

Original Article

Effect of Acute sleep deprivation on blood cell count in healthy young individuals

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Abstract:

Introduction: Various studies throughout the world have reported that sleep deprivation is associated with an increased risk of morbidity and mortality. Thus people with unusual working hours are commonly affected. Various research works have also indicated that there is a relation between the human circadian system in sleep deprivation and the immune parameters. To evaluate the variation of white blood cell (WBC) count in healthy young individuals during day shift and night shift in the same individuals.

Materials and methods: The study was a Hospital based cross sectional study conducted on 20 Normotensive Shift workers aged between 25- 45 years. Blood samples were collected twice from the individuals, once during their day shift and the second during their night shift.

Results: The results were recorded in tabular format and mean with standard deviation was used to express the result. Neutrophil count was found to vary significantly before and after sleep deprivation.

Conclusion: Variation in WBC counts especially granulocytes (neutrophils) is noted from the study and further studies may be done to evaluate the risk factor of sleep deprivation on diseases of the immune system as well as diabetes, obesity and hypertension.

Keywords: Sleep Deprivation, White blood cell count

Introduction:

The human life is governed by the circadian timing system, which includes the regulation of physiology, behaviour, and the sleep-wake cycle. In our day- today activities, these cycles are entrained on a daily basis by regular day-night changes with light as the main synchronizing factor.¹ Several reports indicate that sleep deprivation is associated with an increased risk of morbidity, mortality (Heslop et al 2002) and hypertension (Gangwisch et al 2006).²

It has also been noted that sleep deprivation is associated with the development of severe

pathologies including obesity, diabetes, and hypertension.^{3, 4} People who have unusual working hours, such as shift workers, seem to be particularly affected; a recent in-depth review on the association between night work and the development of chronic diseases including breast cancer, cardiovascular disease, and metabolic syndrome concluded that there is evidence for such a link from currently available datasets.⁵ Several studies have investigated the role of the human circadian system in sleep deprivation and on circulating immune parameters.^{6, 7}

The goal of this study was to provide an in-depth characterization of diurnal rhythms in circulating levels of different blood cell counts under a highly controlled laboratory protocol incorporating a sleep-wake cycle, timed meals, controlled posture, and environmental lighting. In addition, the study assessed the effect of a night of acute sleep deprivation on the blood cell parameters in a within-subject design to characterize changes of the immune system in the body's acute stress response. The present study was done to evaluate complete blood cell count variation in healthy young individuals during day shift and same individuals after night shift.

Materials and Methods:

Study area and setting: The study was conducted in Sri Manakula Vinayagar medical college hospital Madagadipet, Puducherry.

Study design: Hospital Based Cross Sectional study. Permission was obtained from the Institutional ethics committee and all ethical etiquettes were adhered to.

Sample size: Sample size was calculated using WBC count of 5.79 ± 1.04 without sleep deprivation to 6.88 ± 1.31 after sleep deprivation for 3 days² at 95% confidence interval using 80% power in Epi Info Software. The derived sample size was 19 individuals. The study population

Results:

The results are reported in a tabular format as follows.

Table 1: Showing the mean with standard deviation of the white blood count recorded.

Sleep Deprivation/Granulocyte Cell type	Before Sleep Deprivation (Mean with Standard deviation)	After Sleep Deprivation (Mean with Standard deviation)
Neutrophils	48.58 ± 5.30	50.49 ± 5.90
Lymphocytes	39.23 ± 7.10	39.57 ± 7.87
Eosinophils	9.80 ± 6.74	9.42 ± 6.49
Basophils	0.26 ± 0.19	0.39 ± 0.16

As shown in the Table 1, among the granulocytes observed, neutrophils showed a significant variation before and after sleep deprivation.

consisted of 20 shift workers. 20 blood samples were collected during day shift and 20 blood samples were collected after night shift from the same individuals.

Inclusion criteria:

1. Male subjects 25 -45 years of age.
2. Normotensive subjects having blood pressure 120/80mmHg

Exclusion criteria:

1. History of cardiovascular disease
2. History of respiratory disease
3. History of drug Medications (anti-psychotic drugs) for past three months

Data collection:

Informed consent was obtained and details regarding their identity and medical history along with blood pressure were recorded. Blood samples were collected for white blood count.

Complete blood count: Three ml of whole blood will be collected from the patients with dry disposable syringe and needle by veni- puncture under all aseptic precautions.

Analysis of quantitative data: Blood counts like neutrophils, lymphocytes, eosinophils and basophilswere used and mean with standard deviation (SD) after day shift and after night shifts were calculated.

It is also noted from the table that there was an increase in all the parameters i.e. neutrophils, lymphocytes, basophils except eosinophils which showed an increase in the mean value following sleep deprivation.

The eosinophil count decreased from a mean of 9.80 before sleep deprivation to 9.42 after sleep deprivation.

Thus, the difference between the mean values of various types of granulocytes (WBC) before and after sleep deprivation was significantly noted in the neutrophils followed by basophils and lymphocytes.

The eosinophil count was seen to vary unlike the other 3 parameters.

Discussion:

Under normal sleep-wake cycle and lighting conditions, diurnal rhythms have been identified in levels of circulating blood cell counts (leukocyte subsets), with lymphocyte levels peaking during the night.^{8, 9, 10} Inconsistent results, however, have been observed for (neutrophil) granulocytes and monocytes⁹⁻¹³.

Moreover, although some studies have found no statistically significant effect of sleep deprivation on diurnal rhythms in blood cell levels, other studies have reported elevated levels of lymphocytes or leukocytes.^{9, 11}

Born J et al. have explained lymphocytes and their sub populations as monocytes, showing a peak time during night¹². Faraut B et al. showed that the over-

all increase in circulating levels of granulocytes increase in neutrophil counts after one night partial sleep restriction. Lange T et al. have shown that, chronic (partial) sleep loss is part of our modern 24-hr, 7-days-a-week society, and can be accompanied by long-term consequences on the immune system as well as increased risk of developing cardiovascular disease, metabolic syndrome, obesity and diabetes². Pagana KD et al. have showed that, inter- individual variation of the percentage composition of WBC was very high, particularly in the case of the granulocyte population⁴. In the present study it has been noted that there was significant increase in all granulocyte counts except eosinophils. The increase was mainly noted in the mean value of neutrophils, followed by the basophils and lymphocytes.

Conclusion:

As seen from the present study as well as various other literatures recorded it is evident that there is a definite relation between the circadian cycle of the human beings and immunological counts especially those of granulocytes, such as neutrophils, lymphocytes, basophils and eosinophils. Further studies can be conducted in larger populations to establish these immunological variations as well as sleep deprivation as markers of rapidly developing diseases such as diabetes, hypertension, and various other diseases.

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