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Sensory impairments, problems of balance and accidental injury at work – a case-control study

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Abstract

Objectives—Sensory impairments are becoming increasingly common in the workforces of Western countries. To assess their role in occupational injury, and that of disorders of balance, we undertook a case-control study.

Methods—Using the Clinical Practice Research Datalink, which documents all medical consultations, referrals, and diagnoses in primary care for 6% of the British population, we identified 1,348 working-aged patients who had consulted medical services over a 22-year period for workplace injury (cases) and 6,652 age-, sex- and practice-matched controls. Risks were assessed by conditional logistic regression, for earlier recorded diagnoses of visual impairment, common eye diseases, hearing loss, perforated ear drum, non-acute otitis media, and disorders of balance.

Results—In all, 173 (2.2%) subjects had an earlier eye problem, 792 (9.9%) an ear problem (including 336 with impaired hearing and 482 with non-acute otitis media), and 266 (3.3%) a disorder of balance. No associations were found with glaucoma, cataract, retinal disorders, or perforation of the ear drum specifically, but adjusted odds ratios (ORs) were moderately elevated for eye and ear problems more generally, and higher where there was a record of blindness or partial sight (OR 1.90, 95%CI 1.05-3.44) or non-acute otitis media (OR 2.04, 95%CI 1.64-2.54). Risks for non-acute otitis media and for disorders of balance were particularly elevated for consultations in the 12 months preceding injury consultation (OR 2.70, 95%CI 1.58-4.62 and 1.77, 95%CI 1.01-3.11 respectively).

Conclusions—Problems of vision, impairments of hearing, and disorders of balance all may carry moderately increased risks of occupational injury.

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Background

About 2.5% of the UK's population has some degree of visual impairment that is not correctable by refraction, of which two-thirds is sufficiently severe to qualify for legal registration as 'severely sight impaired' (blind) or 'sight impaired' (partially sighted) [1]. In 2006, over 364,000 people were registered in this way, while as many as 2 million people were believed to be living with some degree of visual impairment [2]. The vast majority of affected people were elderly, but in England and Wales some 80,000 people of working age have visual impairment and over 4,800 under 65-year olds are registered as blind or partially sighted [3]. Across the European Union the number of blind and partially sighted people of working age has been put at over 430,000 [4].

Rates of many common eye diseases increase with age. For example, registration with diabetic retinopathy is over seven times more frequent between ages 65 and 74 years than in 16 to 64 year-olds, while for macular degeneration and glaucoma the corresponding ratios are 39 and 18 respectively [3]. Thus, the current trend to work beyond the traditional retirement age in the UK and other Western countries [5], when allied with increasingly stringent laws on age and disability discrimination, may result in more visually impaired workers in modern workplaces. Moreover, some major causes of visual impairment, such as diabetes mellitus, are on the rise. Age-specific certification rates for diabetic retinopathy in England and Wales rose 63% over the decade from 1990-1 to 1999-2000 [3].

Visual impairment can increase the risk of road traffic accidents (notably in drivers with reduced field of vision) [6], a concern reflected in tighter licensing and review arrangements for older drivers, and among older people, those with visual impairment have more falls in the home [7]. This raises the possibility that visual difficulties might also predispose to accidents at work. Risk of occupational injury and poor sight have been the subject of several previous investigations [8-18,25-28]: self-reported visual impairment [8,12,17,18], poor vision with glasses [10,11,18], interviewer-assessed blindness [12] and, to a lesser extent, medically diagnosed eye disorder [15,18], have all been linked with moderate elevations in risk of injury.

Hearing impairment is likewise common in the general population and of increasing prevalence in ageing workforces. In one national survey, 2% of men and women of working age in Britain had severe difficulty in hearing [19], and in another, 8% of 51-60 year-olds had bilateral hearing impairment of 35-45 dB HL and 5% an even greater deficit [20]. Impaired hearing and deafness can result in relative isolation from noisy hazards in the work environment, a failure to recognise auditory warning signals, and perhaps more chance of missing or misunderstanding important safety instructions. In keeping with this, most of 16 recently reviewed studies of hearing impairment and workplace injury [8-14,16,17,21-31] found moderately positive associations (odds ratios (ORs) >1.5) with relative risks sometimes more than doubled.

However, as has been pointed out elsewhere [32], most studies of sensory impairment and risk of injury in the workplace have relied on self-report, both of injury and of health impairment (with the possibility that those with an injury record were more likely to notice

and report sensory limitations than people without accidents – reporting bias), and have been retrospective in design (with the possibility that some people’s sensory impairments were discovered as a consequence of their injury – bias from reverse causation). In relatively few studies have injury and health impairment been independently established through records or third party information [13,15,31] and few studies have been prospective [16,17,30], or accurately established the timing of events [15,31] to ensure that the sensory limitation preceded the accident. In principle, therefore, risks of injury could have been over-estimated.

To explore this possibility, we exploited a primary care database that documented the dates of diagnoses of sensory impairment and workplace injury consultations, to carry out a nested case-control analysis. Problems of hearing are sometimes linked with disorders of balance and symptoms of dizziness. These too might affect risks of occupational injury (although this has seldom been studied [33]). Opportunity was therefore taken additionally to assess these risk factors.

Methods

Almost everyone in Britain registers with a family doctor for medical services that are free at the point of delivery. The Clinical Practice Research Datalink (CPRD), which is maintained by the Medicines and Healthcare Products Regulatory Agency of the English Department of Health (MHRA), logs the entire medical records of some 5 million patients from 590 such general practices throughout the UK [34]. Data are uploaded regularly, and checked for completeness and validity (deemed high for many outcomes in external audit [35]). In 2010, the MHRA supplied us with an anonymised dataset containing the full medical records of 1,602 patients who had consulted their family doctor or been seen in hospital with a workplace injury (cases) between 1/1/1987 and 31/12/2009, together with 8,010 other patients (five per case), individually matched to the cases for sex, general practice and closest date of birth (controls). After excluding 1,476 subjects aged ≥ 65 years at the ‘index’ date (date of injury consultation, or for controls, that of the matched case) and applying a few other exclusions (controls already matched to another case, $n=69$; cases and matched controls where the underlying injury proved to be non-accidental, $n=67$) 8,000 subjects were finally available for analysis.

Medical consultations are classified by the Read system, which employs many thousands of diagnostic codes and descriptors that were supplied to us by MHRA on a ‘look-up’ CD-ROM. For this analysis, we searched systematically for codes relating to impairments of vision, hearing and balance. Specifically, we looked for terms relating to (1) visual loss, visual impairment, blindness, and low visual acuity; (2) three common categories of eye disease, as judged from Hospital Episode Statistics England – glaucoma, cataract and retinal disease (e.g. retinopathy, retinal detachment, retinal vein thrombosis, optic neuritis, macular degeneration); (3) hearing loss, hearing impairment, hearing difficulty, deafness, and use of a hearing aid or appliance; (4) perforations of the ear drum; (5) non-acute otitis media; and (6) terms that might indicate impaired balance – vertigo, Meniere’s disease, labyrinthine and vestibular disorders. (An online Appendix provides details of coding.) In all we identified 90 codes relating to poor vision or blindness; 6, 12 and 27 each for glaucoma, cataract and

retinal disease; 92 codes for hearing loss or deafness; 11 for perforated ear drum; 32 for non-acute otitis media; and 49 for disorders of balance. Decisions about which codes to include were taken by two of us independently, blinded to information on the case-control status of individuals, and differences were resolved by discussion.

We assessed the association between injury consultation and prior sensory impairment using conditional logistic regression, with findings expressed as odds ratios (ORs) and associated 95% confidence intervals (95% CI). For problems of the eye, ear, and balance, we analysed risks according to any medical record of a relevant code before the index date for injury consultation; and additionally, in the case of otitis media and of balance disorders (two health problems with potentially acute effects), we separately estimated risks associated with a last relevant consultation within the 12 months immediately preceding the injury consultation. Analysis adjusted for a history of problem drinking, identified through a search for codes relating to alcohol misuse, alcoholic medical complications and high weekly intake of alcohol. Finally, to allow for a possible bias arising from a non-specific tendency to use medical services, we adjusted for the number of consultations (0, 1, 2) in the previous 12 months for any of seven common medical reasons for consultation in the database (cough, respiratory tract infection, depressive disorder, anxiety state, dyspepsia, diarrhoea and vomiting) (various codes).

Results

The sample had a mean age of 39.9 years (SD 12.7 years) and included 5,915 men. In all 1,386 occupational injuries were identified (in 1,348 cases) and ascribed 1,349 causes. The nature of injury and causal circumstances were often unrecorded (58% and 51% of the time respectively). Where coded, injuries most often involved power machinery or tools (192 cases), burns (154), and poisonings or inhalation events (146). The commonest category of injury was that involving minor soft tissue trauma or sprains (280), other common events being lacerations and open wounds (123), haematomas and crush injuries (78), and fractures (50). One hundred and fifty-nine cases had attended hospital and 230 had been issued with a sick note. Further details have been published elsewhere [36,37].

Among the 8,000 eligible subjects, 173 (2.2%) were classed as having an eye problem before the index date, 792 an ear problem (9.9%, including 336 with deafness or impaired hearing and 482 with a non-acute otitis media), and 266 (3.3%) a problem of balance. Tables 1 to 3 provide adjusted risk estimates in relation to these impairments and diagnoses before the index date for injury consultation.

Having an eye problem was associated with a moderately increased risk of injury consultation (OR 1.33), but this was not statistically significant, and risks associated with specific eye diseases (glaucoma, cataract and disorders of the retina) were less clearly elevated (Table 1). However, where there was a medical record of blindness, partial blindness, visual impairment, poor sight, or loss of field of vision, the OR for an ensuing injury consultation was 1.90 (95% CI 1.05-3.44).

Having an ear problem was significantly associated with injury consultation (OR 1.63, 95%CI 1.36-1.95) (Table 2), but much of this risk emanated from a strong association with history of non-acute otitis media (OR 2.04, 95%CI 1.64-2.54); and risks associated with deafness, hearing impairment, and perforated ear drum were less strongly elevated (OR 1.27 to 1.32) and not statistically significant. For non-acute otitis media, risks were somewhat higher if the last relevant consultation was in the 12 months prior to injury (OR 2.70, 95%CI 1.58-4.62) than >12 months previously (OR 1.97, 95%CI 1.55-2.50).

Table 3 presents risk estimates in relation to disorders of balance. Overall, risk was elevated moderately, findings falling just short of statistical significance at the 5% level (OR 1.30, 95%CI 0.95-1.76). Risks were higher, however, and statistically significant where the last consultation was in the 12 months prior to injury (OR 1.77, 95%CI 1.01-3.11) than when it was more than 12 months before this (OR 1.14, 95%CI 0.79-1.65).

Findings were only slightly different when adjustment was made for frequent consulting in the past 12 months, in addition to problem drinking.

Discussion

Assessment of the risks of occupational injury posed by impairments of the senses is timely, since many citizens of Western countries are intent on postponing their retirement. An evidence base is needed, on the one hand, to safeguard the health of workers with impairments and those who may be affected by their work and, on the other, to avoid restrictions on employment opportunity in circumstances of comparatively low risk.

As a research tool, the CPRD has some useful strengths and some limitations, reviewed elsewhere [36-38]. In brief, the sampling frame is known to have a high degree of completeness (>97%) and validity for many outcomes [35], and is likely to be representative in most respects of the total population. A particular strength from our perspective was the capacity of the database to identify a substantial sample of patients with occupational injuries, drawn from the injury experience of some 6% of the British population over two decades. On the other hand, injuries are only recorded if they present to medical services, and could only be included in analysis if coded as occupational. Under-ascertainment of cases was substantial relative to statutory notification Reporting of Injuries, Diseases and Dangerous Occurrences (RIDDOR) statistics over the study period. (RIDDOR records some injuries that may not present to medical care (e.g. those involving only a short spell of absence), but many that do (e.g. involving sickness certification or hospital attendance). Probably this arose because a large number of medically presenting injuries that were work-related were not coded as such (coded by the nature of the injury but not also its cause). However, omissions would probably have been non-differential in relation to the associations we investigated (simple acts of omission). Additionally, patients' occupations were typically missing from the database and could not be used in this analysis. Thus, while cases will have been employed, this was not certain for all controls. If controls thereby over-represented illness or treatment preventing work, underestimation of risks could arise (this would not explain the positive associations in this report). Conversely, overestimation of risks could arise, in principle, if such illness and treatment was more common in manual

jobs. In practice these two opposing biases may co-exist, and we have shown, using externally published data, that the net impact is likely to be small [38]. Finally, because a person has to consult in order to become a case, associations with consulting for other medical complaints could arise artefactually, through a non-specific propensity to be a user of medical services. We found no evidence of this after adjusting for frequent consultations in the previous 12 months for other reasons, but interpretation should consider this possibility.

These limitations notwithstanding, and in keeping with the wider research literature [8-18, 21-31], our findings indicate modest elevations in risk of occupational injury in workers with problems of vision and impairments of hearing. Our estimates of effect are similar to the median odds ratios in a systematic review that we previously conducted [32], which were 1.37 (based on 37 estimates of risk) for problems of vision and 1.60 (based on 15 estimates of risk) for problems of the ear. However, the first of these estimates is likely to have been reduced by inclusion of studies reporting no effect simply from the wearing of glasses [14, 25-28]. Taking as our exposure more severe eye problems, such as medically diagnosed blindness, partial blindness, “low vision” or visual field defects, resulted in a higher estimate of risk than overall, closer to the sole study in our review that had studied blindness as a risk factor [12].

We found no significant increases in risk in relation to glaucoma, cataract, and disease of the retina, nor for perforation of the ear drum. The three eye diseases were uncommon, however, (31 to 70 people, depending on the pathology), which limited statistical power to draw strong conclusions: risks elevated by as much as 1.6 to 2.9-fold cannot be excluded, although our best estimates of effect are broadly reassuring and compatible with the limited previous data on risks from medically diagnosed eye disorders [15]. Perforated ear drum was also uncommon in our sample, and is, moreover, a correctable condition (either through natural healing or via surgery) that would not necessarily lead to long-term hearing impairment.

Two novel findings were strong associations with non-acute otitis media and disorders of balance. The strength of the former association was somewhat unexpected while, to our knowledge, the latter has been surprisingly little studied.

The category “non-acute” otitis media was chosen to exclude acute middle ear infection, a common event, especially in childhood, that tends to have little enduring effect; but to include chronic infections that could lead to a fluid-filled middle ear and conductive hearing loss. To focus further on ear pathology proximate in time to the injury consultation, we analysed associations with consultation for non-acute otitis media within the previous 12 months and found risks to be higher than when the most recent consultation for this ear condition was more than 12 months earlier (OR 2.70 vs. 1.96). However, if the effect is mediated through hearing impairment it is surprising that risk appears substantially greater than that for deafness and hearing impairment coded as such. (Effects from the latter could be mitigated in some individuals by prescription of a well-functioning hearing aid, but estimates of risk from deafness and hearing impairment were little altered in a sensitivity analysis from which we omitted subjects with codes for hearing aid use). Thus, while it is

possible that the associations between non-acute otitis media and injury risk were causal, they could also have arisen by chance. The relationship could usefully be explored further in other independent studies.

Likewise, our finding of a link between disorders of balance and risk of injury requires corroboration. Such a relationship looks plausible *a priori* and conviction is added by the observation that risks were about 50% higher when the consultation about problems of balance was recent (OR 1.81) than when more distant (OR 1.15). People with dizziness often complain of difficulty in driving [39,40] and physicians sometimes express concern about the safety of such patients when driving [41]. Thus, for example, Cohen *et al* have found that, although self-reported crash rates did not differ, subjects with vestibular disorders tended to report impairment of driving skills, “particularly in situations when visual information is reduced, rapid head movements are used, and specific path integration or spatial navigation skills are needed” [33]. However, this putative risk factor has rarely been studied in an occupational setting, and our earlier systematic review of chronic health problems and risk of accidental injury in the workplace [32] found no relevant primary reports estimating injury risks in relation to vestibular disorders, vertigo, or labyrinth disorders. There is a requirement for further research on this possible hazard. Meanwhile, our data suggest a need to exercise caution in the occupational placement of individuals with such problems, especially in relation to work that carries an unusual degree of risk or which, in the event of occupational injury, could jeopardise the safety of others.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

1. Denniston, AKO.; Murray, PI. Oxford Handbook of Ophthalmology. Oxford University Press; 2009.
2. Patient.co.uk. [accessed 17/06/14] Blindness and Partial Sight. <http://www.patient.co.uk/doctor/Severe-and-Partial-Sight-impairment#ref-1>
3. Bunce C, Wormald R. Leading causes of certification for blindness and partial sight in England & Wales. BMC Pub Health. 2006; 6:58. doi:10.1186/1471-2458-6-58. [PubMed: 16524463]
4. BFI Steiermark EDV-Schulungszentrum. EUROCHANCE European Labour Market Report CZ/03/W/F/LA-161832. Austria: Feb. 2004
5. Office for National Statistics. [accessed 17/06/14] Pension Trends – Chapter 4: The Labour Market and Retirement, 2013 Edition, 26/2/13. (<http://www.ons.gov.uk/ons/rel/pensions/pension-trends/chapter-4--the-labour-market-and-retirement--2013-edition/artpt2013ch4.html>)
6. Palmer KT, Harris EC, Coggon D. Impairment of hearing and vision and the risk of accidental injury: A systematic literature review. Occup Environ Med. 2004; 61:e55. (024.1).
7. Ivers RQ, Cumming RG, Mitchell P, Attebo K. Visual impairment and falls in older adults: the Blue Mountains Eye Study. J Am Ger Soc. 1998; 46:58–64.

8. Browning SR, Trusczyńska H, Reed D, McKnight RH. Agricultural injuries among older Kentucky farmers: the Farm Family Health and Hazard Surveillance Study. *Am J Ind Med.* 1998; 33:341–353. [PubMed: 9513641]
9. Lewis MQ, Sprince NL, Burmeister LF, Whitten PS, Torner JC, Zwerling C. Work-related injuries among Iowa farm operators: an analysis of the Iowa Farm Family Health and Hazard Surveillance Project. *Am J Ind Med.* 1998; 33:510–517. [PubMed: 9557175]
10. Zwerling C, Sprince NL, Wallace RB, Davis CS, Whitten PS, Heeringa SG. Occupational injuries among agricultural workers 51 to 61 years old: A national study. *J Agr Saf Health.* 1995; 1:273–281.
11. Zwerling C, Sprince NL, Wallace RB, Davis CS, Whitten PS, Heeringa SG. Risk factors for occupational injuries among older workers: an analysis of the Health and Retirement Study. *Am J Public Health.* 1996; 86:1306–1309. [PubMed: 8806386]
12. Zwerling C, Whitten PS, Davis CS, Sprince NL. Occupational injuries among workers with disabilities. The National Health Interview Survey, 1985–1994. *JAMA.* 1997; 278:2163–2166. [PubMed: 9417010]
13. Chau N, Mur JM, Benamghar L, Siegfried C, Dangelzer JL, Français M, Jacquin R, Sourdot A. Relationships between certain individual characteristics and occupational injuries for various jobs in the construction industry: a case-control study. *Am J Ind Med.* 2004; 45:84–92. [PubMed: 14691972]
14. Moll van Charante AW, Mulder PG. Perceptual acuity and the risk of industrial accidents. *Am J Epidemiol.* 1990; 131:652–663. [PubMed: 2316497]
15. Voaklander DC, Kelly KD, Rowe BH, Schopflocher DP, Svenson L, Yiannakoulis N, Pickett W. Pain, medication, and injury in older farmers. *Am J Ind Med.* 2006; 49:374–382. [PubMed: 16526061]
16. Park H, Sprince NL, Lewis MQ, Burmeister LF, Whitten PS, Zwerling C. Risk factors for work-related injury among male farmers in Iowa: a prospective cohort study. *J Occup Environ Med.* 2001; 43:542–547. [PubMed: 11411326]
17. Zwerling C, Sprince NL, Davis CS, Whitten PS, Wallace RR, Heeringa SG. Occupational injuries among older workers with disabilities: a prospective cohort study of the Health and Retirement Survey, 1992 to 1994. *Am J Public Health.* 1998; 88:1691–1695. [PubMed: 9807538]
18. Lam LT. Uncorrected or untreated vision problems and occupational injuries among the adolescent and adult population in Australia. *Inj Prev.* 2008; 14:396–400. [PubMed: 19074246]
19. Palmer KT, Griffin MJ, Syddall HE, Davis A, Pannett B, Coggon D. Occupational exposure to noise and the attributable burden of hearing difficulties in Great Britain. *Occup Environ Med.* 2002; 59:634–9. [PubMed: 12205239]
20. Davis AC. The prevalence of hearing impairment and reported hearing disability among adults in Great Britain. *Int J Epidemiol.* 1989; 18:911–17. [PubMed: 2621028]
21. Chau N, Gauchard GC, Siegfried C, Benamghar L, Dangelzer JL, Français M, Jacquin R, Sourdot A, Perrin PP, Mur JM. Relationships of job, age, and life conditions with the causes and severity of occupational injuries in construction workers. *Int Arch Occup Environ Health.* 2004; 77:60–66. [PubMed: 12942333]
22. Hwang SA, Gomez MI, Stark AD, St John TL, May JJ, Hallman EM. Severe farm injuries among New York farmers. *Am J Ind Med.* 2001; 40:32–41. [PubMed: 11439395]
23. Xiang H, Stallones L, Chiu Y. Nonfatal agricultural injuries among Colorado older male farmers. *J Aging Health.* 1999; 11:65–78. [PubMed: 10848142]
24. Crawford JM, Wilkins JR 3rd, Mitchell GL, Moeschberger ML, Bean TL, Jones LA. A cross-sectional case control study of work-related injuries among Ohio farmers. *Am J Ind Med.* 1998; 34:588–599. [PubMed: 9816417]
25. Sprince NL, Park H, Zwerling C, Lynch CF, Whitten PA, Thu K, Gillette PP, Burmeister LF, Alavanja MC. Risk factors for machinery-related injury among Iowa farmers: a case-control study nested in the Agricultural Health Study. *Int J Occup Environ Health.* 2002; 8:332–338. [PubMed: 12412851]

26. Sprince NL, Zwerling C, Lynch CF, Whitten PS, Thu K, Logsdon-Sackett N, Burmeister LF, Sandler DP, Alavanja MC. Risk factors for agricultural injury: a case-control analysis of Iowa Farmers in the Agricultural Health Study. *J Agric Saf Health*. 2003; 9:5–18. [PubMed: 12673912]
27. Sprince NL, Park H, Zwerling C, Lynch CF, Whitten PS, Thu K, Burmeister LF, Gillette PP, Alavanja MC. Risk factors for animal-related injury among Iowa large-livestock farmers: a case-control study nested in the Agricultural Health Study. *J Rural Health*. 2003; 19:165–173. [PubMed: 12696853]
28. Sprince NL, Zwerling C, Lynch CF, Whitten PS, Thu K, Gillette PP, et al. Risk factors for falls among Iowa farmers: a case-control study nested in the Agricultural Health Study. *Am J Ind Med*. 2003; 44:265–272. [PubMed: 12929146]
29. Viljoen DA, Nie V, Guest M. Is there a risk to safety when working in the New South Wales underground coal-mining industry while having binaural noise-induced hearing loss? *Intern Med J*. 2006; 36:180–184. [PubMed: 16503953]
30. Choi SW, Peek-Asa C, Sprince NL, Rautiainen RH, Donham KJ, Flamme GA, Whitten PS, Zwerling C. Hearing loss as a risk factor for agricultural injuries. *Am J Ind Med*. 2005; 48:293–301. [PubMed: 16142735]
31. Girard SA, Picard M, Davis AC, Simard M, Larocque R, Leroux T, Turcotte F. Multiple work-related accidents: tracing the role of hearing status and noise exposure. *Occup Environ Med*. 2009; 66:319–324. [PubMed: 19174422]
32. Palmer KT, Harris EC, Coggon D. Chronic health problems and risk of accidental injury in the workplace: A systematic literature review. *Occup Environ Med*. 2008; 65:757–764. [PubMed: 18417559]
33. Cohen HS, Wells J, Kimball KT, Cynthia O. Driving disability and dizziness. *J Safety Research*. 2003; 34:361–369. [PubMed: 14636658]
34. Walley T, Mantgani A. The UK General Practice Research Database. *Lancet*. 1997; 350:1097–9. [PubMed: 10213569]
35. Hollowell, J. General Practice Research Database (GPRD): Scope and Quality of Data. Office of Population Censuses and Surveys; London: 1994.
36. Palmer KT, D'Angelo S, Harris EC, Linaker C, Coggon D. The role of mental health problems and common psychotropic drug treatments in accidental injury at work, a case-control study. *Occup Environ Med*. 2014; 71:308–12. [PubMed: 24627304]
37. Palmer KT, D'Angelo S, Harris EC, Linaker C, Coggon D. Epilepsy, diabetes mellitus, and accidental injury at work. *Occup Med*. 2014; 64:448–53. 2014.
38. Palmer KT, Kim M, Coggon D. Bypassing the selection rule in choosing controls for a case-control study. *Occup Environ Med*. 2010; 67:872–7. [PubMed: 20864466]
39. Cohen HS, Kimball KT. Development of the vestibular disorders activities of daily living scale. *Arch Otolaryngol, Head, & Neck Surg*. 2000; 126:881–887. [PubMed: 10889001]
40. Sindwani R, Parnes LS, Goebel JA, Cass SP. Approach to the vestibular patient and driving: A patient perspective. *Otolaryngol, Head, & Neck Surg*. 1999; 121:13–17. [PubMed: 10388869]
41. McKiernan D, Jonathan D. Editorial: Driving and vertigo. *Clin Otolaryngol*. 2001; 26:1–2. [PubMed: 11298157]

What is known

Sensory impairments have been linked with occupational injury in earlier studies, but failure to measure exposures and outcomes independently, or to establish their relative timings, may have led to risks being over-estimated; little is known about problems of balance and occupational injury risk.

What this study adds

Using a database that overcame these problems by focussing on events that preceded medical injury consultation, we found that problems of vision, impairments of hearing, and disorders of balance all appear to carry moderately increased risks of occupational injury.

Table 1
Association between prior problems of vision^a and consultation with an occupational injury

Before the index date	N (%)		OR ^b	95 % CI	P-value	OR ^c	95 % CI	P-value
	Cases (n=1348)	Controls (n=6652)						
No eye problem	1312 (97.3)	6515 (97.9)	1					
Any eye problem	36 (2.7)	137 (2.1)	1.33	(0.91-1.93)	0.14	1.31	(0.90-1.91)	0.16
- Glaucoma	6 (0.44)	25 (0.37)	1.22	(0.50-3.00)	0.66	1.21	(0.49-2.97)	0.68
- Cataract	6 (0.44)	32 (0.48)	0.95	(0.40-2.28)	0.91	0.94	(0.39-2.25)	0.89
- Retinal disorders	10 (0.74)	60 (0.90)	0.82	(0.42-1.62)	0.57	0.81	(0.41-1.61)	0.55
- Blindness or other visual impairment	15 (1.1)	39 (0.6)	1.90	(1.05-3.44)	0.04	1.86	(1.02-3.38)	0.04

^a As defined in an online Appendix

^b Adjusted for problem drinking

^c Adjusted for problem drinking and number of consultations in the 12 months before the index date (0, 1, 2 consultations)

Table 2
Association between prior problems of hearing^a and consultation with an occupational injury

Before the index date	N (%)		OR ^b	95 % CI	P-value	OR ^c	95 % CI	P-value
	Cases (n=1348)	Controls (n=6652)						
No ear problem	1163 (86.3)	6045 (90.9)	1			1		
Any ear problem	185 (13.7)	607 (9.1)	1.63	(1.36-1.95)	<0.001	1.62	(1.35-1.94)	<0.001
- Deafness, hearing impairment, or use of a hearing aid	65 (4.8)	271 (4.1)	1.27	(0.96-1.68)	0.10	1.27	(0.96-1.68)	0.10
- Perforated ear drum	9 (0.7)	36 (0.5)	1.32	(0.64-2.75)	0.45	1.35	(0.65-2.82)	0.40
- Non-acute otitis media	130 (9.6)	352 (5.3)	2.04	(1.64-2.54)	<0.001	2.03	(1.62-2.53)	<0.001

^a As defined in an online Appendix

^b Adjusted for problem drinking

^c Adjusted for problem drinking and number of consultations in the 12 months before the index date (0, 1, 2 consultations)

Table 3
Association between prior problems of balance^a and consultation with an occupational injury

	N (%)		OR ^b	95 % CI	P-value	OR ^c	95 % CI	P-value
	Cases (n=1348)	Controls (n=6652)						
No balance problem before the index date	1293 (95.9)	6441 (96.8)	1			1		
Any balance problem before the index date	55 (4.1)	211 (3.2)	1.30	(0.95-1.76)	0.10	1.28	(0.94-1.74)	0.12
- last consultation with balance problem <12 months before	17 (1.3)	47 (0.7)	1.77	(1.01-3.11)	0.05	1.76	(1.00-3.09)	0.05
- last consultation with balance problem >12 months before	38 (2.8)	164 (2.5)	1.14	(0.79-1.65)	0.47	1.12	(0.78-1.62)	0.53

^a As defined in an online Appendix (includes vertigo, labyrinthitis, Meniere's disease and vestibular disorder)

^b Adjusted for problem drinking

^c Adjusted for problem drinking and number of consultations in the 12 months before the index date (0, 1, 2 consultations)