

Surveillance for work-related audiological disease in the UK: 1998–2006

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| Background | Noise-induced hearing loss (NIHL) from prolonged occupational exposure to noise continues to rank among the top worldwide work-related ill-health problems. |
| Aims | To provide an overview of incident cases based on work-related audiological ill-health data collected over a 9-year period from occupational physicians (OPs), audiological physicians (APs), general practitioners and otorhinolaryngologists. |
| Methods | Analysis of numerator data reported by physicians to surveillance schemes within The Health and Occupation Reporting network (THOR). The actual cases were multiplied by the sampling ratio to provide estimated numerator numbers, followed by calculation of incidence rates using denominator data derived from the Labour Force Survey and from surveys of participating OPs. |
| Results | Two thousand five hundred and eighty-two estimated cases (2584 estimated diagnoses) were received from OPs (Occupational Physicians Reporting Activity [OPRA]), and 2192 estimated cases (3208 estimated diagnoses) of work-related audiological ill-health were received from consultant APs [Occupational Surveillance Scheme for Audiological physicians (OSSA)] from 1998 to 2006. Cases where the causal agent was noise exposure (NIHL and tinnitus) made up of 95 and 97% of all cases reported to OPRA and OSSA, respectively. The annual average incidence rate for noise-induced audiological disorders was 7.9 [95% confidence interval (CI) 4.6–11.1] per 100 000 persons employed (OPRA) and 0.8 (95% CI 0.7–1.0) per 100 000 persons employed (OSSA). Workers with the highest incidence were older males employed in public administration and defence and the manufacture of metals. |
| Conclusions | THOR data show that diagnoses related to work-related noise exposure (NIHL/tinnitus), as reported to THOR, remain important health problems, despite preventive measures being in place. |
| Key words | Audiological disorders; noise-induced hearing loss; surveillance; work-related ill-health. |

Introduction

The World Health Organization estimated the number of people affected worldwide by hearing loss (HL) had increased from 120 million in 1995 to 250 million in 2004 and that ~16% resulted from exposure to excessive noise in the workplace [1]. There are scant recent, or consistently available, data to inform us of the national burden of work-related audiological ill-health in the UK. Research undertaken by the Medical Research Council in 1997–98 estimated that 509 000 workers in Great Britain experienced hearing difficulties associated with noise exposure at work [2]. More recently (2002), Palmer *et al.* [3] provided estimates of work-related hearing difficulties for males aged 35–64 years at 153 000 and for females aged 35–64 years at 26 000; for persistent tinnitus, the

corresponding estimates are 266 000 and 84 000. Health surveillance data [4] provided an annual incidence rate (1997–2000) of 1.94 per 100 000 persons employed for noise-induced hearing loss (NIHL). More recent data from the self-reported work-related illness (SWI) and workplace injury survey (SWI 2006/07), carried out by the Health & Safety Executive, estimated a prevalence of 75 000 [95% confidence interval (CI) 63 000–87 000] individuals who reported hearing problems caused or made worse by their occupation. This equates to an incidence rate of 170 per 100 000 persons employed (95% CI 150–200) [5]. The SWI also provides data on working days lost; however, the number of NIHL cases reported for 2006/07 was too low to provide reliable estimates.

In countries like the UK, measures to reduce NIHL are well established in high-risk industries. It is important, therefore, to investigate the current distribution of work-related audiological disorders and to ensure that there is adequate recognition of the associated risks. This paper reports on surveillance data for work-related hearing disorders reported to The Health and Occupation Reporting network (THOR) by occupational physicians (OPs) to the Occupational Physicians Reporting Activity (OPRA) and by audiological physicians (APs) to the Occupational Surveillance Scheme for Audiological physicians (OSSA) from 1998 to 2006 [4, 6]. A summary of cases reported to the Occupational Surveillance of Otorhinolaryngological Disease (THOR-ENT) scheme from 2005 to 2006 and cases of work-related hearing disorders as seen in a general practice setting from THOR in General Practice (THOR-GP) is also given. As THOR reporting is based on newly diagnosed, i.e., incident cases, data produced provide indicators of poor control of exposure to workplace noise, within well-established and emerging industrial sectors.

Methods

OPs began reporting incident cases of work-related ill-health to OPRA in January 1996. Initially, all reporters were enrolled as 'sample' reporters and asked to return case reports for one randomly allocated month per year, while 'core' (continuous) reporting started for a subset of reporters in 2004 [7]. Estimated numbers of cases reported in a calendar year are calculated by multiplying the number of cases received from 'sample' reporters by a factor of 12 and adding this subtotal to the number of cases reported by 'core' reporters. Diagnoses in OPRA are coded using the International Classification of Disease, 10th revision (ICD-10) [8], which allows diagnoses to be mapped to, and analysis undertaken between, reporting schemes.

The OSSA scheme was established in October 1997 and ran until December 2006 [4]. OSSA collected case reports from 13 consultants in audiological medicine (APs) from across the UK [4]. Reporters were asked to return incident case reports for audiological disorders in the following diagnostic categories; sensorineural HL, tinnitus, balance problems, tympanic disorders and other diagnoses (e.g. infections, dermatitis). Initially, participants were 'core' reporters. However, in 2003, reporters were given the option to report as 'sample' reporters; 7 of the 13 APs remained as 'core' reporters and 6 became 'sample' reporters.

The methodology behind OSSA and OPRA has been described in detail elsewhere [4,9], data from nine full years of collection (1998–2006) have been used here. The majority of reporters to THOR report cases via paper-based reporting cards, a method that has changed little in format since 1989 [10]. However, web-based

(electronic) reporting is an option for all THOR reporters, while THOR-GP is exclusively web based [11]. Physicians are asked to supply the patient's age, gender, geographical location (first half of postcode), occupation, industry and suspected agent. Occupation and industry are coded using the Standard Occupational Classification and Standard Industrial Classification systems developed by the Office for National Statistics (ONS) [12–14].

Incidence rates (per 100 000 persons employed per year) in OSSA were calculated using OSSA data as the numerator and age and gender totals from 1998 to 2006 Labour Force Survey (LFS) data as the denominator. The LFS is conducted on an annual basis by the ONS with a sample of employed persons in the UK and estimates the total persons in employment per year [15]. However, the denominator issue is less straightforward when calculating rates for OPRA because coverage of the population by OPs' services is ~12% of the UK's workforce population [16]. Therefore, denominator data gathered by McDonald [16] on the demographics of persons served by OPs who reported to OPRA were used. In addition, 95% CIs were calculated using a method that takes into account the proportion of cases reported by both 'core' and 'sample' participants.

Pilot data were collected from otorhinolaryngologists reporting to THOR-ENT between July 2005 and December 2006. THOR-ENT had support from the British Association of Otorhinolaryngologists—Head and Neck Surgeons and gave an insight into the incidence of work-related disease as seen by otorhinolaryngologists in the UK. THOR-ENT involved exclusively 'core' reporting and allowed piloting of the electronic reporting methodologies now successfully operating throughout THOR. Alongside reports from clinical specialists and OPs, THOR receives reports on work-related hearing disorders as seen in a general practice setting from reporters to THOR-GP. THOR-GP commenced in 2005 and involves a network of GPs trained in occupational medicine to diploma level (Diploma of the Faculty of Occupational Medicine), who report all categories of work-related ill-health [17]. In the time period reported here, there was no 'sample' reporting in THOR-GP; therefore, all figures quoted are actual (not estimated) cases.

Data were analysed using the Statistical Package for the Social Sciences (SPSS) V15.0. Multicentre Research Ethics Committee approval has been given for THOR (ref: MREC 02/8/72).

Results

From 1998 to 2006, OPs returned 12 523 actual case reports of work-related ill-health to OPRA producing 102 305 estimated cases and 108 748 estimated diagnoses. Of these diagnoses, 42% were musculoskeletal, 37% mental ill-health, 11% skin cases, 5% respiratory cases, 3% other (e.g. including infectious disease) and 2%

audiological disorders. Over the same period, APs returned 1972 case reports, resulting in 2192 estimated cases and 3208 estimated diagnoses [a case may be assigned more than one diagnosis (e.g. NIHL and tinnitus)]. The subcategories of audiological disorders reported to OSSA and OPRA (1998–2006) are shown in Table 1.

As the data presented in Table 1 show, HL made up the largest proportion of audiological diagnoses for both OPRA (94%) and OSSA (65%). Within this category, APs rate the diagnosis as mild, moderate or severe. Of the 2192 estimated cases of HL, APs reported 54% as mild, 38% as moderate and 7% as severe. Of note, 33% of the estimated diagnoses reported by APs were 'tinnitus' compared to only 1% reported by OPs during the same period. For cases reported with a co-diagnosis of HL and tinnitus, APs assigned two diagnoses in 50% of cases, whereas <1% of cases reported by OPs were assigned these two labels (Table 1).

APs returned 80 actual case reports (2% of total reported) that did not involve a diagnosis of HL or tinnitus, while OPs reported 141 such cases (6% of total reported). Balance problems accounted for 40% of APs' diagnoses; 87% of which were reported in males, there was a mean age (for all cases) of 55.3 years, (overall age range 31–77 years); the most frequently reported industry sector (37%) was construction. OPs reported one

case of balance problems in a male aged 61 years working in public administration and defence.

Of the tympanic disorders reported by APs, 96% were in males with a mean age (for all cases) of 67.7 years (range 39–84); the most frequently reported industrial sector (46%) was public administration and defence. Likewise, the majority of tympanic disorders reported by OPs (98%) were in males, with a mean age (for all cases) of 41.2 years (range 25–52); the most frequently reported industrial sector was public administration and defence (47%).

'Other' diagnoses reported included ear infections, otitis media/externa, pain syndrome, glue ear, hyperacusis, otosclerosis and aural pressure. APs reported 92% of 'other' cases in males with a mean age (for all cases) of 53.3 years (range 17–84); the most frequently reported industrial sector was the manufacture of basic metals. Of the reports from OPs, 82% were reported in males, with a mean age (for all cases) of 35.5 years (range 24–50); the most frequently reported industrial sector was mining and quarrying (31%).

Cases where the causal agent was noise exposure (NIHL/tinnitus) made up 95 and 97% of all cases reported to OPRA and OSSA, respectively. The following incidence rate calculations will be based solely on this NIHL and tinnitus data.

Table 1. Estimated diagnoses of work-related audiological disorders reported by audiological and OPs by diagnostic group (1998–2006)

| | OPs | | APs | | Additional diagnostic information (e.g. co-diagnoses) |
|-------------------|---------------------|-----|---------------------|-----|---|
| | Estimated diagnoses | % | Estimated diagnoses | % | |
| HL | 2416 ^{ab} | 94 | 2077 | 65 | HL only = 1139 (55%) HL and TIN = 938 (45%) |
| Mild | | | 1128 | | HL only = 573 (51%) HL and TIN = 555 (49%) |
| Moderate | | | 799 | | HL only = 463 (58%) HL and TIN = 336 (42%) |
| Severe | | | 147 | | HL only = 100 (68%) HL and TIN = 47 (32%) |
| Unspecified | 2416 | | 3 | | HL only = 3 (100%) |
| Tinnitus (TIN) | 27 ^a | 1 | 1051 | 33 | TIN only = 113 (11%) TIN and HL = 938 (89%) |
| Mild | | | 758 | | TIN only = 79 (10%) TIN and HL = 679 (90%) |
| Severe | | | 290 | | TIN only = 34 (12%) TIN and HL = 256 (88%) |
| Unspecified | 27 | | 3 | | TIN and HL = 3 (100%) |
| Balance (BAL) | 12 | <1 | 30 | 1 | BAL and HL = 16 (53%) BAL and HL and TIN = 14 (47%) |
| Tympanic (TYM) | 51 | 2 | 26 | 1 | TYM only = 1 (4%) TYM and HL = 19 (73%) TYM and HL and TIN = 6 (23%) |
| Rupture | | | 16 | | |
| Scarring | | | 6 | | |
| Other tympanic | | | 4 | | |
| Unspecified | 51 | | | | |
| 'Other' diagnoses | 78 ^b | 3 | 24 | 1 | e.g. otitis media/externa, hyperacusis, glue ear |
| Total diagnoses | 2584 | 100 | 3208 | 100 | |
| Total cases | 2582 | | 2192 | | |

^aTwo of the diagnoses reported by OPs were co-diagnoses of HL and tinnitus.

^bTwenty-six of the diagnoses reported by OPs were co-diagnoses of HL and HAVS.

Estimated diagnoses and 95% CI for NIHL and tinnitus diagnoses reported to OPRA and OSSA year by year are shown in Figure 1 (1998–2006).

The annual average incidence rate for NIHL and tinnitus diagnoses reported by OPs (1998–2006; using MacDonald denominator data 2001 [16]) was 7.9 per 100 000 persons employed (95% CI 4.6–11.1). This compared to an annual average incidence rate reported to OSSA (1998–2006 using LFS 1998–2006 data as denominator) of 0.8 per 100 000 persons employed (95% CI 0.7–1.0).

Using actual (not estimated) case report data, the median age of patients with diagnoses (NIHL/tinnitus) associated with exposure to noise was 51 years in OPRA and 59 years in OSSA, with nearly all case reports involving males (90% OPRA, 96% OSSA). When analysed by age distribution (Figure 2), the highest incidence is in the 45- to 54-year age group for OPRA reports and the 65 years and older age group for OSSA reports. Further analysis to take into account gender and denominator data (available for OSSA reports only) show the highest annual average incidence rate for work-related noise-induced audiological disorders is found among males in the 65 years and older age group with a rate of 30.1 per 100 000 persons employed; this compares with a rate of 2.7 per 100 000 persons employed in the female 65 years and older age group (Figure 3).

The most frequently reported industrial sectors for OPRA case reports of work-related audiological disorders associated with noise exposure (NIHL/tinnitus) included public administration and defence and manufacture of fabricated metals (both 11%). The most commonly reported occupations within OPRA were metal working production and maintenance fitters (12%), metal working machine operatives (5%) and quarry workers and related operatives (4%). For OSSA, the availability of LFS denominator data allows annual average incidence rates

for industry and occupation to be calculated (Figure 4a and b).

In THOR-ENT, 12 case reports (14 diagnoses) were returned by otorhinolaryngologists (2005–06). Sinusoidal cancer was reported in four woodworkers exposed to wood dust (in activities such as sanding), and HL or other audiological diagnoses were reported in 10 workers exposed to noise (five of whom were marine engineers, shipbuilders or sailors and one of whom was a commercial diver with tympanic damage).

From early reporting in THOR-GP (July 2005 to Dec 2006), there were 19 cases (producing 20 diagnoses) of work-related audiological ill-health reported by general practitioners (GPs), 1% of all the cases reported. Of these audiological cases, 60% were NIHL, 15% tinnitus, 15% tympanic disorders and 10% other disorders (otitis externa). The most frequently reported industries were public administration and defence and construction; the most frequently reported occupations were in the armed services (non-commissioned officer and other ranks) and call centre agents/operators. Eighty-four per cent of the cases were reported in males, with 58% being >54 years of age. GPs also provide details of any sickness absence and onward referral patterns associated with the cases they report. While the number of audiological cases reported is relatively small, it was noted that three cases were issued with sickness certification, resulting in 146 working days lost in that period. Also of note, of the 19 cases of audiological ill-health reported, 10 were referred on to a hospital specialist.

Discussion

The data reported here show that, despite knowledge about preventative measures, diagnoses associated with workplace exposure to noise (NIHL/tinnitus) continue

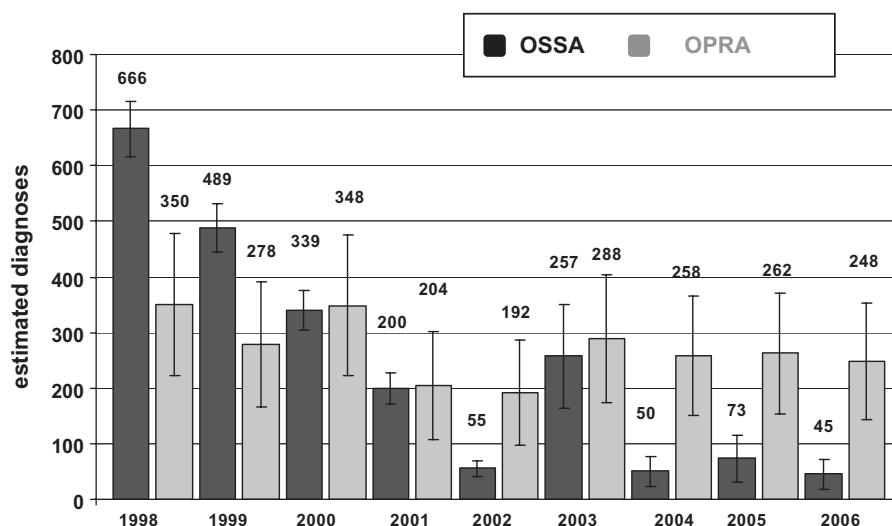


Figure 1. Case reports (estimated diagnoses) and (95% CI) for NIHL and tinnitus reported to OPRA and OSSA (1998–2006).

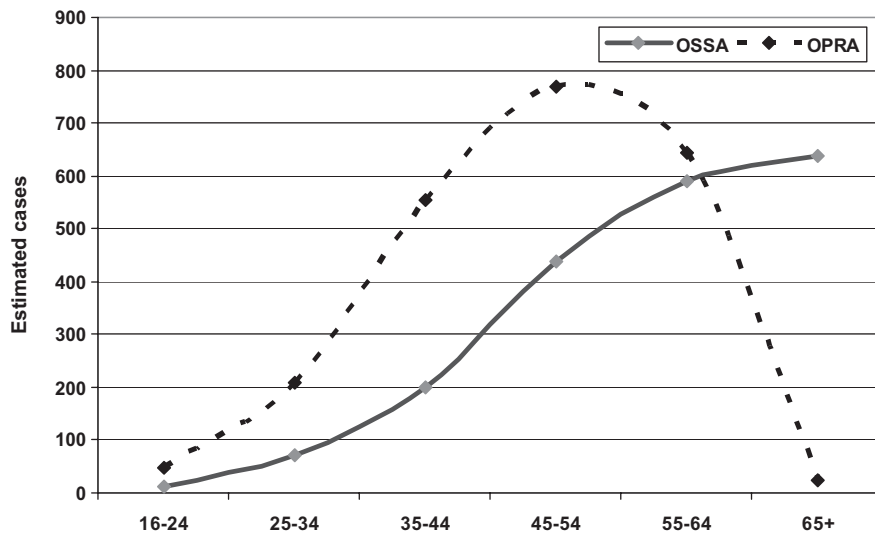


Figure 2. Age distribution of estimated diagnoses associated with noise exposure (NIHL/tinnitus) by age group reported to OSSA and OPRA (1998–2006).

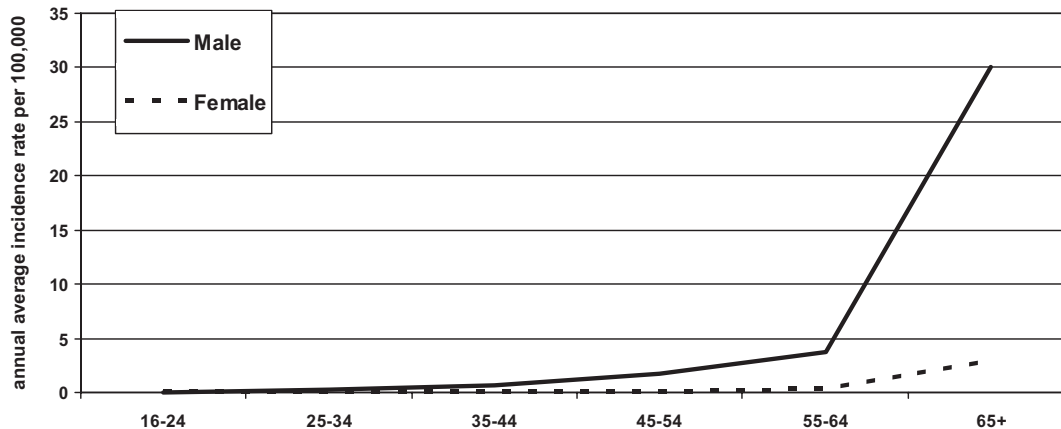


Figure 3. Incidence rates of diagnoses associated with noise exposure (NIHL/tinnitus) by age and gender per 100 000 employed per year using OSSA and Labour Force Survey data (1998–2006).

to be reported to surveillance schemes. In the period 1998–2006, there were 2584 estimated diagnoses of work-related audiological ill-health in OPRA. During the same period, there were 3208 estimated diagnoses of work-related audiological ill-health in OSSA. Both schemes reported a majority of diagnoses associated with noise exposure, especially NIHL. In common with other studies, nearly half of all the NIHL reports to OSSA were co-diagnosed with tinnitus [18–20]. This compares to <1% of dual-diagnosis reports from OPs. One reason for this difference between schemes could be due to the differing reporting cards/webforms for each scheme. OSSA physicians were given tick-box options for the diagnosis, whereas OPs are provided with a free text box to complete, and an ICD-10 code is subsequently assigned. The incidence rate for all work-related audiological ill-health reports to OSSA was 0.8 per 100 000 persons employed (based on LFS data as denominator), and the rate

for reports by OPs (based on McDonald data as denominator [16]) was 8.4 per 100 000 persons employed.

THOR data and information from other sources [1,2,18,20] show that the burden of work-related audiological ill-health is not evenly distributed among the working population but tends to be skewed towards older males working in heavy industrial sectors and male-dominated industries, such as defence and construction. Service in the Armed Forces continues to be a risk factor in acquiring work-related hearing problems [4], both directly and as a contributory factor in later life. In the UK, NIHL is still the single largest category of disability after military service with a 28% prevalence of acoustic trauma in the British Army [21]. The occupation with the highest incidence of work-related audiological ill-health as reported to OSSA (1998–2006) was non-commissioned officers and other ranks with a rate of 33.6 per 100 000 persons employed.

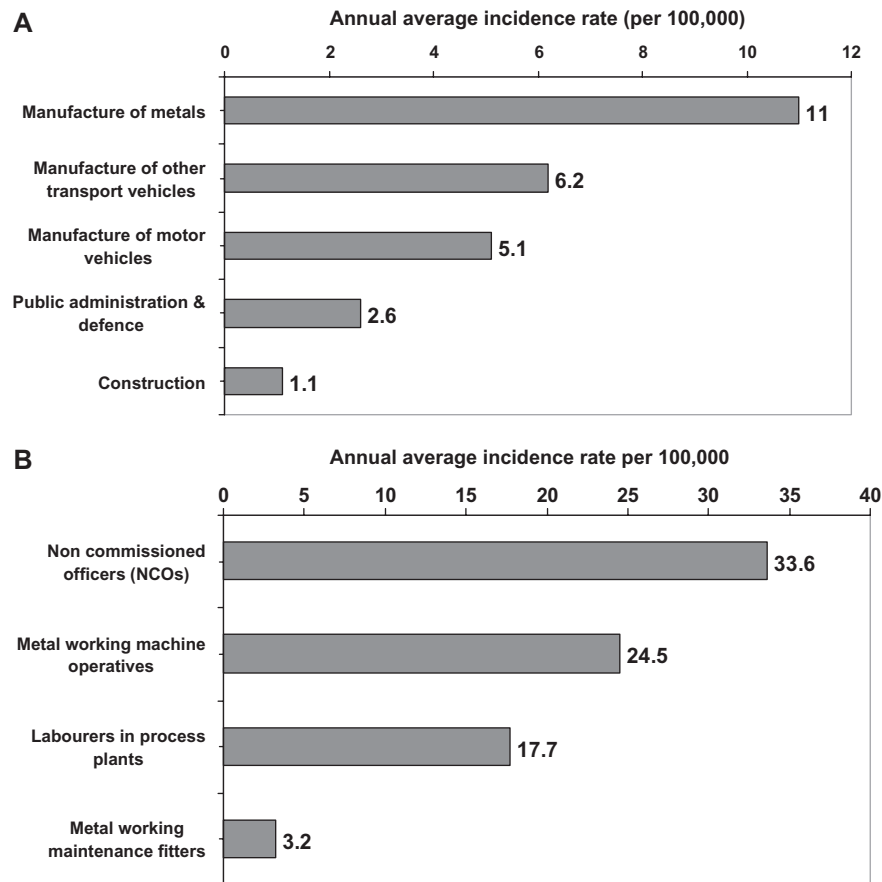


Figure 4. Annual average incidence rates of audiological disorders associated with noise exposure (NIHL/tinnitus) in the most frequently reported (a) industries and (b) occupations in OSSA using Labour Force Survey denominator data (1998–2006).

Incidence rates for OSSA were calculated using the UK-working population information (obtained from the LFS) as the denominator. However, it is unlikely that all eligible audiologists (i.e. seeing patients of working age) reported to OSSA and for those that did, it is unlikely that they reported 100% of their eligible cases. Thus, applying the UK workforce data as the denominator would produce artificially low incidence rates, so the rates presented here should be interpreted as minimum incidence rates. Recent work to investigate the proportion of eligible physicians reporting to other THOR schemes has suggested considerable variation between the schemes [22]. Although incidence rates may be underestimates, there is no reason to believe that cases captured by OSSA are unduly biased by industry/occupation and therefore, the breakdown of cases should be broadly representative of all UK APs' cases. For OPs, estimates of the true denominators were available (from which it was clear that access to an OP within the UK workforce varies between industries) from the McDonald survey [18]. However, incidence rates may be slightly overestimated as no adjustment for the questionnaire response rate was made. Further surveys are ongoing that should enable a more accurate picture of the current OP denominator to be established.

Other studies have highlighted the relationship between diagnoses of NIHL and exposure to hand–arm vibration syndrome (HAVS) or vibration white finger from the continued use of power tools [23,24]. OPs reported only two cases to OPRA (1998–2006) that had a co-diagnosis of NIHL and HAVS; both cases were reported in male local authority road workers: one aged 32 years and one aged 47 years.

Early data from THOR-GP show high referral rates for work-related audiological cases with 53% of cases referred to a hospital specialist. This compares to 8% for cases reported overall, 1% for mental ill-health and 23% for musculoskeletal disorders. Sickness absence data collected by THOR-GP show a relatively low number of days certified for audiological cases (146) compared with mental ill-health (16 454) or musculoskeletal disorders (10 212). This may be explained by the fact that the incidence of work-related audiological ill-health is highest among older males who may have retired or left employment and therefore have no need for sickness certification from their GPs. The GP data presented here are based on a small number of reports; however, THOR-GP data include reports of hearing disorders among call centre workers and cases of otitis externa attributed to ear phone usage. So although clinical specialist physician reporting

to OSSA and THOR-ENT has ceased, the emergence of new industries and new exposures continues to have the potential to be identified by the THOR-GP and OPRA surveillance schemes.

NIHL is ranked among the top 10 work-related problems affecting employees in the world [21]. Legislation and widespread preventative programmes have been put in place to reduce NIHL and other audiological problems but despite these interventions rates of NIHL remain high. Similarly, the occupational risk of sinonasal cancer following exposure to wood dust and other agents [25–27], and measures to reduce such exposure, have long been established, so it is of concern to note that four cases in woodworkers exposed to wood dust were reported to THOR-ENT between 2005 and 2006. In summary, incidence data based on the UK-wide surveillance schemes provide important information for monitoring and protecting workers' audiological function and (more general) health and well-being. THOR continues to collect cases of work-related audiological ill-health through OPRA and THOR-GP. Moreover, work is in progress to determine better current denominator data for OPRA reports. Together with the ongoing THOR-GP scheme [17], this will permit THOR to continue to undertake a national observatory function for work-related audiological and other ill-health in the UK.

Key points

- For physicians reporting incident work-related audiological cases (occupational physicians, audiological physicians, general practitioners and otorhinolaryngologists), noise-induced hearing loss made up the largest proportion of diagnoses.
- The THOR incidence data presented here show work-related audiological disorders associated with noise exposure continue to be reported in older males employed in those industrial sectors in which work-related ill-health due to noise exposure has been a long-standing problem—in particular, public administration and defence and manufacture of metals.
- Service in the Armed Forces continues to be a risk factor in acquiring work-related audiological problems.

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Conflicts of interest

None declared.

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