

Sleepiness and safety at work among night shift NHS nurses

A. Westwell¹, P. Cocco², M. Van Tongeren² and E. Murphy¹

¹The Newcastle upon Tyne Hospitals NHS Foundation Trust, Newcastle upon Tyne, NE7 7DN UK, ²Centre for Occupational and Environmental Health, School of Health Sciences, University of Manchester, Manchester, M13 9PL UK.

Correspondence to: A. Westwell, Newcastle Occupational Health Service, Regent Point, Regent Farm Road, Gosforth, Newcastle upon Tyne NE3 3HD, UK. E-mail: alison.westwell@nhs.net

Background	Sleepiness associated with night shift working (NSW) is known to adversely affect workers' health and well-being. It has been associated with adverse safety outcomes and is a recognized workplace hazard among healthcare workers.
Aims	This study was aimed to assess the prevalence of self-reported sleepiness in NSW nurses and midwives. This study also explored the consequences of sleepiness on safety at work and driving.
Methods	A cross-sectional study of NSW nurses and midwives was conducted at an National Health Service (NHS) hospital trust from 16 March 2020 to 1 June 2020. Data were collected by online questionnaire and included information on demographics, shift work and safety aspects. Sleepiness was assessed with the Epworth Sleepiness Scale (ESS).
Results	Data collection coincided with the first coronavirus pandemic peak in England. Out of 1985 eligible NSW nurses and midwives, 229 participated in the study, with a response rate of 12%. The prevalence of sleepiness was 28%. Following a night shift, 49% of nurses reported nodding off at the wheel and 44% reported a near-miss car accident in past 12 months. An abnormal ESS score was significantly associated with near-miss car accidents (odds ratio [OR] 2.75, 95% confidence interval [CI] 1.31–5.77) and with low confidence in undertaking complex tasks at night (OR 2.64, 95% CI 1.20–5.84).
Conclusions	More than a quarter of NSW nurses and midwives reported excessive daytime sleepiness although, due to the low response rate, this may not be representative. Adverse driving events were common. Elevated ESS scores correlated well with safety issues relating to work and driving.
Key words	Driving; midwife; NHS; nurse; occupational health; prevalence; safety; shift work; sleepiness.

Introduction

Sleepiness is an important health and workplace problem. In healthcare workers, sleepiness relating to shift work has been found to have a negative impact on staff health and well-being [1–4]. Shift work has been shown to affect sleep quality in nurses [5], with more frequent sleep problems and sleepiness than the general population [6]. The adverse effect on patient safety relating to sleepiness in shift working staff nurses is well recognized [6–8].

In the UK, excessive sleepiness causes up to 20% of motorway accidents and has been implicated in up to a quarter of fatal or serious accidents [9,10]. Shift working drivers, particularly those driving home after night shift, are recognized as being at high risk

of accidents [11]. Drowsy driving has been compared with drink driving in terms of level of impairment and risk [12]. Several studies of nurses have demonstrated self-reported episodes of drowsy driving in relation to shift work [13–15].

The National Health Service (NHS) in England provides 24-h care, with night shift work (NSW) an absolute requirement. The Working Time Regulations [16] provide a definition of night shift workers, specify maximum working periods and stipulate the requirement for offering medical assessment. Occupational Health provides an important role in assessing fitness for night shift. There are a number of safety aspects to consider in healthcare work, including staff health and safety, general safety and patient safety.

Key learning points

What is already known about this subject:

- Shift work is a recognized workplace hazard. Daytime sleepiness is a major determinant of drowsy driving and near-miss car accidents, which are significant safety concerns among nightshift workers.

What this study adds:

- Daytime sleepiness is likely to be highly prevalent among UK nurses and midwives working rotating nightshifts.
- Epworth Sleepiness Scale scores correlated well with safety issues relating to work and driving.

What impact this may have on practice, policy or procedure:

- Further research and policies introducing nap periods for nursing staff during consecutive night shifts and support for those too tired to drive home should be considered.
- Fatigue risk management strategies used in other industries could support fatigue risk reduction within the National Health Service.

There has been a rise in the number of UK nurses working long shifts (12 h or longer) in NHS hospitals from 31% in 2005 to 51% in 2009 [17]. The Royal College of Nursing has published guidance on shift work planning [4] adapted from the Health and Safety Executive (HSE) guidance [18]. It highlights a doubling in the accident rate during shifts which extend beyond 12 h. The guidance recommends shift length should not exceed 12 h and suggests limiting night shifts to two to three consecutive shifts.

There has been extensive research on desirable shift patterns and on shift work safety issues. Kecklund and Axelsson [1] conducted a large review of meta-analyses and systematic reviews. They concluded that the adverse effect of shift work was mainly due to acute sleep loss arising from loss of sleep opportunity due to long shifts and circadian rhythm disruption.

Di Muzio *et al.* [8] carried out a large systematic review on the correlation between nursing shift work and clinical risk. Night shift workers were found to sleep on average over an hour less than day shift workers during rest periods. The conclusions of the review highlighted workload, sleep deprivation, staff ratios and workflow interruptions as the main factors behind errors.

Nursing staff in the NHS are working longer shifts, particularly overnight [17]. This leads to reduced sleep opportunity between shifts. In city areas, longer commute times may compound this problem. The nursing profession has a large female predominance [19] with 49% of nurses having children living at home [20], meaning childcare responsibilities may also impact on opportunities for daytime sleep between shifts.

In light of these issues, one would expect the prevalence of sleepiness in NSW NHS nurses to be high. This study aimed to assess the prevalence of self-reported sleepiness in NSW nurses and midwives using the Epworth Sleepiness Scale (ESS). In addition, the study aimed to investigate the link between self-reported sleepiness and work errors, and levels of drowsy driving.

Methods

The study was designed as a cross-sectional study with an online questionnaire self-administered by NSW nurses and midwives.

The levels of reported sleepiness were assessed using a validated screening tool, the ESS [21]. This tool is recommended by HSE for shift work risk assessment [18]. Data collection lasted from 16 March 2020 to 1 June 2020.

NSW staff nurses and midwives employed at an NHS Trust were invited to take part. The number of eligible staff nurses and midwives was estimated to be 1985, including hospital- and community-based teams.

An e-mail invitation was sent to directorate management leads with a request for them to cascade it amongst eligible NSW staff nurses and midwives. The invitation included an explanation of the study and a link to the online questionnaire. Consent and eligibility questions were built into the questionnaire to ensure only those eligible were able to take part. Nurses and midwives who had worked at least one night shift in the previous 28 days were eligible to participate. Participation was entirely voluntary and the questionnaire responses collected were anonymous with no participant identifiable information collected.

The questionnaire sections gathered data on demographics and lifestyle, work shift organization, ESS and safety questions relating to work and driving after night shift (Appendix 1, available as Supplementary data at *Occupational Medicine Online*).

The ESS [21] is a validated tool to assess daytime sleepiness of adults. The response to each one of eight questions is scored from 0 to 3. Therefore, the sum of the scores ranges from 0 to 24. The higher the ESS score relates to increased level of daytime sleepiness. An ESS score ≥ 11 is considered indicative of abnormal daytime sleepiness.

Data were collected regarding shift work. The rota varies between wards and individual staff. There is no

uniform schedule or policy. The questionnaire asked how many consecutive shifts the participants had completed at time of filling in the questionnaire.

The participating staff were asked to report on two work-related safety aspects: needle stick injuries and confidence rating when undertaking complex work tasks during night shifts. To assess driving safety in commuting, drivers were asked to report on three aspects of driving safety: their level of sleepiness when driving home after a night shift over the past month, incidents of nodding off at the wheel and experience of a near-miss car accident, while driving home after a night shift.

Variables were recategorized to allow for clearer statistical analysis and comparisons. ESS, the primary outcome measure, was dichotomized to ESS <11 (normal) and ESS ≥11 (abnormal).

Simple cross-tabulation and chi-squared tests were used to detect univariate associations between outcomes and variables. Logistical regression analysis was used to predict abnormal ESS scores indicative of daytime somnolence and some safety outcomes based on a range of demographic, occupational and sleep-related covariates. The odds ratio was calculated as the anti-logarithm of the regression coefficient, along with the 95% confidence interval (95% CI), as the measure of the strength of association between ESS and safety outcomes, and occupational, lifestyle and sleep-related variables. The analysis was adjusted for potential reciprocal confounding, including age, body mass index (BMI), having children under 4 years, hours of work, commuting time, length of sleep, length of career, consecutive night shifts and regular use of sleeping pills.

The study was approved by University of Manchester Research Ethics Committee (2020-8652-12800) and Health Research Authority (HRA) Research and Development (R&D) for NHS research, Integrated Research Application System (IRAS) (268824) in 2020.

Results

In total, 229 NSW nurses and midwives participated in the study. Twenty per cent (46/229) responded to the first invitation sent on 16 March 2020. This coincided with UK coronavirus pandemic preparations. Another 80% (183/229) responded to the second invitation at the end of April 2020. All completed responses were included.

Table 1 shows summary statistics of selected variables

Ninety per cent of the participating staff worked on rotating day and night shifts with only 10% exclusively engaged in NSW. The distribution number of consecutive night shifts before interview did not vary after excluding nurses permanently engaged in night shifts. Full-time workers (35+ h/week) represented two thirds of the study population.

Table 1. Summary statistics of selected variables

Variable	Range	Number of participants n (%)
Gender	Female	211 (92)
	Male	18 (8)
Age (years)	20–29	80 (35)
	30–39	70 (30)
	40–49	43 (19)
	≥50	36 (16)
BMI	17–24.9	87 (38)
	25–29.9	69 (30)
	≥30	65 (28)
	Missing data	8 (4)
Regular ^a use of sleep medication	Yes	22 (10)
	No	207 (90)
Regular ^a use of strong painkillers	Yes	20 (9)
	No	209 (91)
Length of time being a nurse or midwife (years)	0–5	89 (39)
	6–15	65 (28)
	>15	75 (33)
Children under 4 years living in household	Yes	45 (20)
	No	184 (80)
Journey time to work	≤30 min	167 (73)
	>30 min	62 (27)
Hours of work	Part-time (<35)	75 (33)
	Full-time (≥35)	154 (67)
Hospital department	Paediatrics and Neonates	67 (29)
	Anaesthetics and Critical Care	65 (28)
	Surgical Specialties	41 (18)
	Medical Specialties	31 (14)
	Obstetrics and Gynaecology	25 (11)
	Types of shift undertaken	Night shifts only
	Combination of day/night shift	207 (90)
No. of consecutive shifts completed at time of undertaking questionnaire	0–1	65 (29)
	2	65 (29)
	3	56 (25)
	≥4	42 (18)
	Missing	1
Type of consecutive shifts	Consecutive day shifts	67 (30)
	Consecutive night shifts	95 (42)
	Combination of day/night shift	62 (28)
	Missing	5
Difficulty sleeping between night shifts	Yes	147 (64)
	No	82 (36)
Hours of sleep between night shifts	≥7	33 (14)
	6	68 (30)
	≤5	128 (56)

^aRegular: more than three times weekly.

Night shift length varied from 11 to 14 h (median 12 h). Sixty-four per cent of shift workers reported sleeping difficulty between night shifts. The length of self-reported sleep time between night shifts ranged from 3 to 11 h. Eighty six per cent of study participants ($n = 196$) reported 6 h or less sleep between night shifts.

Of the 95 workers who had completed consecutive night shifts at the time of filling in the questionnaire, 76 (80%) had worked three or less shifts. This is within HSE good practice guidelines [18] which recommend limiting night shifts to two to three consecutive. Nineteen study participants (20%) had worked four or more consecutive shifts, and nine staff reported working seven consecutive night shifts at the time questionnaire completion.

Overall, the median ESS score was 7 (interquartile range [IQR] 4–11) and it was lower among the 22 study participants permanently engaged in NSW (median 5.5, IQR 2.5–9.25) than among rotating shift workers (median 7, IQR 4–11), though not significantly so (Mann–Whitney test = -0.886 , $P = 0.188$). The median ESS score was highest in medical specialties (median 9, IQR 6–11.5) but there was no significant difference in abnormal ESS across specialties ($P = 0.44$). Medical specialties included nurses working in cardiology, haematology, oncology, neurology and gastroenterology.

The ESS frequency distribution among the participating NSW nurses and midwives is shown in Figure 1.

The shape of the ESS score distribution seems approximately bimodal, with a prevalence of ESS score ≥ 11 , indicative of daytime sleepiness, of 28% (63/229).

Participant responses in ESS score did not seem to be affected by the timing of questionnaire completion nor by number of consecutive night shifts. For workers who had completed three consecutive shifts at the time of questionnaire completion, the median ESS score was 6 (IQR 3.5–10), including three nurses who only worked at night, and 8 (IQR 4–12) after excluding them. Nurses who had completed one night shift only had the same ESS score of 7 (IQR 5–11), which increased to 9 (IQR

4.75–11.25) after excluding five nurses who only worked at night. Finally, the median ESS score among seven nurses at their first night shift after resting was 6 (IQR 4.5–7.5) and it was almost identical after excluding one nurse working night shifts only 6.4 (IQR 4.5–7.75).

In the univariate analysis, staff with children under 4 years of age living in their household and those who reported difficulty sleeping between night shifts had an ESS score suggestive of daytime somnolence. The prevalence of abnormal ESS score did not vary by categories of the other demographic variables (Table 2).

Twenty-seven out of 229 participants (12%) reported a needle stick injury in the last 3 years. These events were twice as common during day shifts ($n = 18$) compared to night shifts ($n = 9$). Confidence scoring for undertaking complex work tasks did not vary during night shifts as opposed to day shifts. An abnormal ESS score was significantly associated with low confidence in undertaking complex tasks at night (Table 4).

Car drivers make up 78% ($n = 178$) of the research sample. Of these, 49% ($n = 87$) reported nodding off at the wheel and 44% ($n = 78$) reported a near-miss car accident in the past 12 months when driving home following a night shift. Two workers reported a road traffic collision following night shift in the past 5 years. The score distribution of self-reported sleepiness while driving is skewed towards high levels of drowsy driving (Figure 2), which corroborates the frequently reported incidents of nodding and near-miss incidents at the wheel.

Table 3 shows that an elevated sleepiness (ESS) score is significantly associated with all adverse safety outcomes, except needle stick injury.

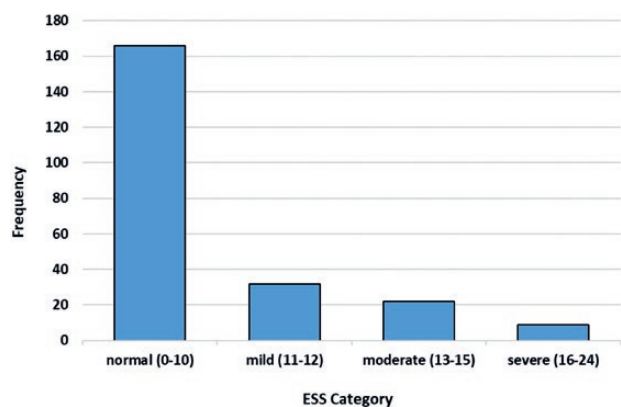


Figure 1. ESS frequency distribution among the participating NSW nurses and midwives.

Table 2. Univariate analysis of excessive daytime sleepiness (ESS ≥ 11) in relation to demographic variables

Demographic variable	Pearson χ^2	P value
Age	3.14	0.371
BMI	3.891	0.143
Gender (female versus male)	0.001	0.979
Children <4 years living in household (yes versus no)	4.380	0.036
Regular use of sleep medication (yes versus no)	0.956	0.328
Regular use of strong painkillers (yes versus no)	1.714	0.190
Journey time to work	1.724	0.189
Length of time in the role	1.443	0.486
Part-time/full-time work	2.864	0.091
Consecutive shifts worked at time of data collection	3.071	0.878
Length of night shift	23.180	0.229
Difficulty sleeping between night shifts	8.705	0.003
Length of average sleep between night shifts	13.578	0.059

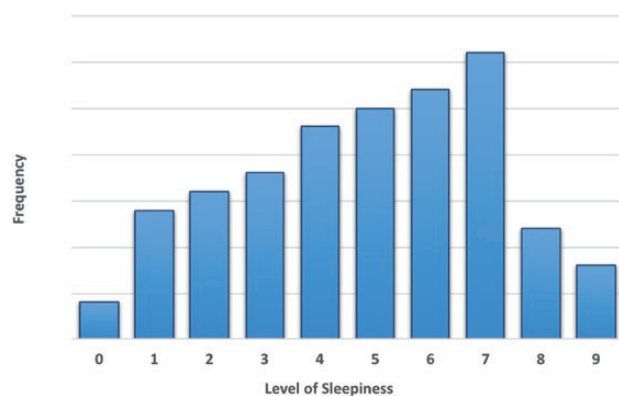


Figure 2. Level of sleepiness whilst driving after night shift (past month).

The five safety outcomes listed in Table 3 were used as dependent variables in multi-variate regression analyses with the ESS and patient demographics (age, BMI and gender) as the independent covariates. As shown in Table 4, an elevated ESS score is strongly associated with all the adverse safety outcomes, with the exception of needle stick injuries. For example, risk of having had a near-miss car accident in the last 12 months was increased 2.8-fold (95% CI 1.3–5.8) among nurses and midwives with an abnormal ESS score. An older age seems protective against near-miss car accidents and needle stick injuries (Wald test for trend = 3.0, $P = 0.0014$, and Wald test for trend = 2.996, $P = 0.0014$). BMI was not related with any of the adverse safety outcomes. There were too few male nurses to assess differences due to gender. The results were confirmed with the inclusion of further potential confounders, namely children <4 years, length of sleep between shifts and regular use of sleeping pills (not shown in the tables).

Discussion

The prevalence of daytime sleepiness in NSW nurses and midwives working in an NHS hospital trust was 28%, defined by an ESS score ≥ 11 . Difficulty sleeping between night shifts was common. The median sleep time between night shifts was 5 h and 86% of participants ($n = 196$) reported getting ≤ 6 h sleep between night shifts. This is less than that recommended by the National Sleep Foundation and is likely to contribute to development of sleep debt [22]. Daytime sleepiness was a significant predictor of nodding off at the wheel and near-miss car accidents in the past 12 months when driving home following a night shift. This association was unaffected by factors such as age, gender, BMI, use of sleeping pills and having children under 4 years in the household, which one may have expected to be confounding variables.

Table 3. Univariate analysis of consequences of sleepiness from NSW on safety and driving

Safety outcome	ESS ≤ 10	ESS ≥ 11	χ^2	P value
	No. (%)	No. (%)		
Nodding at the wheel			4.85	0.028
No	73 (56)	18 (38)		
Yes	57 (44)	30 (63)		
Missing: 0				
Sleepiness after night shift			9.90	0.002
Low	64 (49)	11 (23)		
High	66 (51)	37 (77)		
Missing: 0				
Confidence in complex tasks			4.93	0.026
Confident with tasks	144 (88)	47 (76)		
Finds tasks difficult	20 (12)	15 (24)		
Missing: 3				
Near-miss car accidents			11.42	0.001
No	82 (63)	18 (38)		
Yes	48 (37)	30 (63)		
Missing: 0				
Needle stick injuries			1.39	0.239
No	149 (90)	53 (84)		
Yes	17 (10)	10 (16)		
Missing: 0				

Overall rating of confidence in undertaking complex tasks during night shifts compared to day shift was high, but an ESS score suggestive of daytime sleepiness was associated with low confidence scores. There was no association demonstrated between ESS score and needle stick injuries, nor differences in the ESS scores between hospital departments. Needle stick injuries were more often reported to occur during the day shift compared to the nightshift. It is not clear if this is because more procedures are carried out during the day compared to the night shift. Further research may be required to explore this.

Few publications have specifically studied the prevalence of sleepiness in NSW nurses or midwives. One study looked at 1102 hospital nurses and found the prevalence to be 16% [23]. This study used ESS threshold of ≥ 14 , indicative of abnormal daytime sleepiness, so prevalence would be higher than that of comparable ESS scores in our study. In a recent study of rotating shift workers from civil aviation [24], prevalence of excessive daytime sleepiness was much higher (61%).

This study highlighted some important safety considerations. The drowsy driving figures are similar to those demonstrated in other studies [14,25]. McClelland *et al.* [25] found 57% of UK anaesthetists reported a near-miss incident or nodding off at the wheel. Figures in the general population have been shown to be much lower.

Table 4. Output of the logistic regression analysis

Variables	Nodding at the wheel		Sleepiness after night shift		Near-miss car accident		Confidence in complex tasks		Needle stick injuries	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Age range										
20–29 years	1.0	–	1.0	–	1.0	–	1.0	–	1.0	–
30–39 years	1.49	0.68–3.26	1.03	0.45–2.32	0.78	0.35–1.73	0.72	0.30–1.69	0.40	0.15–1.08
40–49 years	0.97	0.41–2.33	0.63	0.26–1.57	0.64	0.26–1.56	0.40	0.13–1.21	0.18	0.04–0.86
≥50 years	0.72	0.28–1.87	0.58	0.22–1.53	0.16	0.05–0.52	0.22	0.47–1.06	0.10	0.12–0.83
Gender (female versus male)	2.04	0.48–8.64	2.25	0.56–9.11	0.43	0.10–1.85	1.04	0.27–3.96	0.30	0.09–1.01
BMI										
17–24.9	1.0	–	1.0	–	1.0	–	1.0	–	1.0	–
25–29.9	1.01	0.48–2.09	1.51	0.71–3.23	1.51	0.71–3.23	1.38	0.57–3.35	0.90	0.33–2.46
30+	1.18	0.54–2.57	0.77	0.35–1.73	1.05	0.46–2.36	0.77	0.29–1.99	0.55	0.18–1.71
ESS ≤ 10	1.0	–	1.0	–	1.0	–	1.0	–	1.0	–
ESS ≥ 11	2.10	1.02–4.30	3.64	1.64–8.07	2.75	1.31–5.77	2.64	1.20–5.84	0.30	0.09–1.01

In a large European study [26] of 12 434 drivers, the prevalence of falling asleep at the wheel was 17%.

Limitations in interpreting our results include the low overall response rate. There was no data on the number of eligible nurses and midwives (ie those with a least 1 night shift in the 28 days prior to completing the survey). Based on a historic dataset looking at nurses and midwives who had worked a night shift during a 1-month period in December 2018, it was estimated that 1985 would have been eligible, resulting in a response rate of only 12%.

Data collection coincided with the first wave of the UK coronavirus pandemic and a very busy time for the host NHS trust. The onset of the pandemic restricted hospital communication, and recruitment for the study could not be advertised. Ethical and NHS Caldicott principles within the host trust meant that direct contact through staff e-mails was not permitted. Directorate managers were asked to cascade invites to eligible staff. Several directorate managers refused to do this, due to departmental pressures. This will have contributed to the low response rate and possibly could have resulted in selection bias, due to staff from departments at a higher risk of sleep deprivation and adverse safety outcomes, being under represented. Staff from the Medical Directorate, for example, are underrepresented in the data.

Most respondents were from Paediatrics and Neonatal Care. This may reflect admission rates to these areas being less affected by the pandemic. Anaesthetics and Critical Care nurses form the second largest group, with most responses provided after the first pandemic peak. This might have generated higher sleepiness scores, given that staff had just undertaken an unprecedented period of physically and emotionally tiring work.

Because of the low response rate, it is uncertain whether, and to what extent the findings are representative of the hospital staff population. A study looking at sleep quality in nurses within the same hospital trust by McDowall *et al.* [5] had an overall response rate of 34% (*n* = 888). The demographic data collected in the McDowall *et al.*'s study were comparable, suggesting demographics within this study are in keeping with existing published data at a local level.

The HSE acknowledges that shift work is a workplace hazard and legislation places a requirement on employers to mitigate the risks associated with shift work [27]. This study highlights safety concerns related to sleepiness following NSW, which is an important step towards managing those risks.

A risk stratification process to identify and target ‘at risk’ workers based on rota patterns, overtime and reduced sleep opportunity would be useful to build on the findings from this study. Warning systems could be built into rota planning software as part of an effective fatigue risk management strategy. Future research to assess the impact of such strategies would be beneficial.

Staff nurses and midwives are undertaking a safety critical role. Fatigue risk management is central to workforce planning in other safety critical roles, such as the transport sector, or oil and gas sectors. These sectors are significantly more regulated than the NHS and have well established systems. Staff are encouraged to report fatigue hazards. A similar process should be encouraged through NHS reporting systems.

#Fight Fatigue Campaign 2017 followed the McClelland *et al.*'s study [25], and raised awareness and encouraged hospital trusts to improve rest facilities for their staff [28]. Further research and policy review regarding nap periods for nursing staff during consecutive

night shifts should be considered. The high incidence of drowsy driving suggests a policy to support staff who find themselves too tired to drive home would also be worthwhile.

Acknowledgements

We thank Dr Kirstie Anderson, The Newcastle Upon Tyne Hospitals NHS Foundation Trust, for contribution to questionnaire development.

Competing interests

None declared.

References

- Kecklund G, Axelsson J. Health consequences of shift work and insufficient sleep. *Br Med J* 2016;**355**:i5210.
- Bannai A, Tamakoshi A. The association between long working hours and health: a systematic review of epidemiological evidence. *Scand J Work Environ Health* 2014;**40**:5–18.
- Dall’Ora C, Griffiths P, Ball J, Simon M, Aiken LH. Association of 12 h shifts and nurses’ job satisfaction, burnout and intention to leave: findings from a cross-sectional study of 12 European countries. *BMJ open*. 2015;**5**:e008331.
- Royal College of Nursing. *A Shift in the Right Direction: RCN Guidance on the Occupational Health and Safety of Shift Work in the Nursing Workforce*. London: RCN, 2012.
- McDowall K, Murphy E, Anderson K. The impact of shift work on sleep quality among nurses. *Occup Med (Lond)* 2017;**67**:621–625.
- Gander P, O’Keeffe K, Santos-Fernandez E, Huntington A, Walker L, Willis J. Fatigue and nurses’ work patterns: an online questionnaire survey. *Int J Nurs Stud* 2019;**98**:67–74.
- Ayas NT, Barger LK, Cade BE *et al*. Extended work duration and the risk of self-reported percutaneous injuries in interns. *J Am Med Assoc* 2006;**296**:1055–1062.
- Di Muzio M, Dionisi S, Di Simone E *et al*. Can nurses’ shift work jeopardize the patient safety? A systematic review. *Eur Rev Med Pharmacol Sci* 2019;**23**:4507–4519.
- Horne JA, Reyner LA. Sleep related vehicle accidents. *Br Med J* 1995;**310**:565–567.
- Driver I. *Driver Fatigue and Road Accidents*. Birmingham: The Royal Society for the Prevention of Accidents, 2011.
- Lee ML, Howard ME, Horrey WJ *et al*. High risk of near-crash driving events following night-shift work. *Proc Natl Acad Sci USA* 2016;**113**:176–181.
- Higgins JS, Michael J, Austin R, *et al*. Asleep at the wheel—the road to addressing drowsy driving. *Sleep*. 2017;**40**:zssx001.
- Ftouni S, Sletten TL, Howard M *et al*. Objective and subjective measures of sleepiness, and their associations with on-road driving events in shift workers. *J Sleep Res* 2013;**22**:58–69.
- Scott LD, Hwang WT, Rogers AE, Nysse T, Dean GE, Dinges DF. The relationship between nurse work schedules, sleep duration, and drowsy driving. *Sleep* 2007;**30**:1801–1807.
- Scott LD, Hofmeister N, Rogness N, Rogers AE. An interventional approach for patient and nurse safety: a fatigue countermeasures feasibility study. *Nurs Res* 2010;**59**:250–258.
- Working Time Regulations 1998*. SI1998/1833 The Stationery Office.
- Ball J, Maben J, Murrells T, Day T, Griffiths P. *12-Hour Shifts: Prevalence, Views and Impact*. King’s College London Research, 2015.
- Health and Safety Executive (HSE). *Management of health and safety at work. Management of Health and Safety at Work Regulations 1999*. Approved Code of Practice and guidance L21 (Second edition). HSE Books, 2000.
- Nursing and Midwifery Council, Portland Place London. The NMC Register Annual registration data report, 2021.
- Royal College of Nursing. *Spinning Plates—Working Flexibly to Support a Healthy Work–Life Balance: A Guide for RCN Representatives*. London: Royal College of Nursing, September 2015.
- Johns MW. A new method for measuring daytime sleepiness: the Epworth Sleepiness Scale. *Sleep* 1991;**14**:540–545.
- Hirshkowitz M, Whiton K, Albert SM *et al*. National Sleep Foundation’s sleep time duration recommendations: methodology and results summary. *Sleep Health* 2015;**1**:40–43.
- Chen L, Luo C, Liu S *et al*. Excessive daytime sleepiness in general hospital nurses: prevalence, correlates, and its association with adverse events. *Sleep Breath* 2019;**23**:209–216.
- Reis C, Staats R, Pellegrino P, Alvarenga TA, Bárbara C, Paiva T. The prevalence of excessive sleepiness is higher in shift workers than in patients with obstructive sleep apnea. *J Sleep Res* 2020;**29**:e13073.
- McClelland L, Holland J, Lomas JP, Redfern N, Plunkett E. A national survey of the effects of fatigue on trainees in anaesthesia in the UK. *Anaesthesia* 2017;**72**:1069–1077.
- Gonçalves M, Amici R, Lucas R *et al*.; National Representatives as Study Collaborators. Sleepiness at the wheel across Europe: a survey of 19 countries. *J Sleep Res* 2015;**24**:242–253.
- Health and Safety Executive (HSE). *Management of Health and Safety at Work: Management of Health and Safety at Work Regulations 1992*. London: Her Majesty’s Stationery Office, 1992.
- Group Joint Fatigue Working Group. *#Fight Fatigue Campaign*. Association of Anaesthetists, Faculty of Intensive Care Medicine, 2017.