

## Shift work and its effect on pulmonary functions – A pilot study

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### Abstract

**Objectives:** Many of the homeostatic mechanisms of the body are found to be disturbed when there is a change in the circadian rhythm, commonly seen in shift workers. Objective of this study was to evaluate the impact of circadian disturbance on pulmonary functions among a group of Business process outsourcing (BPO) employees. **Methods:** Shift workers of a BPO company were recruited after informed consent. 20 night shift and 20 day shift workers were included in the study. They answered a questionnaire, response to which yielded information pertaining to sleep and personal particulars. The pulmonary functions were assessed in day and night shift workers and compared them. Statistical analysis was done using SPSS 18.0 version software. **Results:** No significant changes were observed in any of the pulmonary function tests. **Conclusion:** These shift workers are prone to have a disturbance in circadian rhythm which could lead to sleep related morbidity. There is a need to create awareness among the organizations about the health related issues associated with shift working. However, as observed with pulmonary functions, there was no disturbance seen in the shift workers.

**Keywords:** Shift work, pulmonary function tests, Sleep deprivation

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### INTRODUCTION

Business process outsourcing (BPO) is the contracting of a specific business task, such as payroll, to a third party service-provider[1]. The most common examples of BPO are call centers, human resources, accounting and payroll outsourcing. India has one of the largest pools of low-cost English speaking scientific and technical talent, thus making it an obvious choice to outsource to multinational companies in India and abroad[1]. Already, more than a lakh Indians are employed in call center operations. In Bangalore more than 45 large BPO units have come up in the last couple of years. In the past 8 months more than 35,000 people have been recruited in Bangalore according to industry experts.

Concern has been expressed over the health problems faced by the young population employed in this industry. Health concerns are a major issue as these centers expect their employees to work in shifts in order to facilitate non-stop day and night service to customers. The various health issues in the BPO industry include those related to stress, depression, eyesight problems, ear problems, behavioral issues and interpersonal relationships[2]. Shift work is also associated with numerous negative effects, including shortened, disturbed sleep, fatigue, decreased alertness, cognitive deficits, increased injuries, accidents, reproductive disorders, and risks to cardiovascular and gastrointestinal health [3].

Circadian rhythms are physiological or behavioral cycles with a period of approximately 24 hours produced by an endogenous pacemaker, evidently the suprachiasmatic nucleus (located in the hypothalamus) being the master circadian clock of the body[4,5]. Circadian rhythm disturbance is not infrequent

among shift workers who, in turn, comprise a large segment of the population employed in the BPO industry. The individual's circadian rhythm is normal but challenged because the sleep-wake internal biological clock setting is at odds with the sleep wake cycle of the shift work schedule.

In addition, many clinical conditions result from disturbed sleep that worsens the acute, chronic respiratory and primary sleep disorders (e.g. insomnia and obstructive sleep apnea). If sleep deprivation alters various aspects of respiratory function, it could have important implications on the management of patients with respiratory disease and sleep disorders[6]. Earlier studies have demonstrated a diurnal rhythm in pulmonary function in healthy individuals and subjects with asthma, with minimal levels occurring during the night. The effect of sleep deprivation on pulmonary functions has been extensively investigated in adult humans [7-10]. But the results have been conflicting. There have been very few studies evaluating pulmonary functions conducted on BPO employees in India. In the present study we sought to determine the magnitude of changes in pulmonary functions among the night shift workers by means of a pilot study and to decrease the inconsistency among results of previous studies.

### MATERIALS AND METHODS

The present study was conducted at a Business process outsourcing company employing people on shift work. Clearance for the study was obtained from the scientific and ethical committee of local institutional ethical board as per ICH GCP Guidelines. Informed consent was obtained from all the participants of the study. The company and the participants who agreed to participate in the study were assured of the confidentiality. Two groups were used in this study. Twenty healthy night shift workers who had been working on regular night shift for at least 3 months were selected after a general physical examination. Those shift workers with pre-existing cardiovascular, pulmonary, psychiatric problems or any other comorbidity were excluded from the study. Age and sex matched twenty healthy day shift workers who had never been exposed to shift work schedule or done night shifts were recruited as control

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group. These workers were recruited from a company that was involved working only in day shift. None of the subjects were on any medication. The working time for night shift was from 22.00 to 08.00 IST and day shift was from 09.00 to 16.00. The subjects were instructed to avoid coffee, tobacco and alcohol consumption for at least 24 hours before the study.

Detailed medical history was recorded using oral questionnaire method. Height, weight, body mass index (BMI) in kg/m<sup>2</sup>, BP was also recorded. Duration of employment was noted. Sleepiness of the shift workers were assessed by Epworth sleepiness scale (ESS). The values of ESS score greater than 10 was considered as indicative of excessive sleepiness (1-6 = normal, 7-9 = average, >10 = very sleepy). The pulmonary function tests were performed using Spirobank G computerized spirometer (RMS, India). The pulmonary function tests (PFT) included forced vital capacity (FVC), forced expiratory volume in 1 second (FEV<sub>1</sub>), FEV<sub>1</sub>/FVC ratio and peak expiratory flow rate (PEFR). The PFT in night shift workers were compared with the day shift workers.

The data of all the above were analyzed using SPSS 18.0 version software (SPSS Inc., Chicago, USA). Comparison of the data was done using the Student's t test. The p value <0.05 was considered significant.

## RESULTS

In this study, age and sex matched controls (day shift workers) were selected. Thus there was no significant difference in the age and gender distribution among the two groups. The body mass index was also not significantly different. Though the duration of employment in months was higher among night shift workers, the difference was not statistically significant from the day shift workers. One factor that differed significantly between the two groups was the sleepiness as indicated by Epworth sleepiness scale (ESS), with night shift workers exhibiting higher sleepiness than day shift workers. We observed that the pulmonary functions did not vary significantly [ ].

## DISCUSSION

Sleep is essential for life, critical for maintenance of good health and well being. Sleep deprivation is a common feature of urbanization, development of information and technology. The need for 24 hour availability of essential services in modern society requires many in the work force to reverse their normal diurnal sleep-wake cycle [12]. In many occupational settings, such as shift work done by BPO employees involved in telephonic and voice support, individuals work during non-conventional hours. They suffer from sleep related problems due to the disruption in their normal sleep pattern. Majority of them are unable to sleep adequately during day time and hence develop cumulative sleep debt leading to significant sleep deprivation[13]. In this study, we found a significant difference in the sleepiness among day and night shift workers, with night shift workers having significantly higher sleepiness during day time and routine activities.

The effects of sleep deprivation on pulmonary function have been extensively studied in adult humans. These include blunting of ventilatory responses to hypoxia and hypercapnia [14], an increase in the frequency and duration of obstructive apnea in patients with sleep apnea syndrome[15]. Though definitive studies are lacking, sleep itself may play a direct role in the nocturnal worsening of asthma. Sleep deprivation reduces, but does not abolish nocturnal airway narrowing. Overnight airway narrowing persists in patients with asthma who are awake all night. Sleep deprivation for as little as 24 hours can reduce the ventilatory drive by as much as one third. Blunting of respiratory drive along with fatigue and persistent bronchospasm, may be a critical factor in the development of hypoxemia and hypercapnia in some of these patients. Circadian variations in airflow, inflammation, physiologic variables including airflow limitation and airway hyper-responsiveness along with melatonin, a neurohumoral regulator of circadian rhythms, might be important[16].

The effect of sleep deprivation has shown decreases in respiratory parameters, such as forced vital capacity and forced vital capacity in one second (FEV<sub>1</sub>) [17], while in another study

**Table1: Comparison of variables between day and night shift workers**

Parameters	Night shift workers Mean ±SD	Day shift workers Mean ±SD	P Value
Age	25.69±3.6	25.69±3.6	1.0
Gender (% of subjects; Males = M, Females = F)	M = 30.6, F = 69.4	M = 27.8, F = 72.2	0.957
Duration of employment (months)	49.42±33.6	41.39±24.6	0.251
Body mass index (in kg/m <sup>2</sup> )	21.94±3.8	20.53±3.0	0.081
ESS Score	9.69±3.7	2.64±1.8	<0.001
Observed FVC	3.17±0.72	3.06±0.90	0.723
Observed FEV <sub>1</sub>	2.63±0.59	2.65±0.78	0.930
Observed FEV <sub>1</sub> /FVC	85.31±9.12	86.89±8.05	0.639
Observed PEFR	6.40±1.95	6.18±1.91	0.769

Note: a) P<0.05 was considered significant.

there were no alterations in any of the lung function parameters [18]. In our study we did not observe any significant variation between the day and the night shift workers. The probable causes may be that the night shift workers pulmonary functions do not change with disturbances in circadian rhythm. Early changes have been reported in the cardiac and cerebral vasculature due to circadian rhythm disturbance[19,20]. It could also be because all the subjects were relatively healthy, the duration of employment was lesser than 5 years.

## CONCLUSION

In the present study the impact of circadian rhythm disturbance in night shift workers in BPO industry on respiratory system has been studied. . There seems to be minimal changes in the pulmonary functions due to disturbance in the circadian rhythm among the night shift workers. Studies involving larger number of subjects who have worked for a longer duration in night shift may through light on the possible pulmonary disturbance. Evaluation of various morbidities suggestion of remedial measures to mitigate these problems is the need of the hour. A healthcare policy aimed at addressing the issues pertaining to the health status of this category of workers (call center employees) would improve the acceptability.

## REFERENCES

1. Business process outsourcing [Internet]. Wikipedia, the free encyclopedia. 2013 [cited 2014 Jan 14]. Available from:[http://en.wikipedia.org/w/index.php?title=Business\\_process\\_outsourcing&oldid=587100037](http://en.wikipedia.org/w/index.php?title=Business_process_outsourcing&oldid=587100037)
2. Suri JC, Sen MK, Singh P, Kumar R, Aggarwal P. Sleep patterns and their impact on lifestyle, anxiety and depression in BPO workers. *Indian J Sleep Med.* 2007;2(2):64–70.
3. Burgess HJ, Sharkey KM, Eastman CI. Bright light, dark and melatonin can promote circadian adaptation in night shift workers. *Sleep Med Rev.* 2002 Oct;6(5):407–20.
4. Lu BS, Zee PC. Circadian rhythm sleep disorders. *Chest.* 2006 Dec;130(6):1915–23.
5. Fahey CD, Zee PC. Circadian rhythm sleep disorders and phototherapy. *Psychiatr Clin North Am.* 2006 Dec;29(4):989–1007; abstract ix.
6. Spengler CM, Shea SA. Sleep deprivation per se does not decrease the hypercapnic ventilatory response in humans. *Am J Respir Crit Care Med.* 2000 Apr;161(4 Pt 1):1124–8.
7. Hetzel MR, Clark TJ. Does sleep cause nocturnal asthma? *Thorax.* 1979 Dec;34(6):749–54.
8. Hetzel MR, Clark TJ. Comparison of normal and asthmatic circadian rhythms in peak expiratory flow rate. *Thorax.* 1980 Oct;35(10):732–8.
9. Bagg LR, Hughes DT. Diurnal variation in peak expiratory flow in asthmatics. *Eur J Respir Dis.* 1980 Oct;61(5):298–302.
10. Guberan E, Williams MK, Walford J, Smith MM. Circadian variation of F.E.V. in shift workers. *Br J Ind Med.* 1969 Apr;26(2):121–5.
11. Johns MW. A new method for measuring daytime sleepiness: the Epworth sleepiness scale. *Sleep.* 1991 Dec;14(6):540–5.
12. Santhi N, Duffy JF, Horowitz TS, Czeisler CA. Scheduling of sleep/darkness affects the circadian phase of night shift workers. *Neurosci Lett.* 2005 Aug 26;384(3):316–20.
13. Freitas J, Lago P, Puig J, Carvalho MJ, Costa O, de Freitas AF. Circadian heart rate variability rhythm in shift workers. *J Electrocardiol.* 1997 Jan;30(1):39–44.
14. White DP, Douglas NJ, Pickett CK, Zwillich CW, Weil JV. Sleep deprivation and the control of ventilation. *Am Rev Respir Dis.* 1983 Dec;128(6):984–6.
15. Guilleminault C. Sleep apnea syndromes: impact of sleep and sleep states. *Sleep.* 1980;3(3-4):227–34.
16. Ghoshal AG. Asthma and sleep. *Indian J Sleep Med.* 2007;2(2):37–9.
17. Murphy K, Delanty N. Sleep deprivation: A clinical perspective. *Sleep Biol Rhythms.* 2007;5(1):2–14.
18. Kaygisiz Z, Erkasap N, Soydan M. Cardiorespiratory responses to submaximal incremental exercise are not affected by one night's sleep deprivation during the follicular and luteal phases of the menstrual cycle. *Indian J Physiol Pharmacol.* 2003 Jul;47(3):279–87.
19. Glos M, Fietze I, Blau A, Baumann G, Penzel T. Cardiac autonomic modulation and sleepiness: Physiological consequences of sleep deprivation due to 40h of prolonged wakefulness. *Physiol Behav.* 2014 Feb 10;125:45–53.
20. Schei JL, Rector DM. Evoked electrical and cerebral vascular responses during sleep and following sleep deprivation. *Prog Brain Res.* 2011;193:233–44.