), diabetes (excluding gestational diabetes), kidney dysfunction or disease, and arthritis.

Five categories of body mass index (BMI=measured weight [kg] / measured height [metres] squared) were examined: underweight (<18.50 kg/m²), normal (18.50 kg/m² to 24.99 kg/m²), overweight (25.00 kg/m² to 29.99 kg/m²), obese—class I (30.00 kg/m² to 34.99 kg/m²), and obese—class II and III (≥ 35.00 kg/m²).²¹

For exposure to smoke, respondents were classified as smoker (daily or occasional) or non-smoker (former smoker or never smoked). Non-smokers were subdivided by second-hand smoke exposure, defined as living in a home where smoking was allowed or being exposed to second-hand smoke in private

vehicles, places of work, someone else’s home or public indoor places.

Respondents were asked in separate questions to rate their mental health and quality of life. Those who reported “poor” or “fair” were grouped together and compared with respondents who reported “good,” “very good” or “excellent” to the respective questions.

Mood disorder was self-reported in response to the question, “Do you have a mood disorder such as depression, bipolar disorder, mania or dysthymia?”

Respondents were asked: “How would you describe your sense of belonging to your local community? Would you say it is very strong? Somewhat strong? Somewhat weak? Very weak?” Those who responded with either of the latter two response categories were categorized as having a weak sense of community belonging.

Responses to the question “Thinking about the amount of stress in your life, would you say that most days are...?” were categorized as high daily stress (“quite a bit” or “extremely stressful”) versus low daily stress (“not at all,” “not very” or “a bit stressful”).

People who responded “never” or “rarely” to the question “How often do you find your sleep refreshing?” were considered to have poor quality sleep, compared with those who responded “sometimes,” “most of the time,” or “all of the time.”

Hearing loss was established using audiometric evaluation. It was defined as a unilateral or bilateral threshold above 25 dB in the worse ear, based on four frequency pure-tone average (PTA) across 0.5, 1, 2 and 4 kHz; high frequency PTA across 3, 4, 6 and 8 kHz; and low frequency PTA across 0.5, 1 and 2 kHz. Individuals with a PTA above the 25 dB threshold over high, low or four frequencies were classified as having hearing loss. The hearing loss threshold for adults aged 19 or older was based on the American Speech-Language-Hearing Association guidelines.²² Audiometric testing was conducted by health measures specialists with training and supervision provided by a certified audiologist who ensured quality control. Testing was carried out while respondents were seated in a portable audiometric booth (Eckel AB-4230), with the door closed. Further details on the audiometric evaluation are available elsewhere.²³

Hearing aid users were those who reported that they had one for their left ear, right ear or both ears.

Analytical techniques

Weighted frequencies and cross-tabulations were calculated to examine the prevalence of past-year tinnitus by sex, age group, noise source, hearing loss, hearing aid use and other factors associated with tinnitus. Prevalence estimates of adverse outcomes associated with

Table 1
Prevalence of tinnitus, past year, by sex and age group, household population aged 19 to 79, Canada excluding territories, 2012 to 2015

Characteristics	Tinnitus (past year)											
	Total		Bothersome				Non-bothersome					
	Number '000	%	95% confidence interval from to		Number '000	%	95% confidence interval from to		Number '000	%	95% confidence interval from to	
Total	9,235	36.6	33.6	39.7	1,650	6.5	5.5	7.7	7,582	30.0	27.3	32.9
Sex												
Men†	4,864	39.3	34.4	44.5	721	5.8	4.2	8.1	4,143	33.5	29.5	37.8
Women	4,372	34.0*	31.6	36.4	930	7.2	5.8	9.0	3,439	26.7*	24.2	29.4
Age group (years)												
19 to 29†	2,295	46.1	40.8	51.4	274 ^E	5.5 ^E	3.3	9.0	2,021	40.6	35.8	45.5
30 to 49	3,088	33.0*	28.3	38.0	592	6.3	4.6	8.6	2,493	26.6*	22.7	31.0
50 to 79	3,853	35.4*	30.5	40.5	784	7.2	5.4	9.5	3,069	28.2*	23.8	33.0

^E use with caution

* significantly different from reference group (p<0.05)

† reference group

Source: 2012 to 2013 and 2014 to 2015 Canadian Health Measures Surveys, combined.

tinnitus are presented. A sex-adjusted logistic regression model was used to examine the odds of reporting past-year tinnitus after accounting for noise exposure. A dichotomous variable for noise exposure grouped individuals who had been exposed to one or more of the selected noise sources versus those who had no exposure to the selected sources. Weighted mean hours of headphone or earbud use per week over the past 12 months by volume were calculated overall and by age group for two populations: the total population and the listening population. Listeners refers to those who self-reported headphone or earbud use over the past year and includes individuals who subsequently reported zero hours of headphone or earbud time per week on average—these respondents were considered occasional users. Occasional users contributed zero hours to the mean, resulting in more conservative estimates. To account for the complex survey design, 95% confidence intervals, standard errors and coefficients of variation were calculated using the bootstrap technique with 22 degrees of freedom.^{24,25} In the tables and text, esti-

mates with a CV of 16.6% to 33.3% are flagged with an E (interpret with caution).

Results

Prevalence of tinnitus

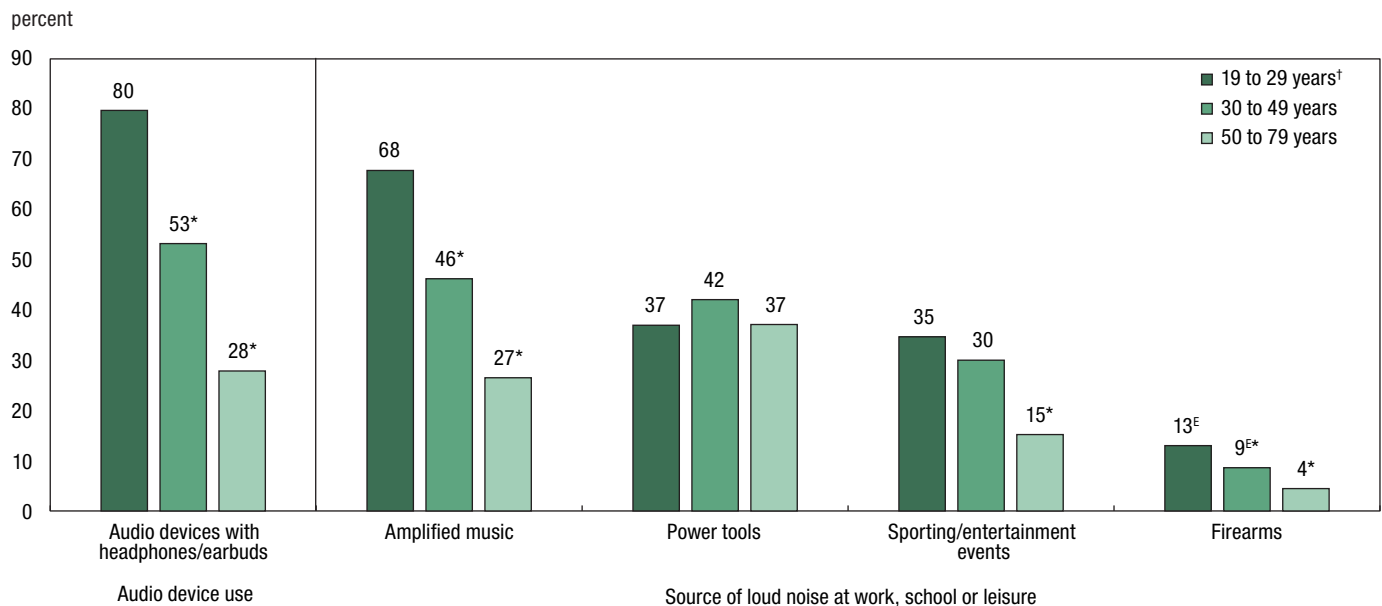
An estimated 37% of adult Canadians (9.2 million) had experienced tinnitus in the past year (Table 1). It was bothersome for 7%, affecting aspects of their lives such as sleep, concentration and mood. Although men were more likely than women to have tinnitus, they were also more likely to report that it was not bothersome. Younger individuals aged 19 to 29 years were more likely than individuals in the older age groups to have experienced tinnitus in the past year but also report that they were not bothered by the condition.

Sources of loud noise

The higher prevalence of past-year tinnitus at younger ages may be partly explained by their use of audio devices with headphones or earbuds and exposure to loud noise from other sources over the same time period. In fact, 80% of adults in the youngest age

group reported using headphones or earbuds connected to audio devices in the past year, significantly more than adults aged 30 to 49 (53%) or 50 to 79 (28%) (Figure 1). The average weekly hours of listening time were higher for 19 to 29-year-olds (6.2 hours per week) than for the middle and older age groups, at 2.9 hours per week and 1.4 hours per week, respectively (Table 2). These averages include the entire population and, therefore, account for the proportion of the population who did not use audio devices with headphones or earbuds in the past year—these users contribute zero hours to the average. However, even when limiting the average weekly listening hours to the subset of listeners in each age group, younger people averaged more time (7.8 hours per week) than those aged 30 to 49 (5.5 hours per week) or 50 to 79 (5.2 hours per week). Similar trends were apparent for average weekly hours at loud volume, which is defined as a volume level that was usually at or above three-quarters of the maximum volume, or so loud that someone at arm's length would have to raise their voice to be understood.

Figure 1
Percentage using audio devices with headphones or earbuds and exposed to loud noise at work, school or leisure, past year, by noise source and age group, household population aged 19 to 79, Canada excluding territories, 2012 to 2015



^E use with caution

* significantly different from reference group ($p < 0.05$)

[†] reference group

Source: 2012 to 2013 and 2014 to 2015 Canadian Health Measures Surveys, combined.

Table 2
Mean hours of headphone or earbud use per week, past year, by volume, selected population and age group, household population aged 19 to 79, Canada excluding territories, 2012 to 2015

Volume Population	Age group											
	Total			19 to 29 years [†]			30 to 49 years			50 to 79 years		
	Hours	95% confidence interval		Hours	95% confidence interval		Hours	95% confidence interval		Hours	95% confidence interval	
	from	to	from	to	from	to	from	to	from	to	from	to
Any volume												
Total population	2.9	2.5	3.4	6.2	4.8	7.6	2.9*	2.3	3.5	1.4*	1.0	1.9
Listening population	6.2	5.4	6.9	7.8	6.2	9.3	5.5*	4.4	6.5	5.2*	4.1	6.3
Loud volume												
Total population	0.9	0.8	1.0	2.3	1.8	2.8	0.8*	0.6	1.1	0.3*	0.2	0.4
Listening population	1.9	1.7	2.1	2.9	2.3	3.4	1.6*	1.2	2.0	1.1*	0.6	1.6

* significantly different from reference group ($p < 0.05$)

[†] reference group

Source: 2012 to 2013 and 2014 to 2015 Canadian Health Measures Surveys, combined.

In addition to the use of audio devices, the younger cohort was more likely than others to be exposed at work, or school, or during leisure time to loud, amplified music that occurs at concerts, nightclubs and other venues as well as to loud noise from firearms (Figure 1). The younger cohort was also more likely than individuals aged 50 to 79 to report loud noise exposure from sporting and entertainment events such as hockey games. Overall, 85% (95% CI: 82 to 87) of men and 70% (95% CI: 68 to 72) of women were exposed to one or more sources of loud noise. When this noise exposure was accounted for in a logistic regression model, the difference between men and women in past-year tinnitus presented in the bivariate analysis (Table 1) was no longer evident. Initially, the odds of men experiencing past-year tinnitus were higher than women (1.26, 95% CI: 1.02 to 1.56). However, when exposure to one or more sources of noise was added to the model, the odds of past-year tinnitus were no longer significant (1.17, 95% CI: 0.96 to 1.42).

Risk factors

Among people with high blood pressure or currently taking medication to control their blood pressure, 42% had experienced tinnitus in the past year, compared with 35% of those without high blood pressure (Table 3). Arthritis was also significantly associated with tinnitus:

43% of individuals with arthritis reported tinnitus, versus 35% of people without the condition. No significant differences in the prevalence of tinnitus were found between people with cardiovascular disease, diabetes or kidney disease and those without these chronic conditions. Despite this, the prevalence of tinnitus was higher (41%) among people who reported one or more of the assessed conditions compared with those without any (34%). No significant associations were evident between BMI and tinnitus. People exposed to smoke—directly as a smoker or indirectly through second-hand smoke—were more likely to report tinnitus (42% and 43% respectively) compared with non-smokers who were not exposed to second-hand smoke (34%).

Poor levels of well-being

Adults who experienced past-year tinnitus, particularly if it was bothersome, were more likely than individuals without tinnitus to report poor levels of well-being (Figure 2). For example, sleep was never or rarely refreshing for 30% of people with bothersome tinnitus and 23% of people with non-bothersome tinnitus, significantly more than for those without tinnitus (17%). An overall rating of poor or fair mental health was reported by 17% of people with bothersome tinnitus and 10% of people with non-bothersome tinnitus, compared with 6% of

those without tinnitus. The prevalence of a mood disorder such as depression or bipolar disorder was more than twice as high for those with bothersome (19%) or non-bothersome tinnitus (17%) than for adults without tinnitus (8%).

Hearing loss and tinnitus

The audiometric assessment and CHMS survey questions revealed that 60% of Canadian adults had either hearing loss or tinnitus (past-year), or both (Table 4). An estimated 24% of adults had some degree of hearing loss in one or both ears with no tinnitus, 22% had tinnitus only and 15% experienced both conditions. People who experienced both hearing loss and tinnitus were twice as likely to use hearing aids (11%) as those with hearing loss alone (5%).

Discussion

This study examined the prevalence of past-year tinnitus and factors associated with the condition among a nationally representative sample of adults aged 19 to 79; an estimated 37% of the adult population had tinnitus in the past year, and 7% reported that the condition was bothersome. McCormack et al.²⁶ reviewed 39 studies—none of which were from Canada—and reported prevalence estimates of tinnitus that varied considerably, ranging from 5% to 43% for current tinnitus and 3% to 31% for bothersome tinnitus. They concluded that comparisons were hampered by the absence of standard criteria and definitions of tinnitus as well as by different survey questions, response categories, time frames, age groups and survey methodologies. Prevalence estimates from the current study are within the ranges reported by McCormack et al.,²⁶ albeit on the upper end for past-year tinnitus and on the lower end for bothersome tinnitus.

According to this study’s bivariate analysis, men were more likely than women to have experienced tinnitus, which is consistent with some,^{15,26,27} but not all^{10,28,29} reports. This difference was no longer significant when noise exposure was taken into account. Men are

Table 3
Prevalence of tinnitus, past year,
by associated factors, household
population aged 19 to 79, Canada
excluding territories, 2012 to 2015

Characteristics	%	95% confidence interval	
		from	to
Chronic conditions			
High blood pressure			
Yes	41.7*	36.0	47.6
No†	35.0	32.1	38.1
Cardiovascular disease			
Yes	41.6	33.1	50.6
No†	36.4	33.5	39.3
Diabetes			
Yes	39.5	33.2	46.1
No†	36.4	33.2	39.6
Kidney dysfunction or disease			
Yes	35.0 ^E	22.8	49.5
No†	36.6	33.6	39.7
Arthritis			
Yes	42.9*	35.4	50.8
No†	35.3	32.5	38.1
One or more comorbid conditions			
Yes	40.8*	35.8	46.0
No†	34.1	31.5	36.9
Body mass index (kg/m²)			
Underweight (<18.50)	28.7 ^E	15.0	48.0
Normal (18.50 to 24.99)†	36.3	32.4	40.4
Overweight (25.00 to 29.99)	34.8	31.1	38.6
Obese Class I (30.00 to 34.99)	37.1	30.7	44.0
Obese Class II and III (≥ 35.00)	42.7	34.3	51.5
Exposure to smoke			
Smoker (daily/occasional)	42.1*	36.4	47.9
Non-smoker (former/never)			
Second-hand smoke exposure	43.2*	35.2	51.6
No second-hand smoke exposure†	34.0	31.3	36.8

^E use with caution

* significantly different from reference group ($p < 0.05$)

† reference category

Source: 2012 to 2013 and 2014 to 2015 Canadian Health Measures Surveys, combined.

more likely than women to work in noisy environments and for longer durations,¹⁷ both of which have been associated with higher rates of tinnitus.^{16,27}

Men were more likely than women to report that they were not bothered by their tinnitus, in that it did not affect their sleep or concentration, for example. This highlights two components of tinnitus: the presence of the condition itself, an emotionally neutral assessment related to the awareness and duration of tinnitus, and the individual reaction to the condition, the level of distress signifying the

subjective feelings of suffering that result from the tinnitus.³⁰ Earlier work shows that women are more likely to report sleep interference and feeling tired or ill because of tinnitus.³¹ Vanneste et al.³² reported that women were more likely than men to experience a depressive state even when there were no differences in tinnitus intensity and tinnitus-related distress and emphasized the importance of considering sex differences in tinnitus research.

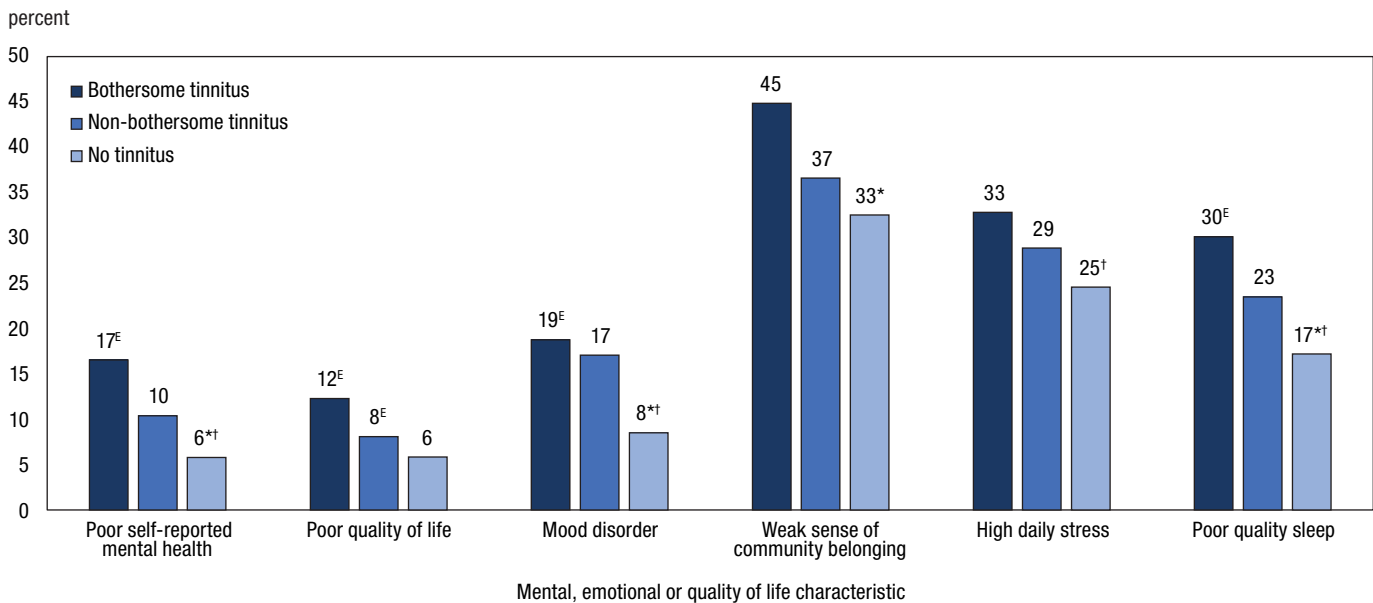
Studies consistently report that the prevalence of tinnitus increases with increasing age.^{6,10,16,26-28} This is to be expected with no cure for tinnitus and more potential life-years of exposure to noise, medications, trauma and other precipitators. However, data from this study revealed that the younger cohort of Canadians (aged 19 to 29 years) was significantly more likely than older adults to have tinnitus, consistent with findings of Nondahl et al.³³ This may reflect more noise exposure at younger ages with changes in technology and individual behaviours, such as the development and use of audio devices with headphones or earbuds, as shown in this study, in addition to increasingly noisy environments.³⁴⁻³⁷ Alternatively, it could reflect a greater awareness and reporting of the condition at younger ages.³³ The higher prevalence of tinnitus at younger ages suggests that population estimates of this condition will increase in the future. Although younger people were more likely to have tinnitus, they were also more likely to report that it was not bothersome. This is consistent with Kim et al.²⁹ who found that older age was associated with an increase in tinnitus that was annoying.

Tinnitus is a symptom rather than a disease in itself.⁷ Although the events and conditions precipitating the onset of tinnitus often cannot be identified,⁶ there are a variety of recognized risk factors, including those that are otological, neurological, cardiovascular, trauma-related and medication-related.^{6,7} The association between high blood pressure and tinnitus found in this study has been seen elsewhere.^{16,28} Arthritis has been identified as

a risk factor for tinnitus,^{7,29,33,38,39} which is consistent with results from the CHMS. Medications to manage pain and inflammation may be ototoxic and precipitate tinnitus.^{10,39} Associations between tinnitus and obesity and diabetes that are seen elsewhere were not evident in this study.^{16,28} Nor was there an association between being underweight and having tinnitus, as Lee et al.⁴⁰ found, although their study population was restricted to premenopausal women. Smoking, which is a risk factor for cardiovascular disease, is also associated with tinnitus.^{4,16} The current study added a dimension with the finding that non-smokers exposed to second-hand smoke were just as likely to have tinnitus as smokers.

Data from this study show that individuals with tinnitus were more likely than those without the condition to report poor levels of mental and emotional well-being. Associations of tinnitus with mood disorders and diminished well-being are consistent with earlier work.^{28,39,41-43} A review by Ziai et al.⁴¹ reported strong associations of tinnitus with depression and anxiety. In addition to these disorders, Bhatt et al.⁴² established that individuals with tinnitus averaged fewer hours of sleep per night. Nondahl et al.³⁹ reported depressive symptoms as a risk factor for tinnitus but acknowledged that the opposite or a bi-directional relationship may exist. Temporal data indicate that the presence of tinnitus can lead to psychological distress.⁴³ Personality traits including more pronounced reactions to stress and lower social closeness may play a role in the distress associated with tinnitus, when individuals' attention is focussed on the condition interfering with positive adaptation.⁴⁴ Although reports of high daily stress and a weak sense of community belonging are associated with tinnitus in the CHMS, it is not possible to establish whether these feelings contributed to or resulted from the tinnitus. Regardless of the direction between tinnitus and diminished well-being, there is agreement that people suffering from this condition could benefit from early intervention, mental health screening and appropriate treatment.^{9,43}

Figure 2
Prevalence of mental, emotional and quality of life characteristics by past year tinnitus status, household population aged 19 to 79, Canada excluding territories, 2012 to 2015



^E use with caution

^{*} significantly different from bothersome tinnitus ($p < 0.05$)

[†] significantly different from non-bothersome tinnitus ($p < 0.05$)

Source: 2012 to 2013 and 2014 to 2015 Canadian Health Measures Surveys, combined.

Table 4
Distribution of tinnitus, past year, and/or hearing loss, and prevalence of hearing aid use, household population aged 19 to 79, Canada excluding territories, 2012 to 2015

Condition	Distribution of hearing loss and tinnitus				Prevalence of hearing aid use			
	Number '000	%	95% confidence interval		Number '000	%	95% confidence interval	
			from	to			from	to
Total	...	100.0	...	...	664	7.2	6.0	8.7
Hearing loss and tinnitus	3,490	14.5	12.7	16.5	387 ^E	11.1 [*]	8.0	15.1
Hearing loss only [†]	5,680	23.5	21.8	25.4	277	4.9	3.9	6.1
Tinnitus only	5,277	21.9	19.9	24.0	...	...	...	...
No hearing loss or tinnitus	9,688	40.1	38.0	42.3	...	...	...	...

... not applicable

^E use with caution

^{*} significantly different from reference group ($p < 0.05$)

[†] reference group

Source: 2012 to 2013 and 2014 to 2015 Canadian Health Measures Surveys, combined.

Hearing loss is a risk factor for tinnitus,^{28,43} and the use of hearing aids is often an effective tool to help manage this condition.^{1,14} Data from the CHMS may be evidence of this finding, given that people with hearing loss and tinnitus were twice as likely to use hearing aids as those with hearing loss alone. Hearing loss management (such as hearing aids, combination instruments and cochlear implants), sound-based therapy (for

example, tinnitus retraining therapy, progressive tinnitus management and tinnitus activities treatment), behavioural interventions (cognitive behavioural therapy, acceptance and commitment therapy, etc.), and educational counselling are all effective interventions depending on the clinical picture of the tinnitus patient.^{1,2,15} Alternatively, the combination of tinnitus and hearing loss may have increased help-seeking behav-

iours and the subsequent use of hearing aids.

Results from this study indicate that one in every five Canadian adults has tinnitus with no measured hearing loss. However, the presence of tinnitus may indicate that a subclinical level of damage has already occurred⁴⁵ and signals future trends in hearing loss among Canadians.

Strengths and limitations

A strength of this study is the large sample representative of the Canadian population. In addition to questions about tinnitus, the CHMS includes self-reports on noise exposure and objective measurements of hearing loss. The study clearly showed the negative association between portable personal sound listening devices and the hearing health of younger adults.

There is no distinction between subjective and objective tinnitus in the CHMS, nor between idiopathic tinnitus and tinnitus secondary to an underlying condition. The CHMS does not include other sound sensitivity disorders that

accompany tinnitus, such as hyperacusis, misophonia and phonophobia.

Clinicians focus on bothersome, persistent (lasting six months or longer) tinnitus. Individuals with persistent tinnitus could not be adequately identified, and, therefore, the classification of tinnitus was limited to bothersome or not.

The CHMS is a cross-sectional survey. It is not possible to establish temporal order between tinnitus and chronic conditions, smoking status and BMI. The lower estimate of past-year tinnitus

among older Canadians could reflect cohort differences or indicate that tinnitus resolved over time.

Conclusion

Tinnitus is a common and potentially distressing condition. Although there is no medical cure for tinnitus, there are many management protocols that have been proven effective at reducing the negative effects of tinnitus and improving overall quality of life. Noise

exposure—particularly through the use of headphones or earbuds—may explain the higher prevalence of tinnitus among younger adults compared with the older cohorts and may indicate areas on which to focus education and behaviour change. Canadians could benefit from greater awareness of tinnitus, prevention strategies and management options. The high prevalence of tinnitus and potentially life-altering consequences indicate that it is an important public health problem. ■

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