

The Bristol Stress and Health Study: accidents, minor injuries and cognitive failures at work

E. J. K. Wadsworth, S. A. Simpson, S. C. Moss and A. P. Smith

Background	Accidents and injuries at work account for several million working days lost each year. Cognitive failures (problems of memory, attention or action) can lead to accidents and injuries in certain contexts.
Aim	This work describes the prevalence and associations of workplace accidents, minor injuries and cognitive failures reported by respondents to a follow-up postal questionnaire as part of the community-based Bristol Stress and Health Study.
Methods	Postal questionnaires were sent to 4673 people who participated in the first phase of the study (in which questionnaires were sent to individuals selected at random from the electoral roll).
Results	Four per cent of workers reported an accident at work, 8% reported quite or very frequent minor injuries and 13% reported quite or very frequent cognitive failures. Accidents at work were associated with being male, smoking and higher negative job characteristics. Respondents reported workplace accidents at a level similar to the overall UK rate. Accidents and minor injuries, and minor injuries and cognitive failures, shared common associations and all three outcomes were associated with each other.
Conclusion	Information about cognitive failures is important in the study of accidents and injuries at work. In addition, negative job characteristics represent part of the context in which human error is translated into injury.
Key words	Cognitive failures; minor injuries; workplace accidents.
Received	6 August 2002
Revised	19 March 2003
Accepted	22 April 2003

Introduction

Accidents and injuries at work accounted for an estimated six and a half million working days lost in 1997/1998 [1]. Indeed, work-related injuries account for just under one-fifth of new Accident and Emergency attendees [2]. Although rates of both fatal and non-fatal injuries are falling [1], over a million workers reported a work-related injury in 1999/2000, a rate of ~4000 per 100 000 workers [1]. The impact of work-related injury is therefore substantial, for employers, employees and the health sector.

Occupational injury rates vary geographically, seasonally [3], by industry sector [3,4] and by job type [5]. In addition, men have higher injury rates than women [1,4,6–10]. The relationship between injury rates and age is more complex. Some studies suggest an increased risk associated with younger workers [3,4,6,7]. However, a recent review, pointing to contradictory findings, has suggested differing associations with age according to the kind of activity involved, with perhaps a U-shaped relationship for some industry groups [11], for example the agro-food sector in France [12].

Rates of accidents and injuries also vary with alcohol use [5,13], smoking [5], subjective ill-health [14], anxiety [15] and sleep disturbance [10].

In Great Britain, the two main sources of information about accidents and injuries at work are the Labour Force Survey and the reports made under the Reporting of

Centre for Occupational and Health Psychology, Cardiff University, 63 Park Place, Cardiff CF10 3AS, UK.

Correspondence to: E. J. K. Wadsworth, Centre for Occupational and Health Psychology, Cardiff University, 63 Park Place, Cardiff CF10 3AS, UK. Tel: +44 29 2087 6599; fax: +44 29 2087 6399; e-mail: wadsworth@cardiff.ac.uk

Injury, Diseases and Dangerous Occurrences Regulations (RIDDOR) [3]. Statistics from RIDDOR provide information about fatal and major accidents, though under-reporting of reportable injuries is estimated at ~56% [1]. The Labour Force Survey provides information about a broader range of injuries and characteristics associated with them [3]. There is little other community-level epidemiological information about workplace injuries. In particular, minor injuries, which make up the majority [5], are less well represented.

Cognitive failures at work, that is problems of memory, attention, or action, are effectively human errors. Although the frequency of cognitive failures can increase under certain conditions—such as with depression [16,17], anxiety [16,18,19], stress [19], abrupt antidepressant discontinuation [20] and insomnia and somatic symptoms [18]—they are an everyday occurrence. Although in most circumstances they do not result in accident or injury, cognitive failures can lead to accidents and injuries [21,22].

Methods

Participants

The first Phase of the Bristol Stress and Health Study [23] was a postal questionnaire survey approaching 17 000 individuals selected at random from the Bristol electoral roll. Seven thousand and sixty-nine completed questionnaires were returned, giving a response rate of 49%. Comparisons with census data showed that the respondents were broadly representative of the community [23]. The data used in this paper were drawn from questionnaires sent to the 4673 individuals who participated in the first phase of the Bristol Stress and Health Study [23] and indicated that they were willing to complete a further questionnaire (66% of those who responded to the first phase).

Procedure

Questionnaires and covering letters were sent in 1999, approximately a year after the first phase of the Bristol Stress and Health Study [23] using regular mail. Reminder letters and questionnaires were sent by regular mail 4 weeks later. Telephone reminders followed after a further 4 weeks and a final letter and questionnaire were sent by recorded delivery after another 4 weeks.

Questionnaire

The questionnaire [23] included sections on physical and mental health, accidents and injuries, health related behaviours and demographic and occupational characteristics.

Analyses

There were three main outcome variables, as follows.

1. Accidents at work: accidents at work requiring medical attention in the last 12 months; those reporting one or more accident were compared with those reporting no accidents.
2. Minor injuries at work: minor injuries (e.g. cuts and bruises) at work that did not require medical attention in the last 12 months, measured on a five-point frequency scale (not at all, rarely, occasionally, quite frequently, very frequently); those reporting quite or very frequent minor injuries were compared with those reporting none, rare or occasional minor injuries.
3. Cognitive failures at work: problems of memory (e.g. forgetting where you put things), attention (e.g. failures of concentration), or action (e.g. doing the wrong thing) at work, measured on a five-point frequency scale (not at all, rarely, occasionally, quite frequently, very frequently); those reporting quite or very frequent cognitive failures were compared with those reporting none, rare or occasional cognitive failures.

Data were analysed with χ^2 tests and logistic regression modelling.

Results

Response rates

Three thousand one hundred and eleven questionnaires were returned completed, giving a response rate of 69%. Overall, 56% of respondents were female, 98% were white, 63% were working and the mean age was 49.8 (range 19–97 years). Among the 1892 working respondents whose data are analysed here, 57% were female, 98% white and the mean age was 42.5 (range 19–82 years).

Rates of accidents, minor injuries and cognitive failures

In the preceding year, 4% of workers had an accident at work, 8% suffered quite or very frequent minor injuries at work and 13% reported quite or very frequent cognitive failures at work. Rates, standardized for age and sex using the direct method, are presented in Table 1.

Respondents' ages were grouped into four categories: <25, 25<40, 40<60 and 60 years and over. Rates of accidents at work did not vary significantly with age. Rates of minor injuries, however, decreased with age (from 13 to 1%) and rates of cognitive failures at work were highest among those aged 40<60 years (14%).

More of those reporting accidents at work also reported quite or very frequent minor injuries (among those

Table 1. Number (%) [standardized rates (confidence limits)] of work accidents, minor injuries and cognitive failures

	Males	Females	Both
Work accidents in the last year (one or more)	43 (5.4) [5.91 (3.93–7.89)]	29 (2.8) [2.97 (1.78–4.15)]	72 (3.9) [4.12 (3.08–5.16)]
Minor injuries at work in the last year (frequently/very frequently)	59 (7.4) [8.91 (5.95–11.88)]	91 (8.7) [9.88 (7.57–12.18)]	150 (8.1) [9.47 (7.70–11.24)]
Cognitive failures at work last year (frequently/very frequently)	94 (11.7) [12.24 (9.07–15.40)]	143 (13.5) [13.27 (10.86–15.68)]	237 (12.7) [12.76 (10.90–14.62)]

Table 2. Description of variables

Health	General health over the preceding 12 months was measured on a five-point Likert scale. Very good, good and fair were compared with bad and very bad
Symptoms	Three symptom measures were used focusing on chronic symptoms, symptoms in the preceding year and symptoms in the preceding 14 days. The scales were adapted from the Whitehall II Study [24] to exclude items which may have been the result of a work injury (e.g. backache) or were measured elsewhere (e.g. depression). Those with a chronic symptom score of 1 or more were compared with those with a score of 0. Those with a year symptom score of 2 or more were compared with those scoring 1 or 0. Those with a 14 day symptom score of 3 or more were compared with those scoring 0, 1 or 2
Anxiety and depression	Anxiety and depression were measured using the Hospital Anxiety and Depression Scale [25]. Those with a score of 11 or lower were compared with those with scores over 11 (the case cut-point above which clinical anxiety/depression is assumed)
Sleeping problems	Sleeping problems were assessed using a single yes/no question about difficulty sleeping in the preceding 14 days used in the Whitehall II Study [24]
Employment status	The self-employed were compared with other workers
Alcohol top 10%	Weekly alcohol consumption was calculated and those in the top 10% (calculated separately for men and women) were compared with those consuming less
Smoking	Current smokers were compared with non-smokers
Work-related and general stress	Stress was measured on five-point Likert scales. Not at all, mildly and moderately stressful were compared with very and extremely stressful
Income	Income was grouped into four categories: those earning less than £10 000 p.a.; £10 000 < £20 000 p.a.; £20 000 < £30 000 p.a.; and £30 000 p.a. or more
Sex	Males and females were compared
Age	There were four age categories: <25; 25 < 40; 40 < 60; and 60 years or over
Total negative score	Total negative score was calculated by summing scores across questions about working hours and patterns, physical hazards and job characteristics to produce a sensitive overall measure of individual characteristics [26,27]. The Job Content Instrument [28] and work stress (described above) questions were included in the score. Quartiles of total negative score were compared

reporting an accident, 22% also reported quite or very frequent minor injuries, whereas among those who did not report an accident, 8% reported quite or very frequent minor injuries; $P < 0.0001$) and cognitive failures (22% of those reporting an accident also reported quite or very frequent cognitive failures, compared with 12% of those who did not report an accident; $P = 0.01$). Similarly, more of those reporting quite or very frequent minor injuries at work also reported quite or very frequent cognitive failures (26 and 12%; $P < 0.0001$).

Characteristics associated with accidents, minor injuries and cognitive failures at work

Univariable analyses were carried out to test for association between accidents, minor injuries and cognitive

failures at work, and possible associated factors. Details of the factors examined are in shown Table 2.

The data were analysed using χ^2 tests and the summarized results are shown in Table 3.

Multivariable analyses

Backward stepwise binary logistic regression was used to model accidents (see Table 4), minor injuries (see Table 5) and cognitive failures at work (see Table 6) with the factors described above.

Accidents at work were associated with smoking, sex and total negative job characteristics. Minor injuries at work were also associated with smoking and total negative job characteristics, as well as with sleeping problems and income. Cognitive failures at work were associated with

Table 3. Summarized univariable analyses (*P*-values)

	Accident at work	Minor injuries at work	Cognitive failures at work
Health	0.28	0.05	0.33
Chronic symptoms	0.44	0.28	0.02
Symptoms in preceding year	0.37	0.15	<0.0001
Symptoms in preceding 14 days	0.25	<0.0001	<0.0001
Anxiety	0.08	<0.0001	<0.0001
Depression	0.48	1.00	<0.0001
Sleeping problems	0.05	<0.0001	<0.0001
Employment status	0.82	0.36	0.71
Alcohol	0.12	0.004	0.07
Smoking	0.006	<0.0001	0.35
Work stress	0.09	0.05	<0.0001
General stress	0.05	0.15	<0.0001
Income	0.11	0.001	0.19
Gender	0.002	0.27	0.18
Age	0.67	0.001	0.01
Total negative score	<0.0001	<0.0001	<0.0001

Table 4. Accidents at work

<i>n</i> = 1546	Odds ratio	Confidence limits	<i>P</i>
General stress			
None/mild/moderate	1.00		0.06
Very/extreme	2.01	0.97–4.15	
Smoking			
No	1.00		0.006
Yes	2.12	1.24–3.60	
Sex			
Male	1.00		0.04
Female	0.57	0.34–0.97	
Total negative score			
1st quartile	1.00		0.001
2nd quartile	3.59	1.16–11.14	
3rd quartile	4.95	1.65–14.82	
4th quartile	7.57	2.61–21.94	

sleeping problems, anxiety, work stress and symptoms in the previous 14 days.

Discussion

Overall, 4% of workers reported having a work accident in the previous year, 8% suffered quite or very frequent minor injuries and 13% quite or very frequent cognitive failures. Standardized rates were 4% (3.1–5.2), 9% (7.7–11.2) and 13% (10.9–14.6), respectively. This is very close to the Labour Force Survey figure of 4010 per 100 000 workers in 1999/2000 [29]. Rates of minor injuries and cognitive failures were higher than rates of accidents, though they were based on a cut-point of the

Table 5. Minor injuries at work

<i>n</i> = 1548	Odds ratio	Confidence limits	<i>P</i>
Sleeping problems			
No	1.00		0.03
Yes	1.53	1.05–2.24	
Smoking			
No	1.00		0.0001
Yes	2.15	1.45–3.18	
Income			
<£10 000	1.00		0.05
£10 000–£20 000	1.66	1.03–2.70	
£20 000–£30 000	1.00	0.53–1.88	
£30k+	0.83	0.34–2.00	
Age			
<25	1.00		0.09
25<40	0.86	0.42–1.76	
40<60	0.60	0.29–1.22	
60+	0.16	0.02–1.31	
Total negative score			
1st quartile	1.00		0.0002
2nd quartile	2.59	1.32–5.10	
3rd quartile	3.17	1.64–6.14	
4th quartile	4.29	2.25–8.16	

Table 6. Cognitive failures at work

<i>n</i> = 1559	Odds ratio	Confidence limits	<i>P</i>
Anxiety			
No	1.00		<0.0001
Yes	2.67	1.80–3.97	
Sleeping problems			
No	1.00		0.007
Yes	1.60	1.14–2.25	
Work stress			
Not at all/mildly/moderately	1.00		0.001
Very/extremely	1.86	1.28–2.69	
Age			
<25	1.00		0.06
25<40	1.05	0.50–2.21	
40<60	1.46	0.71–3.00	
60+	0.20	0.02–1.60	
Total negative score			
1st quartile	1.00		0.08
2nd quartile	1.52	0.91–2.52	
3rd quartile	1.83	1.12–2.99	
4th quartile	1.78	1.08–2.92	
Symptoms preceding 14 days			
0, 1 or 2	1.00		0.01
3 or more	1.59	1.12–2.25	

scales used and so could be different if an alternative point had been chosen.

Accidents at work were independently associated with being male, smoking and total negative job characteristics. This is similar to previous findings [1,4–10]. The linear relationship apparent with the derived total negative job characteristics score [26,27] suggests that this method of describing an individual's work is a

sensitive measure. The association with smoking may suggest a link between accidents and risk taking. There is some evidence that unsafe behaviour is a good predictor of accidents [30], though not all research suggests an association with risk taking [31]. It has been suggested that smoking is not a good proxy for risk taking among older workers [13], so including workers of all ages and assessing both smoking and risk-taking behaviour may shed more light in this area.

Negative job characteristics and smoking were each associated with both accidents and minor injuries. Sleeping problems were also associated with both minor injuries and cognitive failures. In addition, lower income was associated with minor injuries, and work stress, anxiety and recent symptoms with cognitive failures.

An association between sleeping problems and workplace injuries has been reported elsewhere [10]. Small numbers of shift- and night-workers made it impossible to examine the interaction between sleep problems and work patterns in this study, though it has been suggested that excessive daytime sleepiness is associated with work-related injury among day workers [32] and that snoring and sleepiness together are associated with accidents, independently of working patterns [33]. Cognitive failures have also previously been associated with sleeping problems [18], anxiety [16,18], stress [19] and symptoms [18].

Accidents, minor injuries and cognitive failures were associated with each other. Those who had had an accident at work were more likely to report quite or very frequent minor injuries and cognitive failures (22 compared with 8% and 22 compared with 12%, respectively; those reporting minor injuries were also more likely to report cognitive failures: 26 and 12%). Accidents and injuries have been linked to—and may result from—cognitive failures [21,22]. Although not all accidents and injuries are the result of cognitive failures, the context of the cognitive failure can mean an accident or injury occurs, which may affect oneself or others [34]. The association apparent in this study between negative job characteristics and both accidents and minor injuries, but not cognitive failures, may represent the context in which human error is translated into injury.

These results are similar to those from previous work and the overall rate of accidents was close to the Labour Force Survey UK figure [29]. Information about other factors which may be associated with workplace accidents, such as neuroticism [31,35,36] and work experience [37–39], together with more direct information about risk-taking behaviour, would clarify the relationship between accidents and associated factors further. There were common associations between accidents and minor injuries (negative job characteristics and smoking) and between minor injuries and cognitive failures (sleeping problems). Further, accidents, minor injuries and cog-

nitive failures were all associated with each other. If cognitive failures, which occurred most frequently and were not associated with negative job characteristics, are potential minor injuries and accidents that did not happen, then information about them is also important in the study of accidents and injuries at work.

Acknowledgements

This study funded by the UK Health & Safety Executive.

References

1. Health and Safety Commission. *Health and Safety Statistics 2000/01*. Norwich: National Statistics, 2001.
2. Harker C, Matheson AB, Ross JAS, Seaton A. Accidents in the workplace. *J Society of Occup Med* 1991;**41**:73–76.
3. Davies R, Elias P. *An Analysis of Temporal and National Variations in Reported Workplace Injury Rates*. Warwick: Institute for Employment Research, 2000.
4. Schelp L, Svanstrom L. One-year incidence of occupational accidents in a rural Swedish municipality. *Scand J Social Med* 1986;**14**:197–204.
5. Di Lorenzo L, Zocchetti C, Platania A, et al. Minor and major work accidents in a Puglia business in the food sector: a 10-year study. *Med Lav* 1998;**89**:499–513.
6. McKnight A, Elias P. *Workplace Injuries and Workforce Trends: Technical Report*. Warwick: The Institute for Employment Research, University of Warwick, 1998.
7. Lindqvist K, Schelp L, Timpka T. Gender aspects of work-related injuries in a Swedish municipality. *Safety Sci* 1999;**31**:183–196.
8. Blasi B, Caccavari R. Risk of accidents to hospital personnel. *Acta Biomed Ateneo Parmense* 1988;**54**:283–286.
9. Firth H, Herbison GP. Occupation injuries in Dunedin. *N Z Med J* 1990;**103**:265–266.
10. Akerstedt T, Fredlund P, Gillberg M, Jansson B. A prospective study of fatal occupational accidents—relationship to sleeping difficulties and occupational factors. *J Sleep Res* 2002;**11**:69–71.
11. Laflamme L, Menckel E. Aging and occupational accidents: a review of the literature of the last three decades. *Safety Sci* 1995;**21**:145–161.
12. Cellier JM, Eyrolle H, Bertrand A. Effects of age and level of work experience on occurrence of accidents. *Percept Mot Skills* 1995;**80**:931–940.
13. Zwerling C, Sprince NL, Wallace RB, Davis CS, Whitten PS, Heeringa SG. Alcohol and occupational injuries among older workers. *Accid Anal Prev* 1996;**28**:371–376.
14. Kirkcaldy B, Furnham A. Positive affectivity, psychological well-being, accident- and traffic-deaths, and suicide: an international comparison. *Stud Psychol* 2000;**42**:97–104.
15. Murray M, Fitzpatrick D, O'Connell C. Fishermen's blues: factors related to accidents and safety among Newfoundland fishermen. *Work Stress* 1997;**11**:292–297.
16. Merckelbach H, Muris P, Nijman H, de Jong PJ. Self-reported cognitive failures and neurotic symptomatology. *Personality Individ Diff* 1996;**20**:715–724.
17. MacQueen GM, Galway TM, Hay J, Young LT, Joffe RT.

- Recollection memory deficits in patients with major depressive disorder predicted by past depressions but not current mood state or treatment status. *Psychol Med* 2002;**32**:251–258.
18. Houston DM, Allt SK. Psychological distress and error making among junior house officers. *Br J Health Psychol* 1997;**2**:141–151.
 19. Mahoney AM, Dalby JT, King MC. Cognitive failures and stress. *Psychol Rep* 1998;**82**:1432–1434.
 20. Hindmarch I, Kimber S, Cockle SM. Abrupt and brief discontinuation of antidepressant treatment: effects on cognitive function and psychomotor performance. *Int Clin Psychopharmacol* 2000;**15**:302–318.
 21. O'Hare D, Wiggins M, Batt R, Morrison D. Cognitive failure analysis for aircraft accident investigation. *Ergonomics* 1994;**37**:1855–1869.
 22. Larson GE, Alderton DL, Neideffer M, Underhill E. Further evidence of dimensionality and correlates of the Cognitive Failures Questionnaire. *Br J Psychol* 1997;**88**:29–38.
 23. Smith A, Johal S, Wadsworth E, Davey Smith G, Peters T. *The Scale of Occupational Health: The Bristol Stress and Health at Work Study*. London: Health & Safety Executive, 2000.
 24. Marmot M, Davey Smith G, Stansfeld S, *et al*. Health inequalities among British civil servants: the Whitehall II Study. *Lancet* 1991;**337**:1387–1393.
 25. Zigmond A, Snaith R. The Hospital Anxiety and Depression Scale. *Acta Psychiatr Scand* 1983;**67**:361–370.
 26. Smith A, MacKay C. Combined effects of occupational health hazards. In: Hanson MA, ed. *Contemporary Ergonomics*. London: The Ergonomics Society, 2001.
 27. Smith A, Brice C, Sivell S, Wellens B. The combined effects of occupational factors on subjective reports of health. In: Hanson MA, ed. *Contemporary Ergonomics*. London: The Ergonomics Society, 2001.
 28. Karasek R, Brisson C, Kawakami N, Huntman I, Bougers P, Amick B. The Job Context Questionnaire (JCQ): an instrument for internationally comparative assessments of psychosocial job characteristics. *J Occup Health Psychol* 1998;**3**:322–355.
 29. Health & Safety Executive. Levels and Trends in Workplace Injury: Reported Injuries and the Labour Force Survey. London: Health & Safety Commission, 2001.
 30. Mearns K, Flin R, Gordon R, Fleming M. Human and organizational factors in offshore safety. *Work Stress* 2001;**15**:144–160.
 31. Salminen S, Klen T, Ojanen K. Risk taking and accident frequency among Finnish forestry workers. *Safety Sci* 1999;**33**:143–153.
 32. Melamed S, Oksenberg A. Excessive daytime sleepiness and risk of occupational injuries in non-shift daytime workers. *Sleep* 2002;**25**:315–322.
 33. Lindberg E, Carter N, Gislason T, Janson C. Role of snoring and daytime sleepiness in occupational accidents. *Am J Respir Crit Care Med* 2001;**164**:2031–2035.
 34. Wagenaar WA, Hudson PTW, Reason JT. Cognitive failures and accidents. *Applied Cognit Psychol* 1990;**4**: 273–294.
 35. Hansen CP. Personality and characteristics of the accident involved employee. *J Business Psychol* 1988;**2**:346–365.
 36. Sutherland VJ, Cooper CL. Personality, stress and accident involvement in the offshore oil and gas industry. *Personality Indiv Diff* 1991;**12**:195–204.
 37. Larsson T. Risk and the inexperienced worker: attitudes of a social anthropologist. *J Occup Health Safety Austr N Z* 1988;**4**:35–40.
 38. Siskind F. Another look at the link between work injuries and job experience. *Monthly Labor Rev* 1982;**105**:38–40.
 39. Dell T, Berkhout J. Injuries at a metal foundry as a function of job classification, length of employment and drug screening. *J Safety Res* 1998;**29**:9–14.