The Journal of Laryngology & Otology

cambridge.org/jlo

Sociodemographic correlates of occupational, recreational and firearm noise exposure among adults in the USA

A P Knewitz, M C Simpson, D A Harris, J M Sappington and N Osazuwa-Peters

Department of Otolaryngology-Head and Neck Surgery, Saint Louis University School of Medicine, Missouri, USA

Abstract

Objective. To determine sociodemographic factors associated with occupational, recreational and firearm-related noise exposure.

Methods. This nationally representative, multistage, stratified, cluster cross-sectional study sampled eligible National Health and Nutrition Examination Survey participants aged 20–69 years ($n = 4675$) about exposure to occupational and recreational noise and recurrent firearm usage, using a weighted multivariate logistic regression analysis.

Results. Thirty-four per cent of participants had exposure to occupational noise and 12 per cent to recreational noise, and 13 per cent repeatedly used firearms. Males were more likely than females to have exposure to all three noise types (adjusted odds ratio range = 2.63–14.09). Hispanics and Asians were less likely to have exposure to the three noise types than Whites. Blacks were less likely than Whites to have occupational and recurrent firearm noise exposure. Those with insurance were 26 per cent less likely to have exposure to occupational noise than those without insurance (adjusted odds ratio = 0.74, 95 per cent confidence interval = 0.60–0.93).

Conclusion. Whites, males and uninsured people are more likely to have exposure to potentially hazardous loud noise.

Introduction

Noise is often a constant part of everyday life. It plays an important role, allowing for awareness to sources of danger; it affects language and speech development, and is essential in social and occupational functioning.[1] While normal noise levels allow for awareness of surroundings, and facilitate interaction and communication, abnormal and chronic noise exposure could have many detrimental health effects, which could be auditory or non-auditory, including annoyance, sleep disturbance, cognitive impairment in children, cardiovascular disease and noise-induced hearing loss.[1–3] Noise is so ubiquitous in our environment that it is a public health issue which needs to be addressed.[4] However, to effectively address noise from a public health perspective, it is critical that the population profile at greater risk of noise exposure be described, and that appropriate educational awareness and other interventions be targeted.

Two important sources of noise exposure are occupational and recreational noise exposure.[5] Work-related noise-induced hearing loss is the most common self-reported occupational illness or injury in the USA, with an estimated 30 million workers exposed to hazardous noise levels occupationally.[6] In fact, about a quarter of hearing loss cases in the USA are related to lifetime occupational noise exposure.[7] Work-related hearing loss is a major occupational hazard, and has been shown to be most prevalent in industrial settings, such as construction, mining, agriculture, transportation and manufacturing industries.[2,6–8] In addition to the industry workforce, airport workers, racetrack workers, musicians, military personnel and dentists are also prone to excess noise exposure and an increased risk of occupational hearing loss.[1,9] There is even a possibility of some excessive noise exposure in otolaryngology, which requires further exploration.[10]

Besides occupational exposure, recreational noise exposure is also prevalent in the USA, and could be more insidious.[11,12] At least 100 million individuals are exposed to noise from traffic near their homes each year in the USA.[6] Additionally, individuals who frequently engage in woodwork, power tool use and metalwork, and drivers of noisy vehicles or motorcycles, are exposed to higher noise levels and are at greater risk of developing hearing loss.[12–14] Other common sources of social noise include nightclubs, concerts and personal music players.[1,12] With the increased use of personal music devices by young people, the proportion of overall noise exposure and subsequent risk of hearing loss due to recreational activities will likely increase.[6,11,12,15,16]

Another significant and contemporary source of noise exposure is firearm use.[5,11,12] Firearm use is an important source of occupational noise for individuals such as those in the military.[12] It is also a source of noise exposure for those who use

Main Article

Dr N Osazuwa-Peters takes responsibility for the integrity of the content of the paper

Presented in part at the American Public Health Association Annual Meeting and Expo, 10–14 November 2018, San Diego, California, USA.

Cite this article: Knewitz AP, Simpson MC, Harris DA, Sappington JM, Osazuwa-Peters N. Sociodemographic correlates of occupational, recreational and firearm noise exposure among adults in the USA. *J Laryngol Otol* 2020; **134**:121–127. https://doi.org/10.1017/S0022215120000134

Accepted: 25 November 2019
First published online: 4 February 2020

Key words:
Noise Exposure;
Social Determinants of Health; Firearm Noise; Recreational Noise; Occupational Noise; NHANES

Author for correspondence:
Dr Nosayaba Osazuwa-Peters, Department of Otolaryngology – Head and Neck Surgery, Saint Louis University School of Medicine, 3635 Vista Avenue, 6FDT, St Louis, MO 63110-2539, USA
E-mail: nosazuwa@slu.edu
Fax: +1 (314) 268 7401

firearms recreationally, such as recreational hunters.[11] The potential of firearms to remain a source of noise exposure in the USA is underscored by the fact that there are estimated to be over 300 million firearms in the USA, and about 1 in 3 households own a gun.[12] However, firearms are not only important sources of noise exposure; they are associated with acoustic trauma,[17] hearing loss[18] and permanent hearing impairment.[3,19]

It is reasonable to assume that there may be sociodemographic variations in noise exposure due to different occupations and recreational interests. Given that sociodemographic factors are often being associated with disease prevalence, including risk of cardiovascular disease, hearing loss and other age-related conditions,[19,20] it is imperative to examine their role in excess noise exposure. This study aimed to identify the population most at risk of noise exposure by evaluating the sociodemographic correlates associated with occupational, recreational and firearm noise exposure.

Materials and methods

Data source

Data were obtained from the National Health and Nutrition Examination Survey ('NHANES'), conducted from 2011 to 2012 in the USA. The National Health and Nutrition Examination Survey examined demographic, socioeconomic and health-related information, and the sample is representative of the US population.[21] The survey used a complex, multistage, stratified, cluster design. During the 2011–2012 cycle, the National Health and Nutrition Examination Survey oversampled Hispanic, non-Hispanic Asian and non-Hispanic Black individuals to produce nationally representative estimates. Additionally, they oversampled individuals who were at or below 130 per cent of the poverty index. The survey was administered by trained interviewers in the participants' homes via a computer-assisted personal interview.[18]

As the National Health and Nutrition Examination Survey is publicly available with de-identified data, this study was exempt from consideration by the authors' institutional review board.

Measures

We included participants aged 20–69 years, as those were the ages of participants queried about noise exposure. The three outcomes of interest were occupational (work) noise exposure, recreational (non-work) noise exposure and recurrent firearm use.

The NHANES defined occupational noise as being 'exposed to loud sounds or noise 4 or more hours a day, several days a week…[loud] means so loud that [you] must speak in a raised voice to be heard'.

Recreational noise exposure was defined as 'exposure to very loud noise or music for 10 or more hours a week…this is noise so loud that [you have to] shout to be understood or heard 3 feet away'. The examples of recreational noise exposure given were 'power tools, lawn mowers, farm machinery, cars, trucks, motorcycles, motor boats or loud music'.

Firearms were listed as a separate category and not as an example of loud noise outside of work, although participants may have considered them to be an example of non-work noise exposure. In order to define recurrent firearm usage, we used a question asking how many rounds or shots from firearms the participant had fired. Recurrent firearm usage was defined as firing 1000 or more rounds; those who did not use firearms repeatedly either shot fewer than 1000 rounds or had never used firearms.[22]

Independent variables included sex (male or female), race or ethnicity (Hispanic, White, Black, Asian, other race or multiracial), marital status (married or partnered, widowed, divorced or separated, or never married), education (less than high school, high school graduate or General Educational Development test level, a college or associate degree, or college graduate or above), insurance status (yes or no), and age (20–29, 30–39, 40–49, 50–59 or 60–69 years).

Analysis

The proportion of participants with exposure to each noise type was compared to that of participants who did not have such noise exposure, for each independent variable, using chi-square tests. Percentages were weighted to adjust for complex survey design, non-response and post-stratification.[23] Weighted multivariate binary logistic regression determined significant predictors of occupational noise exposure, recreational noise exposure and recurrent firearm usage among the independent variables listed, using adjusted odds ratios and 95 per cent confidence intervals (CIs).

Results

A total of 4675 participants aged 20–69 years were included in our analysis. Of these, 34 per cent had occupational (work) noise exposure, 12 per cent had recreational (non-work) noise exposure, and 13 per cent used firearms repeatedly. The majority of participants were female (51 per cent) and White (65 per cent) (Tables 1–3).

Occupational noise exposure

Males were four times more likely to have occupational (work) noise exposure than females (adjusted odds ratio = 4.08, 95 per cent CI = 3.30–5.04). Compared to Whites, Hispanics (adjusted odds ratio = 0.61, 95 per cent CI = 0.45–0.84), Asians (adjusted odds ratio = 0.25, 95 per cent CI = 0.18–0.33) and Blacks (adjusted odds ratio = 0.67, 95 per cent CI = 0.47–0.95) were less likely to have occupational noise exposure. However, other race or multiracial participants were 72 per cent more likely to have occupational noise exposure than Whites (adjusted odds ratio = 1.72, 95 per cent CI = 1.08–2.74).

Never-married participants were 35 per cent less likely to have occupational noise exposure than married or partnered participants (adjusted odds ratio = 0.65, 95 per cent CI = 0.49–0.87). Participants with a college education or above were 74 per cent less likely to have exposure to occupational noise than participants with less than a high school education (adjusted odds ratio = 0.26, 95 per cent CI = 0.19–0.37). Those with insurance were 26 per cent less likely to have occupational noise exposure than participants without insurance (adjusted odds ratio = 0.74, 95 per cent CI = 0.60–0.93). Compared with participants aged 20–29 years, those aged 50–59 years were 80 per cent more likely to have experienced occupational noise exposure (adjusted odds ratio = 1.80, 95 per cent CI = 1.23–2.62) (Table 4).

https://doi.org/10.1017/S0022215120000134 Published online by Cambridge University Press

Table 1. Demographic characteristics for work noise exposure*

Characteristics	Occupational noise†	Non-occupational noise‡	Total**	*P*-value
Sex				<0.01
– Male	1085 (69.2)	1227 (38.0)	2312 (48.8)	
– Female	451 (30.8)	1912 (62.0)	2363 (51.2)	
Race				<0.01
– Hispanic	353 (15.5)	654 (15.2)	1007 (15.3)	
– White	629 (68.1)	907 (62.8)	1536 (64.6)	
– Black	403 (10.6)	873 (12.7)	1276 (12.0)	
– Asian	92 (2.0)	629 (7.3)	721 (5.5)	
– Other race or multiracial	59 (3.9)	76 (2.0)	135 (2.6)	
Marital status				<0.01
– Married or partnered	892 (62.6)	1770 (61.3)	2662 (61.8)	
– Widowed	66 (2.0)	106 (2.6)	172 (2.4)	
– Divorced or separated	258 (16.8)	424 (12.1)	682 (13.7)	
– Never married	320 (18.7)	835 (24.0)	1155 (22.2)	
Education				<0.01
– Less than high school	404 (19.7)	605 (12.9)	1009 (15.2)	
– High school graduate or equivalent	391 (24.5)	574 (16.6)	965 (19.3)	
– College or associate degree	534 (38.1)	926 (30.4)	1460 (33.0)	
– College graduate	207 (17.7)	1034 (40.2)	1241 (32.4)	
Insurance status				<0.01
– Insured	1025 (71.6)	2361 (80.5)	3386 (77.4)	
– Not insured	510 (28.4)	776 (19.5)	1286 (22.6)	
Age				<0.01
– 20–29 years	266 (18.3)	728 (22.9)	994 (21.3)	
– 30–39 years	337 (18.8)	625 (20.6)	962 (20.0)	
– 40–49 years	287 (21.3)	612 (21.4)	899 (21.3)	
– 50–59 years	336 (27.8)	577 (18.7)	913 (21.9)	
– 60–69 years	310 (13.7)	597 (16.4)	907 (15.5)	

Data represent numbers (and weighted percentages) of individuals, unless indicated otherwise. *Based on National Health and Nutrition Examination Survey ('NHANES') 2011–2012 data. †$n = 1536$; ‡$n = 3139$; **$n = 4675$

Recreational noise exposure

Males were more than two times more likely to have recreational (non-work) noise exposure than females (adjusted odds ratio = 2.63, 95 per cent CI = 1.88–3.70). Compared to Whites, Hispanics (adjusted odds ratio = 0.57, 95 per cent CI = 0.38–0.85) and Asians (adjusted odds ratio = 0.27, 95 per cent CI = 0.17–0.45) were less likely to have exposure to recreational noise (Table 4).

Recurrent firearm usage

Males were 14 times more likely to use firearms repeatedly than females (adjusted odds ratio = 14.09, 95 per cent CI = 9.88–20.10). Compared to Whites, Hispanics (adjusted odds ratio = 0.26, 95 per cent CI = 0.16–0.43), Asians (adjusted odds ratio = 0.15, 95 per cent CI = 0.10–0.22) and Blacks (adjusted odds ratio = 0.34, 95 per cent CI = 0.24–0.49) were less likely to use firearms repeatedly.

Never-married participants were 56 per cent less likely to use firearms repeatedly than married or partnered participants (adjusted odds ratio = 0.44, 95 per cent CI = 0.28–0.69). Compared to participants with less than a high school education, those with a college or an associate degree were 88 per cent more likely to use firearms repeatedly (adjusted odds ratio = 1.88, 95 per cent CI = 1.21–2.92) (Table 4).

Discussion

In this study, we compared the demographics of patients who identified as having occupational (or work-related) noise exposure, as well as those who identified as having recreational and repeated firearm noise exposure. The key sociodemographic correlates we identified as being associated with a general increased risk of noise exposure included being White, male, with lower education attainment and a lack of insurance. While many of these risk factors have been previously identified as independent risk factors for hearing loss,[18,19,24] our study suggests that these sociodemographic factors are also independently associated with occupational and non-occupational noise exposure.

Regarding occupation-specific risk factors, we found that there were independent associations between occupational

https://doi.org/10.1017/S0022215120000134 Published online by Cambridge University Press

Table 2. Demographic characteristics for non-work noise exposure*

Characteristics	Recreational noise†	Non-recreational noise‡	Total**	*P*-value
Sex				<0.01
– Male	386 (69.5)	1926 (45.9)	2312 (48.8)	
– Female	160 (30.5)	2203 (54.1)	2363 (51.2)	
Race				<0.01
– Hispanic	90 (12.2)	917 (15.8)	1007 (15.3)	
– White	245 (69.2)	1291 (64.0)	1536 (64.6)	
– Black	158 (12.4)	1118 (11.9)	1276 (12.0)	
– Asian	29 (1.8)	692 (6.0)	721 (5.5)	
– Other race or multiracial	24 (4.4)	111 (2.4)	135 (2.6)	
Marital status				<0.01
– Married or partnered	276 (54.3)	2386 (62.8)	2662 (61.8)	
– Widowed	14 (1.3)	158 (2.5)	172 (2.4)	
– Divorced or separated	88 (15.4)	594 (13.5)	682 (13.7)	
– Never married	168 (29.0)	987 (21.2)	1155 (22.2)	
Education				0.03
– Less than high school	106 (15.8)	903 (15.1)	1009 (15.2)	
– High school graduate or equivalent	130 (21.1)	835 (19.0)	965 (19.3)	
– College or associate degree	211 (38.3)	1249 (32.3)	1460 (33.0)	
– College graduate	99 (24.7)	1142 (33.5)	1241 (32.4)	
Insurance status				0.03
– Insured	351 (71.3)	3035 (78.3)	3386 (77.4)	
– Not insured	195 (28.7)	1091 (21.7)	1286 (22.6)	
Age				0.06
– 20–29 years	142 (25.2)	852 (20.8)	994 (21.3)	
– 30–39 years	129 (21.9)	833 (19.7)	962 (20.0)	
– 40–49 years	100 (21.3)	799 (21.4)	899 (21.3)	
– 50–59 years	97 (21.4)	816 (21.9)	913 (21.9)	
– 60–69 years	78 (10.2)	829 (16.2)	907 (15.5)	

Data represent numbers (and weighted percentages) of individuals, unless indicated otherwise. *Based on National Health and Nutrition Examination Survey ('NHANES') 2011–2012 data. †$n = 546$; ‡$n = 4129$; **$n = 4675$

(or work-related) noise and male sex, White race, low educational attainment and lack of health insurance. As the common industries associated with hearing loss are construction, mining and manufacturing,[2,7] the findings suggest that these sociodemographic factors may be similar to those of workforce populations.

The area of occupational noise exposure provides a unique opportunity to implement preventative medicine. In a previous study, the main predictors of occupational hearing loss were inadequate use of hearing protection devices and duration of occupational exposure to noise.[25] The lack of use of adequate hearing protection devices is known to worsen the hearing of those exposed.[26] Increasing efforts to educate patients on appropriate hearing protection is necessary. Furthermore, populations at risk of noise exposure may benefit from prevention or early detection through lifelong surveillance. Thus, the at-risk sociodemographic group identified in this study may be candidates for annual audiometric examinations. This early intervention is relevant given the irreversible nature of hearing loss and its subtle onset.

Regarding recreation-related noise exposure, only male sex was shown to be associated with an increased risk, and those of Hispanic and Asian race were less likely to have higher noise exposure relative to those who identified as White. Although occupational noise exposure has decreased over the years,[27] social and recreational noise exposure has increased with the use of personal music players, and attendance at loud concerts and music festivals. Recreational noise exposure is an area where there is little use of hearing protection devices,[28] and it is a type of noise exposure likely to continue to increase in prevalence. There is a need to increase awareness of the potential effects of the prolonged use of devices associated with recreational noise and exposure to loud music.[1,16]

When evaluating participants who had excess noise exposure from repetitive firearm use, the most prominent risk factor was male sex. Other key factors included White race, being married or with a partner, and having a college or associate degree. While it has been documented that target shooters are known to be more compliant with hearing protection devices,[28] this study did not focus on the specific form of firearm exposure and it is unclear what the overall use of hearing protection devices was. However, the threshold set for the definition of firearm noise exposure in this study (at least 1000 rounds fired) suggests that the sociodemographic group

https://doi.org/10.1017/S0022215120000134 Published online by Cambridge University Press

Table 3. Demographic characteristics for recurrent firearm usage*

Characteristics	Recurrent firearm usage†	Non-recurrent firearm usage‡	Total**	*P*-value
Sex				<0.01
– Male	419 (89.6)	1871 (42.8)	2290 (48.7)	
– Female	44 (10.4)	2314 (57.2)	2358 (51.3)	
Race				<0.01
– Hispanic	55 (6.3)	945 (16.6)	1000 (15.3)	
– White	287 (82.6)	1245 (62.1)	1532 (64.7)	
– Black	83 (5.9)	1184 (12.9)	1267 (12.0)	
– Asian	18 (1.1)	696 (6.1)	714 (5.4)	
– Other race or multiracial	20 (4.2)	115 (2.4)	135 (2.6)	
Marital status				<0.01
– Married or partnered	292 (66.7)	2355 (61.0)	2647 (61.7)	
– Widowed	7 (0.9)	163 (2.6)	170 (2.4)	
– Divorced or separated	92 (17.3)	587 (13.2)	679 (13.7)	
– Never married	72 (15.1)	1076 (23.2)	1148 (22.2)	
Education				
– Less than high school	66 (10.9)	935 (15.8)	1001 (15.2)	
– High school graduate or equivalent	112 (21.2)	846 (19.0)	958 (19.3)	
– College or associate degree	195 (44.9)	1255 (31.4)	1450 (33.1)	
– College graduate	90 (23.0)	1149 (33.8)	1239 (32.4)	
Insurance status				0.14
– Insured	345 (81.2)	3021 (76.9)	3366 (77.4)	
– Not insured	118 (18.8)	1161 (23.1)	1279 (22.6)	
Age				0.59
– 20–29 years	74 (17.6)	915 (21.9)	989 (21.4)	
– 30–39 years	103 (18.7)	857 (20.2)	960 (20.0)	
– 40–49 years	91 (22.9)	805 (21.2)	896 (21.4)	
– 50–59 years	94 (24.1)	812 (21.5)	906 (21.8)	
– 60–69 years	101 (16.6)	796 (15.3)	897 (15.5)	

Data represent numbers (and weighted percentages) of individuals, unless indicated otherwise. *Based on National Health and Nutrition Examination Survey ('NHANES') 2011–2012 data. †n = 4185; ‡n = 463; **n = 4648

identified herein may benefit from increased awareness of potential noise exposure associated with firearm use. Additionally, with the contemporary nature of firearm use in the USA,[11,12] it is important that individuals are aware of the potential health consequences of firearm noise exposure when not using hearing protection devices.

Given the multitude of health concerns associated with noise exposure, it is imperative to focus on efforts to reduce noise exposure. Noise exposure can lead to sleep disturbance and an inability to adequately rest, which can have a significant impact on one's quality of life.[29] Noise-induced hearing loss is an important contributor to the epidemic of hearing loss in the USA. It is a self-reported health concern in almost half of all the US population aged over 70 years,[30] which makes it more common than diabetes and cancer.[31]

While this study focused on the adult population, one of the most devastating health effects of noise exposure in paediatrics is the negative impact on cognitive performance and learning outcomes.[1] Yet, younger people are becoming more at risk of noise exposure, especially because of the frequent use and attachment to electronic and music devices.[1,12,16] The culmination of these detrimental health effects further supports the need to increase efforts to educate on and prevent noise exposure. Specifically, for noise-induced hearing loss, the irreversible nature of the damage that occurs to cochlear hair cells with excessive noise exposure makes preventative measures the focus of current treatment.

Strengths and limitations

We used the National Health and Nutrition Examination Survey as our source of data collection. However, it is important to note that this is a cross-sectional estimate. Indicators of both noise exposure and symptoms of hearing loss were self-reported, which adds an element of subjectivity. Additionally, it relies on patients' recollection, which may subject the study to reporting bias. It is possible that the questions asked were inadequate to assess the culmination of noise exposure they acquire during their lifetime.[18]

One of the strengths of the National Health and Nutrition Examination Survey dataset is the population-based sampling strategy. The survey utilised a complex, multistage, stratified, cluster design, which additionally oversampled specific subgroups to provide nationally representative information with

https://doi.org/10.1017/S0022215120000134 Published online by Cambridge University Press

Table 4. Weighted multivariate logistic regression models for work and non-work noise exposure, and recurrent firearm usage

Variable	Work noise		Non-work noise		Recurrent firearm usage	
	Adjusted OR	95% CI	Adjusted OR	95% CI	Adjusted OR	95% CI
Sex (ref = female)						
– Male	4.08	3.30–5.04	2.63	1.88–3.70	14.09	9.88–20.10
Race (ref = White)						
– Hispanic	0.61	0.45–0.84	0.57	0.38–0.85	0.26	0.16–0.43
– Asian	0.25	0.18–0.33	0.27	0.17–0.45	0.15	0.10–0.22
– Black	0.67	0.47–0.95	0.86	0.67–1.11	0.34	0.24–0.49
– Other race or multiracial	1.72	1.08–2.74	1.51	0.78–2.91	1.21	0.70–2.10
Marital status (ref = married or partnered)						
– Divorced or separated	1.21	0.84–1.75	1.34	0.85–2.11	1.44	0.86–2.41
– Never married	0.65	0.49–0.87	1.30	0.96–1.74	0.44	0.28–0.69
– Widowed	0.94	0.41–2.16	0.83	0.27–2.49	0.54	0.16–1.86
Education (ref = less than high school)						
– College graduate	0.26	0.19–0.37	0.71	0.43–1.17	0.72	0.44–1.18
– High school graduate or equivalent	0.88	0.69–1.13	0.93	0.61–1.43	1.21	0.78–1.88
– College or associate degree	0.84	0.60–1.16	1.03	0.62–1.71	1.88	1.21–2.92
Insurance status (ref = not insured)						
– Insured	0.74	0.60–0.93	0.79	0.53–1.18	1.36	0.89–2.10
Age (ref = 20–29 years)						
– 30–39 years	1.16	0.94–1.44	1.07	0.76–1.51	1.04	0.67–1.59
– 40–49 years	1.12	0.81–1.55	0.90	0.56–1.46	0.98	0.58–1.66
– 50–59 years	1.80	1.23–2.62	0.86	0.63–1.17	0.91	0.59–1.42
– 60–69 years	0.95	0.67–1.37	0.60	0.34–1.05	0.85	0.49–1.47

OR = odds ratio; CI = confidence interval; ref = reference

generalisability. With over 4000 patients, there is strength in its sample size.[18]

- Chronic noise exposure is a major risk factor for hearing loss; this exposure might vary based on demographic factors
- In a weighted, nationally representative survey of adults in the USA, at least one in three respondents reported occupational noise exposure
- About 1 in 8 adult Americans may be exposed to noise from firearms of at least 1000 rounds
- Whites and males are significantly more likely to be exposed to both occupational and recurrent firearm noise in the USA

Public health implications

Our study highlights the high prevalence of occupational, recreational and firearm noise exposure. There are many public health implications associated with excess noise exposure. Hearing impairment, regardless of cause, has been associated with an increased risk of disability,[32] higher medical expenditure[33] and a poorer quality of life.[13] From an economic standpoint, it is estimated that 242 million dollars are spent annually on compensation for hearing loss in the USA.[1]

Firearm ownership is an important issue in the USA, and it is estimated that there are over 300 million firearms in the USA currently.[12] While the debate is ongoing regarding whether gun violence, control and safety is a public health issue,[34–38] it is imperative to inform the public of the potential noise exposure associated with recurrent firearm use.[17] Although noise exposure from firearms may never evoke gun safety debates such as those currently being discussed across the USA, it does have long-term health implications, that are preventable through protective measures.[17,28] Additionally, physicians can help by screening individuals to determine excess noise exposure and by counselling patients on the detrimental effects of prolonged exposure.

Conclusion

There are sociodemographic correlates of occupational, recreational and firearm noise exposure among adults in the USA. This study indicates that Whites, males, those with low educational attainment and uninsured people are more likely to be exposed to different types of noise, and past research has found that these groups have an increased risk of hearing loss. The use of hearing protection should be emphasised for these groups. Future interventions for excessive noise exposure prevention may target those sociodemographic groups identified in our study that have greater risk of noise exposure.

Competing interests. None declared

https://doi.org/10.1017/S0022215120000134 Published online by Cambridge University Press

References

1 Basner M, Babisch W, Davis A, Brink M, Clark C, Janssen S *et al*. Auditory and non-auditory effects of noise on health. *Lancet* 2014;**383**:1325–32
2 Masterson EA, Bushnell PT, Themann CL, Morata TC. Hearing impairment among noise-exposed workers - United States, 2003–2012. *MMWR Morb Mortal Wkly Rep* 2016;**65**:389–94
3 Agrawal Y, Platz EA, Niparko JK. Risk factors for hearing loss in US adults: data from the National Health and Nutrition Examination Survey, 1999 to 2002. *Otol Neurotol* 2009;**30**:139–45
4 Alberti P. Noise, the most ubiquitous pollutant. *Noise Health* 1998; **1**:3–5
5 Johnson TA, Cooper S, Stamper GC, Chertoff M. Noise Exposure Questionnaire (NEQ): a tool for quantifying annual noise exposure. *J Am Acad Audiol* 2017;**28**:14–35
6 Chepesiuk R. Decibel hell: the effects of living in a noisy world. *Environ Health Perspect* 2005;**113**:A34–41
7 Masterson EA, Themann CL, Luckhaupt SE, Li J, Calvert GM. Hearing difficulty and tinnitus among U.S. *workers and non-workers in 2007*. Am J Ind Med 2016;**59**:290–300
8 Tak S. Noise, hearing protector use, and hearing loss in American workers. *Update: The Newsletter of the Council for Accreditation in Occupational Hearing Conservation* 2009;**21**:5–6
9 Myers J, John AB, Kimball S, Fruits T. Prevalence of tinnitus and noise-induced hearing loss in dentists. *Noise Health* 2016;**18**:347–54
10 Vaisbuch Y, Alyono JC, Kandathil C, Wu SH, Fitzgerald MB, Jackler RK. Occupational noise exposure and risk for noise-induced hearing loss due to temporal bone drilling. *Otol Neurotol* 2018;**39**:693–9
11 Ivory R, Kane R, Diaz RC. Noise-induced hearing loss: a recreational noise perspective. *Curr Opin Otolaryngol Head Neck Surg* 2014;**22**:394–8
12 Bhatt JM, Lin HW, Bhattacharyya N. Epidemiology of firearm and other noise exposures in the United States. *Laryngoscope* 2017;**127**:E340–6
13 Dalton DS, Cruickshanks KJ, Wiley TL, Klein BE, Klein R, Tweed TS. Association of leisure-time noise exposure and hearing loss. *Audiology* 2001;**40**:1–9
14 McCombe AW. Hearing loss in motorcyclists: occupational and medicolegal aspects. *J R Soc Med* 2003;**96**:7–9
15 Carroll YI, Eichwald J, Scinicariello F, Hoffman HJ, Deitchman S, Radke MS *et al*. Vital signs: noise-induced hearing loss among adults - United States 2011–2012. *MMWR Morb Mortal Wkly Rep* 2017;**66**: 139–44
16 Le Prell CG, Spankovich C, Lobarinas E, Griffiths SK. Extended high-frequency thresholds in college students: effects of music player use and other recreational noise. *J Am Acad Audiol* 2013;**24**:725–39
17 Rabinowitz PM. Noise-induced hearing loss. *Am Fam Physician* 2000;**61**:2749–56, 2759–60
18 Hoffman HJ, Dobie RA, Losonczy KG, Themann CL, Flamme GA. Declining prevalence of hearing loss in US adults aged 20 to 69 years. *JAMA Otolaryngol Head Neck Surg* 2017;**143**:274–85
19 Cruickshanks KJ, Dhar S, Dinces E, Fifer RC, Gonzalez F 2nd, Heiss G *et al*. Hearing impairment prevalence and associated risk factors in the Hispanic Community Health Study/Study of Latinos. *JAMA Otolaryngol Head Neck Surg* 2015;**141**:641–8
20 Agrawal Y, Platz EA, Niparko JK. Prevalence of hearing loss and differences by demographic characteristics among US adults: data from the National Health and Nutrition Examination Survey, 1999–2004. *Arch Intern Med* 2008;**168**:1522–30
21 Centers for Disease Control and Prevention. About the National Health and Nutrition Examination Survey. In: https://www.cdc.gov/nchs/nhanes/about_nhanes.htm [27 July 2018]
22 National Health and Nutrition Examination Survey: 2011–2012 Data Documentation, Codebook, and Frequencies. Audiometry (AUQ_G). In: https://wwwn.cdc.gov/Nchs/Nhanes/2011-2012/AUQ_G.htm [27 July 2018]
23 Centers for Disease Control and Prevention. National Health and Nutrition Examination Survey, Module 3: Weighting. In: https://wwwn.cdc.gov/nchs/nhanes/tutorials/module3.aspx [27 July 2018]
24 Emmett SD, Francis HW. The socioeconomic impact of hearing loss in U.S. adults. *Otol Neurotol* 2015;**36**:545–50
25 Pelegrin AC, Canuet L, Rodriguez AA, Morales MP. Predictive factors of occupational noise-induced hearing loss in Spanish workers: a prospective study. *Noise Health* 2015;**17**:343–9
26 Kerr MJ, McCullagh M, Savik K, Dvorak LA. Perceived and measured hearing ability in construction laborers and farmers. *Am J Ind Med* 2003;**44**:431–7
27 Paul C, Tzelepis F, Walsh RA, Girgis A, King L, McKenzie J. Has the investment in public cancer education delivered observable changes in knowledge over the past 10 years? *Cancer* 2003;**97**:2931–9
28 Nondahl DM, Cruickshanks KJ, Dalton DS, Klein BE, Klein R, Tweed TS *et al*. The use of hearing protection devices by older adults during recreational noise exposure. *Noise Health* 2006;**8**:147–53
29 Seidman MD, Standring RT. Noise and quality of life. *Int J Environ Res Public Health* 2010;**7**:3730–8
30 Zelaya CE, Lucas JW, Hoffman HJ. Self-reported Hearing Trouble in Adults Aged 18 and Over: United States, 2014. NCHS data brief, no 214. Hyattsville, MD: National Center for Health Statistics, 2015
31 Blackwell DL, Lucas JW, Clarke TC. Summary health statistics for U.S. *adults: national health interview survey, 2012*. Vital Health Stat *10* 2014; (260):1–161
32 Chen DS, Betz J, Yaffe K, Ayonayon HN, Kritchevsky S, Martin KR *et al*. Association of hearing impairment with declines in physical functioning and the risk of disability in older adults. *J Gerontol A Biol Sci Med Sci* 2015;**70**:654–61
33 Huddle MG, Goman AM, Kernizan FC, Foley DM, Price C, Frick KD *et al*. The economic impact of adult hearing loss: a systematic review. *JAMA Otolaryngol Head Neck Surg* 2017;**143**:1040–8
34 Branas CC, Flescher A, Formica MK, Galea S, Hennig N, Liller KD *et al*. Academic public health and the firearm crisis: an agenda for action. *Am J Public Health* 2017;**107**:365–7
35 Galea S, Vaughan RD. Learning from the evolving conversation on firearms: a public health of consequence, July 2018. *Am J Public Health* 2018;**108**:856–7
36 Butkus R, Doherty R, Daniel H; Health and Public Policy Committee of the American College of Physicians. Reducing firearm-related injuries and deaths in the United States: executive summary of a policy position paper from the American college of physicians. *Ann Intern Med* 2014;**160**:858–60
37 Gius M. An examination of the effects of concealed weapons laws and assault weapons bans on state-level murder rates. *Appl Econ Lett* 2014;**21**:265–7
38 Planty M, Truman J. *Firearm Violence, 1993–2011*. Washington, DC: Bureau of Justice Statistics, US Department of Justice, 2013

https://doi.org/10.1017/S0022215120000134 Published online by Cambridge University Press