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Original article

Prevalence of hypertension and associated factors among healthcare workers: A cross-sectional study

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Background: Hypertension is an important public health challenge in Thailand. Whether shift work and types of working patterns in healthcare workers is linked to increased risk of high blood pressure remains controversial. The aim of this study was to quantify the prevalence of hypertension and to determine the effect of shift work and working patterns in healthcare workers of a large tertiary, university-based hospital in Bangkok, Thailand.
Methods: A cross-sectional study was conducted using the annual health examination results and occupational health questionnaires of 6,014 healthcare workers at a large tertiary, university-based hospital. Sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI). Associations between hypertension and independent variables based on demographic data, work shift status, and working patterns were assessed using the logistic regression models.
Results: The prevalence of hypertension in healthcare workers was 39.3%. After adjusting for other possible confounders, healthcare workers aged > 50 years had 5.41 fold increased odds of having hypertension, in comparison with healthcare workers aged < 30 years (adjusted OR (aOR) = 5.41; 95% CI 4.47 to 6.55). Healthcare workers with obesity (body mass index (BMI) ≥ 30 kg/m^2) had 14.34 fold increased odds of having hypertension, in comparison with healthcare workers BMI < 18.5 kg/m^2 (aOR=14.34; 95% CI 10.16 to 20.22). Healthcare workers who did shift work, the odds of having hypertension increased by 23%, in comparison with healthcare workers with no shift work (aOR = 1.23; 95% CI 1.03 to 1.48). There were no significant associations between hypertension and working patterns including working hours a day, number of night shifts a month, and the rest interval hours a day.
Conclusions: Shift workers had heightened risks for hypertension compared to the day workers, and the increase of risk was especially marked in workers with higher age, especially higher BMI. No working pattern factors were significantly associated with hypertension.

Keywords: Hypertension, shift work, healthcare workers.

Because healthcare is the industry that covers 24 hours a day, 7 days a week, night work is an integral part of the healthcare working system. Shift work is common among healthcare workers. Centers for Disease Control and Prevention (CDC), the United States, defines the term "shift work" as working outside the normal daylight hours. That is, outside the hours of around 7 AM to 6 PM Similarly, many literatures usually define shift work as "work beyond the typical daily working hours (about 7 - 8 AM to 5 - 6 PM)", including graveyard shifts, night shifts, early morning shift, and rotational work. [1 – 3]

Many reports and researches in the past several decades have pointed out the primary effect of shift work on disruption of circadian rhythms, the 24- hour human's body clock which tells the body when to sleep, rise, and eat. This eventually destroyed the homeostasis of the human biological clock, resulting in sleep insufficiency, chronic fatigue, burnout, and depressive symptoms among healthcare workers.[4 –6] Other health effects of shift work include

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gastrointestinal symptoms, such as peptic ulcers, irritable bowel syndrome, and functional bowel disorders.[7 – 9] In addition, the International Agency for Research on Cancer (IARC) in October 2017 classified shift work that involves circadian disruption as class "2A" (a probable human carcinogen).

Hypertension is an important public health challenge in Thailand. Hypertension has also been identified as one of the most important preventable risk factors for coronary heart disease, stroke, congestive heart failure, and peripheral vascular disease. Whether shift work and working patterns in healthcare workers is linked to an increased risk of high blood pressure remains controversial. Studies reported that shift work has been linked as a significant risk factor for increased blood pressure. [10 – 11] In contrast, a study stated that shift work is not associated with increased blood pressure or the prevalence of hypertension in healthcare personnel working in a large general hospital.[12] This gap of knowledge needs to be investigated as night shifts pose significant occupational risk exposures while night shifts are unavoidable in healthcare workers. Knowing the data provides significant implications for public health in providing a safer and improved working environment for shift workers, and establishing a primary prevention program to protect the health of healthcare workers.

The aim of this study was to quantify the prevalence of hypertension and to determine the effects of shift work and working patterns in healthcare workers of a large tertiary, university-based hospital in Bangkok, Thailand.

Methods

Study population

This study was a cross-sectional study. The study was conducted using the annual health examination results and questionnaires of healthcare workers at a large tertiary, university-based hospital in Bangkok, Thailand who underwent their annual health examination at the hospital from January 1, 2016 to December 31, 2016.

The inclusion criteria were healthcare workers, aged 19 – 60 years, who had no medical condition or had any pre-existing medical conditions, signed consent for participation in the research study and were working at the large tertiary, university-based hospital in Bangkok, Thailand during the study period. Subjects who had no complete measurements of both systolic and diastolic blood pressure results were excluded. Among these subjects, those with systolic blood pressure (SBP) ≥ 140 mmHg or diastolic blood pressure (DBP) ≥ 90 mmHg were classified into the hypertension group. The ethical and trust sponsorship was approved by the Ethics Committee, Faculty of Medicine, Chulalongkorn University in 2016.

A sample size of 289 was required to ensure an acceptable margin of error within 5.0%. The formula applied was $n = 1.96^2 \times p \times (1\text{-}p) / (0.05)^2$, where $P = 0.25$ was reported as the current prevalence of hypertension of adults in Thailand; [13] 0.05 indicated the acceptable margin of error (5.0%).

Data collection

Investigators interviewed the participants at the place of work, using an interview manual with instructions for every section of the questionnaire. With the questionnaire, we investigated aspects pertaining to age, body mass index (BMI), social status, shift work status, working patterns and other risk factors for hypertension including sleep quality. The age of subjects were grouped into < 30, 30 - 40, 40 - 50, > 50 years old. BMI was calculated by dividing weight (kg) by height squared (m^2). Subjects were stratified into the following BMI categories according to the World Health Organization (WHO) classification: Category 1, underweight (BMI < 18.5 kg/m^2); Category 2, normal range (BMI 18.5 - 24.9 kg/m^2); Category 3, overweight (BMI 25 - 29.9 kg/m^2); and Category 4, obese (BMI ≥ 30.0 kg/m^2).

Occupational health data in this study included shift work status (shift work versus non-shift work), number of working hours a day, number of night shifts a month, and number of rest interval hours a day. We described shift work status separately in shift and non-shift work. The number of working hours a day were grouped into three categories: < 8, 8 - 12, >12. The number of night shifts a month were grouped into 3 categories: 1 - 5, 6 - 10, >10. The number of the rest interval hours a day were grouped into 3 categories: < 1, 1 - 3, ≥ 4.

Sleep quality was measured using the Thai version of the Pittsburgh Sleep Quality Index (PSQI). Subjects were grouped into two categories: the 'good' sleep group (Global PSQI score < 5) and the 'poor' sleep group (Global PSQI score ≥ 5). The Pittsburgh Sleep Quality Index (PSQI) consists of 19 items grouped in seven domains. The domains are sleep duration, sleep disturbance, sleep latency, daytime dysfunction due to sleepiness, overall sleep quality, sleep efficiency, and dependency on medicine to sleep. Each domain's

scores were summed to produce a global measure of sleep quality and the scores ranged from 0 to 21. A total score of equal to or above five is defined as 'poor' sleep quality. A higher score indicates poorer quality of sleep. A high degree of internal consistency was observed among the PSQI domains; those with Cronbach α of 0.83 were reported. [14]

We included the PSQI for sleep quality measurement in this study because the PSQI was found to be a valid instrument. The PSQI's validity was supported by polysomnographic findings. [14, 15] Furthermore, the overall test-retest reliability of the PSQI global score was high, with a reliability of 0.90 two days after administration, and 0.87 on an average of 45.[16]

We collected subjects' height, weight, SBP and DBP measurements from the annual health check-up results of the university hospital. We used the Terumo automated blood pressure device model #BPM ES-H2655, the standardized protocol of blood pressure measurement techniques was employed, and the equipment for blood pressure measurement was regularly validated. Subjects with their first-time SBP ≥ 140 mmHg or DBP ≥ 90 mmHg were instructed to rest for 10-15 minutes before repeated blood pressure; the lowest blood pressure values were recorded for valid interpretation of readings. Those with SBP ≥ 140 mmHg or DBP ≥ 90 mmHg were classified into the hypertension group according to the Eighth Joint National Committee (JNC 8) Hypertension, the American Society.

Statistical analysis

We compared the demographic factors and working patterns between workers who had hypertension and those who had no hypertension. The data are expressed as mean ± standard deviation (SD). For age, BMI, the presence of hypertension, sleep quality, and household income, Chi-squared tests were porformed.

Associations between hypertension and independent variables based on demographic data, work shift status, and working patterns were assessed using the logistic regression models. The odds ratios (OR) and their 95% confidence interval (CI) adjusted for age, gender, shift work status, working hours a day, number of night shifts a month, and the rest interval hours a day.

STATA version 14.1 (StataCorp. 2015. Stata Statistical Software: release 14.1, College Station, TX: StataCorp LP.) was used for statistical analysis. The statistical significance level was set at $P < 0.05$.

Results

A total of 6,014 healthcare workers participated. Among these, 5,829 (96.9%) healthcare workers completed both SBP and DBP measurements for the final data analysis (missing data = 185). The prevalence of hypertension among healthcare workers from this study was 39.3%. There were 4,933 women and 1,081 men. The mean (± SD) age of participants was 42.31 (± 12.64) years old. Most of the participants were single or never married without children, had achieved a university degree (mostly bachelor's degree) and had monthly incomes of around 20,000 – 30,000 Thai Baht. The mean (± SD) BMI of the participants was 23.81 (± 4.42) kg/m^2, this means that most subjects were in normal shape according to the WHO classification. 56.8% of all participants had PSQI scores < 5, reflecting that more than half of the participants had 'good' sleep quality. A summary of the characteristics of participants are shown in Table 1.

Healthcare workers' age and BMI with the presence of hypertension were significantly higher than those without hypertension (age, $P = 0.001$; BMI, $P < 0.001$). In addition, healthcare workers with hypertension had significantly poorer sleep quality than those without hypertension ($P < 0.001$).

Shift work status, number of working hours a day, number of night shifts a month, and number of the rest interval hours a day were significantly associated with the presence of hypertension in healthcare workers (shift work status, $P < 0.001$; number of working hours a day, $P < 0.001$; number of night shifts a month, $P < 0.001$; number of the rest interval hours a day, $P = 0.001$), as shown in Table 2.

Associations between hypertension and independent variables based on demographic data and working patterns were investigated using logistic regression models. Increases in age and BMI were associated with significant increases in the odds of having hypertension, even after we adjusted for potential factors. The output of the fully adjusted models shows that healthcare workers aged ≥ 50 years had 5.41 fold increased odds of having hypertension, in comparison with healthcare workers aged < 30 years (adjusted OR (aOR) = 5.41; 95% CI 4.47 to 6.55). Healthcare workers with obesity (BMI ≥ 30 kg/m^2) had 14.34 fold increased odds of having hypertension, in comparison with healthcare workers BMI < 18.5 kg/m^2 (aOR = 14.34; 95% CI 10.16 to 20.22).

Table 1. Summary of participants characteristics (n = 6,014).

Characteristic	n (%) or mean (± SD)
Gender	
Female	4,933 (82.0%)
Male	1,081 (18.0%)
Age (years)	42.3 (± 12.6)
BMI (kg/m^2)	23.8 (± 4.4)
Hypertension (according to JNC8 classification)	
Presence of Hypertension (SBP ≥ 140 mmHg or DBP ≥ 90 mmHg)	2,366 (39.3%)
No Hypertension (SBP < 140 mmHg and DBP < 90 mmHg)	3,463 (57.5%)
Sleep Quality	
Good Sleep (PSQI <5)	3,413 (56.8%)
Poor Sleep (PSQI ≥ 5)	2,601 (43.2%)
Marital Status	
Single or Never Married	2,891 (48.1%)
Married	2,712 (45.1%)
Divorced	391 (6.5%)
Children	
Have children	2,697 (44.8%)
No children	3,300 (54.9%)
Education Level	
High school	1,483 (24.7%)
Postsecondary (certificate/diploma)	525 (8.7%)
Bachelor's degree	3,084 (51.3%)
Master's degree or above	907 (15.1%)
Monthly Income (Thai Baht)	
< 10,000	115 (1.9%)
10,001 – 20,000	2,050 (34.1%)
20,000 – 30,000	2,254 (37.5%)
30,001 – 50,000	1,302 (21.6%)
> 50,000	283 (4.7%)

Table 2. Characteristics of hypertension and non-hypertension groups.

Variable	Hypertension (n = 2,366)	No Hypertension (n = 3,463)	*P* - value
Age group			
< 30 years	245 (10.4%)	924 (26.7%)	0.001
30 - 39 years	525 (22.2%)	1090 (31.5%)	
40 - 49 years	587 (24.8%)	885 (25.6%)	
≥ 50 years	1,009 (42.6%)	564 (16.3%)	
BMI (kg/m^2)			
< 18.5	68 (2.9%)	360 (10.4%)	< 0.001
18.5 - 24.9	1,123 (47.5%)	2,363 (68.2%)	
25 - 29.9	776 (32.8%)	617 (17.8%)	
≥ 30	398 (16.8%)	123 (3.6%)	
Sleep Quality (n, %)			
Good Sleep (PSQI <5)	1,257 (53.1%)	2,057 (59.4%)	< 0.001
Poor Sleep (PSQI ≥ 5)	1,109 (46.9%)	1,406 (40.6%)	
Shift worker status (n, %)			
Non-shift workers	736 (31.2%)	1,417 (40.9%)	< 0.001
Shift workers	1,626 (68.8%)	2,044 (59.1%)	
Working hours per day			
< 8 hours	242 (10.5%)	552 (16.2%)	< 0.001
8 - 12 hours	1,980 (86.2%)	2,763 (80.9%)	
> 12 hours	76 (3.3%)	100 (2.9%)	
Number of night shifts per month			
1 - 5 nights	1,304 (80.2%)	1,519 (74.3%)	< 0.001
6 - 10 nights	296 (18.2%)	502 (24.5%)	
> 10 nights	26 (1.6%)	23 (1.1%)	
Number of the rest interval hours per day			
< 1 hour	2,223 (95.1%)	3,232 (93.9%)	0.001
1 - 3 hours	72 (3.1%)	94 (2.7%)	
≥ 4 hours	43 (1.8%)	117 (3.4%)	

For healthcare workers with shift work, the odds of having hypertension were increased by 23%, in comparison with healthcare workers with no shift work (aOR = 1.23; 95% CI 1.03 to 1.48) after adjusting for other possible confounders. Furthermore, healthcare workers with poor sleep quality were more likely to have hypertension in comparison with healthcare workers who had good sleep quality (aOR = 1.11; 95% CI 1.01 to 1.25).

Stepwise regression was performed and the findings demonstrated that there were no significant associations between hypertension and working patterns including working hours per day, number of night shifts per month, and the rest interval hours per day, as shown in Table 3.

Table 3. Univariate and multivariate logistic regression analyses for hypertension by various factors.

	Unadjusted		Fully adjusted	
	OR (95% CI)	***P* - value**	**Adjusted OR (95% CI)**	***P* - value**
Age group				
< 30 years	Reference	1	Reference	1
30 - 40 years	1.82 (1.53 - 2.16)	< 0.001	1.40 (1.15 - 1.69)	0.001
40 - 50 years	2.5 (2.10 - 2.98)	< 0.001	1.84 (1.52 - 2.22)	< 0.001
> 50 years	6.75 (5.67 - 8.03)	< 0.001	5.41 (4.47 - 6.55)	< 0.001
BMI (kg/m^2)				
< 18.5	Reference	1	Reference	1
18.5 - 24.9	2.52 (1.92 - 3.29)	< 0.001	1.85 (1.39 - 2.45)	< 0.001
25 - 29.9	6.66 (5.03 - 8.81)	< 0.001	4.45 (3.3 - 5.98)	< 0.001
≥ 30	17.13 (12.33 - 23.80)	< 0.001	14.34 (10.16 - 20.22)	< 0.001
Sleep Quality				
Good Sleep (PSQI score < 5)	Reference	1	Reference	1
Poor Sleep (PSQI score ≥ 5)	1.29 (1.16 - 1.43)	< 0.001	1.11 (1.01 - 1.25)	0.049
Shift worker status				
Non-shift workers	Reference	1	Reference	1
Shift workers	1.53 (1.37 - 1.71)	< 0.001	1.23 (1.03 - 1.48)	0.025
Working hours per day				
< 8 hours	Reference	1	Reference	1
8 - 12 hours	1.64 (1.39 - 1.92)	< 0.001	1.27 (1.05 - 0.54)	0.015
> 12 hours	1.73 (1.24 - 2.42)	0.001	1.28 (0.88 - 1.87)	0.202
Number of night shifts per month				
1 - 5 nights	Reference	1	Reference	1
6 - 10 nights	0.69 (0.6 - 0.78)	< 0.001	1.14 (0.93 - 1.41)	0.216
> 10 nights	1.32 (0.84 - 2.08)	0.225	1.32 (0.77 - 2.27)	0.304
The rest interval hours per day				
< 1 hour	Reference	1	Reference	1
1 - 3 hours	1.11 (0.82 - 1.52)	0.499	1.2 (0.85 - 1.69)	0.305
≥ 4 hours	0.53 (0.38 - 0.76)	0.001	0.86 (0.58 - 1.28)	0.465

Discussion

This study demonstrated two main results. First, the prevalence of hypertension in healthcare workers at a large tertiary, university-based hospital in Bangkok, Thailand was 39.3%. Second, workers in the higher age group, higher BMI category, who had poor sleep quality, and engaged with shift work had a significant risk for hypertension.

Our findings are consistent with results reported in previous studies. Age and BMI are well-known risks of hypertension. The association of BMI with blood pressure among 1.7 million Chinese adults in 2018 showed that BMI is positively associated with blood pressure (BP). The association between BMI and BP is positive across tens of thousands of individuals in population subgroups.[17] A dogma of cardiology stated in the American Heart Association 2019 is that the older people are, the more likely people are to get high blood pressure as blood vessels gradually lose elastic quality contributing to increased blood pressure.

Fiorentini A, *et al*. and Liu RQ, *et al.*[18, 19] have also reported that poor sleep quality evaluated by the PSQI is associated with hypertension. Currently, the mechanisms underlying the relationship between sleep and BP regulation are not fully understood. However, sympathetic nerve activity to the vasculature has been reviewed to play an important role in the relationship between poor sleep and hypertension.[20]

Previous studies have shown that, compared to day workers, shift workers are more vulnerable to develop cardiovascular disorders, such as hypertension due to a disruption of circadian rhythm caused by irregular working schedules[21, 22], which are similar to our findings. The plausible pathway is that such adverse health effects are induced by a common mechanism via circadian rhythm disruption. Therefore, our results still indicate that shift workers should pay closer attention to blood pressure control by regularly checking their blood pressure and adjusting lifestyle habits.

With regard to working patterns, our findings show no association of any working patterns and hypertension. Some studies have shown similar results to these findings. For instance, data collected in the Minnesota Heart Survey [23] revealed no association between working hours and blood pressure. Pimenta AM, *et al*. [24] also showed no association between long work hours and the incidence of hypertension among a cohort of Spanish university graduates. The number of working hours per day seems to correlate in a positive direction with hypertension. Healthcare workers who worked 8 - 12 hours per day had 1.27 fold increased odds of having hypertension, in comparison with healthcare workers who worked < 8 hours per day (adjusted OR (aOR) = 1.27; 95% CI 1.05 to 0.54). This finding supports Yoo DH, *et al.* [25] which showed that as the number of working hours per week increased, the hazard ratio for diagnosis of hypertension significantly increased. Because it is difficult to distinguish the effects of shift work typically, many occupational factors other than the shift work itself, such as phychosocial stress, could affect blood pressure and healthcare workers may not be continuously in shift work throughout one year at the workplace because of duty change. Further studies are needed to advance this research field.

A strength of this study is the inclusion of the Pittsburg Sleep Quality Index (PSQI), as it is a reliable, valid, standardized measure of sleep quality, which discriminates 'good' and 'poor' sleepers by using a PSQI ≥ 5 as the cut-off. Statistical adjustment for potential confounding adds weight to the study findings.

This study has some limitations. First, the cross-sectional nature of this study limits the assessment of causality. Second, this study relied on one-time, self-reported sleep data, which may be subjected to recall bias. Third, unhealthy people or people with diseases retire early. Therefore, the prevalence rate of disease may have been underestimated due to the healthy worker survivor effect [26], which makes the existing healthcare workers seem healthier than in reality. Lastly, we did not have information on possible confounders such as job description of workers, which may be related to hypertension.

Conclusion

This study found that the prevalence of hypertension in healthcare workers was 39.3%. Shift workers had heightened risks for hypertension compared to the day workers, and the increase of risk was especially marked in workers with higher age, especially higher BMI. No working patterns factors were significantly associated with hypertension.

Shift workers had heightened risks for hypertension compared to the day workers, and the increase of risk was especially marked in workers with higher age, and especially higher BMI. This study provides significant implications for public health in that providing a safer and improved working environment for shift workers; for example, offering healthy options, like vegetables and fresh fruits, instead of snacks to helps keep workers' energy up, and shift workers should be able to stand up, stretch, or walk periodically to get some exercise during long periods.

Finally, establishing a primary prevention program, such as an obesity prevention program, to protect the health of healthcare workers will contribute to enhance the quality of life of healthcare workers.

Conflict of interest

The authors, hereby, declare no conflict of interest.

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