

## ORIGINAL RESEARCH

## Addressing adult hearing loss in primary care

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**Abstract**

**Aims.** To (a) determine the extent to which primary care providers screen adults for environmental or occupational hearing loss during the primary care visit and (b) determine what techniques are used to screen for hearing loss in the adult primary care patient.

**Background.** Although the prevalence of hearing loss is high, the frequency and techniques of screening for hearing loss among primary care providers are unknown. According to the United States Preventative Task Force, hearing screening promotes early detection, adequate treatment, and improved quality of life.

**Design.** It is a retrospective audit.

**Methods.** Thirty client records were randomly selected from two clinics in 2009 for this retrospective patient record audit.

**Results/findings.** Physical assessment of the structure of the auditory system was completed in all cases selected. Hearing acuity in all cases was determined by patient self-assessment, as indicated on patient-completed history forms; there was no documentation of objective assessment of auditory function.

**Conclusion.** Given the low correlation between perceived and measured hearing ability, assessment of hearing ability by patient report alone may result in failure to detect hearing loss. Research into the nature and extent of barriers to hearing assessment in primary care needs to be explored, and criteria for screening of adults in the primary care setting should be established.

**Keywords:** adult nursing, advanced practice, hearing loss, neurology, nursing, prevalence, screening

**Introduction**

Based on audiometric testing of a representative sample of the US population, an estimated one in five Americans aged 12 and older experiences a hearing loss (Lin *et al.* 2011). The United States Department of Health and Human Services (USDHHS) progress review of *Healthy People 2010* (2008) indicates that of all chronic diseases, hearing loss

ranks third in prevalence among older Americans. In addition, a similar study suggests that 4–6% of youth who are between 9–19 years of age have already experienced some degree of hearing loss (USDHHS 2008). Hearing loss can lead to isolation and reduced quality of life for many individuals. U.S. Department of Health & Human Services, Centers for Disease Prevention (2010) includes objective ENT-VSL-4, ‘to increase the proportion of adults aged 20–

69 years who have had a hearing examination in the past 5 years'.

## Background

### *Threats to adult hearing health*

The National Institute on Deafness and Other Communication Disorders, a division of the National Institutes of Health, estimates 26 million adults who are 20–69 years of age have high-frequency hearing loss attributed to exposure to loud sounds, occupational noise, or noise from leisure activities. Using data from a representative sample of USA residents, Lin *et al.* (2011) estimate that nearly one in five has a unilateral or bilateral hearing loss. Although the global prevalence of hearing loss has not been identified, four million disability adjusted life-years are attributed to noise-induced hearing loss alone (Nelson *et al.* 2005). Common causes of adult hearing loss include occupational exposure to excessive noise, leisure noise exposure (including personal listening devices), selected pharmaceuticals (Li & Steyger 2009), chronic otitis media and age-related changes which can result in irrevocable damage to the ciliated nerve cells that line the cochlea (Yueh *et al.* 2003, Danhauer *et al.* 2009, Shah *et al.* 2009). Additional potential causes of hearing loss include hyperlipidemia (Chang *et al.* 2007), smoking (Nomura *et al.* 2005, Mohammadi *et al.* 2009) and diabetes (Bainbridge *et al.* 2008, Cheng *et al.* 2009). Recent studies have also showed synergistic effects of noise with smoking, diabetes, and hypertriglyceridemia. These exposures accelerate the development of NIHL, increasing the risk to noise-exposed patients with these health conditions and behaviours (Li & Steyger 2009).

### *Consequences to physical, mental, and social well-being*

There are well-documented physiological, psychological, and sociological ramifications associated with diminished hearing acuity, such as social isolation, loss of neural functioning and the practical dangers associated with diminished hearing ability (Fine *et al.* 2005, Valentijn *et al.* 2005). Hearing loss can be prevented and adequately addressed with early identification through secondary prevention screening techniques, treatment, and referral if necessary.

Evidence related to cost of hearing loss and productivity is difficult to establish. The National Institute of Occupational Safety and Health (2008) estimates national cost of disability associated with hearing loss to be \$242.4 million per year, which demonstrates considerable financial burden. A study conducted by Kochkin (2007) where 40,000 households were surveyed concluded the economic burden of untreated hearing loss to be in excess of \$100 billion. Annual loss of individual

household income is estimated to be \$12,000 per year; however, for those receiving treatment *via* hearing aids, the loss of household income can be reduced by 50% (Kochkin 2007).

### *Current screening guidelines*

Although the prevalence of hearing loss is high, there is a lack of evidence in the literature concerning the application of screening techniques among adult primary care providers. This lack of evidence extends to methods of selection of clients for screening and selection of screening techniques used by providers in the primary care setting. Common primary care protocol is to have each patient fill out a review of systems form which relies on patient self-identification of a problem. However, this method of assessment may be inadequate due to the low correlation between perceived and actual hearing ability (Kerr *et al.* 2003).

The United States Preventative Services Task Force (USPSTF 1998) provides screening recommendations based on age. There are definitive screening guidelines for newborn and childhood screening. The USPSTF (1998) guidelines state there is insufficient evidence for the recommendation of routine screening among adolescents and working-aged adults. Further guidance suggests that screening for noise induced hearing loss (NIHL) from occupational exposure should be accomplished by workplace hearing conservation programmes and occupational medicine guidelines (USPSTF 1998). The prevalence of hearing loss points to a gap in screening procedures where only adults who work in high noise exposure occupations and who are served by workplace hearing conservation programmes will benefit from screening mandated by the US Department of Labor, Occupational Safety and Health Administration.

The USPSTF recommends periodic screening of older adults, but counsels that screening is at the discretion of the clinician. In addition, the USPSTF recommends otoscopic examination and audiometric testing for patients with evidence of impaired hearing. However, as hearing screening in primary care is completed at the discretion of the provider, opportunities to use audiometric testing to identify patients with hearing loss could be underutilized. The USPSTF cautions that current hearing screening recommendations are under review; therefore, each clinician must interpret and apply the current guidelines based on clinical experience and patient self-report of problems.

The American Speech-Language Hearing Association (ASHA 2009) guidelines recommend that clinicians screen individuals a minimum of every decade and starting at age 50 screening is to be conducted every 3 years. The ASHA acknowledges that screening is voluntary and at the sole discretion of the clinical provider.

### *Methods of screening for hearing loss in the primary care setting*

Yueh *et al.* (2003) found that a combination of audioscope, hand-held combination otoscope, audiometer, and self-administered Hearing Handicap Inventory for the Elderly-Screening [HHIE-S] is most reliable for the detection of hearing loss.

The Hearing Handicap Inventory for the Elderly-Screening is a validated tool which is a self-administered questionnaire that consists of ten questions that takes approximately 5 minutes to complete. The HHIE-S has been used in practice since its conception in 1982 by Weinstein and Ventry (1982) and has evolved from a 25-question survey to a 10-question survey. The HHIE-S has demonstrated internal consistency reliability using Cronbach's alpha of 0.87 and a test-retest reliability of 0.84 ( $P < 0.0001$ ) (Lichtenstein *et al.* 1988).

An alternative method of screening for hearing loss is the whispered voice test. A systematic review of this method was completed in 2003 involving both adults and children. The results of the review indicate that the voice test is simple to administer, accurate, and comparable with an audioscope. The authors note that reproducibility may be of concern particularly in children, as the tests were most reliable if completed using a standard procedure; however, there are no definitive standard approaches to completing a whispered voice test (Pirozzo *et al.* 2003).

Another method for hearing screening includes the Rinne test, where the clinician strikes the tuning fork and places the base on the mastoid process of a patient. Clinical utility of using a 512-Hz tuning fork was validated in 1998 when researchers found it to be a reliable method of detecting conductive hearing loss (Burkey *et al.* 1998). Use of the tuning fork test can help determine practitioner course of action in diagnosis and treatment of different types of hearing loss.

A second test involving the tuning fork is the Weber test, where the practitioner strikes the tuning fork and places it on the top centre of the head, indicating sensorineural hearing loss. There are conflicting opinions related to the utility of the Weber test (Boatman *et al.* 2007). However, practitioners may use the Weber test especially when combined with other bedside tests such as the Rinne test to determine if more formal audiometric testing is necessary. The portability, cost, and availability of tuning forks with various frequencies contribute to the utility of use in practice, in particular, rural or underserved areas that may not be able to afford more expensive audiometric equipment.

### *Hearing screening practices in primary care*

A systematic review of screening and management of hearing loss in primary care concluded hearing loss in older individuals is underdiagnosed and therefore undertreated

(Yueh *et al.* 2003). A literature review found no studies examining selection criteria or methods of hearing screening for working-aged adults. There are studies where primary care attitudes and practice towards hearing screening were explored (Cohen *et al.* 2005, Danhauer *et al.* 2008, Johnson *et al.* 2008, Wallhagen & Pettengill 2008). One qualitative study which examined individual experiences related to primary care hearing screening methods showed that 85% of participants had never been asked or screened for hearing loss by a primary care provider (Wallhagen & Pettengill 2008).

A national survey of 710 primary care physicians (PCPs) found that PCPs were not completing hearing screening nor were they aware of patient self-report hearing screening tools such as HHIE-S (Johnson *et al.* 2008). In addition, referrals were completed only through patient complaint of a problem. Primary care physicians also indicated that reimbursement for screening is not adequate, but felt that hearing and balance problems were important issues in older people (Johnson *et al.* 2008).

A follow-up to the national survey related to hearing and balance found that primary care providers who were surveyed were likely to screen for hearing problems only if prompted through patient complaints (Danhauer *et al.* 2008). In addition, of the primary care providers who were included in the study, 93% were unaware of the HHIE-S and more than likely would not use such screening tools in the future due to time and reimbursement issues (Danhauer *et al.* 2008). The authors suggest that audiologists should partner with primary care providers to improve screening and treatment of patients with hearing loss; however, reimbursement issues, time, and primary care provider attitude could be obstacles to completion (Danhauer *et al.* 2008).

Although the prevalence of hearing loss is high, the frequency and techniques of screening for hearing loss among primary care nurses are unknown. According to the United States Preventative Task Force, hearing screening promotes early detection, adequate treatment, and improved quality of life. There is a need to examine the hearing screening practices of primary care nurses to assure that high-quality screening practices are provided to clients, so that they may benefit from early detection, adequate treatment, and improved quality of life.

## **The study**

### **Aims**

The purpose of this study was twofold: to (a) determine the extent to which primary care providers screen adults for environmental or occupational hearing loss during the

primary care visit and (b) determine what techniques are used to screen for hearing loss in the adult primary care patient. The theoretical basis for the study is derived from a theory proposed by Leavell and Clark (1965) which first described three levels of prevention: primary, secondary, and tertiary. Each level of prevention is designed to be applied at different stages of illness progression. This theory, adopted by the USPSTF (1998), purports secondary prevention programmes such as hearing screening to promote early detection, adequate treatment, and improved quality of life.

### Design

This cross-sectional study was conducted by means of a retrospective audit of selected patient records at a nurse-managed primary care clinic operated at two sites in a Midwestern city of 114,000 persons (US Census 2011). The nurse-managed clinic is a not-for-profit organization that is supported by external philanthropic funding; payment for services is accomplished through insurance reimbursement and client sliding fee scales.

### Sample/participants

Clinic A and B are nurse-managed primary care centres located in a small Midwestern city. These clinics serve a large population of Hispanic and other ethnic groups and are staffed by family nurse practitioners and ancillary staff.

### Data collection

Retrospective patient record audits were conducted using a random sample of cases obtained from the two primary care practice sites in 2009. The clinic managers generated a Current Procedural Terminology (CPT)-guided, computer-generated list of clients, ages 15–75 who were seen for new patient and annual physicals during a recent 12-month period, for a total of 293 eligible cases. Demographic data from the entire population of clients at each clinic site were used to generate a scheme for proportional sampling. Next, every  $n$ th patient from the list of eligible patients was selected for review, beginning at a random start on the list. The selection process resulted in 18 female and 5 male cases from site A and 5 female and 2 male cases from site B, for a total sample size of 30 cases.

Systematic manual review of written (non-electronic) patient records was conducted using the patient record audit tool. Relevant data were extracted by hand and recorded on a chart audit tool specially created for the study. The tool included demographic information, past

health history, past surgical history, infectious diseases history, employment history including any mention of combat services, environmental exposure, discussion of the patient encounter, and ototoxic drugs. Each record was reviewed twice to ensure that all available information was extracted and recorded.

### Ethical considerations

Prior to data collection, the University Institutional Review Board (IRB) reviewed the study protocol and deemed the project to be exempt from board review. Permission to conduct the audit was obtained from the clinic management.

### Data analysis

After review of all 30 cases was completed, the data were entered into SPSS© (Chicago, IL, USA). A review of descriptive statistics was used to identify input errors. Non-parametric descriptive statistics were used to summarize the characteristics of selected cases.

### Validity and reliability

A review of literature yielded no validated research instruments for data collection; therefore, a patient record audit tool was developed that would capture possible cues to the selection of clients with potential hearing impairment and methods of determining hearing acuity. The audit tool included demographic information, past health history, past surgical history, infectious diseases history, employment history (including combat services), environmental exposure, ototoxic drug exposure history, and discussion of the patient encounter. The tool was reviewed for validity by a panel of nurses with expertise in primary care and promotion of hearing health.

### Results

There was a total of 30 cases reviewed between January–February 2010; 77% of cases were women and 23% were men (Table 1). Married individuals made up the largest portion of the sample at 40% followed by single (30%), partnered (13.3%), divorced (10%), and widowed (6.7%). The largest racial group was Caucasian (46.7%), followed by Hispanic (30%) and African American (6.7%). The ages of cases selected ranged from 18–68 years of age.

Of the 30 records, all indicated that an assessment of the structure of the auditory system was completed. However, functional status was not recorded in any case reviewed;

**Table 1** Demographic data (*N* = 30).

	Frequency (%)
Cases	30 (100)
Age	
60–69	1 (3.3)
50–59	7 (23.3)
40–49	5 (16.7)
30–39	8 (26.7)
20–29	8 (26.7)
15–19	1 (3.3)
Ethnicity	
African American	2 (6.7)
Hispanic	9 (30.0)
Asian/Pacific Islander	1 (3.3)
Caucasian	14 (46.7)
Mixed race	2 (6.7)
Other	2 (6.7)
Sex	
Female	23 (76.7)
Male	7 (23.3)
Employed for pay	23 (76.7)

therefore, there are no data to determine which functional assessment tool was selected by the practitioner. In some instances, a visual description of structures was described by the practitioner, for instance, ‘TM’s clear, cone of light visible, well-visualized landmarks’.

A review of drugs known to cause either hearing damage or tinnitus was included in the audit. In all but two cases selected, there was evidence of one or more potentially ototoxic drugs prescribed; in two cases, evidence that the patient was prescribed five more ototoxic drugs existed.

The documentation for the patient encounters varied. In all instances, health history was ascertained by reviewing both patient-completed review of systems and the practitioner’s notes regarding the encounter. Smoking status was determined in most cases selected; however, very few cases had entire smoking history to determine pack-years status. Alcohol use was assessed in most cases.

Employment history was usually determined by patient-completed intake forms, with very few cases determining years on the job. There were no patient records that indicated use of hearing protection devices. In addition, determination of work history beyond current employment was not possible due to lack of documentation. Subsequently, there was no way to determine risk of hearing loss associated with previous employment. In addition, there was no indication in any patient record of former employment in the armed forces, combat duty, or exposure to combat noise.

The record audit included a section related to environmental noise exposure such as use of personal listening devices, recreational firearms, and motorcycles. There was

no available documentation which addressed any items included in this section. There was no section in the patient-completed review of systems which addressed hearing exposure risk from environmental or occupational noise.

## Discussion

Results of this and previous studies suggest that hearing loss may be an often overlooked component of primary care. Primary care nurses are uniquely positioned to provide hearing screening service to a large segment of the population and to participate in assessment of their hearing health risks (e.g. past and present occupational and recreational noise exposure and history of use of ototoxic pharmaceuticals) and functional hearing status. Further, primary care nurses can use their position to help their patients recognize and manage their hearing health risks and provide referral services where indicated.

Although clinical records in this sample showed routine documentation of assessment of the structure of the auditory system, records did not display assessment of auditory function. Results of this study suggest that hearing loss caused by occupational exposure, leisure exposure, or other types of exposure may be an often overlooked component of primary care, yet a very real health problem that causes economic loss related to productivity and reduced quality of life. This finding suggests that primary care providers may be failing to address the aural health needs of their clients. Failure to address this need may result in higher rates of hearing loss.

Many primary care practices are implementing an electronic medical record; this may facilitate recording of hearing function, particularly if prompts for hearing function are included. A standard simple approach to functional hearing assessment in an occupational health setting would be to include a whispered voice test for both left and right ears at five feet of distance (Federal Motor Carrier Safety Administration, Department of Transportation 2009). This method can easily translate into the primary care setting and serve as a cue for further assessment of hearing function.

Given the lack of national screening guidelines specifically for working-aged adults, an issue for practitioners is deciding who needs further functional screening. There are certain conditions that, when combined, should increase the index of suspicion for possibility of hearing loss and could serve as cues to pursue a more functional assessment of hearing. The results obtained from this patient record audit were not surprising given the evidence which indicates that primary care providers do not routinely screen for hearing

loss in primary care patients unless the patient first identifies a problem (Yueh *et al.* 2003, Johnson *et al.* 2008). For example, one case reviewed indicated that the patient was being followed by an audiologist due to patient self-report of a problem from a previous visit. There was documentation on the patient record in question from the audiologist that provided a written report of the patient's functional assessment of hearing. In this instance, the practitioner who was seeing the patient for an annual physical noted that the patient had previously reported an issue with hearing function and was being followed by an audiologist trained to manage hearing loss.

There was no evidence that the patient's work history was up to date; records included initial patient self-report intake forms that were dated from the past. It was difficult to ascertain if the employment type for each case selected reflected with any degree of accuracy the current employment. The United States Department of Labor, Bureau of Labor Statistics, indicates that individuals between the ages of 25–54 spend on average 8.7 hours per day at work or work-related activities and another 2.6 hours of leisure activity per day (United States Department of Labor, Bureau of Labor Statistics 2009). Many of these workers are exposed to hazardous noise at work, but only a fraction of these will receive work-based hearing conservation services. Primary care providers who care for workers need to investigate current and past employment history, such as through a simple interview or questionnaire item related to occupational and leisure noise exposure.

Although environmental causes of hearing loss were included in the audit, evidence of noise exposure was not identified in any of the selected cases. Inclusion of noise exposure needs to be a consideration when developing intake forms and recording annual updates. For example, there are well over 300 million personal listening devices in use in the USA, and the ear buds sold with personal listening devices have the capacity to deliver music of greater than 100 decibels (Neumay 2007). Given that some individuals listen to the maximum volume, the potential for hearing damage is a very real problem. In the USA, The Occupational Safety and Health Administration permissible exposure limits for 100 decibels is 2 hours in a 24-hour period (United States Department of Labor, Occupational Health & Safety Administration 2009). Exposure at 100 decibels or more beyond 2 hours has the potential to cause hearing damage. One other potential problem associated with the use of personal listening devices is that many use the devices in gym environments, sporting events, and loud cafeterias. In these situations, the device must be set at even higher decibel levels to overcome the loud ambient noise level.

Workplace noise exposure is common worldwide, although the level of protection afforded workers who are exposed to hazardous noise varies. Despite the presence of systems (e.g. Hearing Conservation Standard) to protect the hearing of noise-exposed workers in the USA, Canada, and European countries, noise-induced hearing loss is common. In nations where systems to protect workers' hearing are not as well developed, workers may encounter comparatively greater noise hazards, placing them at even greater risk for noise-induced hearing loss. Clinicians serving these workers are well advised to include an assessment of noise exposure and other risks to hearing health when caring for these patients in primary care settings.

There is a lack of clinical trials which evaluate the value of routine hearing screening to detect undiagnosed hearing loss. However, according to the procedure manual used by the USPSTF, there are general principles that can be applied to the adult population to justify routine screening for certain chronic conditions. While clinicians await new formal guidelines, justification for hearing screening can be accomplished by fulfilling the following three criteria. These criteria include: (a) significant burden of disease; (b) valid screening methods; and (c) effective and available treatment (U.S. Department of Health & Human Services: AHRQ, U.S. Preventative Services Task Force 2009). The burden of disease and valid screening methods have are well established. Effective and available treatment for NIHL includes hearing aids.

However, the best approach to hearing health is primary prevention, such as through noise mitigation and the use of hearing protective devices during exposure to loud noise at work, leisure activities, and seemingly innocuous daily activities. Primary care providers are in a unique position to deliver much needed hearing conservation education especially dealing with high risk to hearing behaviour such as overuse of personal listening devices, firearm use, and any other behaviour or activity that has potential to cause harm to hearing.

## Limitations

The study was limited by a small sample size, which makes generalization of conclusions inappropriate. Although documentation of hearing status was often not present in the health record, it is possible that function was assessed by the ability of the patient to converse, but was not recorded as such. In addition, retrospective analysis of patient records is dependent on excellent record keeping. Practitioners may have assessed function but neglected to include the results in the written report.

### What is already known about this topic

- Hearing loss is prevalent among Americans and is the third leading long-term illness among older people.
- Hearing loss can be prevented and adequately addressed with early identification through secondary prevention screening techniques, treatment, and referral if necessary.
- There are several approaches to screening for hearing problems. The frequency and methods of hearing status examination used by primary care providers are unknown.

### What this paper adds

- Study methods demonstrated feasibility of assessing the primary care provider's assessment of patients' aural health needs using a retrospective case audit.
- Of the 30 records examined, all indicated that an assessment of the structure of the auditory system was completed, but functional status was not recorded.
- Patient exposure to noise hazards was not included in health records, although documentation of exposure to one or more potentially ototoxic drugs was common.

### Implications for practice and/or policy

- Hearing loss may be an often overlooked component of primary care.
- There is a need for further study of hearing conservation practice in primary care, including assessment of current and past occupational and recreational exposures and a review of ototoxic medications.
- Barriers to hearing screening in primary care should be explored and addressed, and criteria for screening of adults should be established.

### Conclusion

The results of this study are consistent with those by Johnson *et al.* (2008), who found that generally, primary care providers do not screen for hearing loss during the primary care visit in a visible methodical and reproducible way. The study results suggest that the audit methods developed here represent a feasible approach to assuring the quality of hearing health screening of adults in the primary care setting. Such practices are needed to assure that high-quality screening practices are provided to clients, so that they may benefit from early detection, adequate referral and treatment, and improved quality of life.

Hearing conservation will take a concerted effort by practitioners, employers, and individual patients. To assure that more individuals do not suffer irreversible hearing loss, it is necessary for primary care providers to routinely screen for hearing loss by use of simple measures such as whispered voice or tuning fork tests. Consideration for hearing conservation in primary care should also include health history questions, which explore current and past occupational exposures, leisure exposures, and a thorough review of medications. The synergistic effects of smoking, diabetes, and hypertriglyceridemia on development of NIHL provide further justification for more systematic methods of screening for hearing function in the primary care setting.

Although practitioners in this study did not record functional status in all cases, the use of electronic medical records may facilitate recording of this, particularly if prompts to do so are included. In addition, there is a need for implementation of clinical preventive services to direct primary care providers in methods of selection and screening for hearing loss. However, barriers to the assessment of hearing function (e.g. time constraints, reimbursement issues characteristic of market-based healthcare delivery systems, and provider unfamiliarity with screening techniques) represent missed opportunities to prevent the loss of quality of life due to impaired hearing acuity. Research into the nature and extent of barriers to hearing assessment in primary care needs to be explored, and criteria for screening of adults should be established. This new knowledge will inform efforts to create health policies and programmes to reduce barriers and improve nursing practice.

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### Conflict of interest

No conflict of interest has been declared by the authors.

### Author contributions

All authors meet at least one of the following criteria (recommended by the ICMJE: [http://www.icmje.org/ethical\\_1author.html](http://www.icmje.org/ethical_1author.html)) and have agreed on the final version:

- substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data;
- drafting the article or revising it critically for important intellectual content.

## References

- American Speech-Language Hearing Association (2009) Hearing Screening. Retrieved from <http://www.asha.org/public/hearing/testing/> (accessed 10 April 2010).
- Bainbridge K.E., Hoffmann H.J. & Cowle C.C. (2008) Diabetes and hearing impairment in the United States: audiometric evidence from the National Health and Nutrition Examination Survey, 1999 to 2004. *Annals of Internal Medicine* **149**(1), 1–10.
- Boatman D., Miglioretti D., Eberwein C. & Alidosi M. (2007) How accurate are bedside hearing tests? *Neurology* **68**, 1311–1314, doi: 10.1212/01.wml.0000259524.08148.16.
- Bureau of Labor Statistics (2009) American Time Use Survey. Retrieved from <http://www.bls.gov/news.release/atus.nr0.htm> (accessed 10 April 2010).
- Burkey J., Lippy W., Schuring A. & Rizer F. (1998) Clinical utility of the 512-Hz Rinne tuning fork test. *American Journal of Otolaryngology* **19**, 59–62.
- Chang N.C., Yu M.L., Ho K.Y. & Ho C.K. (2007) Hyperlipidemia in noise-induced hearing loss. *Otolaryngology-Head and Neck Surgery* **137**, 603–606, doi: 10.1016/j.otohns.2007.04.022.
- Cheng Y., Gregg E.W., Saaddine J.B., Imperatore G., Zhang X. & Albright A. (2009) Three decades change in the prevalence of hearing impairment and its association with diabetes in the United States. *Preventive Medicine* **49**, 360–364.
- Cohen S., Labadie R.F. & Haynes D.S. (2005) Primary care approach to hearing loss: the hidden disability. *Ear Nose and Throat Journal* **84**(1), 26–31.
- Danhauer J., Celani K.E. & Johnson C.E. (2008) Use of hearing and balance screening survey with local primary care physicians. *American Journal of Audiology* **17**, 3–13, doi: 10.59-0889/08/1701-0003.
- Danhauer J.L., Johnson C., Byrd A., DeGood L., Meuel C., Pecile A. & Koch L. (2009) Survey of college students on iPod use and hearing health. *Journal of American Academy of Audiology* (20), 5–27, doi: 10.3766/jaaa.20.1.2.
- Federal Motor Carrier Safety Administration, Department of Transportation (2009) Part 391.43, Medical Examinations; Certificate of Physical Examination. Retrieved from <http://www.fmcsa.dot.gov/rules-regulations/administration/fmcsr/fmcsrruletext.aspx?chunkKey=09016334800238ba> (accessed 10 April 2010).
- Fine I., Finney E., Boynton G. & Dobkins K. (2005) Comparing the effects of auditory deprivation and sign language within the auditory and visual cortex. *Journal of Cognitive Neuroscience* **17**, 1621–1637.
- Johnson C.E., Danhauer J.L., Lotioli Koch L., Celani K.E., Lopez I.P. & Williams V.A. (2008) Hearing and balance screening and referrals for medicare patients: a national survey of primary care physicians. *Journal of American Academy of Audiology* **19**, 171–190.
- Kerr M., McCullagh M., Savik K. & Dvorak L. (2003) Perceived and measured hearing ability in construction laborers and farmers. *American Journal of Industrial Medicine* **44**, 431–437, doi: 10.1002/ajim.10286.
- Kochkin S. (2007) The Impact of Untreated Hearing Loss on Household Income. Retrieved from [http://www.betterhearing.org/pdfs/markettrak\\_income.pdf](http://www.betterhearing.org/pdfs/markettrak_income.pdf) (accessed 10 April 2010).
- Leavell H.R. & Clark E.G. (1965) *Preventative Medicine for the Doctor in his Community: An Epidemiologic Approach*. McGraw-Hill, New York.
- Li H. & Steyger J. (2009) Synergistic ototoxicity due to noise exposure and aminoglycoside antibiotics. *Noise Health* **11**(42), 26–32, doi: 10.4103/1463-1741.45310.
- Lichtenstein M., Bess F. & Logan S. (1988) Validation of screening tools for identifying hearing impaired elderly in primary care. *JAMA* **259**, 2875–2878.
- Lin F.R., Niparko J.K. & Ferrucci L. (2011) Hearing loss prevalence in the United States. *Archives of Internal Medicine* **171**, 1851–1852.
- Mohammadi M., Mazhari H., Mehrparvar M. & Attarchi R. (2009) Cigarette smoking and occupational noise induced hearing loss. *The European Journal of Public Health* **20**, 452–455.
- National Institute of Occupational Safety and Health (2008) NIOSH, OSHA and NHCA Establish Alliance on Workplace Hearing Loss Prevention. Retrieved from <http://www.cdc.gov/niosh/updates/upd-03-24-08.html> (accessed 10 April 2010).
- National Institute on Deafness and other Communication Disorders: National Institutes of Health. Quick Facts. Retrieved from <http://www.nidcd.nih.gov/health/statistics/quick.htm> (accessed 10 April 2010).
- Nelson D.I., Nelson R.Y., Concha-Barreintos M. & Fingerhut M. (2005) The global burden of occupational noise-induced hearing loss. *American Journal of Industrial Medicine* **48**, 446–458.
- Neumay T. (2007) Apple Incorporated. 100 million iPods Sold. Retrieved from <http://www.apple.com/pr/library/2007/04/09ipod.html> (accessed 10 April 2010).
- Nomura K., Nakao M. & Morimoto T. (2005) Effect of smoking on hearing loss: quality assessment and meta-analysis. *Preventive Medicine* **40**, 138–144, doi: 10.1016/j.ypmed.2004.05.011.
- Pirozzo S., Papinczak T. & Glasziou P. (2003) Whispered voice test for screening for hearing impairment in adults and children: systematic review. *British Medical Journal* **327**, 967–971.
- Shah S., Gopal B., Reis J. & Novak M. (2009) Hear today, gone tomorrow: an assessment of portable entertainment player use and hearing acuity in a community sample. *Journal of American Board of Family Medicine* **22**, 17–23, doi: 10.3122/jabfm.2009.01.080033.
- United States Census Bureau (2011) State and County QuickFacts. Retrieved from <http://quickfacts.census.gov/qfd/states/26/2603000.html> (accessed 10 April 2010).
- United States Department of Labor, Occupational Health and Safety Administration (2009) Noise and Hearing Conservation. Retrieved from [http://www.osha.gov/dts/osta/otm/noise/standards\\_more.html](http://www.osha.gov/dts/osta/otm/noise/standards_more.html) (accessed 10 April 2010).
- United States Preventative Services Task Force (1998) *Clinicians Handbook of Preventative Services*, 2nd edn. Hearing Handicap Inventory for Elderly Screening. Retrieved from <http://www.ncbi.nlm.nih.gov/bookshelf/br.fcgi?book=hsarchive&part=A4489&rendertype=table&id=A6812> (accessed 10 April 2010).



- U.S. Department of Health and Human Services (2008) NORC Final Report: Healthy People User Study. National Opinion Research Center, Bethesda, MD, USA.
- U.S. Department of Health & Human Services, Centers for Disease Prevention (2010) Healthy People 2020. Retrieved from <http://www.healthypeople.gov/2020/default.aspx> (accessed 10 April 2010).
- U.S. Department of Health & Human Services: AHRQ, U.S. Preventative Services Task Force (2009) *Procedure Manual*. Retrieved from <http://www.ahrq.gov/clinic/uspstf08/methods/procmanual.htm> (accessed 10 April 2010).
- Valentijn S., Van Boxtel M.P., Van Hooren S.A., Bosma H., Beckers H.J., Ponds R.W. & Jolles J. (2005) Change in sensory functioning predicts changes in cognitive functioning: results from a 6-year follow up in Masstricht Aging Society. *Journal of the American Geriatrics Society* 53, 374–380.
- Wallhagen M.I. & Pettengill E. (2008) Hearing impairment: significant but underassessed in primary care settings. *Journal of Gerontological Nursing* 34(2), 36–42.
- Weinstein B.E. & Ventry I.M. (1982) Hearing impairment and social isolation in the elderly. *Journal of Speech and Hearing Research* 4, 593–599.
- Yueh B., Shapiro N., MacLean C.H. & Shekelle P.G. (2003) Screening and management of adult hearing loss in primary care. *JAMA* 289(15), 1976–1985.

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