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ASSOCIATION OF MELATONIN SECRETION IN NIGHT SHIFT HEALTHCARE WORKERS IN A TERTIARY CARE HOSPITAL IN WESTERN UTTAR PRADESH

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Abstract

Introduction: The pineal gland is positioned in the hypothalamus of the brain and it is influenced by the level of exposure to light. Melatonin secretion exhibits a diurnal rhythm, its level rises sharply 3-5 hours after sleep. Night shift work has been found to expose individuals to several elements that can potentially disrupt the circadian physiological mechanism. Insufficient sleep as well as sleep disorders resulting from shift work, have been linked to adverse impacts on hormonal regulation and an increase in energy balance. **Aim:** To find association between melatonin secretion in night shift and day shift healthcare workers in a tertiary care Hospital in Western UP **Materials and Methods:** Blood Samples of night shift and day shift healthcare workers were collected and melatonin levels were estimated in the plasma using ELISA. Anthropometry measurements like weight and height were also measured. **Results:** Insignificant variations in the melatonin levels between night shift and day shift healthcare workers were observed. **Conclusion:** Insignificant variations in the melatonin levels between night shift and day shift healthcare workers were observed. There is no correlation of melatonin with BMI and age in both case and control study groups. It can be concluded from this study, that melatonin levels do not vary according to the time of shift and duration of sleep at night.

Keywords: Melatonin, Shift Work, Healthcare Workers, ELISA

INTRODUCTION

The pineal gland is positioned in the hypothalamus of the brain and it is influenced by the level of exposure to light. The gland produces the hormone melatonin[1]. Melatonin secretion exhibits a diurnal rhythm, characterized by a significant increase occurring approximately 3 to 5 hours after the onset of nocturnal rest in the absence of light and minimal production during daylight hours[2]. Melatonin receptors are distributed across several tissues throughout the body, including pancreatic islet cell[3]. The secretion of melatonin facilitates sleep and suppresses waking signals. Shift labour has become an integral part of the community, extending beyond vital services such as healthcare and public safety to encompass various manufacturing sectors and service industries[4]. Night shift work has been found to expose individuals to several

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elements that can potentially disrupt the circadian physiological mechanism, leading to desynchronization[5,6]. Extensive research has demonstrated that engaging in shift work is related with a considerable risk of developing dyslipidaemias, diabetes, and systemic arterial hypertension[7,8]. Several studies have found a favourable correlation between night shifts and body mass index (BMI), with night shift workers having considerably higher BMI compared to those who work during the day[9,10].

According to Knutson et al., a shorter sleep duration is linked to a higher risk of developing metabolic syndrome[11]. Insufficient sleep, characterised by a duration of 6 hours or less each day, as well as sleep disorders resulting from shift work, have been linked to adverse impacts on hormonal regulation and an increase in energy balance[12]. The concept of the "melatonin hypothesis" is being discussed in many researches. The hormone melatonin is synthesised during night-time and periods of darkness. The suprachiasmatic nucleus (SCN) receives information about patterns of light and darkness from the retina. Some researchers have demonstrated that melatonin can directly scavenge free radicals[13].

Sleep disruption is a common occurrence among those engaged in shift work due to the disruption of their circadian rhythm. Circadian rhythm disruption results in hormonal dysregulation of various hormones, including melatonin and cortisol, hence elevating the susceptibility to metabolic syndrome (MetS) conditions such as obesity and type 2 diabetes mellitus (T2DM)[14].

MATERIALS AND METHOD

A study was conducted within the Department of Biochemistry at the School of Medical Sciences and Research, Sharda University, Greater Noida, Uttar Pradesh. Prior to the commencement of the investigation, approval was obtained from the Institutional Ethical Committee. Eighty samples in total were collected. 40 healthcare workers, aged between 30 and 50 years, who were assigned night shifts, were selected from the Sharda Hospital. An equal number of healthy healthcare workers, matched in terms of age and sex, who worked during the day, were randomly drawn. Blood samples were taken from the healthcare workers and the levels of Melatonin were assessed using the Enzyme-Linked Immunosorbent Assay (ELISA) method. Anthropometric measurements were employed to determine weight and height, with a non-elastic measuring tape.

Statistical Analysis

The data collected underwent statistical analysis using SPSS Software version 22. A p-value less than 0.05 will be considered statistically significant.

RESULT

The frequency of Melatonin levels in blood (Mel Group) in night shift healthcare workers according to the number of days of night shift is shown in Table No. 1 & Graph No. 1. Table No. 2 & Graph No. 2 present the frequency of Melatonin levels in the blood (Mel Group) in night shift healthcare workers according to the duration of sleep at night.

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The Table No. 3 & Graph No. 3 illustrate the distribution of Melatonin levels in the blood for both the Case (Ca) and Control (Co) study groups. Mean ± SD in both Case (Ca) and Control (Co) is shown in Table No. 4. P value is calculated using student t-test shown in Table No. 5. P-value ≤ 0.05 is considered significant and P-value ≤ 0.005 is considered highly significant. Pearson Correlation coefficient is employed to study the correlation between Age, BMI, and melatonin in Case (Ca) and Control (Co) study groups as shown in Table No. 6. The Chi Square Test is used to examine the associations between the different variables as shown in Table No. 7, 8, 9, 10.

Table No. 1

Crosstab				
Count				
	Mel Group	DAYS OF NIGHT SHIFT		Total
		<6 DAYS	>6 DAYS	
	<2	13	8	21
	>2	8	11	19
Total		21	19	40

Graph No. 1

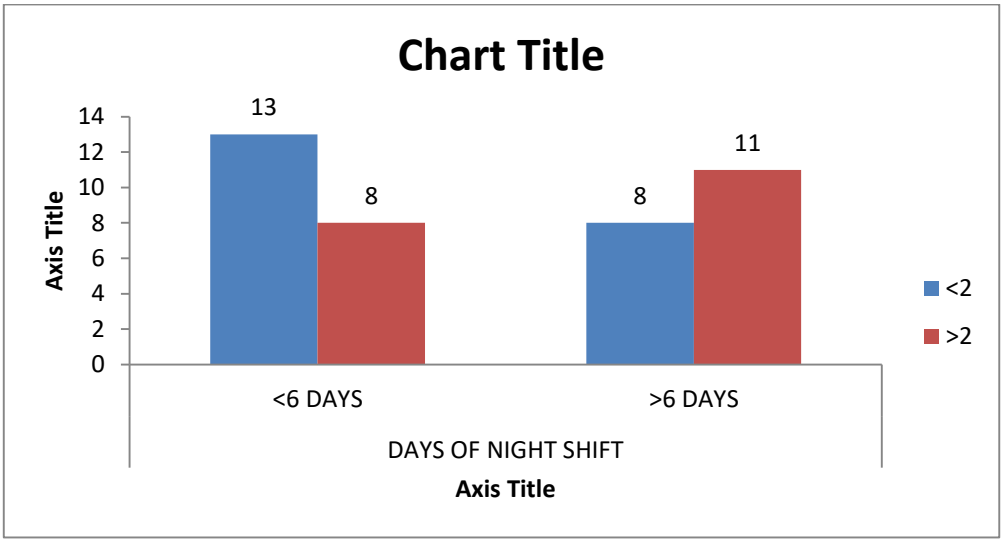

Table No. 2

Crosstab				
Count				
	Mel Group	DURATION OF SLEEP AT NIGHT		Total
		<2 HRS	>2 HRS	
	<2	15	6	21
	>2	16	3	19
Total		31	9	40

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Graph No. 2

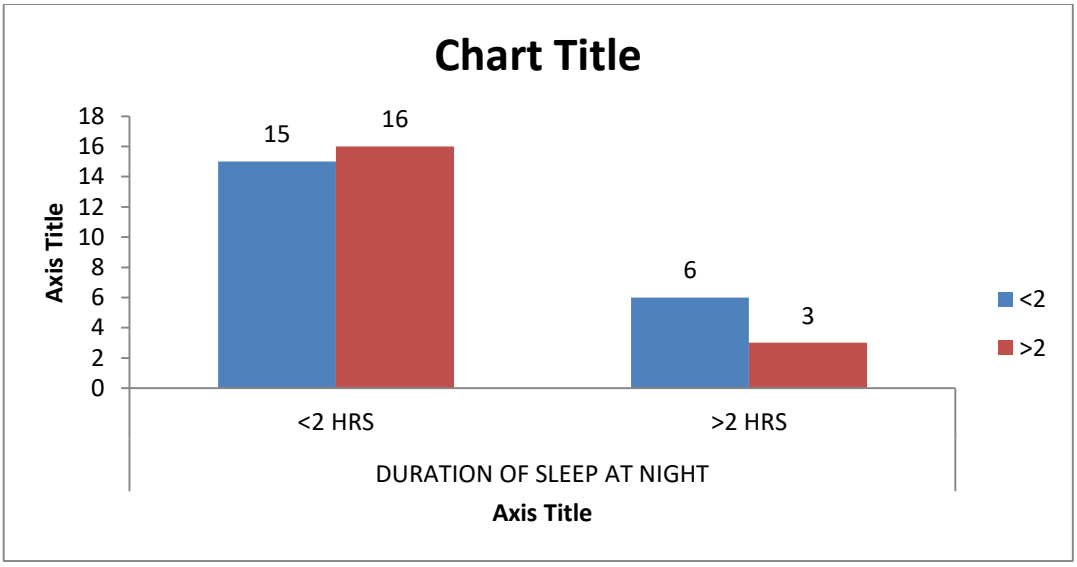

Table No. 3

Mel Group * Group Crosstabulation				
Count				
	Mel Group	Group		Total
		Ca	Co	
	<2	21	3	24
	>2	19	37	56
Total		40	40	80

Graph No. 3

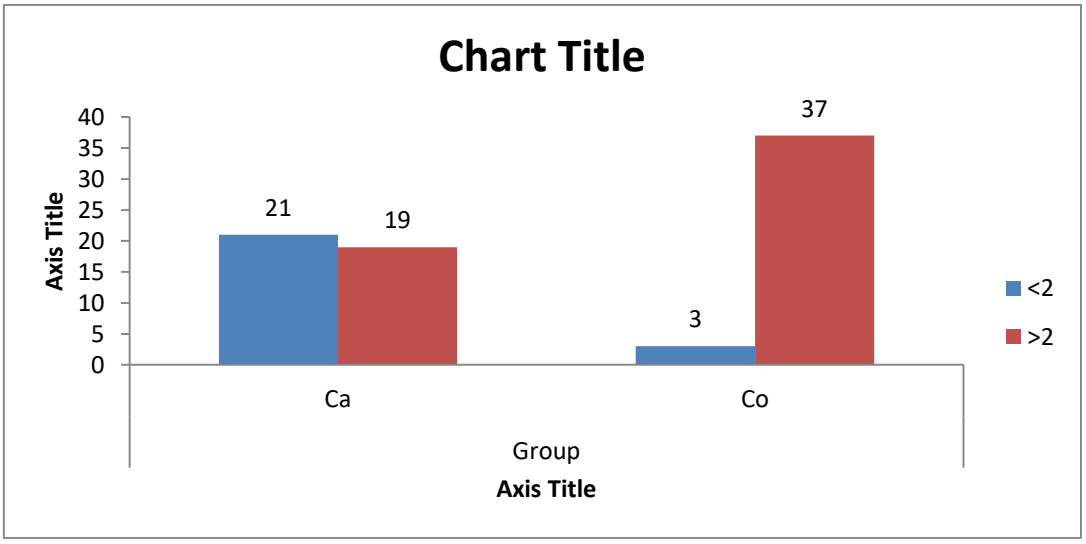

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Table No. 4

Group Statistics					
	Group	N	Mean	Std. Deviation	Std. Error Mean
BLOOD MELATONIN	Ca	40	3.4173	2.41754	.38225
	Co	40	3.7003	1.26874	.20061

Table No. 5

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
BLOOD MELATONIN	Equal variances assumed	18.598	.000	-.656	78	.514	-.28297	.43169	-1.14240	.57645
	Equal variances not assumed			-.656	58.968	.515	-.28297	.43169	-1.14679	.58084

Table No. 6

Correlations					
Group			AGE (yrs)	BMI (KG/M^2)	BLOOD MELATONIN
Ca	AGE (yrs)	Pearson Correlation	1	.092	.021
		Sig. (2-tailed)		.572	.895
		N	40	40	40
	BMI (KG/M^2)	Pearson Correlation	.092	1	.228
		Sig. (2-tailed)	.572		.156
		N	40	40	40
	BLOOD MELATONIN	Pearson Correlation	.021	.228	1
		Sig. (2-tailed)	.895	.156	
		N	40	40	40
Co	AGE (yrs)	Pearson Correlation	1	.289	.107
		Sig. (2-tailed)		.071	.510
		N	40	40	40
	BMI (KG/M^2)	Pearson Correlation	.289	1	-.024
		Sig. (2-tailed)	.071		.881
		N	40	40	40
	BLOOD MELATONIN	Pearson Correlation	.107	-.024	1
		Sig. (2-tailed)	.510	.881	
		N	40	40	40

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Table No. 7

Crosstab				
Count				
		DURATION OF SLEEP AT NIGHT		Total
		<2 HRS	>2 HRS	
Mel Group	<2	15	6	21
	>2	16	3	19
Total		31	9	40

Table No. 8

Chi-Square Tests					
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.935[a]	1	.334		
Continuity Correction[b]	.345	1	.557		
Likelihood Ratio	.952	1	.329		
Fisher's Exact Test				.457	.280
N of Valid Cases	40				
a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 4.28.					
b. Computed only for a 2x2 table					

Table No. 9

Crosstab				
Count				
		DAYS OF NIGHT SHIFT		Total
		<6 DAYS	>6 DAYS	
Mel Group	<2	13	8	21
	>2	8	11	19
Total		21	19	40

Table No. 10

Chi-Square Tests					
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.568[a]	1	.210		
Continuity Correction[b]	.875	1	.350		
Likelihood Ratio	1.578	1	.209		
Fisher's Exact Test				.342	.175
N of Valid Cases	40				
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.03.					
b. Computed only for a 2x2 table					

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DISCUSSION

Shift workers have the flexibility to work during the night, early morning hours, or rotate between different shifts. These disturbances, particularly nocturnal work, might have implications for the sleep and wake cycles, commonly referred to as circadian rhythm. Shift work refers to the practise of individuals working outside the conventional 9 am to 5 pm time frame. This schedule may entail working during nocturnal hours or in the early hours of the morning.

The circadian rhythm, regulated by the suprachiasmatic nucleus located in the hypothalamus, plays a crucial role in maintaining optimal health and well-being in individuals. The circadian rhythm is subject to disruption in those who work night shifts, perhaps leading to detrimental effects on their overall well-being. There is a greater incidence of insomnia and mental illnesses among individuals who work in shifts as opposed to those who do not. Sleep disruption is a common occurrence among those engaged in shift work due to the disruption of their circadian rhythm. Circadian rhythm, so contributing to an elevated susceptibility to metabolic syndrome (MetS) conditions, such as obesity and type 2 diabetes mellitus (T2DM)[14].

This study revealed that there is no statistically significant distinction (p value = 0.514) in the concentrations of Melatonin observed between the case and control study groups. Additionally, our findings indicate that there is no observed association between Blood Melatonin levels with Age and BMI in both the case and control groups.

There is lack of correlation between melatonin levels and both the number of night shifts and the duration of sleep among healthcare workers who perform night shift.

In their study, Grundy et al. (2009) showed that there is no statistically significant association in melatonin and estradiol levels between people who work day shifts and those who work night shifts. Furthermore, it revealed no substantial correlation between light exposure and either peak melatonin levels or the difference in melatonin levels recorded during the two shifts[13,15].

Papantoniou K et al. reported 33.8 % reduction in melatonin production in the night-shift workers compared to their day-shift counterparts during the 24-hour study period. Night-shift workers with a diurnal propensity for daytime activities exhibited a reduction of 53.7% in melatonin levels compared to their counterparts engaged in day-shift work. Melatonin levels of workers who had worked the night shift for four or less occasions in the preceding two weeks were found to be 40.6% lower compared to those of workers on the day shift. However, as the number of recent night shifts rose, the degree of melatonin suppression became less severe[13,16].

CONCLUSION

The study reveals no significant association between the melatonin levels in night shift and day shift workers. Thus, we conclude that shift work does not cause variation in melatonin secretion in our body.

Limitation: In this investigation, a very limited sample size was used.

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References

1) Peschke E, Mu¨hlbauer E. New evidence for a role of melatonin in glucose regulation. Best Pract Res ClinEndocrinolMetab. 2010;24(5):829-841.

2) Waldhauser F, Dietzel M. Daily and annual rhythms in human melatonin secretion: role in puberty control. Ann N Y Acad Sci. 1985;453:205-214.

3) Claustrat B, Brun J, Chazot G. The basic physiology and pathophysiology of melatonin. Sleep Med Rev. 2005;9(1):11-24.

4) Hohor S, Mandanach C, Maftei A, Zugravu CA, Oțelea MR. Impaired Melatonin Secretion, Oxidative Stress and Metabolic Syndrome in Night Shift Work. Antioxidants [Internet]. 2023;12:959. Available from: http://dx.doi.org/10.3390/antiox12040959

5) Akerstedt T, Wright KP. Sleep loss and fatigue in shift work and shift work disorder. Sleep Med Clin. 2009;4(2):257–71.

6) Garaulet M, Ordovás JM, Madrid JA. The chronobiology, etiology and pathophysiology of obesity. Int J Obes. 2010;34 (12):1667–83.

7) Morikawa Y, Nakagawa H, Miura K, Soyama Y, Ishizaki M, Kido T, et al. Shift work and the risk of diabetes mellitus among Japanese male factory workers. Scand J Work Environ Health. 2005;31(3):179–83.

8) Copertaro A, Barbaresi M, Bracci M. Shift work and cardiometabolic risk. RecentiProg Med. 2009;100(11):502–7.

9) Di Lorenzo L, De Pergola G, Zocchetti C, L'Abbate N, Basso A, Pannacciulli N, et al. Effect of shift work on body mass index: results of a study performed in 319 glucose-tolerant men working in a Southern Italian industry. Int J ObesRelatMetabDisord J IntAssoc Study Obes. 2003;27(11):1353–8.

10) Biggi N, Consonni D, Galluzzo V, Sogliani M, Costa G. Metabolic syndrome in permanent night workers. Chronobiol Int. 2008;25(2):443–54.

11) Knutson KL, Spiegel K, Penev P, Van Cauter E. The metabolic consequences of sleep deprivation. Sleep Med Rev. 2007;11(3):163–78.

12) Centers for Disease Control and Prevention. Short sleep duration among workers. MMWR. 2012; 61(16):281–5.

13) Hunter CM, Figueiro MG. Measuring Light at Night and Melatonin Levels in Shift Workers: A Review of the Literature. Biol Res Nurs. 2017 Jul;19(4):365-374.

14) Jehan S, Zizi F, Pandi-Perumal SR, Myers AK, Auguste E, Jean-Louis G, McFarlane SI. Shift Work and Sleep: Medical Implications and Management. Sleep Med Disord. 2017;1(2):00008. Epub 2017 Oct 6.

15) Grundy A, Sanchez M, Richardson H, Tranmer J, Borugian M, Graham CH, Aronson KJ. Light intensity exposure, sleep duration, physical activity, and biomarkers of melatonin among rotating shift nurses. Chronobiol Int. 2009 Oct;26(7):1443-61.

16) Papantoniou K, Pozo OJ, Espinosa A, Marcos J, Castaño-Vinyals G, Basagaña X, Ribas FC, Mirabent J, Martín J, Carenys G, Martín CR, Middleton B, Skene DJ, Kogevinas M. Circadian variation of melatonin, light exposure, and diurnal preference in day and night shift workers of both sexes. Cancer Epidemiol Biomarkers Prev. 2014 Jul;23(7):1176-86.