The Impact of Shift Work on Sleep Quality and Self-Rated Attentional Control in Night Shift Workers Compared to Day Shift Workers in a Factory Setting

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Abstract

Previous research has shown the many negative impacts shift work can have on individuals. **Aims:** The aim of this study was to investigate the impact of working night shift (NS) on sleep quality, and attention abilities in comparison to day shift workers (DS) in a factory setting in Ireland. This study investigated whether there was a difference in mean sleep score or attention between DS and NS workers. In addition, this study investigated weather sleep would predict variation in attention control in either of the 2 shift groups**.** **Method:** 4 questionnaires were administered to participants ($N = 50$) through google forum through use of a QR code poster which was made available to them at work. This consisted of a demographics questionnaire, Perceived Sleep Quality Questionnaire- Adapted (PSQI), Perceived Stress Scale (PSS), The Attention Control Scale (ATTC). **Results**: Results showed that NS workers have a significantly lower sleep quality compared to DS workers. There was no difference in ATTC scores between DS and NS. Sleep did not predict variance in ATTC for DS workers but it did significantly predict 37% of the variance in ATTC for NS workers. **Conclusion**: Findings provide a further contribution to the already known negative impact of SW on sleep in addition its ability to influence attention. Implications for this study are discussed.

Keywords: Shift work (SW), Night shift (NS), Day shift (DS), sleep, attention, factory setting

Table of Contents

Introduction

This project examines whether sleep quality predicts attentional control in two separate groups of factory workers in Ireland, day shift workers, and night shift workers, to better understand whether sleep quality predicts this important aspect of cognitive processes across both groups. Due to global demands of services some industries are required to provide 24-hour services which typically include members from a healthcare, production, manufacturing or transportation industry (Feng et al., 2021). Shift work is classified as any work that extends beyond the typical 9am-5pm shift schedule (Vogel et al., 2012; Wang et al., 2011).

Shift work

Shift work goes against the natural biological clock within the body known as the circadian rhythm (Huang et al., 2021). Several studies have shown negative consequences as a result of atypical working hours these include sleep disruptions, decreased mood, impaired quality of life, and decreased overall general health (Bolhe et al, 1989; Dai et al., 2019; Di Muzio et al., 2020; Kang et al., 2014; Kazemi et al., 2016; Nena et al., 2018; Niu et al., 2015; Ramin et al., 2015; Wyse et al., 2017; Zhao et al., 2019). One study investigating the effect of night shift on sleep quality and depressive symptoms among Chinese nurses concluded that working nightshift may be associated to higher rates of depression and poor sleep quality, induced by nightshift. (Dai et al., 2019). It is widely known that sleep is essential in promoting overall health in individuals (Irwin, 2015). The recommended amount of sleep per night for adults is 7 or more hours every night on a regular basis (Watson et al., 2015). However, receiving adequate sleep is a challenge faced by many. Numerous major U.S. studies have been used to estimate the amount of hours that most individuals spend sleeping, beginning with an American Cancer Society poll in 1982. Many surveys have found a concerning proportion of "short" sleepers (those who sleep for less than 6 hours) among

respondents, as well as a general trend toward shorter sleep duration between 1975 and 2006 (Worley, 2018).

When sleep duration falls below seven hours, and especially when it falls below 6 and a half hours or fewer, the likelihood for the prevalence for a variety of illnesses rises (Worley, 2018). Previous research into lack of sleep has shown that insufficient or inadequate sleep can play a role in the occurrence and development of several major health issues such as obesity, diabetes, strokes, depression and cardiovascular disease (Joynt et al., 2003). This has become a concerning topic of interest for individuals working in fields which engage in shift work (Zhao et al., 2019) as research reveals that nightshift work may be associated with poor sleep quality, induced by nightshift (Dai et al., 2019; Nena et al., 2018). In Europe, 40% of health care professionals are involved in shift work (Di Muzio et al., 2020) and as a result, much of the research on shift work involves nurses. One cross sectional study looking at sleep quality in 1246 nurses who have worked or are working night shifts revealed that during consecutive night shifts sleep quality gradually decreased and got worse as the days went on (Huang et al., 2021). In relation to the effects of shift work in factory workers specifically, research is predominately focused on the effects of shift work on blood pressure and hypertension (Asfaw et al., 2015; Chen et al., 2010; Golabadi, at al., 2012; Guo et al., 2013; Nazri et al., 2008; Yeom et al., 2017). Sleeping less than 7 hours every night is also linked to a weakened immune system, increased pain, decreased performance, more errors, and a higher chance of accidents (Watson et al., 2015). At night, productivity and safety may deteriorate, especially over the course of several night shifts (Folkard et al., 2003).

Evidence shows that some of the historical industry-related accidents during the last few decades, such as Chernobyl, Three Mile Island, Bhopal, and chemical spill into Rhine and Valdez, have all occurred in the middle of the night, which according to investigations, the main cause of these accidents was reported to be human errors committed by control

room operators during night shift (Folkard et al., 2003). Research suggests there is a possible correlation between tiredness, reduced performance, and increased accident rates in the work place however causation of workplace accidents is complex and research is lacking as it is often difficult to compare working conditions across various studies (Harrington, 2001).

Shift work and sleep quality

Many studies have been conducted to determine the effects of night shift work for nurses in relation to their sleep quality most commonly using the PSQI (Akbari et al., 2015; Dai et al., 2019; Gaspar, 2019; Kang et al., 2020; Lin et al., 2011; Palhares et al., 2014). The PSQI was developed in 1989 by Buyssse and colleagues. It suggests that sleep quality is made up of several components, which include subjective sleep quality (this is determined by a number of factors such as sleep commencement), sleep continuity (number of awakenings), and/or sleep depth, sleep latency (the time it takes a person to fall asleep), sleep duration (the length of time spent asleep), habitual sleep efficiency (the usual effectiveness of sleep), sleep disturbances (any usual disruptions during sleep period), daytime dysfunction (any negative effects caused by lack of sleep during the day such as sleepiness) and the use of sleeping medication (Buysse et al., 1989). These components of sleep have been examined throughout peer-reviewed literature. Further supporting the negative association between night shift work and poor sleep quality is a systematic review and meta-analysis that was conducted on the sleep quality among shift work nurses. This analysis reviewed SQ among shift-work nurses which included 13 articles between 1991 and 2018 (Kang et al., 2020). The main aim was to assess the results of sleep intervention research and it reviewed the quality of sleep assessment tools used by shift-work nurses. The PSQI (sleep quality), Verran and Snyder-Halpern Sleep Scale (measures sleep trends), Single Quality Sleep scale (effects of sleep on daily living) and Sleep Quality Numeric Rating Scale to collect data on subjective sleep quality. In five studies, an actigraph (bio-signal recording device) was used to collect

physiological data about sleep quality. In addition, two research papers used at records such as sleep and activity logs. However, overall, poor sleep quality of shift workers was most commonly reported (Kang et al., 2020). It concluded that Aromatherapy was widely used as a non-drug intervention which did enhance the sleep quality of shift-work nurses although the effect was small (Kang et al., 2020). However, from this analysis alone, the need for and widespread use of such sleep interventions among nurses is a clear indication of the extent to which lack of sleep is an issue for shift work causes.

One study investigating the association between night shift work, sleep quality and health related quality of life among manufacturing workers in a middle income setting revealed that working night shift was related to reduced health related quality of life in addition to sleep impairment and reported that shift workers had significantly lower mean scores in all of the domains in relation to sleep quality compared to day shift workers (Lim et al., 2020).

However, in contrast, one meta-analysis contradicts the findings in the previous studies mentioned as it suggests the opposite results in relation to how night shift work affects elements of sleep quality. This Meta-analysis assessed differences in sleep quality based on actigraphy (Monitors human rest/activity cycles in a non-invasive way) between day and night shift workers and the moderating effect of age for studies published between January 2020 and April 2021 which included 12 papers in total (Chang et al., 2021). Results indicated that those working night shift presented longer sleep-onset-latency and greater wake after sleep onset compared to day shift workers (Chang et al., 2021), but in contrast to the last studies mentioned previously by Dai (2019), Di Muzio (2020), Kang (2020), Kazemi (2014) and Lim (2020) this study found that night shift workers could in fact regulate their rest time and had adequate total sleep time and therefore was not different from day shift workers in relation to sleep efficiency (Chang et al., 2021).

As described above, research has widely demonstrated the ability of shift work to negatively impact sleep quality, but it has also been shown to have the ability to also affect cognitive functions and performance also (Rouch et al., 2005). Sleep deprivation (SD) reduces cognitive resources which then has an effect on attentional performance (Massar et al., 2019).

Shift work and Attention

Three types of attention at the brain level have been identified by Neuroscientists selective attention, executive attention, and vigilance (Ocasio, 2011). According to Weinberg and colleagues (1993), vigilance is a condition of constant attentiveness, wakefulness also known as being in a state of alertness. Vigilance can also be referred to as sustained attention (Oken, et al., 2006). Though various aspects of cognition and attention exist, in general, attention in the broad sense of the meaning is often an important requirement when completing repetitive, which shift work often entails. Attention focusing and attention shifting are two main aspects of attentional control (Derryberry et al., 2002). According to the American Psychological Association Dictionary of Psychology, shifting the focus of attention from one place to another is known as attention shifting and the ability of the brain to focus its attention on a specific stimuli for an extended length of time is known as attention focusing. Achieving effective attentional control requires a balance between utilizing the environment's stable and predictable elements while also being able to adjust attention to changing circumstances (Whitney et al., 2017). It has been argued that deficits in vigilant attention are a universal root cause of cognitive impairments associated with sleep loss (Lim et al.,2008). The effects of sleep deprivation (SD) are quite apparent for tests of vigilant attention, while tests of working memory, decision making, and executive functioning show smaller, more inconsistent effects (Whitney et al., 2017). SD severely compromises the ability of human beings to respond to stimuli in a timely fashion

(Lim et al.,2008). SD reduces cognitive resources, which has an effect on attentional performance (Massar et al., 2019). It has also been discovered that partial sleep deprivation affects attention, particularly alertness but few studies have been conducted on its effects on higher-order cognitive functions (Alhola et al., 2007).

One study looked at how petrochemical control room shift workers performed in terms of cognitive function, drowsiness, and sleep quality in sixty shift employees. The continuous performance test, n-back test, and simple reaction time test were used to examine cognitive performance; the subjective Karolinska Drowsiness Scale (KSS) was used to assess sleepiness; and the PSQI questionnaire was used to assess sleep quality. Results of this study indicated that all measures linked to cognitive function declined considerably towards the conclusion of both day and night shifts. A significant difference in drowsiness was also found between daily and nightly trends indicating that sleepiness was higher for the night shift. Participants experienced poor sleep quality on both day and night shifts, and there were significant variations in subjective sleep quality and quantity between the day and night shift (Kazemi et al., 2014).

However, in contrast to the previous findings in support of shift work negatively affecting cognitive performance, one study from Sharjah which investigated the effect of shift work on police officers' stress, sleep quality, and cognitive performance contradicts these findings as it states that there is no conclusive evidence of a link between shift status and cognitive performance (Bushra et al., 2021). However it is hard to compare this data research with similar studies as on and attention and cognitive functions is limited.

One cross-sectional study of 13,610 individuals from an electronics factory examined the link between shift work and work-related injuries. A self-reported questionnaire about shift work experiences, work-related injuries, along with other demographic variables were used to conclude that current and former shift employees had a 2.7- and 1.7-fold higher risk

of work-related injury, respectively, than non-shift workers indicating that shift work increased the likelihood of work-related injuries, with varying effects depending on the gender (Ryu et al., 2017).

Another cross-sectional study of 120 workers in a Sugar Factory compared severity of exhaustion and drowsiness across shift and non-shift workers, as well as the relationship between these factors and workplace accidents. Sleepiness and exhaustion symptoms were assessed using the Insomnia Severity Index, the Epworhth Sleepiness questionnaire and the Fatigue Scale to determine the prevalence of symptoms of sleepiness. The data revealed that when compared to non-shift workers, shift workers had a higher prevalence of tiredness and more work accidents. Accidents were more likely among those who were drowsy to a greater extent (Bolghanabadi et al., 2014).

Overview of the previous research

As demonstrated above, lots of research has been conducted to investigate the impact of shift work on sleep quality (Kang et al., 2020; Palhares et al., 2014; Kang et al., 2020; Chang et al., 2021; Huang et al., 2021).Some studies were also conducted on the impact of night shift work on sleep quality and how it effects cognitive performance such as psychomotor performance (Di Muzio et al., 2020) and although limited, peer reviewed literature has also supported the fact that shift work negatively impairs cognitive function and or/ attention (Lim et al.,2008, Massar et al., 2019, Whitney et al., 2017). In addition, previous studies show that lack of sleep can cause accidents in the workplace with lack of attention as a possible factor due to lack of sleep (Bolghanabadi et al., 2014; Ryu et al., 2017).

Rationale

Upon analysing previous research, it became apparent that, no recent studies had investigated the effect of shift work sleep quality and attention in a factory setting independently. It was also evident that majority of the research literature regarding shift work

was in relation to healthcare professionals such as nurses, which, as demonstrated by the lack of similar aforementioned studies in factory setting indicated the lack of similar studies being conducted. Research involving self-rated attention also in shift workers has been very limited over the years**.** In addition, a further gap in the literature was identified as it became apparent that little research of a similar nature had been conducted recently in Ireland.

This is a particular topic of interest as accidents in the work place can occur in any line of work, however, particular care should be taken for workers on night shift when research suggests that their sleep quality will more than likely be reduced as a result. Factories and manufacturing companies often operate large machinery and can be a place of danger. This risk is heightened for NS workers due to the likelihood of poor sleep quality something which according to pre-existing research, is highly to play a role where SW work is present. As research has demonstrated that sleep deprivation can lead to lowered attention and therefore may increase the likelihood of accidents in the work place, the intention of this current study was to directly assess sleep quality and attentional control of shift workers in a factory setting in Ireland to further investigate whether there was a relationship. Altogether, this provided strong rational for the basis if this current study as it was the intention to conduct a study to incorporate all these elements together, something which to the researchers knowledge has not been previously done to date**.**

The current study

The aim of this study was to investigate 2 groups of workers in a factory setting ;day shift and night shift workers, to compare their sleep quality, and attentional control scores to determine if there is a difference. In more recent years, health and safety is becoming increasingly important in the workplace. The relationship between sleep and subjective attention in a factory setting is particularly under researched. Further research on this topic is important for workers on night shift and in potentially dangerous situations such as a factory.

Simultaneously investigating the impact that working night shift has on sleep quality and attentional control ability in comparison to day shift workers in the same field could provide recent data and a useful insight for both employers and employees engaging in shift work.

There will be 4 research questions addressed in this study; does sleep differ between shift work and non-shift work groups, does attention differ between shift work and non-shift work groups, does sleep predict variation in attentional control in day shift workers and does sleep predict variation in attentional in night shift workers. Based on past studies, it is hypothesized that there will be a difference in mean sleep score between day shift and night shift workers, there will be a difference in mean attention score between day shift and night shift workers, sleep will predict variation in attention control in shift workers, and that sleep will correlate with variation in attention control in non-shift workers.

Methodology

Participants

Participants were recruited using a convenience sampling technique. The data for this study was collected through method of online questionnaires. The participants for this study were a sample of employees from a medical device manufacturing company called Hollister. This company was selected as it operates 24 hours and its employees work set shift schedules as opposed to rotating shifts so that participants can be easily separated; individuals who work night shift and individuals who work day shift. All eligible employees of the factory had an equal chance to participate voluntarily if they wished to do so.

As T-tests, and multiple regressions were conducted in this study G*Power Statistical Power Analyses (Faul et al., 2009) was used to determine the required sample size for a statistically powerful analysis. Each of these tests were entered individually into G power and the highest required sample size was recorded. This test indicated that a sample size of 84 would produce a 95% chance that the type 1 error would be reduced. As there were 2 groups in this case; dayshift and night shift workers, the minimum desired total was 168 participants, 84 dayshift and 84 night shift. No incentives were given for participation. The initial sample consisted of 56 participants in total that were over the age of 18. However, due to the nature of the study those working either day, evening or night shift were only eligible to take part in the study. Those working 2 day shifts followed by 2 night shifts each week (continental shift) were not eligible to take part in this current study. From looking at results from the PSQI it was clear 10.6% *(N* = 6) of participants who completed the study were on continental shift as for example for PSQI 3 they gave 2 bed times, one for when they are on dayshift and one for when they are on night shift and therefore as a result, these participants were excluded from the study bringing the final total of participants to 50. The final sample consisted of 17 males

and 33 females with a mean age of 56.46 years (SD = 11.41) ranging from 20-62. 44% of the sample were dayshift (N = 22) and 56% of the sample were night shift workers (N = 28).

Measures

Demographics A demographics questionnaire was the first questionnaire used in the study. This addressed participants sex (male/female/ other), age (in years), current role in the factory (production operator/fitter/mechanic/electrician/ quality assurance/ team leader/supervisor or office work), how many years they have completed on their current shift (in months/years) and type of shift work (dayshift = 8am-4pm/ evening = 4pm-12am/ nightshift = 12am- 8am). For the purpose of this study participants working evening shift were added to the dayshift category as they did not fit the category for night shift work.

The Pitsbourg Sleep Quality Index (PSQI) – Adapted. The PSQI is a 19 item self-report measure of individuals sleep quality (Buysse et al., 1989). This questionnaire is a valid and reliable method of sleep quality assessment (Lim et al., 2020). The PSQI assesses 7 components of sleep; 1 = subjective sleep quality, 2 = sleep latency, 3 = sleep duration, 4 = habitual sleep efficacy, 5 = sleep disturbance, 6 = the use of sleep medication and 7 = daytime dysfunction (Buysse et al., 1989). Each component in the questionnaire is rated on a 4-point scale (0-3) which generates a total score ranging between 0 and 21. A global score greater than 5 is an indication of poor quality sleep and a score below 5 indicates good sleep quality (Buysse et al., 1989).

The wording of the questions in the PSQI phrases its questions more so to individuals who do not live off a night shift schedule as it asks ‘what time at night do you go to bed’, for people on a night shift sleeping pattern, it would be morning/day time they would typically go to bed. Taking this into consideration, a slightly adapted version of the PSQI to suit night

shift workers was created for a pilot study after approval from the Ethics board. This adapted version kept all the questions the same as the original PSQI but with a slight change to the wording of some questions in order to suit both night and day shift workers (see Appendix A for original PSQI, see Appendix B for adapted version of the PSQI). For example the original PSQI phrases questions like 'what time of night do you go to bed/sleep at', in this case the wording was changed to 'what time of day/night do you to go to sleep at? please specify am/pm' so that those working night shift could specify am if that suited them as opposed to pm. This pilot study was conducted on 2 dayshift workers and 2 night shift workers for the factory and it was deemed successful. However, due to the changes in the adapted version, 6 participants filled out PSQI question 3 incorrectly and 5 participants filled out PSQI question 5 incorrectly. As these questions are used assessing component 4 and 5 of sleep, instead of removing these 9 participants from the data it was decided that for this sample, component 4 and 5 would not be included and therefore the global PSQI score would be derived from 5 sleep components instead of the typical 7. This current questionnaire had a total score range of between 0 and 15 instead of 21 to allow for the loss of 2 components. The Cronbach's alpha for the current samples Global PSQI score (.43) is based of 5 standardised items.

Perceived stress scale The 3rd questionnaire was the Perceived Stress Scale (PSS) version 10. This is the most common psychological instrument for measuring perceived levels of stress (Lee, 2012). It is a measure of the degree to which situations in one's life are deemed stressful. Items were designed to assess how unpredictable, uncontrollable, and overloaded respondents find their lives. The scale also includes aspects about current levels of experienced stress. The questions in thee PSS ask about feelings and thoughts over the last month. In each case, respondents are asked how often they felt a certain way. This current study will use the smaller version 10 (PSS-10), (Cohen et al., 1983). Psychometric properties for this scale support internal consistency reliability, with one meta-analysis on its

psychometric properties reporting that Cronbach's alpha for the PSS- 10 was above the acceptable alpha level (.70), (Lee, 2012). Although collected, the data on stress was not analysed in this current research paper as this data was collected for a dataset that could be analysed further in future studies by including stress a variable, however this current research paper focused on just sleep and attention.

Attentional Control Scale The 4th questionnaire in this study was the Attention Control Scale (ATTC). The ATTC is a subjective self-report measure that measures two major components of attention; attention focusing and attention shifting (Addiction Research Center, 2021). The ATTC consists of 20 items that are rated on a four-point likert scale from 1 (almost never) to 4 (always), (Addiction Research Center, 2021). The ATTC results combine results to form one total scale and two subscales (attention shifting and attention focusing). Questions 1,2,3,6,7,8,11,12,15,16 18 and 20 are reverse scored (Addiction Research Center, 2021). Scale scores are calculated as the sum of respective items.

Design

This current study used a quantitative approach with an observational, cross-sectional design. To address the 4 hypotheses a between-participants design was used. The predictor variables were gender, age, and type of shift (dayshift or night shift) and global PSQI sleep scores. Global PSQI Sleep scores was also separately used as a criterion variable for certain hypothesis analysis in addition to attentional control. The use of variables as predictor or criterion variables depended on the hypotheses being addressed which is outlined below in methods of data analysis.

Procedure

This research was approved by the National College of Irelands Ethics Committee and

is also in line with the Psychological Society if Ireland Code of Professional Ethics (2010) and the NCI Ethical Guidelines for involving Human Participants. However, initially the study was only provisionally granted on the basis of proof of permission from the company to carry out the study. In order to do so, a permission request was sent to the manager of the company outlining the nature of the study and stating that it had passed provisional ethical approval if permission was granted to carry out the study. When permission was granted by the company by letter, the project had obtained full Ethical Approval in order to begin data collection.

Data was collected online through a Google Fourms survey. To determine the length of the study and to ensure no issues arose beforehand, a pilot study was undertaken by 2 day shift workers and 2 night shift workers. The results from this pilot study revealed that the study took approximately 10 minutes on average to complete and no issues were reported. These individuals did not click the final 'submit' at the end of the study and therefore their results were not officially recorded or included in the study. This information of completion time was then included in the participants information sheet which was uploaded to the Google Fourms survey.

Once the survey was made, a QR code was created free online using the website QRcodegenerator.com. This website turned the URL for the link to the study into a picture of a digital code (QR code) which if scanned by the camera on any smart phone, would bring up a link on their own phone which participants can then click to bring them directly to the online study. This QR code was used to create an information poster and leaflets which multiple copies were created in order to obtain participants (see Appendix C). The poster and leaflets had the same content on both but just varied in size. They contained information about eligibility, background to the study, what it would involve and instructions to use the

QR code If they wanted to take part. As per safety regulations of the manufacturing company, only those who work there are permitted on site.

Therefore, the information posters and leaflets were given to 2 members of staff, who at the start of daily shift meetings, mentioned the study to the different shift groups and offered the chance to take an information leaflet with the QR code about the study if they wished to take part. These staff members also explained to employees where the posters for the study were located which also had the QR code on them to scan if they wished to take part. All employees were also made aware that it was voluntary and that participation did not have any effect on their job.

When participants followed the QR code to the Google Fourm they were first presented with the information sheet (see Appendix D). This contained all relevant information about the study including eligibility criteria, who the author and supervisor were with relevant contact details if needed, the organisation, background information to the study and what the study would involve. Participants were then presented with a consent form sheet which they were required to agree to in order to proceed to the study (see Appendix E). This forum required participants to verify that they were over the age of 18. It also reminded them that they were free to exit the study at any stage without penalties, except for once they click submit after completion as by then their data will be submitted anonymously and therefore not possible to identify in order to exclude. Once the consent form is completed, they will be presented with the demographic's questionnaire (see appendix F) followed by the PSQI - Adapted (see Appendix B), The Perceived Stress Inventory questionnaire (see Appendix G), and finally the Attention Control Scale (see Appendix H). Once the questionnaires were completed participants are then presented with the debrief sheet outlining the nature of the study once again and thanking them for their participation (see Appendix I). Helpline

numbers for support lines and contact details for the researcher and supervisor also were listed here again should a need or any questions arise as a result of the study. Participants had to finish submission by clicking ‘Submit’ on this page and they were then finished with the study. Although no obvious harm was expected to be encountered as a result of this study, helpline numbers were still presented in the debrief sheet should any participant feel they needed support related to the content.

Results

Descriptive statistics

Descriptive statistics are presented in Table 1 for both the dayshift and night shift groups. Dayshift workers accounted for 44% of the sample (N = 22) and night shift workers accounted for 56% (N = 28). 34% of the sample were males (N = 17) and 66% were female (N = 33). 58% of the sample were not married (N = 29), 40% were married or living with a domestic partner (N = 20) and 2% were separated (N = 1). Production operators made up 82% of the sample (N = 41), team leader/ supervisor 10% (N = 5), quality assurance accounted for 4% (N = 2), office work accounted for 4% off the sample (N = 2).

Table 1

Frequencies for the current sample on demographic variables (N = 50)

Variable	Frequency	Valid %
Gender		
Males	17	34
Females	33	66
Marital status		
Single never married	29	58
Married/ domestic partner	20	40
Separated	1	2
Job role		
Production operator	41	82
Quality assurance	2	4
Team leader/ supervisor	5	10

Office work	2	4
Type of shift		
Day	22	44
Night	28	56

Means (M) and standard deviations (SD) for all continuous variables are presented in Table 2. The overall total sample had a mean age of 56.46 years (SD = 11.41), ranging from 20-62. When further broken down into groups depending on the type of shift, the dayshift sample had a mean age of 37.41 years (SD = 11.31), ranging from 23-56. and the night shift sample had a mean age of 33.93 (SD = 11.45), ranging from 20-62. This can be seen below in table 2.

A non-significant Shapiro-Wilk test result (>.05) for the PSQI global scores and the ATTC total scores for both dayshift and night shift indicated that both were normally distributed. Inspection of the histograms further indicate that the data is relatively normally distributed. A significant result (< 0.05) of the Shapiro-Wilk test for age for both dayshift and night shift workers indicating that age may not be normally distributed throughout the sample. Visual inspection of the graphs show the data for both dayshift and night shift workers were both positively skewed. Each participants data was inspected initially to check for any missing answers or questions answered incorrectly which resulted in removing a total of 6 participants from the study. Therefore, any outliers in the sample which were identified in the box plots did not appear to be incorrect answers so the trimmed means value and the mean value was compared to assess how much of an issue including the individual outliers would cause to the data. All the trimmed means were similar the actual mean values indicating these values would not cause too much of an issue for analysis's therefore none of the outliers were removed from the final analysis.

Table 2

Descriptive statistics for all continuous variables (N = 50)

Variable	*M* [95% CI]	*SD*	Range
Age			
Dayshift	37.41 [32.40, 42.42]	11.31	23-56
Night shift	33.93 [29.49, 38.37]	11.45	20-62
Years on shift			
Dayshift	5.19 [1.52, 8.86]	8.30	.33-27
Night shift	3.06 [1.86, 4.28]	3.15	.25-15
PSQI Global score			
Dayshift	4 [2.82, 5.18]	2.70	0-11
Nightshift	7.56 [2.10, 8.38]	2.10	3-11
ATTC Total score			
Dayshift	50.73 [45.56, 54.90]	9.41	35-73
Nightshift	50.85 [45.56, 54.90]	6.87	31-61

Inferential statistics

To examine the data a Chi- square, 3 T-tests and 2 regressions were conducted. As such, this paper will be assuming statistical significance at $p \leq 0.05$. To determine if there was a difference in age between dayshift an night shift workers the non-parametric version of a T-test, A Mann-Whitney U Test, was conducted to assess whether there was a difference between age and type of shift; dayshift or nightshift. This was obtained by accessing the median scores for each group. Preliminary analysis's were conducted to ensure no violations of the assumptions both variables are categorical. The assumptions of random sample and independent observations were met in this sample, cells in the contingency table are mutually

exclusive. And lastly the expected value of the cells in the contingency table should are 5 or greater in at least 80% of cells and that no cell had an expected value less than 1. The Mann-Whitney U Test revealed no significant difference of age between the day shift workers (Md = 38.50, *n* = 22) and night shift workers (Md = 30.50, n = 28), U = 252, z = -1.10, p = .30, r = .20.

Next, to determine gender ratios between day and night shift workers a Chi-Square test was performed**.** Preliminary analysis's were conducted to ensure no violations of the assumptions. The assumptions for the non- parametric tests such as the Chi-square test of random sample and independent observations were met in this sample. The additional assumption of the lowest frequency in any cell should be 5 was also met as 0 cells (.0%) have an expected count of less that 5.

As the variables for this question has 2 categorical variables with 2 levels sex (male/ female) and type of shift (day/ night) the continuity correction value was used as opposed to the Pearson Chi -Square value from the SPSS output due to the over compensation of this value for a 2x2 table. A chi-square test for independence (with Yates' Continuity Correction) indicated a no significant association between gender and type of shift, x^2 (1 , *n* = 50) = < .00, *p* = 0.773, *phi* = -.04.

Hypothesis 1

To determine if there is a difference in mean sleep PSQI sleep scores between day shift and night shift workers an Independent samples T test was conducted. Preliminary analysis's were conducted to check for violations of the assumptions of independence, normality, random sampling an homogeneity. This data set for this test did not violate the any of the assumptions and the assumption of equal variance assumed was met as the significance value for the Levene's Test (.34) was larger than the Alpha levels of .05 (Pallant, 2007). An independent samples T-test was conducted to compare Global PSQI sleep scores for day shift

workers and night shift workers. There was a significant difference in scores for dayshift (M = 4.00, SD = 2.70) and night shift workers (M = 7.60, SD = 2.10; t (47) = -5.30, p = < .00, two-tailed). The magnitude of the difference in the means (mean difference = -3.60, 95% CI: -4.92 to -2.20) was moderate (eta squared = .13) (Cohen, 1988).

Hypothesis 2

T-test to determine if there is there a difference in mean attention scores between day shift and night shift workers**.** Preliminary analysis's were conducted to check for violations of the assumptions of independence, normality, random sampling an homogeneity. This data set for this test did not violate any of the assumptions for this test. The assumption of equal variance assumed was met as the significance value for the Levene's Test (.30) was larger than the Alpha levels of .05 (Pallant, 2007).

An independent samples T-test was conducted to compare total Attention scores for day shift workers and night shift workers. There was no significant difference in scores for dayshift (M = 50.73, SD = 9.50) and night shift workers (M = 50.86, SD = 6.90; t (48) = -.06, p = .96 (two-tailed). As the result was non-significant, an effect size was not calculated for this question.

Hypothesis 3

Standard multiple linear regression to determine if PSQI predicted attentional control for day shift workers. Preliminary analysis's were conducted to ensure no violations of the assumptions of normality, linearity, homoscedasticity and independence of variables. To ensure there was no multicollinearity, a Pearson corelation coefficient was calculated to examine the relationship between global sleep score and attentional control scores in day shift workers. The coefficient (r = -.41) indicated that the assumption of multicollinearity was not violated. Moreover, tolerance (1) and variance inflation factor (1) values did not indicate a violation of this assumption. A scatter plot was created to assess the assumption that the

variance of the residuals was constant (homoscedasticity). The plot did not violate this assumption. A P-P plot was created to check that the assumption that the values of the residuals are normally distributed. This plot did not violate this assumption.

Therefore, a multiple linear regression was conducted to examine the ability of global sleep score to predict attentional control a in day shift workers. This result was not statistically significant $F(1,20) = 4.13$, $p = .056$, explaining 13% ($R^2 = .13$) of the variance in the attentional control. Due to the small sample size, the adjusted R square value (.13) was used instead of the R square value (.17). The coefficients from the regression can be seen below in table 3.

Table 3

Standard multiple regression table for Global PQI scores on Attention control scores for day shift workers

Variable	R^2	B	SE	β	*t*	*p*
Global PSQI score	.13	1.47	.72	.41	2.03	.056

Note: R^2 = R-squared; B = unstandardized beta value; SE = Standard errors of B; β = standardized beta value; t = test statistics; p = significance level; N = 28

Hypothesis 4

Standard multiple linear regression to determine if PSQI predicted attentional control for night shift workers. Preliminary analysis's were conducted to ensure no violations of the assumptions of normality, linearity, homoscedasticity and independence of variables To ensure there was no multicollinearity, a Pearson corelation coefficient was calculated to examine the relationship between global sleep score and attentional control scores in night shift workers. The coefficient ($r = -.63$) suggested that the assumption of multicollinearity

was not violated. Moreover, tolerance (1) and variance inflation factor (1) values did not indicate a violation of this assumption. A scatter plot was created to assess the assumption that the variance of the residuals was constant (homoscedasticity). The plot did not violate this assumption. A P-P plot was created to check that the assumption that the values of the residuals are normally distributed. This plot did not violate this assumption.

A multiple linear regression was conducted to examine the ability of global sleep score to predict attentional control scores in night shift workers. This result was statistically significant $F(1,25) = 16.30$, $p = < .005$, explaining 37% ($R^2 = .37$) of the variance in the outcome variable. Due to the small sample size, the adjusted R square value (.37) was used instead of the R square value (.40). The coefficients from the regression can be seen below in table 4.

Table 4

Standard multiple regression table for Global PQI scores on Attention control scores for night shift workers

Variable	R^2	B	SE	β	*t*	*p*
Global PSQI score	.37	2.07	.51	.63	4.04	<.005

Note: R^2 = R-squared; B = unstandardized beta value; SE = Standard errors of B; β = standardized beta value; t = test statistics; p = significance level; N = 2

Discussion

Shift work is widely shown to be negatively corelated with sleep quality which can also lead to a decrease in a define of cognitive functions such as attention. While there are a number of variables that may affect shift workers such as stress levels for example, this paper focused on sleep and attentional control. This first stage if this analysis aimed to determine whether there was any significant differences in the demographics for dayshift and night shift workers. To address these, (1) to determine if there was a difference in age between dayshift and night shift workers, A Mann-Whitney U Test was conducted and revealed no significant difference between dayshift (Md = 38.50, *n* = 22) and night shift workers (Md = 30.50, n = 28); (2) to determine gender ratios between day and night shift workers a Chi-Square test was performed which indicated no significant association between gender and type of shift.

For the inferential statistics, the first study aimed to determine if there was a difference in mean sleep PSQI sleep scores between day shift and night shift workers. There was a significant difference in scores for dayshift (M = 4.00, SD = 2.70) and night shift workers (M = 7.60, SD) which is referred to as moderate. Therefore, first hypothesis that there is a difference in mean sleep score between day shift and night shift workers was supported by the data.

The second study aimed to determine whether there was a difference in mean attention scores between day shift and night shift workers. There was no significant difference in scores for dayshift (M = 50.73, SD = 9.50) and night shift workers (M = 50.86, SD = 6.90). Therefore, the second hypothesis that there is a difference in mean attention score between day shift and night shift workers was not supported by the data in this case.

The third study aimed to determine if global PSQI scores predicted attentional control for day shift workers. This result was not statistically significant explaining just 13%

of the variance in the attentional control. The third hypothesis that sleep correlates with and predicts variation in attention control in shift workers was not supported by the data.

The fourth study aimed to determine if PSQI predicted attentional control for night shift workers. This result was statistically significant and was responsible for explaining 37% of the variance in the attentional control variable. The fourth hypothesis that sleep correlates with and predicts variation in attention control in non-shift workers was supported by the data.

In summary, the initial tests which were completed conclude that there was no significant differences in age or gender ratios between the two groups dayshift and night shift indicating that the groups were similar in relation to gender. The first test revealing that night shift workers have a significantly higher mean PSQI global score therefore indicating a lower sleep quality is consistent with previous literature indicating that night shift workers generally have a lower sleep quality like expected. However it should also be mentioned that this PSQI sleep score measure was an adapted version of the original one. In addition, the global score was comprised of only 5 components of sleep as opposed to the 7 that are proposed in the original one due to errors in the data and therefore this measure showed a questionable Cronbach alpha coefficient for this current sample therefore caution must be applied when interpreting data from these results. The second test produced a negative finding in relation to there being a mean difference in attentional control score between dayshift and night shift workers. This could be due to the fact a small sample size was used or, these results may be similar to findings reported by Bushra and colleagues (2021) that found no significant difference in cognition between dayshift or night shift groups.

The third and fourth study results show that although sleep did not predict variance in attentional control in day shift workers, it did significantly predict variance in attentional control for night shift workers and was explained for 37% of the variance in scores.

Although the result was not significant for day shift workers, the p value (.056) was quite close to yielding a significant result as it was close to the alpha value (<.05). It may be plausible to suggest that a future study with more participants may yield a significant result supporting the hypothesis that sleep does predict variation in ATTC in dayshift as well as night shift. However, in relation to studies previously mentioned in regards to the association between SW and lack of sleep and reduced cognition, this finding of sleep to only be significant in night shift is consistent with existing data which support the negative relationship typically experienced by night shift as opposed to dayshift.

Practical implications

Information regarding the negative associations between sleep and shift work is should be made available to all shift workers so they are aware of the consequences of sleep deprivation from night shift. Highlighting the impacts of the possible dangers associated with shift work as a result of reduced attention is important for both employer and employees as awareness and knowledge of the potential impact it can cause may be beneficial when designing shift schedules and taking break times into account also. Policies aimed at promoting good sleep hygiene practices for night shift workers may be benefit shift workers and help them to engage in ways to potentially improve their sleep habits in the hopes to in turn increase their sleep quality which may reduce the risk for workplace accidents overall.

Limitations and further research

One of the main strengths of this study is that it attempted to expand upon previous research which, to the researchers knowledge had not been completed before in relation to examine the set variables together in a subjective manor. However there are a number of limitations to be considered in this present study. Firstly, This study used self-report measures to determine sleep quality and attentional control. Therefore as these variables were measured subjectively, biases in the data may be present. One other key limitation of this

study was the design of the PSQI adapted questionnaire. Although it successfully passed pilot testing of 2 dayshift workers and 2 night shift workers with no issues, when investigating the results before analysis it became apparent that 2 of the questions in particular caused confusion for participants.7 participants for Question 1 ‘During the past month, when have you usually gone to bed at night/day? Usual bed time (specify pm/am)’ and 6 participants for question 3 ‘ During the past month, when have you usually gotten up in the morning/evening? Usual getting up time (specify am/pm)’ reported only am or pm as their answer without the specific times and therefore it was not possible to calculate sleep component 4. In future, if this adapted version of the PSQI is ever to be used again it would better serve to have this 2 parts for question 1 and question 3 to avoid confusion. For example part a for question 1 could be a ‘During the past month, when have you usually gone to bed at night/day? and for question 3 could be ‘During the past month, when have you usually gotten up in the morning/evening? Usual getting up time’ and then part b for both questions could then be a separate question ‘please specify pm/am’ to ensure both parts are answered equally so that component 4 can be easily assessed.

There was also a slight issue was for PSQI question 5, as for the multiple choice questions, 5 participants clicked more than 1 box as their answer. It then was not possible for the researcher to identify which answer was their preferred choice and therefore was not possible to accurately calculate sleep component 5. In future, when designing online studies, consideration should be made to ensure it is designed in a way that only one multiple choice answer can be entered per question by participants to avoid this. Due to the number of issues generated by the PSQI , a decision was made to exclude these 2 components from the global sore analysis and focus on the other 5. Perhaps analysis of these other 2 sleep components would have altered the sleep score data and yielded different results.

Another limitation to this study is the low number of participants gathered in

comparison to the estimated targe sample size given in G*. The current sample consisted of 22 dayshift workers and 28 night shift workers in comparison to the 84 participants per group suggested by G*.While this study was a unique attempt to build on previous research, future studies could benefit from employing a larger sample size or by measuring the same variables in an objective manor to get a clearer understanding of the association.

Conclusion

This present study found no significant difference in attentional control scores between shift workers and non-shift workers, but it did find a significant difference in sleep scores in both groups, with night shift workers having significant lower sleep quality. This study also found there to be a significant predictive utility of sleep scores on attentional control in night shift workers but not in day shift workers. This research further demonstrates the widely known fact night shift workers have a typically lower sleep quality than day shift workers. Therefore, policies aimed at promoting sleep hygiene information in the workplace should be implemented to increase awareness of the impact shift work may have for workers in the hopes to promote workplace safety and reduce the risk of accidents..

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Appendix A. Original Pitsbourg Sleep Quality Index

PITTSBURGH SLEEP QUALITY INDEX (PSQI)

INSTRUCTIONS: The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions.

1. During the past month, when have you usually gone to bed at night?

   USUAL BED TIME _____

2. During the past month, how long (in minutes) has it usually take you to fall asleep each night?

   NUMBER OF MINUTES _____

3. During the past month, when have you usually gotten up in the morning?

   USUAL GETTING UP TIME _____

4. During the past month, how many hours of actual sleep did you get at night? (This may be different than the number of hours you spend in bed.)

   HOURS OF SLEEP PER NIGHT _____

INSTRUCTIONS: For each of the remaining questions, check the one best response. Please answer all questions.

5. During the past month, how often have you had trouble sleeping because you...

	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
(a) ...cannot get to sleep within 30 minutes	☐	☐	☐	☐
(b) ...wake up in the middle of the night or early morning	☐	☐	☐	☐
(c) ...have to get up to use the bathroom	☐	☐	☐	☐
(d ...cannot breathe comfortably	☐	☐	☐	☐
(e) ...cough or snore loudly	☐	☐	☐	☐
(f) ...feel too cold	☐	☐	☐	☐
(g) ...feel too hot	☐	☐	☐	☐
(h) ...had bad dreams	☐	☐	☐	☐
(i) ...have pain	☐	☐	☐	☐
(j) Other reason(s), please describe _____ _____				
How often during the past month have you had trouble sleeping because of this?	☐	☐	☐	☐

PSQI Page 1

	Very good	Fairly good	Fairly bad	very bad
6. During the past month, how would you rate your sleep quality overall?	☐	☐	☐	☐

	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
7. During the past month, how often have you taken medicine (prescribed or "over the counter") to help you sleep?	☐	☐	☐	☐
8. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?	☐	☐	☐	☐

	No problem at all	Only a very slight problem	Somewhat of a problem	A very big problem
9. During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?	☐	☐	☐	☐

	No bed partner or roommate	Partner/ roommate in other room	Partner in same room, but not same bed	Partner in same bed
10. During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?	☐	☐	☐	☐

If you have a roommate or bed partner, ask him/her how often in the past month you have had...

	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
(a) ...loud snoring	☐	☐	☐	☐
(b) ...long pauses between breaths while asleep	☐	☐	☐	☐
(c) ...legs twitching or jerking while you sleep	☐	☐	☐	☐
(d) ...episodes of disorientation or confusion during sleep	☐	☐	☐	☐
(e) Other restlessness while you sleep; please describe	☐	☐	☐	☐

_____

_____

Appendix B Original Pitsbourg Sleep Quality Index - Adapted

Sleep Quality Questionnaire

The following questions relate to your usual sleep habits during the past month only.

Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions.

1. During the past month, when have you usually gone to bed at night/day?
USUAL BED TIME (specify pm/am)

Short answer text

2. During the past month, how long has it usually taken you to fall asleep each night/day?
NUMBER OF MINUTES

Short answer text

3. During the past month, when have you usually gotten up in the morning/evening?
USUAL GETTING UP TIME (specify am/pm)

Short answer text

4. During the past month, how many hours of actual sleep did you get at night/day? (This may be different than the number of hours you spend in bed.) HOURS OF SLEEP PER NIGHT/DAY

Short answer text

INSTRUCTIONS: For each of the remaining questions, please select the response that applies to you. Please answer all questions.

5. During the past month, how often have you had trouble sleeping because *

	Not during the pas...	Less than once a ...	Once or twice a we...	Three or more tim...
(a) ...cannot get to ...	☐	☐	☐	☐
(b) ...wake up in th...	☐	☐	☐	☐
(c) ...have to get up...	☐	☐	☐	☐
(d) ...cannot breath...	☐	☐	☐	☐
(e) ...cough or snor...	☐	☐	☐	☐
(f) ...feel too cold	☐	☐	☐	☐
(g) ...feel too hot	☐	☐	☐	☐
(h) ...had bad drea...	☐	☐	☐	☐
(i) ...have pain	☐	☐	☐	☐
(j) Other reason(s),...	☐	☐	☐	☐

If you selected (j) in the above question , please describe the other reason

Short answer text

6. *

	Very good	Fairly good	fairly bad	Very bad
During the past mo...	☐	☐	☐	☐

7. *

	Not during the pas...	Less than once a ...	Once or twice a we...	Three or more tim...
During the past mo...	☐	☐	☐	☐

8. *

	Not during the pas...	Less than once a ...	Once or twice a we...	Three or more tim...
During the past mo...	☐	☐	☐	☐

9. *

	No problem at all	Only a very slight p...	Somewhat of a pro...	A very big problem
During the past mo...	☐	☐	☐	☐

10. *

	No bed partner or r...	Partner/ roommat...	Partner in same ro...	Partner in same bed
During the past mo...	☐	☐	☐	☐

If you have a roommate or bed partner, ask him/her how often in the past month you have

	Not during the pas...	Less than once a ...	Once or twice a we...	Three or more tim...
(a) loud snoring	☐	☐	☐	☐
(b) long pauses be...	☐	☐	☐	☐
(C)legs twitching o...	☐	☐	☐	☐
(d) episodes of dis...	☐	☐	☐	☐
(e) Other restlessn...	☐	☐	☐	☐

If you selected (e) in the previous question, please describe the other

Short answer text

Appendix C Participation information sheet

Participant Information Sheet

-Title of the project?
How does type of shift work (day or night) affect factory workers in relation to sleep quality, and attention abilities?

-Who is the researcher and what is this study about?
My name is Niamh Langan, I am a final year student in the BA in Psychology programme at National College of Ireland. As part fulfilment of my degree, I am required to carry out an independent research project, which I am completing under the supervision of Dr David Mothersill. This study aims to investigate the impact of shift work; dayshift or nightshift, work in relation to workers sleep quality, and attention abilities and to compare the results from both groups. This is a topic of particular interest form a health and safety point of view due to the fact environments like factories where large machinery are present, focused attention is needed to prevent accidents and any impact that night shift work may have on attention control needs to be investigated.

-Who has approved the study?
This study has been approved by the National College of Ireland Ethics Committee. A copy of this approval can be provided on request.

-Who can take part in the study?
You can take part in this study if you are aged over 18 and are an employee of Hollister in any department working any day, evening or night shift EXCEPT for continental shift. The study contains subgroups for the shift type in the demographics questionnaire where you can select your shift type.

-Do I have to take part?
No, participation in this research is voluntary. You are not obliged to take part and a decision not to take part will have no consequences for you. Management or other members in Hollister will not be aware of those that participate and those that do not. However, I would appreciate if you could spare 10 minutes of your time to help me investigate this topic. If you do decide to take part, you will be required to provide consent, to confirm you have read and understood the information sheet about the study and the contents of the consent sheet in order to proceed. If you do decide to participate and give consent, you can still withdraw from the study up until any point before the final questionnaire is completed and submitted without reason by simply exiting out of the google forums link. However, once you have submitted the results to the final questionnaire; it will not be possible to withdraw your data from the study. This is due to the fact the questionnaire is anonymous and individual responses cannot be identified and therefore it wouldn’t be possible to identify or remove any submitted responses.

-What will taking part in the study involve?
If you decide to take part in this research, you will be asked to complete a sequence of 4 short online questionnaires on google forums which would take approximately 10 minutes to complete. The first questionnaire will include generic demographic questions such as gender/age/questions relation to the type of work and hours you do in the factory. The 2nd questionnaire will be addressing your sleeping habits to access your quality of sleep. The 3rd questionnaire will ask questions in relation to your own perceived attention abilities and as stress may be a contributing factor affecting sleep quality and/or attention abilities, the final questionnaire will ask generic questions about your perceived levels of stress. No name will be required for any section though out the study and all results of the questionnaires are completely anonymous, and results are un-identifiable

-What are the possible risks of taking part?
This study and questionnaires should not expose you to any risk. Although the risk of harm or distress will be minimal due to the nature of the variables involved, some people may find questions relate to stress to cause some distress. If this occurs at stage while carrying out the study you are free to exit the study, and if you wish to continue a contact details for Samaritan's, a 24 hour emotional support helpline will be provided at the end in the debrief sheet who you can reach out to for support if needed.

-What are the possible benefits of benefits of taking part?
There are no direct benefits to you for taking part in this research. However, the information gathered from participation in this study may benefit workers from a health and safety point of view as the information will contribute to research that helps to understand the impact that shift work may have on workers in relation to sleep quality, and the ability for attention control, something which may be beneficial to the wider community.

-Will taking part be confidential and what will happen to my data?
Yes, taking part in this study is fully confidential. The questionnaires are anonymous, and it is not possible to identify a participant based on their responses to the questionnaire. It is important to also note that management or other members of the company have any way to know those that participated in the study or those that did not. All data collected for the study will be treated with the strictest level of confidence. Only myself the researcher and Dr David Mothersill my academic supervisor will have access to the data collected. In line with the NCI data retention policy, data will be retained for 5 years after the study and stored securely in a password protected/encrypted file on the researcher's computer.

-What will happen to the results of the study?
The results of this study will be presented in my final dissertation, which will be submitted to National College of Ireland. The results of the project may be presented at conferences and/or submitted to an academic journal for publication.

-Who should you contact for further information?
Should you have any questions or concerns regarding this any information provided or this research study please do not hesitate to contact myself or my supervisor through the contact details provided below.
Niamh Langan, 3rd year Student (researcher) email: x19465962@student.ncirl.ie
Dr. David Mothersill (Supervisor) email: david.mothersill@ncirl.ie

Appendix D Information poster

Appendix E Consent form sheet

Consent Form

In agreeing to participate in this research I understand the following:
-This research is being conducted by Niamh Langan, an undergraduate student at the School of Business in the National College of Ireland.

-The method proposed for this research project has been approved in principle by the Departmental Ethics Committee, which means that the Committee does not have concerns about the procedure itself as detailed by the student. It is, however, the above-named student's responsibility to adhere to ethical guidelines in their dealings with participants and the collection and handling of data.

-If I have any concerns about participation, I understand that I may refuse to participate or withdraw at any stage.

-I have been informed as to the general nature of the study and agree voluntarily to participate.

-There are no known expected discomforts or risks associated with participation.

-I am over the age of 18

-All data from the study will be treated confidentially. The data from all participants will be compiled, analysed, and submitted in a report to the Psychology Department in the School of Business. No participant's data will be identified by name at any stage of the data analysis or in the final report.

-At the conclusion of my participation, any questions or concerns I have will be fully addressed.

-I may withdraw from this study at any time up until the questionnaires are submitted as once, they are completed there will be no way to identify what data belongs to which individual as there anonymous.

Please tick this box if you understand the above form consent form and wish to give consent * to proceed to the study?

☐ 'Yes"

Appendix F Demographic's questionnaire

Demographics Questionnaire

Please select the answer which best describes you

1. What Gender do you identify with?

Male / Female / Prefer not to say

2. What age are you? (Please specify in years)

_____

3. What is your marital status?

Single never married

Married or domestic partnership

Widowed

Divorced

Separated

4. Which role in the factory best suits your job description?

Production operator

Fitter/ mechanic/ electrician

Quality assurance

Team leader/ supervisor

Office work

5. Which shift do you currently work

Dayshift / Evening / Night shift

6. How long have you been on the current shift specified above (Number of years)

_____

Appendix G The Perceived Stress Scale

Perceived Stress Scale questionnaire

For each question choose from the following alternatives:

0 - never 1 - almost never 2 - sometimes 3 - fairly often 4 - very often

_____ l. In the last month, how often have you been upset because of something that happened unexpectedly?

_____2. In the last month, how often have you felt that you were unable to control the important things in your life?

_____3. In the last month, how often have you felt nervous and stressed?

_____4. In the last month, how often have you felt confident about your ability to handle your personal problems?

_____5. In the last month, how often have you felt that things were going your way?

_____6. In the last month, how often have you found that you could not cope with all the things that you had to do?

_____7. In the last month, how often have you been able to control irritations in your life?

_____8. In the last month, how often have you felt that you were on top of things?

_____9. In the last month, how often have you been angered because of things that happened that were outside of your control?

_____10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

Appendix H Attention Control Scale

Attention Control Scale

Here are some different ways that people can feel about working and concentrating. Please indicate how strongly each statement applies to you.

	1 = Almost never 2 = Sometimes 3 = Often 4 = Always
1. It's very hard for me to concentrate on a difficult task when there are noises around.	1 2 3 4
2. When I need to concentrate and solve a problem, I have trouble focusing my attention.	1 2 3 4
3. When I am working hard on something, I still get distracted by events around me.	1 2 3 4
4. My concentration is good even if there is music in the room around me.	1 2 3 4
5. When concentrating, I can focus my attention so that I become unaware of what's going on in the room around me.	1 2 3 4
6. When I am reading or studying, I am easily distracted if there are people talking in the same room.	1 2 3 4
7. When trying to focus my attention on something, I have difficulty blocking out distracting thoughts.	1 2 3 4
8. I have a hard time concentrating when I'm excited about something.	1 2 3 4
9. When concentrating I ignore feelings of hunger or thirst.	1 2 3 4
10. I can quickly switch from one task to another.	1 2 3 4
11. It takes me a while to get really involved in a new task.	1 2 3 4
12. It is difficult for me to coordinate my attention between the listening and writing required when taking notes during lectures.	1 2 3 4
13. I can become interested in a new topic very quickly when I need to.	1 2 3 4
14. It is easy for me to read or write while I'm also talking on the phone.	1 2 3 4

	1 = Almost never 2 = Sometimes 3 = Often 4 = Always
15. I have trouble carrying on two conversations at once.	1 2 3 4
16. I have a hard time coming up with new ideas quickly	1 2 3 4
17. After being interrupted or distracted, I can easily shift my attention back to what I was doing before.	1 2 3 4
18. When a distracting thought comes to mind, it is easy for me to shift my attention away from it.	1 2 3 4
19. It is easy for me to alternate between two different tasks.	1 2 3 4
20. It is hard for me to break from one way of thinking about something and look at it from another point of view.	1 2 3 4

Appendix I Debrief sheet

Debrief sheet

Please just click 'SUBMIT" at the bottom of this page to submit your responses.

Thank you very much for taking the time to participate in my research study!

I appreciate your help in allowing me to investigate the association between shift work, sleep quality, and how they may impact attention.

If you have any questions or concerns regarding this research study, please do not hesitate to contact me or my supervisor. I have listed our contact details below.

Myself the researcher: Niamh Langan,

3rd year Student researcher at the National College of Ireland,

x19465962@student.ncirl.ie

My supervisor and Programme Director of the Psychology department at NCI:

Dr. David Mothersill

David.Mothersill@ncirl.ie

Should you feel distressed after completing this research, please feel free to contact Samaritans who are open 24 hours a day to provide confidential non-judgemental emotional support.

Web:www.samaritans.org

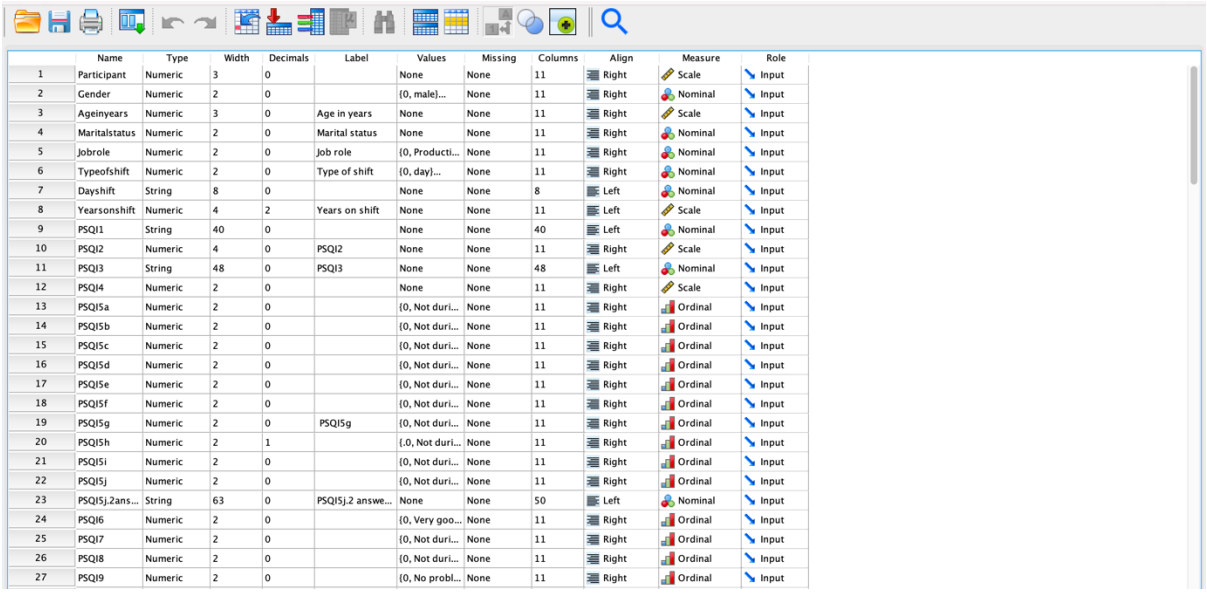
Helpline: 116 123

Phone 01 067 0071

Support Email: jo@samaritans.org

Appendix J Evidence of data from SPSS output

SPSS output



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4	Maritalstatus	Numeric	2	0	Marital status	None	None	11	Right	Nominal	Input
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6	Typeofshift	Numeric	2	0	Type of shift	{0, day}...	None	11	Right	Nominal	Input
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11	PSQI3	String	48	0	PSQI3	None	None	48	Left	Nominal	Input
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14	PSQI5b	Numeric	2	0		{0, Not duri...	None	11	Right	Ordinal	Input
15	PSQI5c	Numeric	2	0		{0, Not duri...	None	11	Right	Ordinal	Input
16	PSQI5d	Numeric	2	0		{0, Not duri...	None	11	Right	Ordinal	Input
17	PSQI5e	Numeric	2	0		{0, Not duri...	None	11	Right	Ordinal	Input
18	PSQI5f	Numeric	2	0		{0, Not duri...	None	11	Right	Ordinal	Input
19	PSQI5g	Numeric	2	0	PSQI5g	{0, Not duri...	None	11	Right	Ordinal	Input
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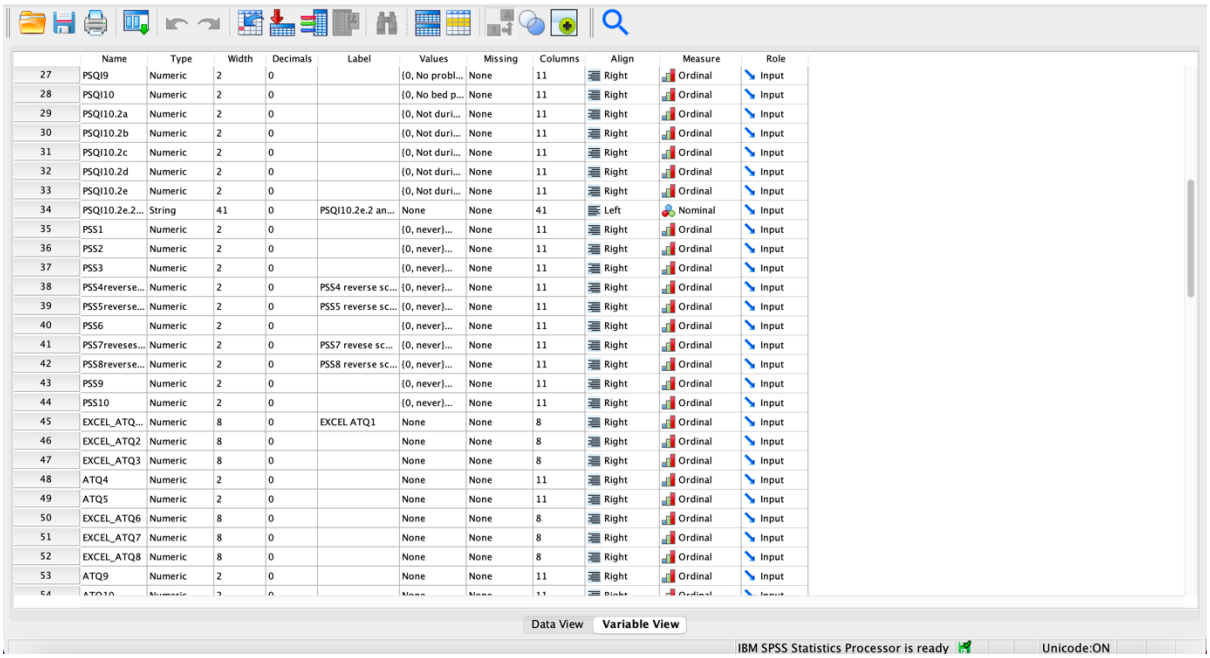
24	PSQI6	Numeric	2	0		{0, Very goo...	None	11	Right	Ordinal	Input
25	PSQI7	Numeric	2	0		{0, Not duri...	None	11	Right	Ordinal	Input
26	PSQI8	Numeric	2	0		{0, Not duri...	None	11	Right	Ordinal	Input
27	PSQI9	Numeric	2	0		{0, No probl...	None	11	Right	Ordinal	Input



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30	PSQI10.2b	Numeric	2	0		{0, Not duri...	None	11	Right	Ordinal	Input
31	PSQI10.2c	Numeric	2	0		{0, Not duri...	None	11	Right	Ordinal	Input
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36	PSS2	Numeric	2	0		{0, never}...	None	11	Right	Ordinal	Input
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38	PSS4reverse...	Numeric	2	0	PSS4 reverse sc...	{0, never}...	None	11	Right	Ordinal	Input
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43	PSS9	Numeric	2	0		{0, never}...	None	11	Right	Ordinal	Input
44	PSS10	Numeric	2	0		{0, never}...	None	11	Right	Ordinal	Input
45	EXCEL_ATQ...	Numeric	8	0	EXCEL ATQ1	None	None	8	Right	Ordinal	Input
46	EXCEL_ATQ2	Numeric	8	0		None	None	8	Right	Ordinal	Input
47	EXCEL_ATQ3	Numeric	8	0		None	None	8	Right	Ordinal	Input
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52	EXCEL_ATQ8	Numeric	8	0		None	None	8	Right	Ordinal	Input
53	ATQ9	Numeric	2	0		None	None	11	Right	Ordinal	Input

Data View | Variable View

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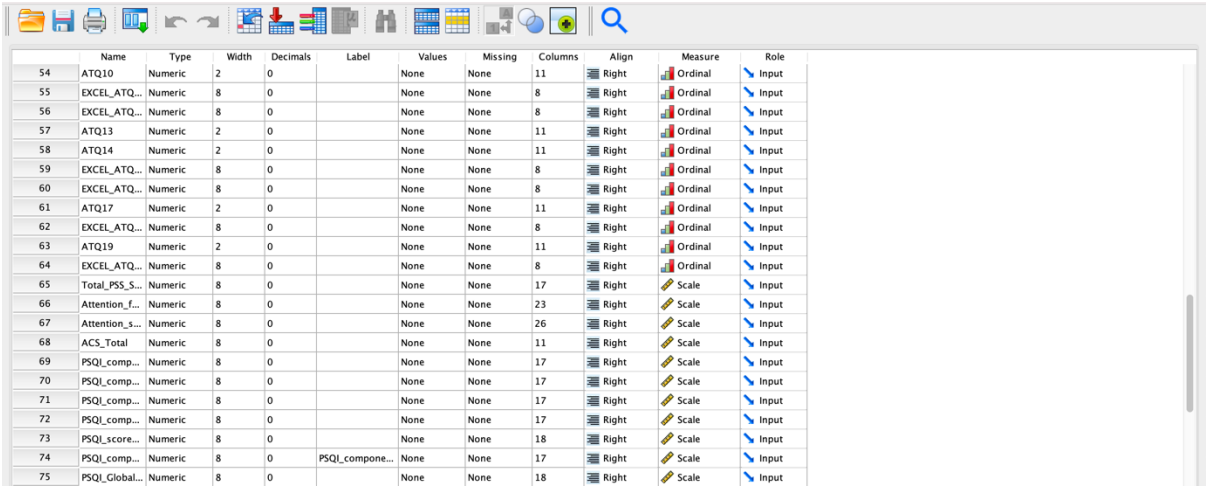

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71	PSQI_comp...	Numeric	8	0		None	None	17	Right	Scale	Input
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