The SNOOZE project: the impact of night shifts on junior doctors' reaction times

Sleep deprivation and fatigue are an increasingly common problem among junior doctors. The 2016 General Medical Council training survey reported that 25% of junior doctors in England felt sleep deprived on a daily or weekly basis, a 3.4% increase from 2012. Shift work, including nights and early mornings, has been shown to increase sleepiness and fatigue (Åkerstedt and Wright Jr, 2009; Sallinen and Kecklund, 2010) and it is well documented that sleep deprivation has adverse effects on human functioning and ability to perform even basic cognitive tasks (Pilcher and Huffcutt, 1996).

Previous studies examining the effects of sleep deprivation and fatigue in on-call doctors have shown a profound increase in reaction times (Saxena and George, 2005), and there is a growing body of evidence which suggests that junior doctors who are sleep deprived are at increased risk of making more clinical and technical errors (Friedman et al, 1971; Taffinder et al, 1998; Grantcharov et al, 2001; Eastridge et al, 2003; Landrigan et al, 2004).

News reports of junior doctors involved in road traffic collisions are, sadly, not uncommon and research has shown that driving after long shifts, and night shifts particularly, is associated with decreased concentration and increased risk of accidents (Horne and Reyner, 1999; Steele et al, 1999; Åkerstedt et al, 2005). McClelland et al (2017) conducted a national survey of anaesthetic trainees in the UK in which 57% of respondents reported being in an accident or near-miss when driving after a night shift. Indeed, there is robust evidence that more than 19–20 hours of wakefulness (such as may be experienced before starting a set of night shifts) results in performance impairment equivalent to a blood alcohol concentration of 0.10% (Lamond and Dawson, 1999; Williamson and Feyer, 2000), above the UK legal driving limit of 0.08%.

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Aim

The SNOOZE (SHOs of Nottingham Orthopaedics Observation of 'Zzz' Effect) project aimed to examine the compliance of junior doctors with recommended rest patterns and the impact of a 12.5-hour night shift on senior house officers' reaction times.

Method

A brief pilot study was initially conducted over a 2-week period wherein all senior house officers (grades FY2, CT1, CT2 and clinical fellow) undertaking night shifts in trauma and orthopaedics at a major trauma centre were asked to perform a psychomotor vigilance task before and after their shift, and complete a questionnaire. Psychomotor vigilance tasks have been shown to be a valid method for measuring reaction time when the standard 10-minute test is used; as this was deemed to be prohibitively long in the context of an on-call shift, a shorter test of approximately 1-minute duration was used. Data collected included total rest and/or sleep overnight, hours slept during the preceding day and number of caffeinated beverages consumed overnight.

The data from the pilot study were used to generate a power calculation, following which the study was carried out over 59 consecutive night shifts, using the same psychomotor vigilance task and questionnaire.

The standard was the New Deal requirement of a minimum of 30 minutes continuous rest for each 4-hour period of duty, with a target compliance of 75%.

The mean change in reaction times pre- and post-night shifts was calculated and compared using the independent student's *t*-test.

A reaction time change of ≥50 ms was deemed to be clinically significant, as this equates to an increase of 1.6 metres additional braking distance when travelling at 70 mph on a motorway.

Results

Questionnaires were completed for 52 out of 59 night shifts (88%). Twenty-five respondents (48%) reported having less than 60 minutes total rest or sleep overnight, while 6 out of 52 (12%) reported having less than 30 minutes total rest or sleep overnight.

The mean (standard deviation) change in reaction time for senior house officers with at least 60 minutes rest was +3.2 ms (34 ms), and +5.5 ms (44 ms) for those senior house officers who achieved less than 60 minutes rest (P=0.84).

A total of 7 out of 52 (13.5%) respondents demonstrated an increase in reaction time of ≥50 ms.

Senior house officers who achieved a minimum of 60 minutes rest overnight reported an average of 4.76 hours sleep during the preceding day, while those who achieved less than 60 minutes averaged 6 hours sleep (P=0.008).

Discussion

Night shifts are a fundamental component of most junior doctors' rotas and are vital to providing round the clock care for patients. But they require doctors to fight against the natural instinct to sleep at night and, often, to be alert when people are at their most somnolent. Since the implementation of the European Working Time Directive in the form of the UK Working Time Regulations in 2009, there have been significant changes to doctors' work patterns which mean many no longer work a true 'on call', but rather are expected to do a 12–13-hour full shift overnight with little to no opportunity for sleep. While the UK Working Time Regulations have led to reductions in excessive working hours, fatigue as a result of shift mixtures remains a persistent issue for trainees, as reported by Morrow et al (2014)

and Brown et al (2010), and shift work has long been associated with deleterious health effects (Hobson, 2004), not just in health care but also in many other industries (Folkard and Tucker, 2003; Krishnaswamy et al, 2016).

The Terms and Conditions of Service for NHS Doctors and Dentists in Training 2016 (NHS Employers, 2016) state:

> **'A doctor must receive:**
> **a. at least one 30-minute paid break for a shift rostered to last more than five hours, and**
> **b. a second 30-minute paid break for a shift rostered to last more than nine hours.'**

This means that during a 12.5-hour night shift, doctors should be aiming to achieve a minimum of two periods of 30 minutes' continuous rest to adhere to working time regulations.

In this study, over half of respondents reported having less than 60 minutes rest during a night shift in a busy trauma centre. Other authors, notably Jackson and Moreton (2013), have reported similar findings with many juniors unable to achieve the recommended rest period when working night shifts. While no significant difference was detected in the reaction times of these two groups, seven respondents demonstrated an increase in reaction time of more than 50 ms, equating to an additional 1.6 metres braking distance if travelling at 70 mph on a motorway.

Taking regular, prescribed breaks during shift work is vital, and there is some evidence that a short nap of approximately 15–20 minutes duration can be beneficial in reducing fatigue and improving focus (Naithoh, 1992; Reyner and Horne, 1997). However, other groups have concluded that napping for 30 minutes or more may lead to sleep inertia on waking and actually make sleepiness worse (Hilditch et al, 2016, 2017), and there does not yet seem to be any scientific consensus on the ideal duration of a work-based nap (Slanger et al, 2016).

Limitations

Owing to the design of this study, the authors were not able to control for confounders such as daytime sleep or administration of potent psychoactive compounds (e.g. coffee). The measure of reaction time was selected to be minimally intrusive; as the effects of sleep deprivation are cumulative and compounded by prolonged focus, alternative measures of reaction time and concentration may have yielded different results.

Recommendations

Awareness of fatigue is crucial for patient and doctor safety and the authors therefore advocate a protected rest period when on call overnight. This could be achieved by several means: asking a colleague to cover while resting, in exchange for reciprocal cover to allow them to take a break, or by asking hospital-at-night coordinators to delay all non-emergency bleeps for a 30-minute period, if this is feasible.

If doctors have a drive ahead after a night shift, they should consider carefully whether they are safe to be behind the wheel; a cup of coffee (150 mg caffeine) and a 15-minute nap taken together have been shown to be extremely effective in reducing sleepiness and fatigue-related driving incidents (Reyner and Horne, 1997).

Working the night shift takes a toll on all health-care workers, but night shifts are essential for good patient care and safety; to ensure that this, as well as health-care workers' own safety, is maintained to the highest standard, it is vital to learn how to adapt to the night shift. In 2006 Horrocks and Pounder, via the Royal College of Physicians, issued evidence-based guidance for junior doctors on preparing, surviving and recovering from night shifts. The authors highly recommend it. **BJHM**

Conflict of interest: none.

KEY POINTS

- Fatigue and subsequent 'burn-out' are becoming an increasing risk to junior doctors working within a stretched health-care system in the UK.
- Current rota models often make achieving recommended rest patterns extremely difficult, especially during on-call and night shifts.
- Awareness of fatigue and sleep-deprivation are essential to make sure health-care workers' own health and wellbeing is protected.

Åkerstedt T, Peters B, Anund A, Kecklund G (2005) Impaired alertness and performance driving home from the night shift: a driving simulator study. *J Sleep Res* **14**(1): 17–20. https://doi.org/10.1111/j.1365-2869.2004.00437.x

Åkerstedt T, Wright KP Jr (2009) Sleep loss and fatigue in shift work and shift work disorder. *Sleep Med Clin* **4**(2): 257–271. https://doi.org/10.1016/j.jsmc.2009.03.001

Brown M, Tucker P, Rapport F, Hutchings H, Dahlgren A, Davies G, Ebden P (2010) The impact of shift patterns on junior doctors perceptions of fatigue, training, work/life balance and the role of social support. *Qual Saf Health Care* **19**(6): e36. https://doi.org/10.1136/qshc.2008.030734

Eastridge BJ, Hamilton EC, O'Keefe GE et al (2003) Effect of sleep deprivation on the performance of simulated laparoscopic surgical skill. *Am J Surg* **186**(2): 169–174. https://doi.org/10.1016/S0002-9610(03)00183-1

Folkard S, Tucker P (2003) Shift work, safety and productivity. *Occup Med (Chic Ill)* **53**(2): 95–101. https://doi.org/10.1093/occmed/kqg047

Friedman RC, Bigger JT, Kornfeld DS (1971) The intern and sleep loss. *N Engl J Med* **285**(4): 201–203. https://doi.org/10.1056/NEJM197107222850405

General Medical Council (2016) General Medical Council National Training Survey. www.gmc-uk.org/National_training_survey_2016___key_findings_68462938.pdf (accessed 26 January 2018)

Grantcharov TP, Bardram L, Funch-Jensen P, Rosenberg J (2001) Laparoscopic performance after one night on call in a surgical department: prospective study. *BMJ* **323**(7323): 1222–1223. https://doi.org/10.1136/bmj.323.7323.1222

Hilditch CJ, Centofanti SA, Dorrian J, Banks S (2016) A 30-Minute, but not a 10-minute nighttime nap is associated with sleep inertia. *Sleep* **39**(3): 675–685. https://doi.org/10.5665/sleep.5550

Hilditch CJ, Dorrian J, Banks S (2017) A review of short naps and sleep inertia: do naps of 30 min or less really avoid sleep inertia and slow-wave sleep? *Sleep Med* **32**: 176–190. https://doi.org/10.1016/j.sleep.2016.12.016

Hobson J (2004) Shift work and doctors' health. *Student BMJ* **12**: 393–436.

Horne J, Reyner L (1999) Vehicle accidents related to sleep: a review. *Occup Environ Med* **56**(5): 289–294. https://doi.org/10.1136/oem.56.5.289

Horrocks N, Pounder R (2006) Working the night shift: preparation, survival and recovery. A guide for junior doctors. https://shop.rcplondon.ac.uk/products/working-the-night-shift-preparation-survival-and-recovery (accessed 26 January 2018)

Jackson EJ, Moreton A (2013) Safety during night shifts: a cross-sectional survey of junior doctors preparation and practice. *BMJ Open* **3**(9): e003567. https://doi.org/10.1136/bmjopen-2013-003567

Krishnaswamy U, Chhabria M, Rao A (2016) Excessive sleepiness, sleep hygiene, and coping strategies among night bus drivers: A cross-sectional study. *Indian Journal of Occupational and Environmental Medicine* **20**(2): 84–87. https://doi.org/10.4103/0019-5278.197526

Lamond N, Dawson D (1999) Quantifying the performance impairment associated with fatigue. *J Sleep Res* **8**(4): 255–262. https://doi.org/10.1046/j.1365-2869.1999.00167.x

Landrigan CP, Rothschild JM, Cronin JW et al (2004) Effect of reducing interns work hours on serious medical errors in intensive care units. *N Engl J Med* **351**(18): 1838–1848. https://doi.org/10.1056/NEJMoa041406

McClelland L, Holland J, Lomas JP, Redfern N, Plunkett E (2017) A national survey of the

effects of fatigue on trainees in anaesthesia in the UK. *Anaesthesia* **72**(9): 1069–1077. https://doi.org/10.1111/anae.13965
Morrow G, Burford B, Carter M, Illing J (2014) Have restricted working hours reduced junior doctors experience of fatigue? A focus group and telephone interview study. *BMJ Open* **4**(3): e004222. https://doi.org/10.1136/bmjopen-2013-004222
Naithoh P (1992) Minimum sleep to maintain performance: the search for sleep quantum in sustained operations. In: Stampi C, ed. *Why we nap*. Birkhäuser, Boston: 199–216.
NHS Employers (2016) Terms and Conditions of Service for NHS Doctors and Dentists in Training 2016. http://www.nhsemployers.org/-/media/Employers/Documents/Need-to-know/Junior-doctors-terms-and-conditions-of-service-May-2016---changes-to-para-references-only.pdf (accessed 20 February 2018)
Pilcher JJ, Huffcutt AI (1996) Effects of sleep deprivation on performance: a meta-analysis. *Sleep* **19**(4): 318–326. https://doi.org/10.1093/sleep/19.4.318
Reyner LA, Horne JA (1997) Suppression of sleepiness in drivers: combination of caffeine with a short nap. *Psychophysiology* **34**(6): 721–725. https://doi.org/10.1111/j.1469-8986.1997.tb02148.x
Sallinen M, Kecklund G (2010) Shift work, sleep, and sleepiness - differences between shift schedules and systems. *Scand J Work Environ Health* **36**(2): 121–133. https://doi.org/10.5271/sjweh.2900
Saxena AD, George CFP (2005) Sleep and motor performance in on-call internal medicine residents. *Sleep* **28**(11): 1386–1391. https://doi.org/10.1093/sleep/28.11.1386
Slanger TE, Gross JV, Pinger A et al (2016) Person-directed, non-pharmacological interventions for sleepiness at work and sleep disturbances caused by shift work. *Cochrane Database Syst Rev* (8): CD010641. https://doi.org/10.1002/14651858.CD010641.pub2
Steele MT, Ma OJ, Watson WA, Thomas HA Jr, Muelleman RL (1999) The occupational risk of motor vehicle collisions for emergency medicine residents. *Acad Emerg Med* **6**(10): 1050–1053. https://doi.org/10.1111/j.1553-2712.1999.tb01191.x
Taffinder NJ, McManus IC, Gul Y, Russell RCG, Darzi A (1998) Effect of sleep deprivation on surgeons dexterity on laparoscopy simulator. *Lancet* **352**(9135): 1191. https://doi.org/10.1016/S0140-6736(98)00034-8
Williamson AM, Feyer AM (2000) Moderate sleep deprivation produces impairments in cognitive and motor performance equivalent to legally prescribed levels of alcohol intoxication. *Occup Environ Med* **57**(10): 649–655. https://doi.org/10.1136/oem.57.10.649