ABSTRACT

BACKGROUND: Shift work is recognised as a component of work organisation that may affect the balance between employee’s efficiency, effectiveness and wellbeing. Shift work is frequent in healthcare and for nurses in particular, as they typically comprise a large proportion of the workforce in healthcare

AIM: To identify the characteristics of shift work that have an effect on employee’s performance (including job performance, productivity, safety, quality of care delivered, errors, adverse events and client satisfaction) and wellbeing (including burnout, job satisfaction, absenteeism, intention to leave the job) in all sectors including healthcare

METHODS: A search of electronic databases (CINAHL, MEDLINE, PsychINFO, SCOPUS) to identify primary quantitative studies was conducted between January and March 2015. Studies were drawn from all occupational sectors (i.e. health and non health), meeting the inclusion criteria: involved participants aged ≥18 who have been working shifts or serve as control group for others working shifts, exploring the association of characteristics of shift work with at least one of the selected outcomes. Reference lists from retrieved studies were checked to identify any further studies

RESULTS: 35 studies were included in the review; 25 studies were performed in the health sector. A variety of shift work characteristics are associated with compromised employee’s performance and wellbeing. Findings from large multicentre studies highlight that shifts of 12 hours or longer are associated with jeopardised outcomes. Working more than 40 hours per week is associated with adverse events, while no conclusive evidence was found regarding working a ‘Compressed Working Week’; working overtime was associated with decreased job performance. Working rotating shifts was associated with worse job performance outcomes, whilst fixed night shifts appeared to enable resynchronisation. However, job satisfaction of employees working fixed nights was reduced. Timely breaks had a positive impact on employee fatigue and alertness, whilst quick returns between shifts appeared to increase pathologic fatigue. The effect of shift work characteristics on outcomes in the studies reviewed is consistent across occupational sectors

CONCLUSIONS: This review highlighted the complexity that encompasses shift work, but many studies do not account for this complexity. While some consistent associations emerge (e.g. 12 hour shifts and jeopardised outcomes), it is not always possible to conclude that results are not confounded by unmeasured factors

Key words:

Shift work

Shift length

Quality of Health Care

Patient Safety

Job performance

Job satisfaction

Burnout, Professional

Absenteeism

Personnel Turnover

INTRODUCTION

Employers worldwide are constantly challenged to organise the healthcare workforce effectively, so that employees can deliver high quality services that respond to the needs and expectations of their clients (Curson et al. 2010) within limited budgets. In this search for effectiveness (and cost-effectiveness), the centrality of employee well-being and organizational factors has been recognized in healthcare (Michie and West 2004), where there is evidence of employees’ impaired psychological wellbeing playing mediating roles between work environment and poor job outcomes, including the delivery of poor quality care (Van Bogaert et al. 2013).

A component of the work organisation that may affect the balance between efficiency and wellbeing is shift work; healthcare work is characterised by 24-hour operations, so that drawing upon shift work is common for several nursing services. The challenge to provide 24-hour services is not unique to healthcare, since other occupational sectors such as police, transport and power provision industries have to adopt shift work on a regular basis.

Shift work refers to a wide variety of working time arrangements, including all working hours that are outside the normal daytime ones (Knutsson 2004). Shift systems can be organised in different ways, depending on how several components are set, including shift length, rest breaks and consecutive shifts (Folkard et al. 2007), which may consequently lead to a different impact on employee’s performance and wellbeing.

The variability in the organisation of shift work in nursing specifically has been described in large European studies, including the RN4CAST (Griffiths et al. 2014) and NEXT (Estryn-Behar et al. 2012) studies. Due to this variability in shift work, previous research aimed to describe favourable shift patterns using an aggregate of acceptable shift characteristics and averted strong conclusions about the implementation of “ideal” shift systems.

Previous reviews have considered the effect of single shift characteristics on adverse outcomes, including the effect of 12 hour shifts on patient safety (Bae and Fabry 2014; Clendon and Gibbons 2015; Harris et al. 2015) and job satisfaction (Estabrooks et al. 2009), the association of extended hours and fatigue (Harrington 2001) and safety (Wagstaff and Sigstad Lie 2011). These reviews have largely contributed to expand the evidence on individual components of shift work, however, up to date no synthesis of all these shift characteristics has been produced. Therefore, the aim of this review is to identify evidence for the characteristics of shift work that have an effect on employee’s performance and wellbeing, drawing on literature from all sectors.

DESIGN

We referred to the framework outlined by Arskey and O’Malley to conduct a scoping review, aiming to summarise existing empirical evidence and to identify gaps in research on shift work (Arksey and O'Malley 2005). Scoping studies do not systematically assess the quality of included studies; however a narrative comment is provided in the discussion section.

METHODS

The main literature search was performed between January and March 2015. A number of industries beyond the healthcare sector that have opted to implement shift work, therefore, in order to achieve a comprehensive understanding of the topic, our review encompassed occupational contexts beyond healthcare.

The outcome measures of interest in this review are indicators of employee’s performance (including job performance, productivity, safety, quality of care delivered, errors, adverse events and client satisfaction) and of employee’s wellbeing (including burnout, job satisfaction, absenteeism, intention to leave the job).

We included studies published in the English language that met all of the following criteria: participants aged >18, are or have been working shifts or serve as control group for others working shifts; the study is a primary study, has quantitative design and explores the association of characteristics of shift work and at least one of the selected outcomes (including job performance, productivity, safety, quality of care delivered, errors, adverse events and client satisfaction; burnout, job satisfaction, absenteeism, intention to leave the job). Reviews, editorials, notes, letters, and case reports were not included. No limits were put on the date of included research, in order to ensure that the review of research was as comprehensive as possible.

Data Sources

We searched Medline (Ovid), Cinahl (EBSCO), PsycInfo (EBSCO), Scopus, Cochrane Library using the following terms (title, abstract, key words): “shift work”, “work schedule”, “shift pattern” “shift length”, “shift or schedule”, “safety”, “error”, “satisfaction”, burnout”, “quality”, “performance”, “efficiency”, “stress”. We also searched related index terms (Table 1).

The following data were extracted from included studies: Occupational Context; Country; Sample Size; Study Design; Shift Characteristic studied; Outcome Measures; Relevant Results.

RESULTS

13975 records were retrieved from the database searches. The titles and abstracts were screened and 13693 studies were rapidly excluded, while 282 papers were identified as potentially relevant, (i.e. directly addressing the effect of shift work on one or more relevant outcomes) and the full text was accessed. References of the 282 papers were checked to identify any additional articles: this resulted in the addition of further three papers. After reading the full text, 250 papers were excluded, due to lack of explicit methodology, and 35 papers were included in the final review. Figure 1 reports the flow chart of the study selection.

The 35 studies explored a variety of shift-work characteristics including shift length, weekly hours and compressed working week, overtime working, night work and fixed/rotating shifts, rest and break opportunity as organisational characteristics of shift work that have an impact on employee performance and wellbeing.

The included studies were published between 1988 and 2014. The majority of the studies (n = 24) were published in the last decade, with 11 published more than one decade ago. Most of the studies were conducted in the United States/Canada region (n=21), 3 in Central Europe, 3 in the United Kingdom, 3 in Northern Europe, 3 in Asia and 2 in Australia. The majority of the studies related to the healthcare sector (n=25), predominantly in nursing (n=21); other industries were chemical/electrical (n=3), police (n=2), mining (n=1), transport (n=1), automotive (n=1), manufacturing (n=1) and one study covered multiple occupational contexts.

The majority of the studies had a cross-sectional design (n=23), 5 were experimental, 2 descriptive observational, 2 case-control, 2 longitudinal and 1 was retrospective. The sample size ranged from 12 to 31,627.

Results are reported by shift work characteristics and their association with the selected outcomes, namely: job performance, productivity, safety, quality of care delivered, errors, adverse events and client satisfaction; burnout, job satisfaction, absenteeism, intention to leave the job. We extracted meaningful parameters indicating the size of effect; where these were not available, only statistical significance is reported (with exact p value if given). All studies are summarised in table 2, table 3 and table 4. Table 2 presents studies regarding the association of work hours factors and outcomes within the health sector, while table 3 covers those from other occupational sectors. Table 4 summarises results of studies regarding the association of fixed/rotating shifts, night shifts and rest opportunities and the selected outcomes.

1. SHIFT LENGTH

Overall, we found 17 studies regarding the association of shift length and outcomes of interest. Of these, 15 studied job performance and 11 examined employee wellbeing (total number does not sum up to 17 because some of these studies were exploring both job performance and employee wellbeing).

* 1. SHIFT LENGTH AND JOB PERFORMANCE

Most studies exploring the effect of shift length on job performance focussed on the comparison between 8 and 12 hour shifts; none of the studies found an improvement in job performance after the introduction of 12 hour shifts or when employees work 12 hour shifts, compared to those working 8 hour shifts.

A single before and after study found no statistically significant impact on job performance, following the introduction of 12 hour shifts among 41 underground miners in Canada (mean differences not reported) (Duchon et al. 1994). A study from the USA aimed to identify changes in cognitive performance due to different shift lengths working either 12 or 24 hours shifts. This cross sectional study was carried out within 34 air medical providers and the results indicated no difference (mean differences not reported) in cognitive performance; however, air medical providers working 24 hour shifts were able to sleep on average 6.8 hours during the shift, whereas those working 12 hours slept on average 1 hour on shift (Guyette et al. 2013). A cross-sectional study carried out with 745 nurses from different nursing organisations found a link between shift length and fatigue, and between fatigue and job performance. Nurses’ shifts of 9-12 hours were associated with higher levels of physical fatigue (p < 0.001), and higher levels of acute fatigue (p < 0.001), and fatigue levels were negatively correlated with performance (Barker and Nussbaum 2011).

Two studies aimed specifically to evaluate the association between shift length and alertness, vigilance and fatigue. One reported no significant change, whilst the other found a reduction in alertness when employees work 12 hours shifts. A cross-sectional study of 162 chemical workers, reported that when employees worked 12 hour shifts, their fatigue and mean alertness levels did not differ significantly from employees working 8 hours shifts (Tucker et al. 1996). Scott and colleagues performed a cross-sectional study on 502 critical care nurses, recruited randomly from the American Association of Critical Care Nurses, in order to explore whether long hours affect nurses’ vigilance. Nurses who worked more than 12.5 hours were more likely to struggle to stay awake at work (OR =1.5, p=0.007), and were twice as likely to report risking to make an error (OR = 1.94, p = 0.03) compared to those who worked fewer hours (Scott et al. 2006).

The evidence regarding the association of shift length and safety and errors/adverse events is consistent as regards the detrimental effect that long shifts have.

104 employees working either 8 or 12 hour shifts at different nuclear power plants were included in a retrospective observational study, and were tested for several safety outcome measures: no difference was found in safety system failures, but a significant increase in operator error was reported (R2 = 0.20, p<0.05) (Baker et al. 1994). Similarly, a study in an electrical plant reported an increase in the mean number of errors on a standardised test following the introduction of 12 hours shifts. Authors reported a 30% increase in errors made after a 12 hour day shift, compared to a eight hour day shift and a 50% increase after a 12 hour night shift, compared to a eight hour night shift (p<0.02). A possible explanation provided for the increased error rate was an increase in fatigue experienced by the employee at the end of the working day (Mitchell and Williamson 2000). A study performed in the healthcare sector, comprising 1092 patient records and 1159 staff, reported a similar association: a mean ward-level working hours of more than 8 hours and 45 minutes was associated with nearly 3 times higher infection risk, compared to a mean ward-level working of ≤ 8 hours and 45 minutes (OR= 2.74, 95% CI: 1.07-7.04) (Virtanen et al. 2009). Lastly, when 393 nurses from a single hospital, sampled for a cross-sectional study, worked 12.5 hours or more, they were more likely to report making a medication error, when compared to their peers working 8 hour shifts (OR = 3.29, p = 0.001) (Rogers et al. 2004).

As far as quality of care is concerned, contrasting results were derived from four nursing studies. A single small descriptive exploratory study sought to evaluate the nurses’ perceptions in a hospital unit after the introduction of 12 hour shifts. Twelve nurses agreed to participate in the study, six of which expressed no perceived change in the quality of nursing care they provided, while six nurses agreed or strongly agreed it had improved (Dwyer et al. 2007). However, the questionnaire to evaluate 12 hour shifts was distributed at a single point in time, just 3 months after the new shift pattern had been implemented, and the small sample size prevents any generalizability. A further cross-sectional study of 805 nurses from 13 hospitals found no difference in nurse reported quality of care for nurses working 8 and 12 hour shifts (OR= 1.35, 95% CI= 0.79-2.29) (Stone et al. 2006). By contrast, a study performed in 12 European countries on a large sample of hospital nurses (n= 31,627) concluded that 12 hour shifts are detrimental for quality of care, patient safety and missed care, as reported by nurses. A full report of ORs and 95% CIs for these associations is available in table 2; however the odds of nurses working 12 or more hours and reporting adverse patient outcomes were increased in a range of 30-41%, in comparison with nurses working 8 hours or less (Griffiths et al. 2014). Three large studies from the US (sample size ranging from 3,710 to 22,275 nurses), performed in different hospitals and settings, explored the association of long shifts and quality of care, patient safety and patient dissatisfaction. They concluded that all these outcomes were negatively affected when nurses worked shifts of 13 hours or longer (ORs and 95% CIs are available at table 2) (Stimpfel et al. 2012; Stimpfel and Aiken 2013; Stimpfel et al. 2013).

1.2 SHIFT LENGTH, JOB SATISFACTION AND PSYCHOLOGICAL WELLBEING

The evidence regarding the impact of length of shifts on employee outcomes, including job satisfaction, burnout, and psychological wellbeing, satisfaction with schedule and employee morale is mixed.

Working 12 or 8 hour shifts did not appear to influence 162 chemical plant employees’ psychological wellbeing, in terms of job satisfaction and attitudes towards shift work (Tucker et al. 1996). Studies of small samples of workers (sample size ranging from 12 to 41) testing the impact of the introduction of 12 hour shifts on employees’ satisfaction with schedule concluded that staff largely prefer longer shifts and wanted to retain them (Duchon et al. 1994; Mitchell and Williamson 2000; Dwyer et al. 2007). However a similar study with 162 nurses reported the opposite result, namely, after the introduction of 12 hour shifts, nurses were more dissatisfied with their job (p < 0.0001) (Todd et al. 1993). A further cross sectional study of 805 nurses from 13 hospitals, comparing job satisfaction and burnout among nurses working 8 or 12 hour shifts, reported that those working 12 hour shifts were more likely to be satisfied with their job (β = 1.05, p = 0.025) and to experience less burnout, with a reduction of 5.9 points on the emotional exhaustion scale (p<0.001) (Stone et al. 2006). However, a large-scale study from Europe (n = 25,924 nurses) indicated that working 12 hour shifts was associated with higher burnout scores (OR = 1.34; 95% CI= 1.00-1.78), in comparison with working 8 hours or less (Estryn-Behar et al. 2012).

Two large cross sectional studies (sample size respectively 22,275 nurses and 3,710 nurses) from the US indicated that when nurses are working 13 hour shifts or longer, the odds for them reporting job dissatisfaction and burnout were higher than for those working 8 hours, with ORs ranging from 2.02 to 2.73 (full reports of ORs and 95% CIs are available at table 2) (Stimpfel et al. 2012; Stimpfel et al. 2013).

Three studies explored absenteeism and intention to leave with conflicting results. Stone and colleagues reported that, after having introduced 12 hour shifts, 805 nurses were less likely to report missing shifts (OR= 0.42, 95% CI=0.29-0.60) (Stone et al. 2006). In contrast, two multistate large cross sectional studies (sample size respectively 22,275 nurses and 3,710 nurses) by Stimpfel and colleagues, indicated that nurses were more likely to report intention to leave when they worked ≥ 12 hour shifts (Stimpfel et al. 2012; Stimpfel et al. 2013).

In summary, there is insufficient evidence to conclusively say that 12 hour shifts are safe and lead to more productivity. Large multi-site healthcare studies report that working 12 hour shifts are associated with decreased quality of care, patient safety and increased rates of errors. Results are conflicting as regards employees’ job satisfaction and wellbeing, with some small-scale studies reporting increased job satisfaction for employees working 12 h shifts; these results are contrasted by larger studies, which conclude that 12 h shifts are associated with higher rates of burnout, job dissatisfaction and intention to leave.

2. WEEKLY HOURS OF WORK

Two recent cross-sectional studies regarding the effect of weekly hours of work and job performance and wellbeing were included. Olds and colleagues’ work aimed at examining the relationship between nurses’ weekly work hours and self-reported adverse events and errors. Overall 11,516 nurses from the US were included in the sample. The results indicate that the likelihood of observing or experiencing occasional or frequent (versus never or rare) adverse events such as patient falls with injury, nosocomial infections and medication errors was increased respectively by 17%, 14% and 28% when nurses worked 40 or more hours per week, compared to working less than 40 hours per week (Olds and Clarke 2010). After fitting multiple regression models separated by sex of a large sample deriving from a health survey, comprising overall 7,103 workers, Artazcoz and colleagues concluded that in men, working 51-60 hours per week was associated with job dissatisfaction (aOR= 2.05; 95% CI= 1.49-2.82), in comparison with those working 30-40 hours per week (Artazcoz et al. 2009).

We conclude that there is limited evidence on the association of weekly hours and job performance and wellbeing; however, studies we reviewed concluded that more than 40 weekly hours of shift work may have a negative impact on employee’s performance and job satisfaction.

3. COMPRESSED WORKING WEEK

The compressed working week is a type of work schedule in which the hours worked per day are extended, whilst the days worked are reduced, so that the standard number of weekly hours are worked in fewer days (Bambra et al. 2008). This shift organisation links together two features that have already been presented in our review: shift length and weekly hours. It appears rather intuitive that long shift lengths themselves might or might not lead to negative consequences, while detrimental outcomes might start to emerge only when long shifts are worked and weekly hours are increased. The vast majority of studies described focussed on either shift length or weekly hours; few looked at both characteristics simultaneously, making it difficult to discern whether there is an interaction between the two. The only exception was a study that included full time/part time status as a control variable, which takes some account of the weekly hours worked (Griffiths et al. 2014).

Three studies regarding compressed working week were identified, two of which were performed as experiments within the police sector. The oldest study, comprising a sample of 105 patrol officers, sought to describe the attitudinal and productivity effects of using a ‘three 13-hour shifts per week’ schedule. Patrol officers perceived the compressed working week as beneficial for them, in terms of personal life and work performance, however, objective measures found that there was no change in productivity after the introduction of the compressed working week (Vega and Gilbert 1997). A similar study, a randomised block experimental study on 231 police officers, evaluated the impact of different work schedule organisations (8 hours/5 days vs 10 hours/4 days vs 12 hour/3 days + 18 hour day every other week) on performance and fatigue and reported no significant differences. However, when police officers worked the 12 hour shift/3 days schedule, they were more likely to report a significantly lower average level of alertness (mean=6.11) than the average alertness levels among officers on the 8 hour shift/5 days schedule (mean=6.74, p=.012), but not the 10 hours shift/4 day schedule (mean=6.31, p=ns) (Amendola et al. 2011).

In the nursing sector, a cross sectional study of 520 subjects, sampled through a nursing association, analysed the effect of the compressed working week (either 3 or 4 11-hour shifts per week compared to 5 days of 7.5 hour shifts) on the perceived quality of care provided to hospital patients and dissatisfaction with schedules, noting that negative associations were found only when the compressed working week was performed with rotating shifts (p<0.01) (Havlovic et al. 2002). A rotating schedule indicates that the employee rotates between day and night shifts.

Overall, these studies on the effects of the compressed working week provide mixed results. In terms of job performance, there do not seem to be any objective improvements after introducing the compressed working week, while some decrements in alertness have been reported.

1. OVERTIME

Working overtime is a shift characteristic intertwined with both shift length and weekly hours. For this reason, a frequent shortcoming in previous research has been the inability to analyse separately overtime working and long shifts, leading to uncertain results as to whether negative effects should be attributed to scheduled long hours or long hours resulting from overtime.

Overall, four studies have reported an effect for overtime working and job performance. A large cross sectional study of 31,627 nurses from 12 European countries found an association between working overtime on a shift and increased likelihood of nurses reporting poor quality of care (OR=1.32, 95% CI = 1.23-1.42), poor patient safety (OR = 1.67, 95% CI = 1.51-1.86) and higher rates of missed care (tasks not completed during last shift due to lack of time) (RR = 1.29, 95% CI = 1.27-1.31) (Griffiths et al. 2014). Two further studies exploring the impact of overtime on errors were produced within the nursing field. The cross sectional study from Rogers and colleagues reported increased odds of making at least one error when the 393 nurses were working overtime (OR=2.06, p <0.0005) (Rogers et al. 2004). Results from the other study, using a cross sectional design on 11,516 nurses, highlight that voluntary paid overtime was associated with self-reported medication errors both as a linear trend and with a cut point of regular voluntary paid overtime of 4 hours or more in the average work week (OR= 1.30, 95% CI = 1.11-1.53) (Olds and Clarke 2010). A cross sectional study of 206 automotive workers found that overtime work resulted in decreased cognitive function, measured by a set of neuropsychological tests, in the areas of attention and executive function (p<0.05) (Proctor et al. 1996).

In summary, studies indicate that there is a relationship between overtime working and increased likelihood of making errors, of having reduced cognitive function and of reporting poor quality of care, patient safety and higher rates of missed care.

1. NIGHT WORK AND FIXED/ROTATING SHIFTS

We report the results for night work and fixed/rotating shifts together because these two shift characteristics are linked to one another: studies in the literature come to different conclusions regarding night work, according to the presence or absence of rotation. It appears that the majority of the studies produced so far have not investigated night work per se; the focus is more often on the interaction between time of the day and whether night work is undertaken as part of a fixed schedule or if the employee rotates between day and night shifts. The rationale for this association is mainly that adaptation to night work tends to happen within one or two weeks of continuous night work (Fossum et al. 2013), leading to resynchronisation (Wagstaff and Sigstad Lie 2011). Therefore, sleepiness, fatigue, and decreased alertness are more likely to be present when employees work rotating shifts, because adaptation to working nights might not occur.

Eight studies investigating night work and/or fixed/rotating shifts were included. An experimental study carried out on 62 nurses in a single hospital in Taiwan explored the effect of schedules that involved consecutive night shifts; nurses were randomly assigned to groups working 2, 3 or 4 consecutive night shifts, with the purpose to test cognitive performance at the end of each shift. Subjects working 2 consecutive nights had poorer perceptual and motor ability (components of cognitive performance), when compared to those working 4 consecutive nights (p< 0.05) (Chang et al. 2011). When 463 nurses were surveyed to assess the relationship between type of schedule and job performance, measured with the Six-Dimension Scale of Nursing Performance, the results indicated that job performance was highest for nurses working fixed day shifts, while it was worst for those working rotating shifts (p< 0.0001) (Coffey et al. 1988). Similar results are reported from a randomised prospective study of 62 nurses in a medical centre: the error rate on a standard test for night shift workers in the rotating shift group was 44% higher (p < 0.001) than that of fixed day shift workers (Niu et al. 2013).

A cross sectional study explored the interaction between being sleep deprived (defined by a nurse reporting needing more continuous sleep to feel rested than obtained during the past 24 hours) and working the night shift and the effect this has on patient errors. The results indicate that 56% of 289 nurses in the sample were sleep deprived. Sleep-deprived nurses reported a higher mean number of patient care errors than non sleep-deprived nurses did (F =7.9; df = 1, 218; p = 0.005); moreover, an increase of 1 hour of sleep reduced the estimated odds for 1 or more patient care errors by 25% (Johnson et al. 2014).

As regards fatigue, the results from a cross-sectional study of 58 nurses working 3 consecutive 12 hour shifts, either on fixed nights (41%) or routinely rotating shifts (23%), highlight that nurses on rotating shifts had higher levels of acute fatigue (measured through the OFER scale) compared to those on fixed shifts (p<0.04) (Han et al. 2014). A secondary analysis of data from 819 emergency medics who were asked to report the status of night shift work and the effects they believed it had on fatigue shows that 36% of the sample believed that night work had an impact on their fatigue levels (Smith-Coggins et al. 2014).

The number of years of night shift work does not seem to have had an effect on shift work tolerance (the ability to adapt to shift work without adverse consequences). When 749 nurses were divided in two groups, one who had worked night shifts for less than a year and one who had worked night shifts for more than 6 years, no differences in shift work tolerance, described as the ability to work shifts without experiencing negative consequences thereof, including fatigue, were found (Saksvik-Lehouillier et al. 2013).

A study involving a sample of 376 healthcare workers highlights that permanent night workers (19% of the sample) were the most likely to report job dissatisfaction (p<0.05) and absenteeism (p <0.05), compared to all other workers (Burch et al. 2009).

From this evidence, we conclude that there is evidence of the association of night work and disrupted performance when night work is performed as part of a rotating shift schedule. Results also suggest that working patterns of fixed night shifts is associated with increased job dissatisfaction.

1. REST AND BREAKS OPPORTUNITIES

Four studies from diverse occupational groups reported on rest opportunities, mainly between shifts but also within shifts as significant characteristics affecting fatigue and accidents.

A case-control study compared 136 concerning crash cases and 271 non-crash cases among truck drivers. These two groups were compared to assess whether they had different exposure to number of rest breaks and rest-break duration. Results indicated that in a 10 hour trip, taking 1 or 2 breaks of 30 minutes reduced accident risk; having long off-duty times (>11 hours) before undertaking a trip was not effective in reducing crash risk (Chen and Xie 2014).

A cross-sectional study in the manufacturing sector investigated whether introducing a > 24 hour off-duty time between blocks of day and night shifts could have a beneficial effect on fatigue and alertness. Results indicate that having such time off within shifts was associated with higher means of alertness (unadjusted means: 6.40 for off-duty time of > 24 hours and 6.15 for no off-duty time) and lower means of fatigue (unadjusted means: 2.62 for off-duty time of > 24 hours and 2.75 for no off-duty time) than having no such off-duty time (Tucker et al. 1999).

A longitudinal study of 1224 nurses explored the impact of having quick returns (<11 hours between shifts) on fatigue levels at baseline (T1) and after one year (T2): the annual number of quick returns at T1 predicted the occurrence of pathological fatigue (OR=1.01, 95% CI 1.00 to 1.01) at T2 (Flo et al. 2014).

Wisetborisut and colleagues aimed to explore the association between burnout and number of days off within a sample of 2,772 healthcare workers in a single hospital. They indicate that having at least 8 days off per month is associated with lower odds of burnout, compared to having fewer than 8 days off per month (OR = 0.6; 95% CI: 0.5-0.8)(Wisetborisut et al. 2014).

Overall, these studies of relationships between rest opportunities and outcomes suggest that taking breaks can impact positively on employee fatigue and alertness, while quick returns between shifts appear to be detrimental for pathologic fatigue.

DISCUSSION

This scoping review, set out to identify the characteristics of shift work that have an effect on employees’ job performance and wellbeing, included 35 papers overall. We found evidence of the association of six shift characteristics and employees’ job performance and wellbeing: shift length; weekly work hours; the compressed working week; overtime; night work/rotating or fixed shifts; and rest opportunities.

Shift length appears to be widely studied across occupational sectors, with some conflicting results reported. Overall, large scale and multi centre studies performed in the healthcare sector tend to report a negative effect of long shifts (≥ 12 hours) on employee’s performance and satisfaction, although some smaller studies report no difference in performance, but increased job satisfaction. However, it appears that these smaller studies have been frequently carried out in environments where employees had previously agreed on the introduction of 12 hour shifts and in the immediate aftermath of their introduction, thus being possibly biased by the so-called “honeymoon effect” (Peacock et al. 1983). Smith and colleagues agree that if employees perceive 12 hour shifts as beneficial, they may use greater effort to reduce any possible detrimental effects of increased fatigue (Smith et al. 1998). Studies reporting favourable findings for 12 hour shifts schedules included in this review were performed after a few months of introducing these long shifts; it may be worthwhile evaluating whether employees’ attitudes change in the longer term once the honeymoon effect is over.

Despite limited evidence regarding weekly hours, studies we reviewed concluded that more than 40 weekly hours of shift work may have a negative impact on employee’s performance and job satisfaction, suggesting a yet untested but plausible link between long weekly hours and increased fatigue, and between fatigue and adverse events/errors.

The studies on the effects of the compressed working week provided mixed results. However, every study included in the review provided a different operationalization of compressed working week, in terms of different number of hours and different number of days worked per week in each study, which may partially explain the different results. Due to European legislations, which set an upper limit to weekly working hours (Directive 2003/88/EC 2003), most of the studies on shift length probably included also a compressed working week. This would imply that when employees were working 12 hour shifts, they were also reducing the number of work days in the week, in order to maintain a set number of weekly hours. Nonetheless, only the three studies included in the review were explicitly mentioning the compressed working week, and we cannot assume that studies regarding 12 hour shifts were involving a compressed working week.

All the studies on overtime report an association between overtime working and impairments of job performance, in terms of increased likelihood of making errors, of having reduced cognitive function and of reporting poor quality of care, patient safety and higher rates of missed care. One study reported that voluntary paid overtime was also associated with increased odds of making errors, suggesting that despite staff having control and choice on the hours they work, extending work hours in order to increase income may not be an ideal strategy.

Night work is associated with disrupted performance and safety indicators when such shifts are done as part of a rotating shift schedule, suggesting that permanent night work could be a good strategy to reduce circadian misalignment (i.e. disruption of the endogenous circadian rhythm and the sleep-wake schedule). However, results from another study suggest that working fixed night shifts, despite offering adaptation to these shifts on a cumulative basis, can be associated with increased job dissatisfaction (Perrucci et al. 2007). Whether employees should work fixed or rotating shifts represents a controversial case as regards the balance between employee productivity, wellbeing and satisfaction. However, links between fatigue and safety and error have been previously identified (Williamson et al. 2011), so that we can hypothesise that fixed shift patterns may reduce error and represent a safer option. Despite the risk of decreased job satisfaction, fixed shift patterns could be a favourable solution for reducing error.

Studies regarding rest opportunities, deriving from both the health sector and other occupational sectors, suggest that timely breaks can impact positively on employee fatigue and alertness, and in particular quick returns between shifts appear to be detrimental for pathologic fatigue. However, none of these studies were able to capture the quality of the rest breaks, in terms of activities performed when having a break or a day off. This could be a crucial factor in determining fatigue levels (Folkard et al. 2007). Furthermore, none of these studies considered interactions of rest breaks with other shift characteristics; future research should address these gaps.

Our review highlighted that fatigue is a potential mediator between shift length and adverse outcomes (i.e. impairments in job performance and safety). For example, Barker and Nussbaum concluded that long working hours were associated with fatigue and that fatigue was associated with decreased job performance (Barker and Nussbaum 2011). This plausible link between shift work and fatigue and fatigue and decreased performance remains untested, and should be considered for future research.

Although some authors suggest that the impact of shift work characteristics on the outcomes is likely to be occupation specific (Ferguson and Dawson 2012), our results suggest that there is not a systematic difference by occupational sector. In this respect, associations of shift characteristics and outcomes in the healthcare sector were similar to those found in other occupational sectors. For example, the detrimental effect of shifts of 12 hours or longer on making errors was found both in the healthcare and in the nuclear sector. After the introduction of 12 hour shifts, job satisfaction appeared to increase in some of the nursing studies and in the electrical sector studies, while some nursing studies report that 12 hour shifts are associated with job dissatisfaction. However, the absence of industry specific effects may be due to the small number of studies from industries other than healthcare included in the review. Whilst overall associations may be similar regardless of occupational sector, it remains possible that there are different thresholds for the effect of long shifts on performance or wellbeing that are occupation specific.

Furthermore, it is possible that different operationalisations of the same variable (e.g. each of the three studies on compressed working week defined “compressed working week” in a different way) and different outcome measurements explain partly the variability in the findings.

Furthermore, there is a paucity of studies that examined or controlled for more than one shift characteristic at a time; no studies provided a comprehensive examination of all shift factors. However, shift work is better conceptualised as a complex interaction of factors, rather than a combination of linear characteristics (Ferguson and Dawson 2012). A more multivariate examination that takes account of the complex interplay of shift characteristics is needed to embrace entirely the complexity of shift work, in which the role of moderating/mediating factors remains unexplored.

LIMITATIONS

We found that six different shift characteristics are associated with employee’s performance and wellbeing; however, none of the included studies was able to control for all of these characteristics simultaneously. Our ability to draw firm conclusions about the effect of individual factors is also limited, owing to contrasting results; different measurements of outcomes and shift work factors; diverse populations and sample sizes.

Despite having developed a comprehensive search strategy and having drawn upon databases that were not specific to healthcare (e.g. SCOPUS), the majority of the studies found were in the healthcare sector. This limited our ability to explore the impact of shift work characteristics across different industries. Quality appraisal to determine the strength of studies according to methodological design is not part of a scoping review (Arksey and O'Malley 2005) and this limited our conclusions about the strength of the evidence.

CONCLUSIONS

This review identified the complexity of shift work and the numerous characteristics that are associated with difference in employee performance and wellbeing. To our knowledge, this multiplicity has not been captured by any single study so far. This complexity highlights the challenges faced by managers organising shift work in healthcare and researchers seeking to understand it. While recent focus has been on the length of the individual nursing shift, shift workers and their managers must also be mindful of other aspects of shift work including the total hours worked per week, overtime, shift rotation, night shifts and rest opportunities and the potential interaction between these factors. Introducing fixed shift patterns may represent an option to decrease employee circadian misalignment and improve safety. Managers should be cautious requesting nurses to work more than 40 hours per week, as this has shown to be associated with medication errors and patient falls with injuries and, therefore, could lead to patient safety issues (Olds and Clarke 2010). Some consistent associations have emerged in the research, such as the absence of any clear evidence for benefits of introducing 12 hour shift schedules. Not only this shift pattern has not been associated with improvements in job performance in any studies, but there is also evidence that it is associated with decreased job performance and poor safety outcomes.

However, it is still possible that these results are confounded by unmeasured factors including other aspects of shift work and working patterns. Future research should use techniques that can capture and explore the complexity of shift work considering shift patterns, total work hours and breaks between shifts and take into account intervening variables that may have an impact on employee’s performance and wellbeing.

**Funding:** The current research was funded by the National Institute for Health Research Collaboration for Leadership in Applied Health Research and Care (NIHR CLAHRC). The views expressed in this publication are those of the authors and not necessarily those of the NHS, the National Institute for Health Research or the Department of Health.

REFERENCES

Amendola KL, Weisburd D, Hamilton EE, Jones G and Slipka M (2011) An experimental study of compressed work schedules in policing: Advantages and disadvantages of various shift lengths. Journal of Experimental Criminology 7(4): 407-442

Arksey H and O'Malley L (2005) Scoping studies: towards a methodological framework. International Journal of Social Research Methodology 8(1): 19-32

Artazcoz L, Cortès I, Escribà-Agüir V, Cascant L and Villegas R (2009) Understanding the relationship of long working hours with health status and health-related behaviours. Journal of Epidemiology and Community Health 63(7): 521-527

Bae SH and Fabry D (2014) Assessing the relationships between nurse work hours/overtime and nurse and patient outcomes: systematic literature review. Nursing Outlook 62(2): 138-56

Baker K, Olson J and Morisseau D (1994) Work practices, fatigue, and nuclear power plant safety performance. Human Factors 36(2): 244-257

Bambra C, Whitehead M, Sowden A, Akers J and Petticrew M (2008) "A hard day's night?" The effects of Compressed Working Week interventions on the health and work-life balance of shift workers: a systematic review. Journal of Epidemiology & Community Health 62(9): 764-77

Barker LM and Nussbaum MA (2011) Fatigue, performance and the work environment: a survey of registered nurses. Journal of Advanced Nursing 67(6): 1370-1382

Burch JB, Tom J, Zhai Y, Criswell L, Leo E and Ogoussan K (2009) Shiftwork impacts and adaptation among health care workers. Occupational Medicine 59(3): 159-166

Chang YS, Wu YH, Hsu CY, Tang SH, Yang LL and Su SF (2011) Impairment of perceptual and motor abilities at the end of a night shift is greater in nurses working fast rotating shifts. Sleep Medicine 12(9): 866-869

Chen C and Xie Y (2014) The impacts of multiple rest-break periods on commercial truck driver's crash risk. Journal of Safety Research 48: 87-93

Clendon J and Gibbons V (2015) 12h shifts and rates of error among nurses: A systematic review. Int J Nurs Stud 52(7): 1231-1242

Coffey LC, Skipper Jr JK and Jung FD (1988) Nurses and shift work: effects on job performance and job-related stress. Journal of advanced nursing 13(2): 245-254

Curson JA, Dell ME, Wilson RA, Bosworth DL and Baldauf B (2010) Who does workforce planning well? Workforce review team rapid review summary. International journal of health care quality assurance 23(1): 110-9

Directive 2003/88/Ec:

Duchon JC, Keran CM and Smith TJ (1994) Extended workdays in an underground mine: A work performance analysis. Human Factors 36(2): 258-268

Dwyer T, Jamieson L, Moxham L, Austen D and Smith K (2007) Evaluation of the 12-hour Shift Trial in a Regional Intensive Care Unit. Journal of Nursing Management 15(7): 711-720

Estabrooks CA, Cummings GG, Olivo SA, Squires JE, Giblin C and Simpson N (2009) Effects of shift length on quality of patient care and health provider outcomes: systematic review. Quality & Safety in Health Care 18(3): 181-8

Estryn-Behar M, Van Der Heijden BI and Group NS (2012) Effects of extended work shifts on employee fatigue, health, satisfaction, work/family balance, and patient safety. Work 41 Suppl 1: 4283-90

Ferguson SA and Dawson D (2012) 12-h or 8-h shifts? It depends. Sleep Medicine Reviews 16(6): 519-28

Flo E, Pallesen S, Moen BE, Waage S and Bjorvatn B (2014) Short rest periods between work shifts predict sleep and health problems in nurses at 1-year follow-up. Occup Environ Med 71(8): 555-61

Folkard S, Robertson KA and Spencer MB (2007) A Fatigue/Risk Index to assess work schedules. Somnologie 11(3): 177-185

Fossum IN, Bjorvatn B, Waage S and Pallesen S (2013) Effects of shift and night work in the offshore petroleum industry: a systematic review. Industrial Health 51(5): 530-44

Griffiths P, Dall'ora C, Simon M, Ball J, Lindqvist R, Rafferty AM, Schoonhoven L, Tishelman C, Aiken LH (2014) Nurses' shift length and overtime working in 12 European countries: The association with perceived quality of care and patient safety. Medical Care 52(11): 975-981

Guyette FX, Morley JL, Weaver MD, Patterson PD and Hostler D (2013) The effect of shift length on fatigue and cognitive performance in air medical providers. Prehospital Emergency Care 17(1): 23-8

Han K, Trinkoff AM and Geiger-Brown J (2014) Factors associated with work-related fatigue and recovery in hospital nurses working 12-hour shifts. Workplace Health and Safety 62(10): 409-414

Harrington JM (2001) Health effects of shift work and extended hours of work. Occupational and Environmental Medicine 58(1): 68-72

Harris R, Sims S, Parr J and Davies N (2015) Impact of 12 h shift patterns in nursing: A scoping review. International Journal of Nursing Studies 52(2): 605-634

Havlovic SJ, Lau DC and Pinfield LT (2002) Repercussions of work schedule congruence among full-time, part-time, and contingent nurses. Health Care Management Review 27(4): 30-41

Johnson AL, Jung L, Brown KC, Weaver MT and Richards KC (2014) Sleep deprivation and error in nurses who work the night shift. Journal of Nursing Administration 44(1): 17-22

Knutsson A (2004) Methodological aspects of shift-work research. Chronobiology International 21(6): 1037-47

Michie S and West MA (2004) Managing people and performance: an evidence based framework applied to health service organizations. International Journal of Management Reviews 5-6(2): 91-111

Mitchell RJ and Williamson AM (2000) Evaluation of an 8 hour versus a 12 hour shift roster on employees at a power station. Applied Ergonomics 31(1): 83-93

Niu SF, Chu H, Chen CH, Chung MH, Chang YS, Liao YM and Chou KR (2013) A Comparison of the Effects of Fixed- and Rotating-Shift Schedules on Nursing Staff Attention Levels: A Randomized Trial. Biological Research for Nursing 15(4): 443-450

Olds DM and Clarke SP (2010) The effect of work hours on adverse events and errors in health care. Journal of Safety Research 41(2): 153-62

Peacock B, Glube R, Miller M and Clune P (1983) Police officers' responses to 8 and 12 hour shift schedules. Ergonomics 26(5): 479-93

Perrucci R, Macdermid S, King E, Tang C-Y, Brimeyer T, Ramadoss K, Kiser SJ and Swanberg J (2007) The significance of shift work: Current status and future directions. Journal of Family and Economic Issues 28(4): 600-617

Proctor SP, White RF, Robins TG, Echeverria D and Rocskay AZ (1996) Effect of overtime work on cognitive function in automotive workers. Scandinavian Journal of Work, Environment & Health 22(2): 124-32

Rogers AE, Hwang WT, Scott LD, Aiken LH and Dinges DF (2004) The working hours of hospital staff nurses and patient safety. Health Affairs 23(4): 202-12

Saksvik-Lehouillier I, Bjorvatn B, Hetland H, Sandal GM, Moen BE, Mageroy N, Akerstedt T and Pallesen S (2013) Individual, situational and lifestyle factors related to shift work tolerance among nurses who are new to and experienced in night work. Journal of Advanced Nursing 69(5): 1136-46

Scott LD, Rogers AE, Hwang WT and Zhang Y (2006) Effects of critical care nurses' work hours on vigilance and patients' safety. American Journal of Critical Care 15(1): 30-37

Smith-Coggins R, Broderick KB and Marco CA (2014) Night shifts in emergency medicine: The American Board of Emergency Medicine Longitudinal Study of Emergency Physicians. Journal of Emergency Medicine 47(3): 372-378

Smith L, Folkard S, Tucker P and Macdonald I (1998) Work shift duration: a review comparing eight hour and 12 hour shift systems. Occupational & Environmental Medicine 55(4): 217-29

Stimpfel AW and Aiken LH (2013) Hospital staff nurses' shift length associated with safety and quality of care. Journal of Nursing Care Quality 28(2): 122-129

Stimpfel AW, Lake ET, Barton S, Gorman KC and Aiken LH (2013) How differing shift lengths relate to quality outcomes in pediatrics. Journal of Nursing Administration 43(2): 95-100

Stimpfel AW, Sloane DM and Aiken LH (2012) The longer the shifts for hospital nurses, the higher the levels of burnout and patient dissatisfaction. Health Affairs 31(11): 2501-9

Stone PW, Du Y, Cowell R, Amsterdam N, Helfrich TA, Linn RW, Gladstein A, Walsh M and Mojica LA (2006) Comparison of nurse, system and quality patient care outcomes in 8-hour and 12-hour shifts. Medical Care 44(12): 1099-1106

Todd C, Robinson G and Reid N (1993) 12-hour shifts: job satisfaction of nurses. Journal of Nursing Management 1(5): 215-220

Tucker P, Barton J and Folkard S (1996) Comparison of eight and 12 hour shifts: Impacts on health, wellbeing, and alertness during the shift. Occupational and Environmental Medicine 53(11): 767-772

Tucker P, Smith L, Macdonald I and Folkard S (1999) Distribution of rest days in 12 hour shift systems: Impacts on health, wellbeing, and on shift alertness. Occupational and Environmental Medicine 56(3): 206-214

Van Bogaert P, Kowalski C, Weeks SM, Van Heusden D and Clarke SP (2013) The relationship between nurse practice environment, nurse work characteristics, burnout and job outcome and quality of nursing care: a cross-sectional survey. International Journal of Nursing Studies 50(12): 1667-77

Vega A and Gilbert MJ (1997) Longer days, shorter weeks: Compressed work weeks in policing. Public Personnel Management 26(3): 391-402

Virtanen M, Kurvinen T, Terho K, Oksanen T, Peltonen R, Vahtera J, Routamaa M, Elovainio M and Kivimäki M (2009) Work hours, work stress, and collaboration among ward staff in relation to risk of hospital-associated infection among patients. Medical Care 47(3): 310-318

Wagstaff AS and Sigstad Lie JA (2011) Shift and night work and long working hours - a systematic review of safety implications. Scandinavian Journal of Work, Environment & Health 37(3): 173-85

Williamson A, Lombardi DA, Folkard S, Stutts J, Courtney TK and Connor JL (2011) The link between fatigue and safety. Accident Analysis & Prevention 43(2): 498-515

Wisetborisut A, Angkurawaranon C, Jiraporncharoen W, Uaphanthasath R and Wiwatanadate P (2014) Shift work and burnout among health care workers. Occupational Medicine 64(4): 279-286