COVID-19 Pandemic and Rotational Shift Work : Impact on Physical and Mental Health of Indian Nurses

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ABSTRACT:

Rotating shift work is necessary for many sectors that render 24-hour services, health institutions are one of these services. But shifting duty hampers both physical and mental health including sleep quality of the nurses. In particular, the night shift is one of the prominent stressors for the disruption of circadian rhythms, causing significant alterations of sleep and physiological functions that can affect physical and psychological well-being and negatively impact work performance. The study aimed to assess the effect of shift work on both the physical and mental well-being of the nurses (N=140) at a district Government Hospital, West Bengal, due to COVID 19 pandemic and subsequent shift work. A questionnaire-based cross-sectional study was performed. Sleep quantity and quality, depressive symptomatology, workload, alertness, and other health issues were assessed. Poor sleep quality, deteriorated physical and mental health had been reported which suggest that nurses with rotating shift schedule need special attention due to the higher risk of undesirable mental and physical health effects. Flexible policies should be taken to reduce the risk of COVID-infection, which will improve their health and wellbeing.

Keywords: *Shift work, COVID 19, Pandemic, Sleep, Depression, Workload, Alertness*

1. **Introduction:**

Working on a shift system, i.e., outside the regular 9 a.m. to 5 p.m. working hours, is frequently required in workplaces that operate on a 24-h schedule (Parent-Thirion et al. 2012). Schedules may differ by length, a number of consecutive shifts or shifts per week, speed, and/or direction of rotation and the presence or absence of night work (Parent-Thirion et al. 2012). The adverse effects of shift work on the workers' health and well-being have long been a subject of several previous studies (Boggild et al.1999; Ruggiero 2003; Erren et al. 2008; Fritschi et al. 2011; Bohle and Tilley 1989; Fossey 1990; Haus and Smolensky 2006). Rotational shift work is associated with an increased risk of metabolic disorders, cardiovascular abnormalities, cancer, and psychological disorders (Boggild et al.1999; Ruggiero 2003; Erren et al. 2008; Fritschi et al. 2011; Bohle and Tilley 1989; Fossey 1990; Haus and Smolensky 2006).

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Hospitals commonly require health care workers to work on a shift schedule to ensure continuity of care. Nurses make up an essential part of the health care team and have a wide range of responsibilities that involve constant monitoring and care of patients. They not only face the challenging nature of the job itself but also the hardships and the various effects associated with shift work. It is common for hospital nurses to work on rapidly rotating shift systems which may vary by the direction of rotation. They may follow a clockwise (CW) (forwards) rotation direction (i.e., day, afternoon, night) or a counterclockwise (CCW) (backwards) rotation direction (i.e., day, night, afternoon). The effect on the workers' physical and mental health due to the different directions of rotation is inconclusive. Several studies have shown that a CCW rotation schedule was associated with poorer sleep quality and quantity (Shon et al. 2016; Knauth 1997; Hakola and Harma 2001; Lavie et al. 1992). Other studies, however, have failed to show that the direction of shift rotation had differing repercussions on sleep, work performance, and work-life balance (Lavie et al. 1992; Cruz et al. 2003; Cruz et al. 2003).

The present study aimed to investigate the relationship between the shift system and its effects on hospital nurses' sleep quantity and quality, depressive symptomatology, workload, and other health issues. The understanding of these aspects is crucial for improving the work schedule organization of hospital nurses to promote health and wellness and reduce the shift work mal-adaptation.

On the other hand, pandemics or epidemics are public health emergencies. Nurses play a key role in the public health response to such a crisis. Nurses have been reported to experience more stress, anxiety, and depression during this 'Coronavirus Disease 2019' (COVID-19) challenging time as their work involves direct contact with affected patients. They are willing to accept the risk but concerns for personal and family safety, fear, and vulnerability issues remain paramount (Ritin et al. 2020). The significant impact of nurses' experiences highlights a need for strategies around self-care and ongoing support to ensure the health of nurses is maintained.

2. Methodology:

2.1 Subjects:

One hundred forty (140) subjects from a district Government Hospital, West Bengal, of age group ranging from 22 - 61 years (36.1 ± 12.60 years) were considered for the study. Out of which, 40 female subjects were nursing administrators comprising nursing superintendent, deputy nursing superintendents, and sister-in-charges and were involved in permanent dayshift system. The other 100 subjects were working as a staff nurse and engaged in counterclockwise rotational three-shift schedules (Morning-Night-Afternoon). All the data were collected following the human ethical guidelines according to the Declaration of Helsinki (drafted in 1964, amended in 2013).

2.2 Exclusion criteria: Subjects with any sort of genetic, congenital, and pathological condition were exempted from the study.

2.3 Assessment of shift system: Standard Shift-work Questionnaire (SSI) (Barton et al. 1995) was used to assess the shift system which deals with assessing general biographical health assessment, shift-working detailing, general job satisfaction, workload, and alertness evaluation.

2.4 Sleep quantity, sleepiness, and sleep quality: Munich Chrono-Type Questionnaire for Shift-Workers (MCTQshift) of Roenneberg et al. (2003) was used to record schedules like sleep duration, sleep latency, sleep inertia during workdays, and free days. Also, it was used to procure social jet lag.

Epworth Sleepiness Scale (ESS, Johns 1991) was used to determine the level of sleepiness at unusual times where the participants were categorized as under normal, mild, and moderate feelings of sleepiness. For evaluation of sleep quality, the Pittsburgh Sleep Quality Index (PSQI) had been used where score ≥5 indicates poorer sleep quality.

2.5 Evaluation of depressive symptomatology: The Center for Epidemiological Studies-Depression Scale (CES-D), as described by Radloff (1977), was used to determine the presence of depressive symptomatology. The score obtained was used to determine the severity of depressive symptomatology where scores between the range of 0 to 15 were considered under non-depressed and score equal to or greater than 16, were considered as depressed individuals.

2.6 Statistical analysis: Data represented as mean ± standard deviation (SD) and percentages when applicable. Statistical comparisons were performed by Student's *t*-test and ANOVA (Analysis of Variance). All statistical analyses were done using SPSS (Statistical Package for Social Sciences, Version 20.0, SPSS Inc., Chicago, IL) and differences were considered significant at $p<0.05$.

3. Results:

General biographical detailing as deduced from Standard Shiftwork Index revealed that participants belong to the age group 22-61 years with a mean age of 36.1 ± 12.60 years and experience of 7.1 ± 2.31 years. Shift working female personnel were found to be engaged in counterclockwise rotational three-shift schedules (Morning-Night-Afternoon) where, morning shift schedule accounts from 8a.m. to 2p.m. (8:00:00-14:00:00) = 6h; evening shift schedule from 2p.m. to 8p.m. (14:00:00-20:00:00) =6h and night shift schedule from 8p.m. to 8a.m. (20:00:00- 8:00:00) =12h. Table No. 1 depicts alertness and workload among the non-shift

worker and shifts workers across different shifts during and before the pandemic phase wherein significant ($p<0.001$) differences had been deduced during the pandemic phase.

Table 1: Alertness, Physical Workload, Mental Workload, Time pressure, and Emotional Stress among non-shift workers and shift workers during and before the pandemic phase.

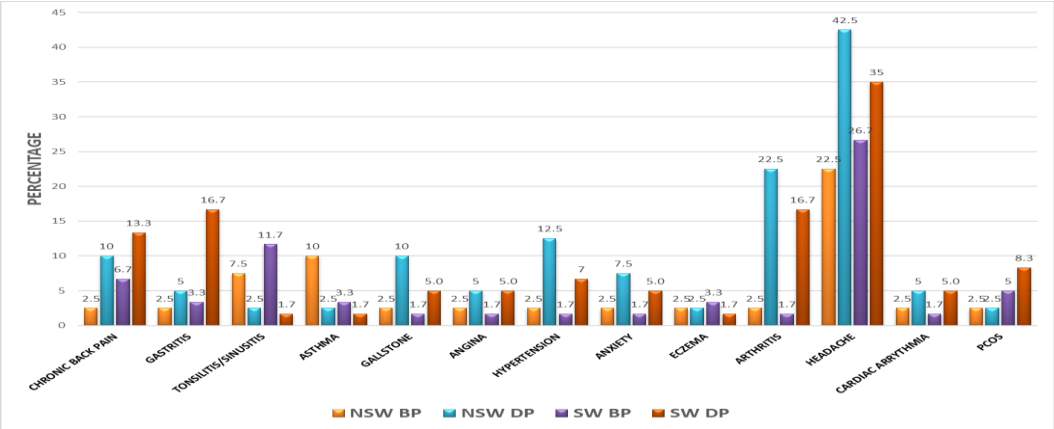
	NON-SHIFT WORKER		SHIFT WORKER						F-value	P-value
PANDEMIC PHASE	*Before pandemic*	*During pandemic*	*Before pandemic*			*During pandemic*				
SHIFT SCHEDULE			*Morning shift*	*Evening shift*	*Night shift*	*Morning shift*	*Evening shift*	*Night shift*		
ALERTNESS	61 ± 6.49	57.2 ± 5.48	60.7 ± 7.75	59.3 ± 7.36	65.1 ± 7.91	59.1 ± 6.01	53.1 ± 5.09	66.1 ± 5.52	16.873	<0.001
PHYSICAL WORKLOAD	3.6 ± 0.65	3.5 ± 0.71	3.7 ± 0.47	3.5 ± 0.49	3.5 ± 0.56	3.6 ± 0.61	3.2 ± 0.52	3.3 ± 0.60	4.703	<0.001
MENTAL WORKLOAD	3.4 ± 0.58	3.6 ± 0.67	3.6 ± 0.48	3.3 ± 0.54	3.7 ± 0.52	3.3 ± 0.50	3.1 ± 4.8	3.6 ± 0.62	7.159	<0.001
TIME PRESSURE	2.8 ± 0.74	4.1 ± 0.58	3.2 ± 0.75	2.9 ± 0.60	4.5 ± 0.49	3.1 ± 0.74	2.8 ± 0.52	4.5 ± 0.54	71.105	<0.001
EMOTIONAL STRESS	2.9 ± 0.62	2.7 ± 0.63	2.8 ± 0.81	2.6 ± 0.78	3.3 ± 0.81	2.6 ± 0.68	2.4 ± 0.63	3.3 ± 0.68	9.390	<0.001

Values expressed as mean ± SD.

The non-shift workers and shift workers had complained the significant presence of health comorbidities as experienced before (BP) and during (DP) pandemic phase and intensity of which had been depicted as a percentage increase in **Figure 1**. The figure is indicative of an increase in complains of hypertension, back pain, headache, digestive problems, a reproductive problem during the pandemic phase both among shift and non-shift workers.

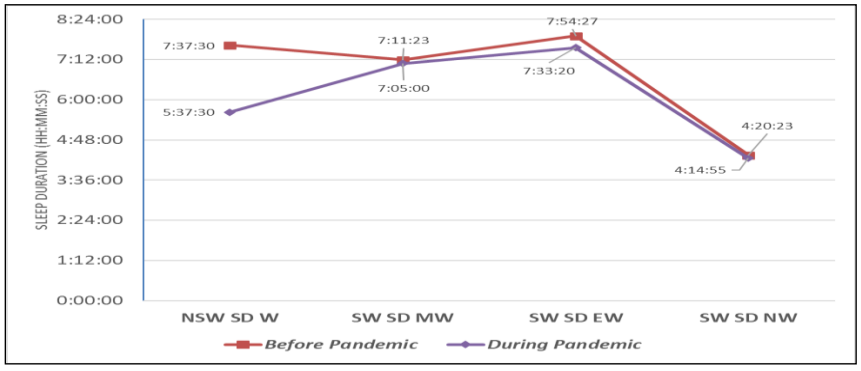
On analyzing sleep quantity and sleep quality, it was revealed that sleep duration had been worsened significantly ($F=6.801$, $p<0.001$) among the shift-workers in comparison to non-shift workers and also across various shifts both during workdays and work-free days as depicted in **Figure 2a & 2b**. Pandemic phase had a subsequent deleterious effect on sleep duration as evidenced during workdays which had to comprehend during free days. Further assessment on sleep latency depicted that each group had significantly ($F=3.906$, $p<0.001$) lowered sleep latency during the pandemic phase on comparing the prior situation which may be attributed to the fact of feeling excessive tiresome and sleepy. This had been depicted in Figures **3a & 3b**. Sleep inertia is another indicator of sleep parameter, on analysis of which revealed deteriorated value during a pandemic phase which marks sleep disturbance and had been presented in **Figures 4a & 4b**.

Figure 1: Subsequent increase in health comorbidities among non-shift and shift workers during the pandemic phase as compared to earlier.

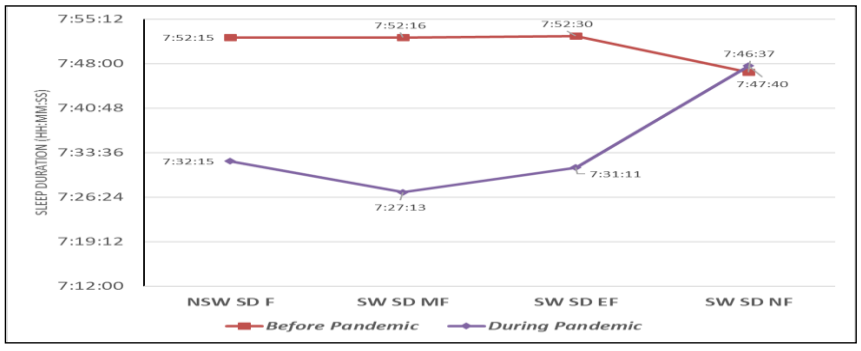


NSW BP=Non-Shift workers Before Pandemic; NSW DP=Non-Shift workers During Pandemic
SW BP= Shift workers Before Pandemic; SW BP= Shift workers During Pandemic

Figure 2: Statistical relation of sleep duration during (a) workdays (before and during pandemic) and (b) work-free days (before and during pandemic) among non-shift and shift workers.



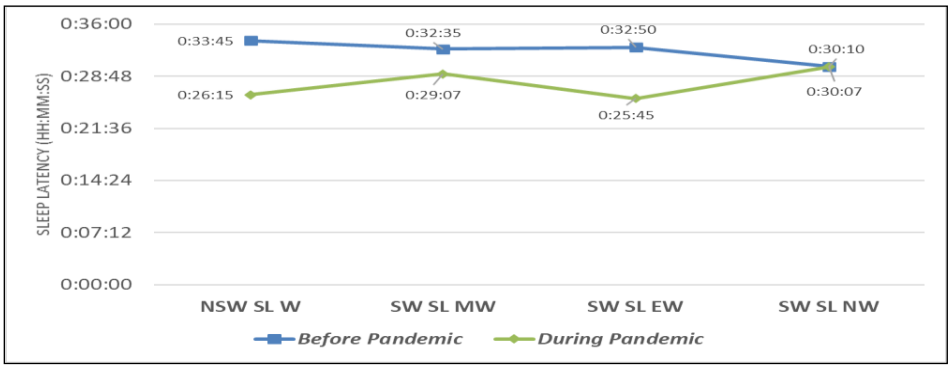
(2a) workdays (before and during pandemic)



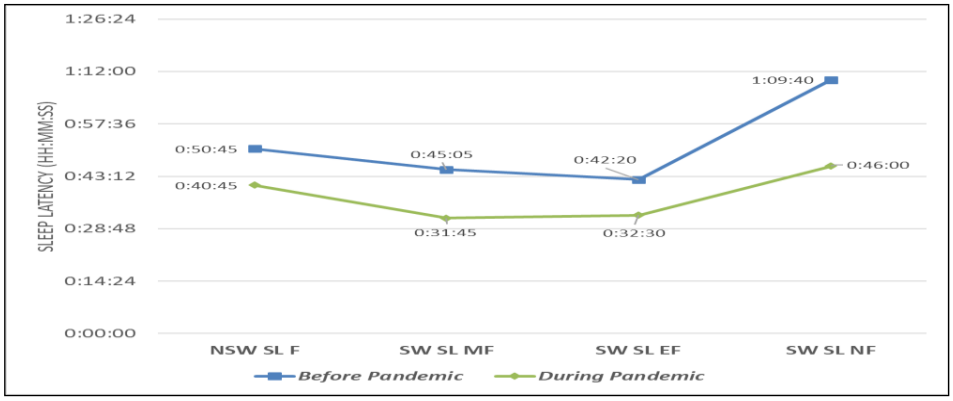
(2b) work-free days (before and during pandemic)

NSW SD W/F=Non-shift Workers Sleep Duration Workdays/Work-free days
SW SD MW/F=Shift Workers Sleep Duration Morning Shift Workdays/Work-free days
SW SD EW/F= Shift Workers Sleep Duration Evening Shift Workdays/Work-free days
SW SD NW/F= Shift Workers Sleep Duration Night Shift Workdays/Work-free days

Figure 3: Statistical relation of sleep latency during (a) workdays (before and during pandemic) and (b) work-free days (before and during pandemic) among non-shift and shift workers.



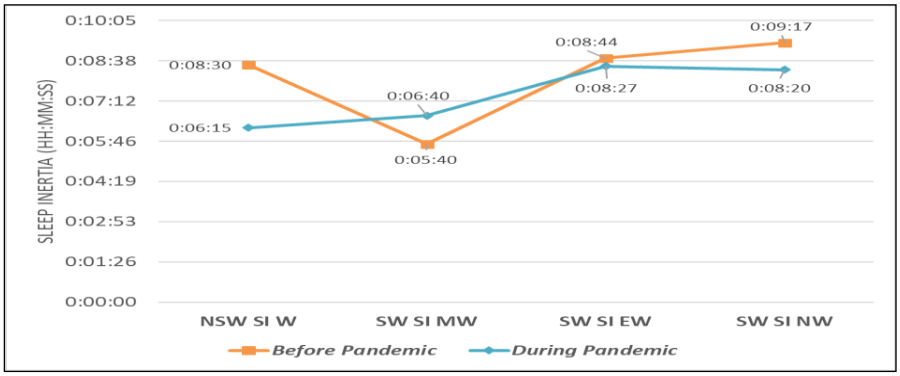
(3a) workdays (before and during pandemic)



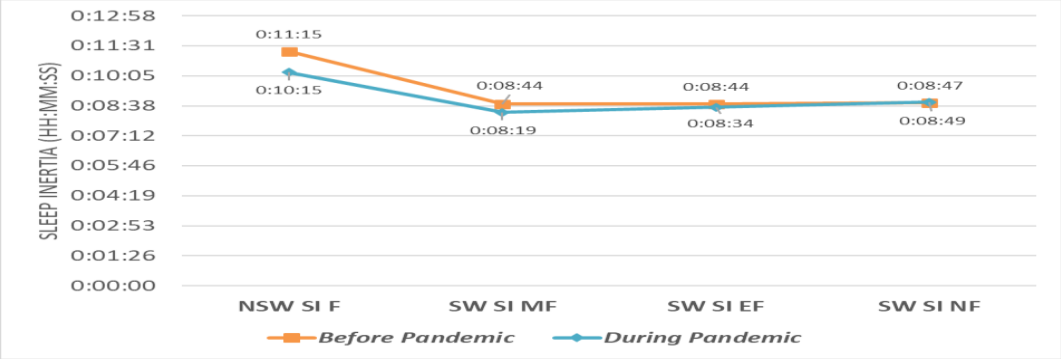
(3b) work-free days (before and during pandemic)

NSW SL W/F=Non-shift Workers Sleep Latency Workdays/Work-free days;
SW SL MW/F=Shift Workers Sleep Latency Morning Shift Workdays/Work-free days
SW SL EW/F= Shift Workers Sleep Latency Evening Shift Workdays/Work-free days
SW SL NW/F= Shift Workers Sleep Latency Night Shift Workdays/Work-free days

Figure 4: Statistical relation of sleep inertia during (a) workdays (before and during pandemic) and (b) work-free days (before and during pandemic) among non-shift and shift workers.



(4a) workdays (before and during pandemic)



(4b)) work-free days (before and during pandemic)

NSW SI W/F=Non-shift Workers Sleep Inertia Workdays/Work-free days
SW SI MW/F=Shift Workers Sleep Inertia Morning Shift Workdays/Work-free days
SW SI EW/F= Shift Workers Sleep Inertia Evening Shift Workdays/Work-free days
SW SI NW/F= Shift Workers Sleep Inertia Night Shift Workdays/Work-free days

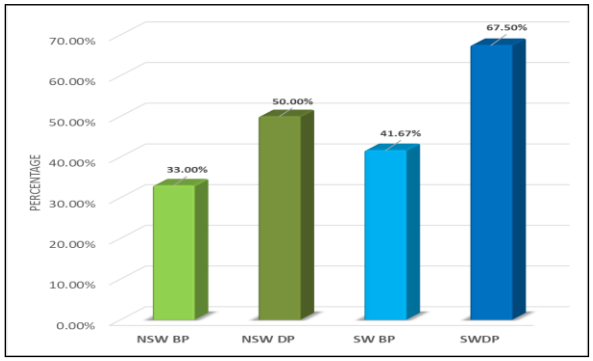
Interestingly a higher proportion of shift workers reported moderate sleepiness across the pandemic phase while comparing the prior situation as presented in **Figure 5**. A similar kind of situation was also prevalent among the non-shift workers though the situation is less adverse because of their working schedule. 50% of non-shift workers and 67.50% of shift workers (**Figure 6**) had reported poorer sleep quality as indicated by PSQI score ≥5. This is quite alarming and had been also depicted from sleep quantity analysis.

Figure 5: Percentage distribution of non-shift and shift workers concerning unusual sleepiness.

Inner circle depicts normal sleepiness; middle circle depicts mild sleepiness and outer circle depicts moderate sleepiness.

NSW BP=Non-Shift workers Before Pandemic;
NSW DP=Non-Shift workers During Pandemic
SW BP= Shift workers Before Pandemic;
SW BP= Shift workers During Pandemic

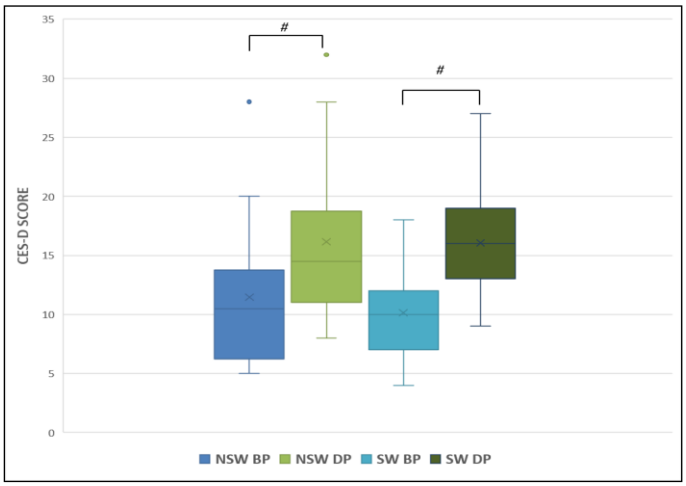
Figure 6: Percentage distribution of non-shift and shift workers depicting sleep quality as indicative of PSQI score.



NSW BP=Non-Shift workers Before Pandemic; NSW DP=Non-Shift workers During Pandemic
SW BP= Shift workers Before Pandemic; SW BP= Shift workers During Pandemic

Subsequent workload due to pandemic phase, reduce sleep quantity and quality, enhanced health problems affect the mental health and cause the development of depressive symptomatology as depicted in **Figure 7** where, CES-D score had ensued during pandemic phase significantly ($F=24.7921$, $P<0.001$) as compared to the prior situation and interestingly a similar trend was found both among non-shift and shift workers though shift workers had shown drastic alteration.

Figure 7: Box-Whisker plot representing the statistical relation of depressive symptomatology days among non-shift and shift workers during and before pandemic.



Data represented as median (horizontal bars inside the box) and range (Y-error bars).
NSW BP=Non-Shift workers Before Pandemic; NSW DP=Non-Shift workers During Pandemic
SW BP= Shift workers Before Pandemic ; SW BP= Shift workers During Pandemic

4. Discussion:

COVID 19 is a highly contagious disease that had been singly handled by the frontline workers of the world comprising of healthcare personnel, police, medical lab technicians, and others to

name so. Our study on shift working nurses of a government hospital revealed that they had been engaged in a counter-clockwise shift schedule with hectic 12 hours night duty. This pandemic session demanded an extensive workforce to combat patient safety and health. The contagious nature of this disease entails wearing of Personal Protective Equipment and enhanced workload. Though shiftwork had been associated with poor performance and reduced alertness attributed to circadian misalignment as reported (Ganesan et al. 2019), this pandemic had been cursing this phenomenon as the alertness had been significantly ($p<0.001$) disturbed due to this phase and also across the different shift. While comparing with non-shift workers there had been also significant ($p<0.001$) detrimental effect on alertness during the pandemic. Reduced alertness among shift working nurses may be attributed to the development of depressive symptomatology, as our study indicates a percentage increase from 6.25% to 39.56% among the shift workers and 2.63% to 11.23% among the non-shift workers. Depression had been associated with poor performance due to shifting working reported in earlier studies (Kang et al. 2017; Lee et al. 2017; Angerer et al. 2017) which is consistent with our findings and also this pandemic stress and anxiety had ensued its level. Our findings revealed significant ($p<0.001$) enhancement of mental and physical workload on both shift and non-shift workers during the pandemic phase as compared to earlier, with increased time pressure and emotional stress, which may also contribute to disturbed alertness and mental health. Extensive working hours and shift schedules had been associated with the reduced performance which is consistent with our findings (Caruso, 2014). There had also been temporal variations of job demand and thus varied physical workload which causes postural stress and subsequent development of musculoskeletal disorder which demands ergonomic interventions (Sahu et al. 2012; Goswami et al. 2013). Nature of job demand in night shift is more in the psychological domain rather than the physiological one due to disruption of biological rhythms where perceived exertion found to be higher in night shifts whereas reaction time was found to be lower in both the morning and night shifts (Halder et al. 2013).

Shift working nursing staff reported health problems more during pandemic phase than previous and this phenomenon is similar among non-shift working staff though percentage response of deteriorated health is common among shift workers. Headache, back pain, cardiovascular problems, gastrointestinal problems, and reproductive problems were highest to be reported by the respondents during the pandemic and mostly among shift working for personnel. Hectic shift schedules may be associated with the development of health comorbidities which get worsened during this pandemic, even non-shift workers also reported significantly higher health issues. Costa (2010) had summarized the effect of shift work on health which depicted that disruption of biological circadian rhythms and sleep/wake cycle ends in several psychosomatic troubles and disorders, including cancer, and extending to impairment of performance efficiency as well as family and social life. A study suggests that shift work is associated with menstrual irregularities, reproductive disturbances, and risk of

adverse pregnancy outcome (Labyak et al. 2002) which is quite homogenous with our findings which showed increment (5.0% to 8.3%) in Poly Cystic Ovarian Syndrome among the shift workers. Nurses with rotating night schedule develop job dissatisfaction and undesirable health effects as reported by the lowest mean score in the items of job satisfaction, quality, and quantity of sleep, with more frequent chronic fatigue, psychological, and cardiovascular symptoms in comparison with the day shift workers, in a statistically significant way (Ferri et al. 2016).

Shift work had been linked with the development of Shift Work Sleep Disorder (SWSD) owing to shift schedule and circadian misalignment due to altered sleep/wakeful cycle (Haile et al. 2019). Our study confirmed that shiftwork emanates sleep disturbances while reducing proper and continuous sleep duration consistent across different shift schedules. It was observed that the pandemic phase had also demarcated its efficacy on sleep duration among both shift and non-shift workers ($F=6.801$, $p<0.001$). 67.50% shift working respondents reported poorer sleep quality during pandemic compared with 50% non-shift workers. Prior to the pandemic phase, 41.67% shift workers reported poor sleep quality that may be due to their hectic shift schedule, working hours, and workload. Considering the feeling of sleepiness among the shift workers, it was observed that 52.5% shift workers reported moderate sleepiness while 22.5% reported normal sleepiness during the pandemic phase which indicated dearth inappropriate sleep. Sleep impairment among shift workers is quite common which is associated with an increased level of health complaints and physiologic indices of stress (Fadeyi et al. 2018; McDowall et al. 2017). Disease pandemic and subsequent lockdown had been associated with depression and poor sleep quality was also reported among office workers and students (Majumdar et al. 2020). Sleep latency and sleep inertia were also found to vary significantly across the group due to pandemic and shift schedules. Lesser sleep latency and more sleep inertia are indicative of disturbed sleep, anxiety, and fatigue. Our findings suggested significant varied sleep latency among shift workers performing shifting duty while in pandemic on comparison with non-shift workers ($F=2.136$, $p<0.05$), also, the value of sleep inertia altered significantly among the groups ($F=3.906$, $p<0.001$). Shift work is associated with reduced sleep duration and least between night shifts impairs work efficiency due to hampered alertness and performance (Halder et al. 2015).

So, it can be concluded that sleep disorders among shift working nurses are very common and the situation is becoming alarming due to the COVID-related stress. This study proves a high prevalence of disturbed mental health, physical health, and poor sleep quality among shift working nurses due to extensive night shift workload and unorganized shift schedules where night shifts were associated significantly with altered alertness.

Preservation of normal diurnal orientation is very important for good sleep quality and adequate sleep duration of nurses. From this perspective, the sleep-wake strategy with long naps during night work and short day-time sleep is more beneficial for sleep quality and readjustment to diurnal life than the strategy with long day-time sleep and preventive late afternoon naps to anticipate sleepiness during night work. Therefore, shift-working nurses should be properly counseled on their sleep-wake strategy.

On the other hand, COVID-19 being a highly contagious disease, it is believed that a flexible, adjustable policy and protocols play a vital role in reducing the infection. Policies that reduce the effects of shift work may include reducing the night shift hours, increasing the rest time between shifts, providing adequate meal times, and providing a fair distribution of weekend and holiday work, etc. The WHO (COVID-19 Treatment Guidelines. *www.nih.gov*. National Institutes of Health), the Chinese national health commission, and the United States' National Institutes of Health have published recommendations for taking care of people, who are hospitalized with COVID-19 (Cheng et al. 2020), that should be followed strictly. Thus, by maintaining personal hygiene, having a healthy lifestyle, and spreading proper awareness, the COVID-related stresses can be reduced.

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***Authors' Contribution:**

Subhashis Sahu conceived the study design and finally approved the manuscript. Piya Majumdar conceived the study design and responsible for data collection, manuscript writing, data representation, data analysis, and data interpretation. Olivia Barman contributed to data collection. Pritha Chakraborty contributed to manuscript writing.

***Disclosure statement:**

The authors report no conflict of interest.

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