

AMBULATORY BLOOD PRESSURE MONITORING IN HEALTH WORKERS DURING NIGHT SHIFT DUTY

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ABSTRACT

BACKGROUND

BP and heart rate fluctuate over a 24 hours period. External stresses and subject's activities have direct effects on BP and heart rate. BP and heart rate also vary according to their own circadian rhythm.¹ Stress can cause hypertension through repeated elevations of BP.

METHODS

This is a cross-sectional study conducted in Regional Institute of Medical Sciences (RIMS) Hospital amongst Health Workers.

RESULTS

Most of the Health Workers are Males (63%) and in the age group of 21-30 years with mean age of 30.22±6.32. Both systolic and diastolic hypertension was found during day, night and over 24 hours duty. Systolic hypertension during day duty was 10% which increases to 39% during night time duty. Systolic and diastolic hypertension during the 24 hours duty was found to be 22% and 39% respectively. DBP hypertension during day time duty was found to be 26% which increases to 48% during night time duty. The overall hypertensive distribution of hypertension of health workers is 29%, 52% and 42% during day time, night time and 24 hours duty respectively.

CONCLUSIONS

During Night time duty, more Health Workers were hypertensive (52%) as compared to day time duty which was lesser (29%) and over the 24 hours duty 42% of health workers were hypertensive. Thus, the present findings suggest effects of occupational stress on ABP measured at work, in night shift and over 24 hours period among health workers. In the long run, stressful night duty increases the risk of development of hypertension.

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BACKGROUND

BP and heart rate fluctuate over a 24 hours period and are regulated by complex internal physiological mechanisms. External stress and activities have direct effects on BP and heart rate. Day time and night time may attempt to synchronise BP to their own circadian rhythm.¹ Stress can cause hypertension through repeated BP elevations. Factors affecting BP through stress include white coat hypertension, job strain, race, social environment, and emotional distress. Furthermore, when one risk factor is coupled with other stress producing factors, the effect on BP is multiplied. Several studies show that stress does not directly cause hypertension, but can lead to repeated BP elevations, which eventually may lead to hypertension.²

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BP elevations have been reported among Health Care Workers during particularly arduous working conditions such as 24 hours or night shifts in the emergency room, compared to less strenuous periods. Elevated BP and risk of hypertension have been reported in other stressful occupations, such as among air-traffic controllers, sea pilots, and professional drivers.³

Shift work changes the diurnal variation of BP from a dipper to a non-dipper pattern, thus increasing the risk of hypertension among night shift workers. Individuals who show a nocturnal BP fall of at least 10% of mean arterial pressure (MAP) are classified as dippers. Non-dippers are characterised by a lack of, or a very limited nocturnal BP fall. Cardiovascular outcomes are worsened in individuals who have an excessive morning BP surge and in those who lack the normal nocturnal BP fall.⁴

Aims and Objectives

Comparison of Blood Pressure changes during night, day and 24 hours shift duty among Health Care Workers.

METHODS

This is a Cross-Sectional study conducted in Regional Institute of Medical Sciences (RIMS) Hospital, Imphal.

Inclusion Criteria

- Doctors, nurses and paramedical staffs on emergency night shift duty willing to participate in the study.
- BP at clinic evaluation <140/90 mmHg on at least two occasions (previously normotensive adults).
- Age >18 years.

Exclusion Criteria

- Hypertension.
- Pregnant or lactating women.
- History of congenital heart disease.
- Persons taking anti-hypertensive medication for indications other than hypertension (alpha blocker for prostatic enlargement, Angiotensin converting enzyme inhibitor for Congestive Heart Failure).
- Substance abuse (cigarette, alcohol), psychiatric drug or other medications that can affect BP.
- Unwilling participants.

With the participant consent, BP was measured twice using mercury BP machine in order to rule out hypertension and to have a baseline reading. After which ambulatory blood pressure (ABP) device was connected to the participant and ABP was recorded from the non-dominant upper limb from 1:00 pm to 1:00 pm the next day.

Recording was taken at intervals of at least one hour during day time and at intervals of at least two hours at night time. Blood pressure recorded after 6:00 pm to 6:00 am the next morning was considered night time and the rest was considered day time recording. The mean value for systolic and diastolic blood pressure was then calculated for night, day and 24 hours' time period.

The person's status was classified as hypertensive if at least one of the criteria based on 24-hour BP monitoring is satisfied.

Ethical Approval

Prior permission was taken from the Institutional Research Ethics Board, RIMS, Imphal before the study was conducted. Informed consent of the participants of the study was taken as per research ethics board guidelines.

Statistical Analysis

The data collected was checked for consistency and completeness. The data was analysed using statistical package for social sciences (SPSS version for Windows statistical computer software version SPSS 21). Descriptive statistics like mean, standard deviation and percentages was used. ANOVA and T-test was used to see the association between change in BP and selected variables. P value < 0.05 was taken as significant.

RESULTS

Ambulatory BP monitoring was done on 100 health workers comprising doctors, nurses and others (paramedical staffs), working in different departments. The results were tabulated and statistically evaluated using proper methods.

Age in Years	No. of Health Workers	%
21-30	65	65.0
31-40	26	26.0
41-50	9	9.0
Total	100	100.0

Table 1. Age Distribution of Health Workers Studied

Mean ± SD: 30.22±6.32

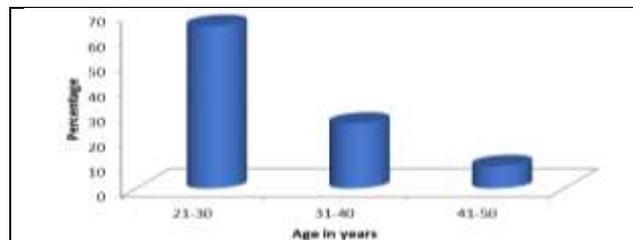


Figure 1. Age Distribution of the Health Workers (n =100)

Majority of the health workers studied were from age group 21-30 years which accounts 65%, 31-40 years accounts 26%, and 41-50 years accounts 9% of health workers.

Gender	No. of Health Workers	%
Female	37	37.0
Male	63	63.0
Total	100	100.0

Table 2. Gender Distribution of Health Workers Studied

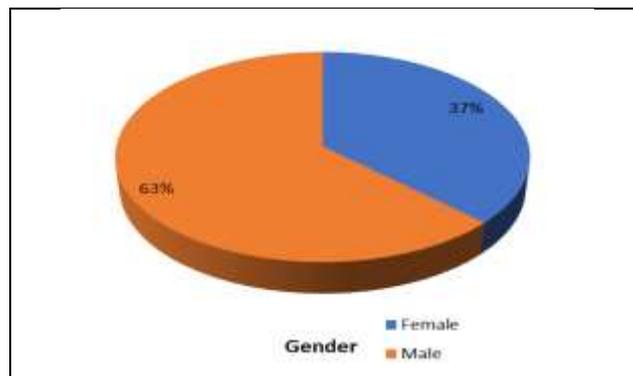


Figure 2. Gender Distribution of the Health Workers (n =100)

Most of the Health Workers were male which accounts 63%. Female accounts 37% of the Health Workers as shown in the table and figure.

Religion	No. of Health Workers	%
Hindu	61	61.0
Christian	30	30.0
Muslim	3	3.0
Others	6	6.0
Total	100	100.0

Table 3. Religion Distribution of Health Workers Studied

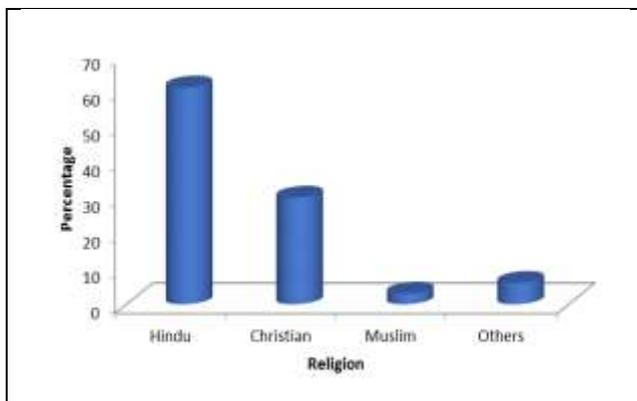


Figure 3. Religion Distribution of the Health Workers (n =100)

Majority of the Health Workers studied were Hindu (61%). Christian and Muslim accounts 30% and 3% respectively and as shown in the table and figure.

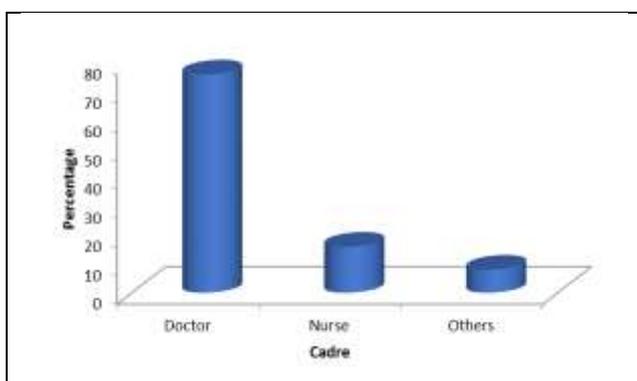


Figure 4. Cadre Distribution of the Health Workers (n =100)

Majority of the Health Workers studied were Doctors which accounts 63%. Nurses and Others (Paramedical Staffs) accounts 16% and 8% respectively as shown in the table and figure.

BMI (kg/m ²)	No. of Health Workers	%
Normal	80	80.0
Overweight	17	17.0
Obese	3	3.0
Total	100	100.0

Table 5. BMI (kg/m²) Distribution of Health Workers Studied

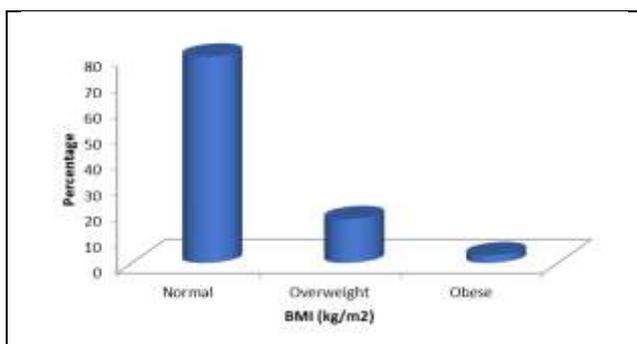


Figure 5. BMI (kg/m²) Distribution of Health Workers (n =100)

Most of the Health Workers' BMI were normal (80%). Around 17% of the health workers were in overweight category and only 3% were obese as shown in the table and figure.

Hypertension (Systolic)	No. of Health Workers (n=100)	%
Day Time Duty		
Normal	90	90.0
Hypertensive	10	10.0
Night Time Duty		
Normal	61	61.0
Hypertensive	39	39.0
24 hrs Duty		
Normal	78	78.0
Hypertensive	22	22.0

Table 6. Hypertension (Systolic) Distribution of Health Workers Studied

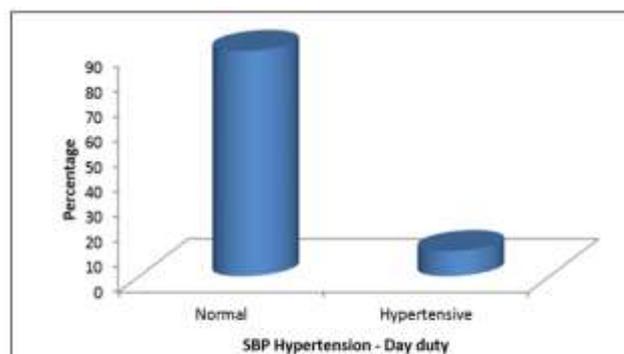


Figure 6 (a). Systolic Blood Pressure Distribution of The Health Worker During Day Time Duty

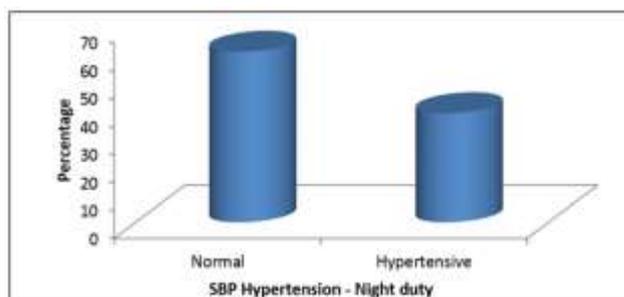


Figure 6 (b). Systolic Blood Pressure Distribution of The Health Worker During Night Time Duty

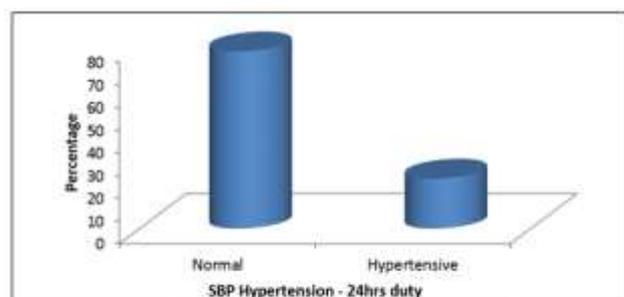


Figure 6 (c). Systolic Blood Pressure Distribution of The Health Worker During 24 Hrs. Duty

During day time duty 90% of the health workers had normal SBP where as 10% were found to be hypertensive in SBP but during night time duty the number of normal SBP pressure decreases to 61% and the number of hypertensive SBP increases to 39%. And in the whole 24 hours duty BP monitoring it was found that 78% of the health workers had normal SBP and 22% were found to be hypertensive in SBP.

Hypertension (Diastolic)	No. of Health Workers (n=100)	%
Day Time Duty		
Normal	74	74.0
Hypertensive	26	26.0
Night Time Duty		
Normal	52	52.0
Hypertensive	48	48.0
24 hrs. Duty		
Normal	61	61.0
Hypertensive	39	39.0

Table 7. Hypertension (Diastolic) Distribution of Health Workers Studied

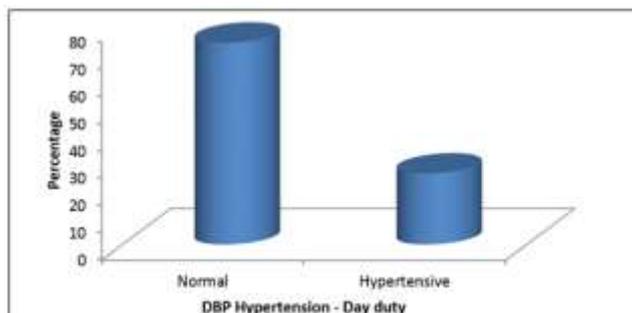


Figure 7 (a). Diastolic Blood Pressure Distribution of The Health Worker During Day Time Duty

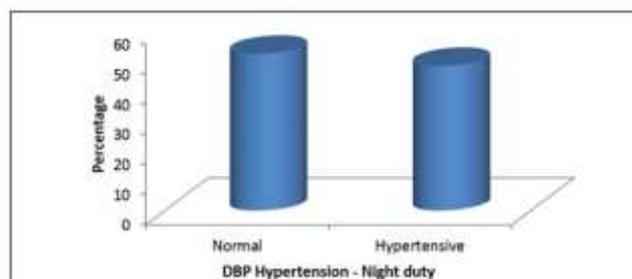


Figure 7 (b). Diastolic Blood Pressure Distribution of The Health Worker During Night Time Duty

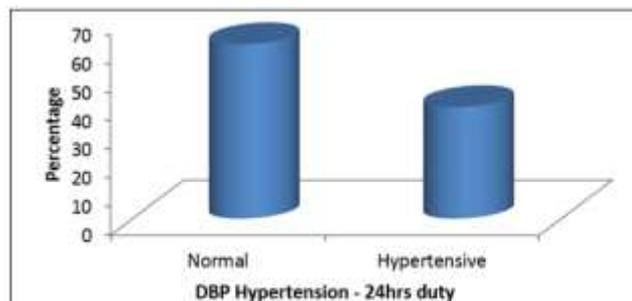


Figure 7 (c). Diastolic Blood Pressure Distribution of The Health Worker During 24 Hours Duty

During day time duty 74% of the health workers had normal DBP where as 26% were found to be hypertensive in DBP but during night time duty the number of hypertensive DBP increases to 48%. And, during 24 hours duty BP monitoring it was found that 39% of the health workers were found to be hypertensive in DBP.

Hypertension	No. of Health Workers (n=100)	%
Day Time Duty		
Normal	71	71.0
Hypertensive	29	29.0
Night Time Duty		
Normal	48	48.0
Hypertensive	52	52.0
24 hrs. Duty		
Normal	58	58.0
Hypertensive	42	42.0

Table 8. Hypertension (Systolic and Diastolic) Distribution of Health Workers Studied

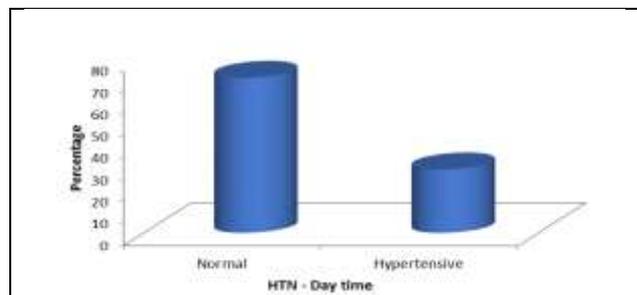


Figure 8 (a). Blood Pressure Distribution of The Health Workers During Day Time Duty

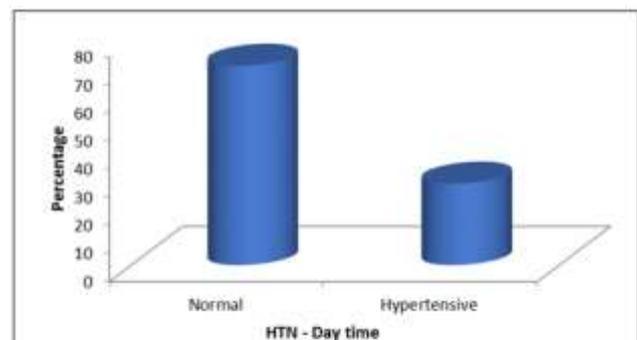


Figure 8 (b). Blood Pressure Distribution of The Health Workers During Night Time Duty

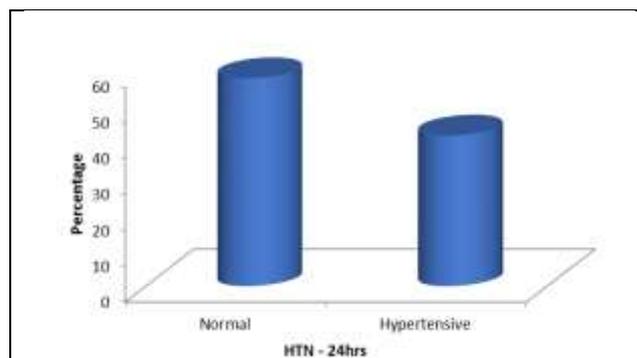


Figure 8 (c). Blood Pressure Distribution of The Health Workers During 24 Hrs Duty

Out of the 100 health workers, during day time duty 29% were found to be hypertensive which increases to 52% during night time emergency duty which may account to more stress and improper sleep while doing emergency duties at night. And during 24 hours duty BP monitoring it was found that 42% of the health workers were found to be hypertensive.

Variables	Age in Years			p Value
	21-30 yrs.	31-40 yrs.	41-50 yrs.	
Day Duty SBP (Mean)	121.82± 8.64	124.46± 11.82	128.78± 10.12	0.098
Night Duty SBP (Mean)	116.35± 10.23	119.58± 13.26	121.00± 12.58	0.305
24 hrs. Duty SBP (Mean)	119.97± 8.28	123.04± 11.95	126.44± 10.22	0.098

Table 9. Mean Systolic Blood Pressure (SBP) According to Age in Years

Table 9 shows the association between mean of day, night and 24 hours duty SBP with different age category. Older age group between 41-50 years have higher mean SBP. This association was not found to be statistically significant.

Variables	Age in Years			p Value
	21-30 yrs.	31-40 yrs.	41-50 yrs.	
Day Duty DBP (Mean)	77.68± 6.90	82.69± 8.96	80.11± 9.05	0.021
Night Duty DBP (Mean)	72.62± 8.04	78.58± 10.61	72.22± 7.22	0.013
24 hrs Duty DBP (Mean)	76.03± 6.84	81.31± 9.26	77.78± 7.92	0.014

Table 10. Mean Diastolic Blood Pressure (DBP) According to Age in Years

Table 10 shows the association between mean of day, night and 24 hours duty DBP with different age category. Here age group between 31-40 years have higher mean DBP as compared to older age group between 41-50 years. This association was found to be statistically significant.

Variables	Gender		p Value
	Male	Female	
Day Duty SBP (Mean)	125.10± 9.25	119.78± 9.96	0.008
Night Duty SBP (Mean)	118.78± 9.79	115.62± 13.43	0.179
24 hrs Duty SBP (Mean)	123.03± 8.88	118.49± 10.35	0.022

Table 11. Mean Systolic Blood Pressure According to Gender

The table above chart shows the mean SBP of day, night and 24 hours duty with gender. Male group were found to have higher SBP as compared to female. This association was found to be statistically significant during day and 24 hours duty but was not statistically significant during night time duty.

Variables	Gender		p Value
	Male	Female	
Day Duty DBP (Mean)	81.40± 7.00	75.46± 8.03	<0.001
Night Duty DBP (Mean)	75.90± 8.67	71.11± 8.92	0.010
24 hrs Duty DBP (Mean)	79.63± 7.13	74.03± 7.95	<0.001

Table 12. Mean Diastolic Blood Pressure According to Gender

The table above shows the mean DBP of day, night and 24 hours duty with gender. Male group were found to have higher DBP as compared to female. This association was found to be statistically significant.

Variables	BMI (kg/m ²)			P Value
	<25 kg/m ²	25-30 kg/m ²	>30 kg/m ²	
Day Duty SBP (Mean)	121.71± 8.81	127.94± 11.21	133.67± 15.95	0.009
Night Duty SBP (Mean)	116.08± 10.88	122.71± 10.27	129.67± 16.77	0.014
24 hrs Duty SBP (Mean)	119.88± 8.83	126.29± 9.94	132.67± 15.95	0.004

Table 13. Mean Systolic Blood Pressure According to BMI

The given table shows the association of mean SBP of day, night and 24 hours duty with BMI. With increasing BMI mean SBP also increases. This association was found to be statistically significant.

Variables	BMI (kg/m ²)			P Value
	<25 kg/m ²	25-30 kg/m ²	>30 kg/m ²	
Day Duty DBP (Mean)	77.88± 7.01	83.53± 7.96	90.00± 15.39	0.001
Night Duty DBP (Mean)	72.75± 7.93	78.06± 10.15	88.67± 14.15	0.001
24 hrs Duty DBP (Mean)	76.23± 6.92	81.76± 8.24	89.33± 14.74	0.001

Table 14. Mean Diastolic Blood Pressure According to BMI

The given table shows the association of mean DBP of day, night and 24 hours duty with BMI. With increasing BMI mean DBP also increases. This association was found to be statistically significant.

Variables	CADRE			p Value
	Doctor	Nurse	Others	
Day Duty SBP (Mean)	123.43± 9.23	121.50±12.69	123.50±9.83	0.772
Night Duty SBP (Mean)	117.79± 10.67	117.56±14.87	116.00±10.62	0.915
24 hrs Duty SBP (Mean)	121.58± 8.94	120.38±13.16	121.13±9.34	0.902

Table 15. Mean Systolic Blood Pressure According to Cadre

The table above shows the mean SBP of day, night and 24 hours duty with cadre. Doctors were found to have higher SBP as compared to nurses and others. However, this association was not found to be statistically significant.

Variables	CADRE			p Value
	Doctor	Nurse	Others	
Day Duty DBP (Mean)	79.71±7.35	77.31±9.99	78.13±8.82	0.507
Night Duty DBP (Mean)	74.67±8.70	72.88±10.51	71.50±9.49	0.537
24 hrs Duty DBP (Mean)	78.07±7.34	75.88±10.04	76.13±8.66	0.525

Table 16. Mean Diastolic Blood Pressure According to Cadre

The table above shows the mean DBP of day, night and 24 hours duty with cadre. Doctors were found to have higher DBP as compared to nurses and others. However, this association was not found to be statistically significant.

DISCUSSION

This study included 63% males and 37% females comprising of doctors, nurses and others which included laboratory technicians, attendants, etc. This is comparable with study conducted by O'Connor DB et al⁵ in which 63% general practitioners were males and 37% were females. Out of the 100 health workers who participated in the study the age group was in the range of 21 to 50 years old with

30.22±6.32 as mean. This was comparable with the study conducted by Light KC et al⁶ in which out of the 129 working men and women the age group was in the range of 18 to 47 years and mean ages were 32.9 and 31.3 years for men and women respectively.

Hypertension is more prevalent among night shift compared with day shift workers.⁷ This finding indicated that more than one fourth (29%) of the participants had high BP during day which increases to almost half at night time (48%). This result is consistent with study done by Chau NP et al¹ in 24 hours ABP in shift worker in France. Similar finding was also reported by Su T et al⁸ which showed that 12 hours night shift duty gave a persistently elevated systolic and diastolic blood pressure compared to 12 hours day shift duty. This may be accounted for more stress which can be psychological as well as physical when doing emergency duties at night due to sleep deprivation, fatigue, pressure and continuous mobility. Epidemiological studies have shown the profound influence of stress on cardiovascular mortality and morbidity as well as on ABP. As the setting was a training medical college, the stress was anticipated because most of the participants were junior doctors who were more prone to develop the stress. Acute sleep deprivation is associated with an increased sympathetic activity and decreased parasympathetic modulation.⁸ In addition, sleep disturbance may also result in sympatho-vagal imbalance.⁹

Our study also found that though both systolic and diastolic blood pressure was raised during day, night and over 24 hours duty, the increase in measured DBP during day, night and 24 hours duty (26%, 48%, 39% hypertensive respectively) are more as compared to increase in SBP during day, night and 24 hours duty (10%, 39%, 22% hypertensive respectively). This is consistent with the study reported by Ogawa Y et al¹⁰ which showed that the DBP was significantly higher after total sleep deprivation. Theorell T et al¹¹ also found that job strain was significantly associated with DBP at night and during work.

The study found out that mean SBP measured in 24 hours was more in the older age group 41-50 years (126.44 ± 10.22; p value 0.098) but do not have any significant difference. The mean DBP during day duty (82.69±8.96; P value 0.02), night duty (78.58±10.61; P value 0.013) and 24 hours duty (81.31±9.26; P value 0.014) was found more in the age group 31-40 years and it was statistically significant which is opposite to the study done by Kario K et al¹² where there was increase in SBP than DBP.

Male in 24 hours duty had more mean SBP (123.03±8.88; P value 0.022) as well as mean DBP (79.63±7.13; P value <0.001) in comparison to female mean SBP (118.49±10.35) and mean DBP (74.03±7.95) and this was consistent with study done by O'Connor DB et al⁵ on British general practitioners. The significance of the relationship and stressful condition at night is not clear cut. There is still a debate about whether a job strain can induce transient or sustained hypertension.⁵ Some author still argues that stress at work can increase BP during working

hours only and that it does not predicts BP level in the long run.¹⁰

As seen from many studies, obesity was a risk factor for hypertension and many chronic diseases. In this study as well, BMI >30 kg/m² has more SBP (132.67 ± 15.95; p value 0.004) and DBP (89.33 ± 14.74; p value 0.001) in 24 hours duty and this finding was statistically significant when compared to BMI <25 kg/m² and 25-30 kg/m². But mean SBP and DBP are more during day duty for all the groups. This result was consistent with the study conducted by Gaudemaris R et al¹³ in France among nurses and nursing assistants. The strength of this study can be attributed to the BP measured with validated automatic device and adequate sample size.

CONCLUSIONS

The development of non-invasive ABP monitoring devices has been a great impetus to clinical hypertension research, and ABP monitoring is now widely used in clinical practice. Hypertension is commonly associated with occupations which involve regular long period of stressful night shift duty. The present study was conducted among the hospital staff during night shift to monitor the diastolic and systolic blood pressure for day, night and 24 hours duty. During day time duty out of 100 health workers studied, about 10% satisfied the criteria for systolic hypertension based on 24-hour BP monitoring and so they were classified as hypertensive. Likewise, 39% of health workers were found to be systolic hypertensive during night time duty which was increased as compared to day time duty. Similarly, the same result was seen in DBP in which 26% and 48% health workers were found to be diastolic hypertensive during day time and night time duty respectively. The result was significant in DBP as compared to SBP.

Therefore, in the study, during night time duty, more health workers were hypertensive (52%) as compared to day time duty which was lesser (29%) and over the 24 hours duty, 42% of health workers were hypertensive. Thus, the present findings provide indicate that occupational stress has an effect on ABP measured at work, in night shift and over 24 hours period among health workers, and in the long run, stressful night duty increases the risk of development of hypertension.

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