Parental Perspectives on Adolescent Hearing Loss Risk and Prevention

Deepa L. Sekhar, MD, MSc; Sarah J. Clark, MPH; Matthew M. Davis, MD, MAPP; Dianne C. Singer, MPH; Ian M. Paul, MD, Msc

**IMPORTANCE** Data indicate that 1 in 6 adolescents has high-frequency hearing loss, which is typically noise related and preventable. Parental participation improves the success of adolescent behavioral interventions, yet little is known about parental perspectives regarding adolescent noise-induced hearing loss.

**OBJECTIVE** To perform a survey to determine parental knowledge of adolescent hearing loss and willingness to promote hearing conservation to discern information that is critical to design adolescent hearing loss prevention programs.

**DESIGN, SETTING, AND PARTICIPANTS** A cross-sectional, Internet-based survey of a nationally representative online sample of parents of 13- to 17-year-olds.

**INTERVENTIONS** A survey conducted with the C.S. Mott Children's Hospital National Poll on Children's Health, a recurring online survey.

**MAIN OUTCOMES AND MEASURES** Parental knowledge of adolescent hearing loss and willingness to promote hearing conservation.

**RESULTS** Of 716 eligible respondents, 96.3% of parents reported that their adolescent was slightly or not at all at risk of hearing problems from excessive noise, and 69.0% had not spoken with their adolescent about noise exposure, mainly because of the perceived low risk. Nonetheless, to protect their adolescents' hearing, more than 65.0% of parents are either willing or very willing to consider limiting listening to music, limiting access to excessively noisy situations, or insisting on the use of hearing protection (earplugs or earmuffs). Higher parental education increased the odds of promoting hearing-protective strategies. Parents were less likely to insist on hearing protection for older adolescents. Parents who understood that both volume and time of exposure affect hearing damage were more likely to have discussed hearing loss with their adolescent (odds ratio [OR], 1.98; 95% CI, 1.29-3.03). The odds of discussing hearing loss were also increased for those who were willing or very willing to limit time listening to music (OR, 1.88; 95% CI, 1.19-2.26) and to insist on hearing protection (OR, 1.92; 95% CI, 1.15-3.18) compared with parents who were very unwilling, unwilling, or neutral.

**CONCLUSIONS AND RELEVANCE** Despite the rising prevalence of acquired adolescent hearing loss, few parents believe their adolescent is at risk. Those with higher education are more willing to promote hearing conservation, especially with younger adolescents. To create effective hearing conservation programs, parents need better education on this subject as well as effective and acceptable strategies to prevent adolescent noise exposure.
he prevalence of adolescent hearing loss, 19.5%, is even higher than the 18.4% prevalence of obesity among 12- to 19-year-olds, and obesity is considered a national epidemic.¹ ² Most adolescents demonstrate high-frequency hearing loss (HFHL), which is often related to noise exposure.³ Large-scale surveys of adolescents indicate that they often exceed the current occupational safety standard for noise exposure, with common exposures being personal listening devices and concerts.³ Hearing loss related to noise is irreversible but highly preventable, particularly if noise exposures are minimized or hearing loss is identified early.⁴ ⁵

Based on studies of occupational noise exposure, noise-induced hearing loss (NIHL) can have significant negative effects on the quality of life.⁶ As individuals continue to expose themselves to sound-hazardous environments, hearing loss will progress, with long-term negative consequences on speech, communication, and quality of life.⁵ Early detection of even mild HFHL has the potential to prevent long-term morbidity for adolescents.⁴ ⁵

To our knowledge, no studies have examined parental concern and knowledge of hazardous noise exposures and hearing loss for adolescents. However, numerous studies have examined parents’ positive impact in reducing adolescent risk-taking behaviors.⁷ ⁸ For example, parental involvement has been shown to decrease substance abuse and risky sexual behavior in teenagers.⁷ ⁸ Specific to hearing and noise exposure, a study of hearing loss from use of personal listening devices among adolescents rated parents as an important party to prevention efforts but raised concerns regarding lack of parental knowledge about hazardous noise exposures.⁹ The goals of the present study were to evaluate current parental knowledge and concerns regarding adolescent hearing loss and to assess parental willingness to make changes to preserve adolescent hearing. These are key elements in designing prevention programs for adolescent hearing loss.

Methods

Study Design
In September 2011, we conducted a cross-sectional, Internet-based survey of a nationally representative sample of the US population regarding adolescent hearing loss. This survey was conducted as part of the C.S. Mott Children’s Hospital National Poll on Children's Health (NPCH), a recurring online survey of parents and nonparents. Funding for the NPCH is provided by the University of Michigan Health System and the Department of Pediatrics and Communicable Diseases. The study was approved by the University of Michigan Medical School and the Pennsylvania College of Medicine Institutional Review Boards.

Data Source
The NPCH is conducted using the GfK Custom Research, LLC (GfK) Group’s web-enabled KnowledgePanel, a probability-based panel designed to be representative of the US population. Potential participants are chosen scientifically by a random selection of telephone numbers and residential addresses and then invited by telephone or by mail to participate in the web-enabled KnowledgePanel. If individuals agree to participate but do not already have Internet access, GfK provides them a laptop and ISP connection at no cost. Those with an existing personal Internet connection will have their bill paid by GfK. Panels then receive unique log-in information for accessing surveys online and then are sent e-mails throughout each month inviting them to participate in research. Completion of the survey once enrolled in KnowledgePanel constituted panelists’ consent to participate in this study.

Survey Administration
The NPCH was pilot tested by GfK in August 2011 with a separate convenience sample of 126 KnowledgePanel members. A unique KnowledgePanel sample was drawn for the NPCH that contained the survey items for this study. The introductory e-mail invited participation in a survey about child health. No additional incentive participation was offered beyond the usual KnowledgePanel participation points. The participation points are analogous to a “frequent flyer” program. Respondents are credited with points in proportion to their participation in the surveys. Panelists receive cash-equivalent checks every 4 to 6 months depending on their level of panel participation, which commonly results in distributions in the range of $4 to $6 per month. KnowledgePanel has found that the incentives successfully increase the survey completion rates in general. To ensure adequate representation, parents (defined as having children aged ≤17 years living in the household) and racial/ethnic minorities were oversampled.

Statistical Analysis
KnowledgePanel provided deidentified data, along with census-based poststratification weights used to match the US population distribution on sex, age, race/ethnicity, education, census region, and urbanicity.

Frequency distributions were calculated on all weighted items. Descriptive statistics were calculated for all participants. Bivariate analysis was done of weighted items using χ² and Cochran-Mantel-Haenszel tests to determine the relationships between survey responses and demographic variables. Logistic regression was used to analyze the odds of parents engaging in hearing-protective strategies and discussing hearing loss with their adolescent.

Results
Of the 1626 parents surveyed, 725 (44.6%) had adolescents aged 13 to 17 years. Nine respondents were excluded as their teenager had been diagnosed with hearing loss by a medical professional, leaving 716 respondents eligible for inclusion. Demographics of the 716 parent respondents are detailed in Table 1. Respondents had equal numbers of male and female teenagers.

Table 2 details the survey questions and responses. More than two-thirds of parents had not discussed hearing loss related to noise with their adolescent, mostly because they believed their teenager was not at risk for hearing loss. For the
few parents who did discuss hearing loss, their primary im-
petus was thinking that the teenager played music too loudly.
More than half of parents understood that both high-volume
sounds and time exposed may be equally damaging to hear-
ing. However, when presented a list of potential hearing-
hazardous activities, only headphone use with a personallis-
tening device was considered a high-risk hearing activity by
most parents (Table 3). More than 65.0% of parents were will-
ing or very willing to take steps to protect their adolescent’s
hearing. Less than half knew about volume-limiting head-
phones, and most thought that their teenager would be un-
likely to use these devices. Many parents believed that ado-
lescent hearing screening was best conducted at a physician’s
visit.

Parental demographic factors as well as teenagers’ age and
sex were subsequently examined in relation to parents’ will-
ingness to engage in various hearing-protective strategies.
There were no differences in parental survey responses based
on the sex of the teenager, parent age, ethnicity, or Internet
access. Parents who had completed college or had a bach-
elor’s degree had increased odds of being willing or very will-
ing to insist on use of hearing protection (earplugs or ear-
muffs), limit access to excessively noisy situations, or purchase
volume-limiting headphones and believe that their teenager
would wear such headphones. Higher-income parents were

### Table 1. Characteristics of 716 Parent Participants

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Participants, No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>331 (46.2)</td>
</tr>
<tr>
<td>Female</td>
<td>385 (53.8)</td>
</tr>
<tr>
<td>Race</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>523 (73.0)</td>
</tr>
<tr>
<td>African American or black</td>
<td>59 (8.2)</td>
</tr>
<tr>
<td>Hispanic or Latino</td>
<td>98 (13.7)</td>
</tr>
<tr>
<td>Other</td>
<td>36 (5.0)</td>
</tr>
<tr>
<td>Age, y</td>
<td></td>
</tr>
<tr>
<td>20–29</td>
<td>11 (1.5)</td>
</tr>
<tr>
<td>30–44</td>
<td>322 (45.0)</td>
</tr>
<tr>
<td>45–59</td>
<td>366 (51.1)</td>
</tr>
<tr>
<td>&gt;60</td>
<td>17 (2.4)</td>
</tr>
<tr>
<td>Educational level</td>
<td></td>
</tr>
<tr>
<td>Less than high school</td>
<td>46 (6.4)</td>
</tr>
<tr>
<td>High school</td>
<td>208 (29.1)</td>
</tr>
<tr>
<td>Some college</td>
<td>240 (33.5)</td>
</tr>
<tr>
<td>Bachelor’s degree or higher</td>
<td>222 (31.0)</td>
</tr>
<tr>
<td>Annual income, $</td>
<td></td>
</tr>
<tr>
<td>&lt;30 000</td>
<td>121 (16.9)</td>
</tr>
<tr>
<td>30 000 to &lt;60 000</td>
<td>174 (24.3)</td>
</tr>
<tr>
<td>60 000 to &lt;100 000</td>
<td>185 (25.8)</td>
</tr>
<tr>
<td>≥100 000</td>
<td>236 (33.0)</td>
</tr>
<tr>
<td>Internet access</td>
<td></td>
</tr>
<tr>
<td>Personal</td>
<td>637 (89.0)</td>
</tr>
<tr>
<td>GfK-provided laptop and Internet access</td>
<td>79 (11.0)</td>
</tr>
</tbody>
</table>

Abbreviation: GfK, GfK Custom Research, LLC.

### Table 2. Survey Questions and Responses

<table>
<thead>
<tr>
<th>Question</th>
<th>Responses, No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Has your child been diagnosed by a medical professional with hearing loss or hearing impairment?</td>
<td></td>
</tr>
<tr>
<td>If yes, exclude</td>
<td>9</td>
</tr>
<tr>
<td>No</td>
<td>716</td>
</tr>
<tr>
<td>2. Have you recently (within the past 2 y) talked with your teenager about hearing problems related to excessive noise? (n = 712)</td>
<td></td>
</tr>
<tr>
<td>Yes (proceed to 3A and 3B)</td>
<td>221 (31.0)</td>
</tr>
<tr>
<td>No (proceed to 3C)</td>
<td>491 (69.0)</td>
</tr>
<tr>
<td>3. A. If yes, what prompted the conversation? (n = 288)</td>
<td></td>
</tr>
<tr>
<td>Personal experience</td>
<td>69 (24.0)</td>
</tr>
<tr>
<td>Something I read</td>
<td>25 (8.7)</td>
</tr>
<tr>
<td>Something I saw on television/Internet</td>
<td>24 (8.3)</td>
</tr>
<tr>
<td>Conversation with a medical professional</td>
<td>10 (3.5)</td>
</tr>
<tr>
<td>My teenager brought it up</td>
<td>7 (2.4)</td>
</tr>
<tr>
<td>My teenager plays his/her music too loudly</td>
<td>153 (53.1)</td>
</tr>
<tr>
<td>B. What were the main messages you tried to emphasize? (n = 348)</td>
<td></td>
</tr>
<tr>
<td>You won’t be able to hear as well one day</td>
<td>183 (52.6)</td>
</tr>
<tr>
<td>You will have problems in school</td>
<td>20 (5.7)</td>
</tr>
<tr>
<td>You will have difficulty talking with your friends</td>
<td>21 (6.0)</td>
</tr>
<tr>
<td>You will have difficulty enjoying activities</td>
<td>32 (9.2)</td>
</tr>
<tr>
<td>You will have difficulties with work in the future</td>
<td>38 (10.9)</td>
</tr>
<tr>
<td>No specific message, just “turn down the volume”</td>
<td>54 (15.5)</td>
</tr>
<tr>
<td>C. If no, why not? (n = 529)</td>
<td></td>
</tr>
<tr>
<td>My teenager is not at risk for hearing loss</td>
<td>375 (70.9)</td>
</tr>
<tr>
<td>I feel there are other more pressing issues to address with my teenagers</td>
<td>130 (24.6)</td>
</tr>
<tr>
<td>I would not know how to discuss this</td>
<td>7 (1.3)</td>
</tr>
<tr>
<td>My child is unlikely to listen to me</td>
<td>17 (3.2)</td>
</tr>
<tr>
<td>4. A. To what extent do you perceive your teenager to be at risk from hearing problems related to excessive noise? (n = 712)</td>
<td></td>
</tr>
<tr>
<td>Very much at risk</td>
<td>26 (3.7)</td>
</tr>
<tr>
<td>Somewhat/slightly/not at all risk</td>
<td>686 (96.3)</td>
</tr>
<tr>
<td>B. Which is more likely to damage your teen’s hearing? (n = 710)</td>
<td></td>
</tr>
<tr>
<td>Volume and exposure time may be equally damaging (correct)</td>
<td>412 (58.0)</td>
</tr>
<tr>
<td>High-volume sounds are more damaging OR Longer time exposed, even to moderate-level sounds, is more damaging (incorrect)</td>
<td>298 (42.0)</td>
</tr>
<tr>
<td>C. What do you think is the risk that these activities will cause teenage hearing loss? (n = 715)</td>
<td></td>
</tr>
<tr>
<td>A. Limiting time listening to music with headphones or earbuds (n = 714)</td>
<td></td>
</tr>
<tr>
<td>Very unwilling/unwilling/neural</td>
<td>219 (30.7)</td>
</tr>
<tr>
<td>Willing/very willing</td>
<td>477 (66.8)</td>
</tr>
<tr>
<td>Not applicable</td>
<td>18 (2.5)</td>
</tr>
<tr>
<td>B. Insisting he/she wears earplugs/earmuffs when exposed to very loud noises (n = 716)</td>
<td></td>
</tr>
<tr>
<td>Very unwilling/unwilling/neural</td>
<td>182 (25.4)</td>
</tr>
<tr>
<td>Willing/very willing</td>
<td>519 (72.5)</td>
</tr>
<tr>
<td>Not applicable</td>
<td>15 (2.0)</td>
</tr>
<tr>
<td>C. Limiting access to situations with excessive noise (n = 715)</td>
<td></td>
</tr>
<tr>
<td>Very unwilling/unwilling/neural</td>
<td>213 (29.8)</td>
</tr>
<tr>
<td>Willing/very willing</td>
<td>491 (68.7)</td>
</tr>
<tr>
<td>Not applicable</td>
<td>11 (1.5)</td>
</tr>
</tbody>
</table>

(continued)
more likely to insist on the use of hearing protection and purchase volume-limiting devices. Parents had decreased odds of engaging in hearing-protective strategies for older teenagers (15-17 years) (Table 4). Mothers had almost twice the odds (odds ratio, 1.89; 95% CI, 1.27-2.79; P = .002) of correctly answering that both volume and time exposed to noise may damage hearing.

Knowledge of hearing loss and willingness to engage in hearing-protective strategies was subsequently examined in relation to recently talking to a teenager regarding hearing loss (Table 5). Parents who understood that both volume and time exposed to noise may damage hearing had almost twice the odds of having discussed hearing loss with their adolescent. Odds of discussing hearing loss were also almost doubled for parents who were willing or very willing to limit time listening to music and to insist on hearing protection. The odds of discussing hearing loss were 3 times higher for parents who were very likely or likely to purchase volume-limiting headphones.

Discussion

Although recent national data show that 1 in 6 adolescents has HFHL, the results of this study demonstrate that most parents do not think their teenager is at risk for hearing loss caused by noise exposure. Furthermore, parents do not recognize common potential causes of teenage hearing loss. Although most parents report that their teenager is at low risk for hearing loss, those with higher education, higher income, and younger teenagers were more willing to take measures to limit noise exposure for their children. Most parents support national requirements for adolescent hearing screening. This information is key to informing hearing loss prevention programs for adolescents.

Different individuals experiencing the same hazardous noise exposure may have different degrees of hearing loss or none at all. Some of this variation depends on an individual’s genetic susceptibility to hearing-related damage. With continued exposure to sound-hazardous environments, HFHL will progress, having negative consequences for speech, communication, and educational success. Research has demonstrated that hearing loss as a result of occupational NIHL has a significant negative effect on quality of life. Audiologic damage caused by excessive sound exposure is irreversible, although it is the most preventable type of hearing loss and can be prevented by avoiding sound-hazardous environments. Avoidance of such environments is more important in individuals who have been identified as having early indications of HFHL. This simple strategy can allow adolescents to achieve their full academic potential as well as a better quality of life.

When given a list of common adolescent noise exposures with the potential to cause hearing loss, most parents did not consider these activities to be high risk. Many of the listed activities could be a routine part of a teenager’s day. The musicians are known to experience NIHL, although fewer studies have been done among high school musicians. Certainly, many of the hearing-hazardous activities in which adolescents partake are also important components of their education, growth, and development. The goal is not to eliminate these activities but to approach them with some knowledge of the potential hearing risks and take the appropriate steps for hearing conservation. For example, the Centers for Disease Control and Prevention lists common adolescent school

### Table 2. Survey Questions and Responses (continued)

<table>
<thead>
<tr>
<th>Question</th>
<th>Responses, No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. A. Were you aware that volume-limiting headphones and earbuds are available to prevent the listener from turning up the volume to potentially damaging noise levels? (n = 715)</td>
<td>Yes 228 (31.9) No 487 (68.1)</td>
</tr>
<tr>
<td>B. The average price for this type of product is $15-$30. How likely would you be to purchase such a device? (n = 713)</td>
<td>Very unlikely/unlikely/neutral 319 (44.7) Likely/very likely 394 (55.3)</td>
</tr>
<tr>
<td>C. How willing would your teen be to use it? (n = 715)</td>
<td>Very unwilling/unwilling/neutral 479 (67.0) Willing/very willing 236 (33.0)</td>
</tr>
<tr>
<td>7. What do you think is the best approach for testing the hearing of teenagers? (n = 713)</td>
<td>Test all teenage students at school in one grade during high school 252 (35.3) Test individual teenagers at their doctor check-ups 391 (54.8) Test only those teenagers who have concerns for a problem (or parental concern) 64 (9.0)</td>
</tr>
<tr>
<td>Hearing testing is not necessary 6 (0.8)</td>
<td>8. National standards for hearing screening are in place for newborns. Some have suggested that we have national requirements for hearing screening of school-age children and adolescents through 12th grade. Do you agree or disagree with a national hearing screening requirement? (n = 712)</td>
</tr>
</tbody>
</table>

a Percentages add up to more than 100% because participants were asked to select all that apply.
b See Table 3.

### Table 3. Potential Hearing-Hazardous Activities and Parental Perception of Risk of Hearing Loss

<table>
<thead>
<tr>
<th>Activity</th>
<th>High Risk</th>
<th>Medium Risk</th>
<th>Low or No Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using headphones to listen to an iPod, 1 h/d at maximum volume (n = 713)</td>
<td>417 (58.5)</td>
<td>225 (31.6)</td>
<td>71 (10.0)</td>
</tr>
<tr>
<td>Operating a lawn mower or lawn tractor, 5 h/d in the summer (n = 711)</td>
<td>196 (27.6)</td>
<td>312 (43.9)</td>
<td>203 (28.6)</td>
</tr>
<tr>
<td>Hunting or gunfire, 1 h/mo (n = 707)</td>
<td>199 (28.1)</td>
<td>235 (33.2)</td>
<td>273 (38.6)</td>
</tr>
<tr>
<td>Riding a motorcycle, motorbike, or ATV, 5 h/wk (n = 710)</td>
<td>169 (23.8)</td>
<td>310 (43.7)</td>
<td>231 (32.5)</td>
</tr>
<tr>
<td>Using shop equipment at school, 1 h/d (n = 710)</td>
<td>105 (14.8)</td>
<td>286 (40.3)</td>
<td>319 (44.9)</td>
</tr>
<tr>
<td>Participating in band or orchestra, 1 h/d (n = 706)</td>
<td>60 (8.5)</td>
<td>252 (35.7)</td>
<td>394 (55.8)</td>
</tr>
<tr>
<td>Talking on a cell phone, 1 h/d at maximum volume (n = 714)</td>
<td>110 (15.4)</td>
<td>278 (38.9)</td>
<td>326 (45.7)</td>
</tr>
</tbody>
</table>

Abbreviation: ATV, all-terrain vehicle.
Table 4. Bivariate Analysis of Parental Willingness to Engage in Hearing-Protective Strategies and Various Demographic Factors

<table>
<thead>
<tr>
<th>Demographic Factor by Strategy</th>
<th>Parents, No. (%)</th>
<th>Very Unwilling, Unwilling, or Neutral</th>
<th>Willing or Very Willing</th>
<th>P Value</th>
<th>Odds Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Limit Time Listening to Music (n = 696)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Educational level</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High school or less</td>
<td>85 (12.2)</td>
<td>159 (22.8)</td>
<td>.06</td>
<td>1 [Reference]</td>
<td></td>
</tr>
<tr>
<td>Some college</td>
<td>67 (9.6)</td>
<td>166 (23.9)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bachelor’s degree</td>
<td>67 (9.6)</td>
<td>152 (21.8)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teenager’s age, y</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13-14</td>
<td>64 (9.2)</td>
<td>207 (29.7)</td>
<td>&lt;.001</td>
<td>1 [Reference]</td>
<td></td>
</tr>
<tr>
<td>15-17</td>
<td>155 (22.3)</td>
<td>270 (38.8)</td>
<td></td>
<td>0.45 (0.29-0.71)</td>
<td></td>
</tr>
<tr>
<td><strong>Insist on Using Hearing Protection (n = 701)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Educational level</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High school or less</td>
<td>74 (10.6)</td>
<td>172 (24.5)</td>
<td>.01</td>
<td>1 [Reference]</td>
<td></td>
</tr>
<tr>
<td>Some college</td>
<td>60 (8.6)</td>
<td>176 (25.1)</td>
<td></td>
<td>1.50 (0.90-2.51)</td>
<td></td>
</tr>
<tr>
<td>Bachelor’s degree</td>
<td>48 (6.8)</td>
<td>171 (24.4)</td>
<td></td>
<td>2.19 (1.28-3.73)</td>
<td></td>
</tr>
<tr>
<td><strong>Annual income, $</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;30 000</td>
<td>32 (4.6)</td>
<td>86 (12.3)</td>
<td>.02</td>
<td>1 [Reference]</td>
<td></td>
</tr>
<tr>
<td>30 000 to &lt;60 000</td>
<td>51 (7.3)</td>
<td>115 (16.4)</td>
<td></td>
<td>0.51 (0.25-1.03)</td>
<td></td>
</tr>
<tr>
<td>60 000 to &lt;100 000</td>
<td>45 (6.4)</td>
<td>138 (19.7)</td>
<td></td>
<td>1.01 (0.51-1.99)</td>
<td></td>
</tr>
<tr>
<td>≥100 000</td>
<td>54 (7.7)</td>
<td>180 (25.7)</td>
<td></td>
<td>1.20 (0.63-2.30)</td>
<td></td>
</tr>
<tr>
<td>Teenager’s age, y</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13-14</td>
<td>65 (9.3)</td>
<td>209 (29.8)</td>
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<tr>
<td>15-17</td>
<td>117 (16.7)</td>
<td>310 (44.2)</td>
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<td>0.61 (0.38-0.96)</td>
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<tr>
<td><strong>Limit Access to Excessively Noisy Situations (n = 704)</strong></td>
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<tr>
<td>Educational level</td>
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<tr>
<td>High school or less</td>
<td>80 (11.4)</td>
<td>167 (23.7)</td>
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<tr>
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<td>173 (24.6)</td>
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<tr>
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<td>69 (9.8)</td>
<td>151 (21.4)</td>
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<td>1.64 (1.00-2.70)</td>
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<tr>
<td>Teenager’s age, y</td>
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<tr>
<td>13-14</td>
<td>70 (9.9)</td>
<td>203 (28.8)</td>
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<tr>
<td>15-17</td>
<td>143 (20.3)</td>
<td>288 (40.9)</td>
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<td><strong>Purchase Volume-Limiting Headphones (n = 713)</strong></td>
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<td>High school or less</td>
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<td>88 (12.3)</td>
<td>133 (18.7)</td>
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<td>1.93 (1.20-3.11)</td>
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<td><strong>Annual income, $</strong></td>
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<td>&lt;30 000</td>
<td>69 (9.7)</td>
<td>52 (7.3)</td>
<td>.005</td>
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<td>30 000 to &lt;60 000</td>
<td>89 (12.5)</td>
<td>84 (11.8)</td>
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<td>1.24 (0.66-2.32)</td>
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<td>60 000 to &lt;100 000</td>
<td>73 (10.2)</td>
<td>111 (15.6)</td>
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<td>≥100 000</td>
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<td>Teenager’s age, y</td>
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<tr>
<td>13-14</td>
<td>123 (17.3)</td>
<td>156 (21.9)</td>
<td>.02</td>
<td>1 [Reference]</td>
<td></td>
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<tr>
<td>15-17</td>
<td>196 (27.5)</td>
<td>238 (33.4)</td>
<td></td>
<td>0.63 (0.42-0.94)</td>
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<tr>
<td><strong>Wear Volume-Limiting Headphones (n = 715)</strong></td>
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<td>Educational level</td>
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<tr>
<td>High school or less</td>
<td>184 (25.7)</td>
<td>70 (9.8)</td>
<td>.04</td>
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<td>Some college</td>
<td>161 (22.5)</td>
<td>78 (10.9)</td>
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<td>1.30 (0.78-2.17)</td>
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<tr>
<td>Bachelor’s degree</td>
<td>134 (18.7)</td>
<td>88 (12.3)</td>
<td></td>
<td>1.87 (1.13-3.12)</td>
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<tr>
<td>Teenager’s age, y</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>13-14</td>
<td>187 (26.2)</td>
<td>92 (12.9)</td>
<td>.95</td>
<td>1 [Reference]</td>
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<tr>
<td>15-17</td>
<td>292 (40.8)</td>
<td>144 (20.1)</td>
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<td>1.01 (0.67-1.55)</td>
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</tbody>
</table>
Parents, No. (%)

<table>
<thead>
<tr>
<th>Factor</th>
<th>Yes</th>
<th>No</th>
<th>P Value</th>
<th>Odds Ratio (95% CI)</th>
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</thead>
<tbody>
<tr>
<td>Perception of teenager’s risk for hearing problems</td>
<td></td>
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<tr>
<td>Very much (n = 708)</td>
<td>19 (2.7)</td>
<td>7 (1.0)</td>
<td>.049</td>
<td>3.05 (0.96-9.76)</td>
</tr>
<tr>
<td>Somewhat/slightly/not at all (n = 706)</td>
<td>201 (28.4)</td>
<td>481 (67.9)</td>
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<td>1 [Reference]</td>
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<tr>
<td>Knowledge of hearing damage (n = 706)</td>
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<tr>
<td>High-volume sounds OR time exposed</td>
<td>77 (10.9)</td>
<td>219 (31.0)</td>
<td></td>
<td>1 [Reference]</td>
</tr>
<tr>
<td>Volume and time</td>
<td>143 (20.3)</td>
<td>267 (37.8)</td>
<td>.002</td>
<td>1.98 (1.29-3.03)</td>
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<tr>
<td>Willingness to limit time listening to music (n = 693)</td>
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<tr>
<td>Very unwilling/unwilling/neutral</td>
<td>52 (7.5)</td>
<td>165 (23.8)</td>
<td></td>
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</tr>
<tr>
<td>Willing/very willing</td>
<td>164 (23.7)</td>
<td>312 (45.0)</td>
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<td>1.88 (1.19-2.96)</td>
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<td>Insist on use of hearing protection (n = 698)</td>
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<tr>
<td>Very unwilling/unwilling/neutral</td>
<td>45 (6.4)</td>
<td>135 (19.3)</td>
<td></td>
<td>1 [Reference]</td>
</tr>
<tr>
<td>Willing/very willing</td>
<td>172 (24.6)</td>
<td>346 (49.6)</td>
<td>.01</td>
<td>1.92 (1.15-3.18)</td>
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<tr>
<td>Limit access to noisy situations (n = 701)</td>
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<tr>
<td>Very unwilling/unwilling/neutral</td>
<td>57 (8.1)</td>
<td>154 (22.0)</td>
<td></td>
<td>1 [Reference]</td>
</tr>
<tr>
<td>Willing/very willing</td>
<td>159 (22.7)</td>
<td>331 (47.2)</td>
<td>.24</td>
<td>1.33 (0.83-2.15)</td>
</tr>
<tr>
<td>Likelihood of purchasing volume-limiting headphones (n = 709)</td>
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</tr>
<tr>
<td>Very unlikely/unlikely/neutral</td>
<td>58 (8.2)</td>
<td>257 (36.2)</td>
<td></td>
<td>1 [Reference]</td>
</tr>
<tr>
<td>Likely</td>
<td>99 (14.0)</td>
<td>165 (23.3)</td>
<td>&lt;.001</td>
<td>2.83 (1.71-4.68)</td>
</tr>
</tbody>
</table>

Noise exposures with estimated decibel levels and times of maximum recommended exposure durations without hearing protection.22 However, it seems that this information is not widely used by parents and high schools, considering the lack of parental knowledge on this topic.

Although most parents reported that their teenager was at low risk of hearing loss, these same parents were very much in support of measures to prevent hearing loss. Theories of behavior change, such as the health belief model, indicate that individuals are unlikely to modify behavior in response to a perceived low-risk threat.13 It is doubtful that parents would strictly enforce rules on limiting time listening to music, wearing hearing protection, and avoiding sources of hazardous noise if they believe that their teenagers are at low risk of hearing loss. The survey results suggest that targeting less well-educated parents of younger teenagers may be a good starting point for an intervention. This is an important consideration in planning adolescent hearing conservation programs. Parents are known to be key elements in the success of adolescent behavioral interventions for other risk-taking behaviors.22,28 Vogel et al30 rate parents as an important party to teenage hearing conservation but raised concern about the lack of parental knowledge on this topic. For adolescent hearing loss prevention programs to be successful, parents must first understand that their teenager is at risk for hearing loss and have a basic understanding of what risks are involved.

Many parents also supported national requirements for hearing screening of teenagers. There is no national standard for adolescent hearing screening, with some individuals receiving screening in the school setting and others being tested at individual physician visits. Others may not be tested during the teenage years at all.14 A national standard for adolescent hearing screening may raise community awareness of adolescent hearing loss. Increasing awareness and changing social norms is another possible way to increase the success of health behavior interventions.13

Our survey was limited by its multiple-choice format. Although we attempted to account for additional responses in our pilot testing, there may be other reasons parents did or did not discuss hearing loss with their teenager. The list of potential activities causing adolescent hearing loss might have been missing relevant exposures. Furthermore, in questioning the best approach for hearing testing of teenagers, it is a possibility that, if given the opportunity, parents would have had suggestions other than those included in the survey. Finally, a parental history of hearing loss was not directly asked about and may have affected the survey responses. This study was conducted using a nationally representative web-enabled panel. The makeup of the panel is affected by the willingness to participate in survey research when initially contacted. However, when given the opportunity to participate in individual
surveys, participants are not informed of the content. Because parents were not invited to participate in our survey based on interest in adolescent hearing loss, the results should not have been biased in this way. The NPCH has been conducted on a variety of subjects and has been important in informing numerous topics in the medical literature.16-17

In conclusion, few parents believe that their teenager is at risk of hearing loss and most parents have a poor understanding of hazardous noise exposures for adolescents. Parental support of adolescent behavioral interventions can be an important piece of their success. In designing adolescent hearing conservation programs, the results suggest that a focus on parents with lower educational attainment and younger teenagers may be most helpful. Preventing progression of NIHL among adolescents has significant implications for future quality of life. Improved education on hearing loss must be combined with effective and acceptable strategies for hearing loss prevention.

REFERENCES