Risk Factors of Arterial Hypertension Among Mongolian Nurses

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Objectives: This study aims to survey the prevalence and risk factors of hypertension (HTN) among nurses. **Methods:** Data was collected from 528 nurses of 23 hospitals in Ulaanbaatar (UB) and local hospitals in other regions. We randomly selected day-shift only nurses (264) and shift nurses (264), collected blood samples, administered a health survey questionnaire, and processed data with SPSS 19.0 statistic software. **Results**: Overall, 8% of participants who work for shift and 7.2% of day working nurses are smokers ($p<0.0001$). 3.2% of shift working nurses and 3.8% day working nurses use overuse alcohol ($p<0.0001$). The day working nurses and the shift working nurses and compared their BMI to measured normal (42.1% and 36.4%) overweight (39.7% and 43.9%), obesity (18.2% and 19.7%) ($p<0.02$), central obesity normal (39.4% and 34.5%), and central obesity≥ 80 (60.6% and 65.5%), body fat percentages are normal (29.2% and 16.1%) and increase (70.8% and 73.9%), visceral obesity are normal (65.9% and 63.3%) and increase (34.1% and 36.7%). Nurses (day-work and shift-work) who have arterial HTN are detected by normal (72.3% and 59.1%), prodromal period (14.4% and 16.7%), 1st stage (12.1% and 19.7%), 2nd stage (1.2% and 4.5%) ($p<0.002$). Working time of nurses detected that shift working nurses' arterial hypertension amount is higher than day time working nurses. **Conclusion:** 24.2% of shift working nurses have HTN is showed that higher than day time working nurses. Hypertension is directly related to overweight, obesity, visceral obesity and high blood glucose level. ($p<0.0001$).

Keywords: Nurses, Work, Risk factors, Hypertension

Introduction

Health is important for everyone. Many researchers have studied the negative influence of shift work for human health, reporting that night shifts increase risks for many diseases and are influential to developing non-communicable diseases. Shift work includes working during non-standard hours (i.e., work during night, weekend, rotation work) [1]. 15% of the labor force in the U.S, 23% in Japan, 16% in Australia, 18% in the U.K, and 13% in France work as night shift workers of various professions, including nursing [2-3]. Nurses frequently have shift and irregular work schedules.

One leading non-communicable disease is cardiovascular disease. If systolic pressure increases by 20 mm and diastolic pressure by 70 mm in a 40-70 year old, the cardiovascular disease risks increase rapidly. Burt et al. showed the risk of hypertension (HTN) increases 10% for a 50 year old, 20% for a 60 year old, and about 30% for a 70 year old [4]. In 2009, a study by Devore et al. showed that 55% of shift workers who worked 1-9 years have HTN, 59% for those who worked 10-19 years, and 61% for those who worked more than 20 years [5]. The study from Brown et al. among nurses showed that the nurses who work more than 15 years have slight HTN [6]. In Canada, the study by Sfreddo et al. compared HTN among 493 day-only and shift nurses. 57.2% of day-only nurses had normal HTN levels, 27.3% had a previous period of HTN, and 15.4% were diagnosed with HTN. In contrast, 53.8% of shift nurses had normal HTN levels, 29.1% had a previous period of HTN, and 17% were assessed with HTN [7].

In 2013, HTN composed 5.4% of all diseases in Mongolia, occurring 379.9 times for every 10 000 people [8]. With regards to gender, females had more HTN, occurring 1317.7 times for every 10000 females in the 45-65 age range and 2852.2 times for every 10000 females in the 65 and over range. In addition, HTN has increased 15.6% compared to last year for the labor population [8].

Non-communicable diseases have become a leading and increasing health problem. International researchers have reported on the high risks of arterial HTN and cardiovascular diseases, which therefore necessitates the study of arterial HTN risk and spread. Like other living organisms, humans have body rhythms which are regulated by a ‘circadian clock’ in the brain. Over a 24-hour period, the circadian clock regulates sleep/wake patterns, body temperature, hormone levels, digestion and many other functions [9]. Shorter periods of sleep, which have been described for shift workers, could also lead to higher blood pressure [10-11]. In Mongolia, 5500 out of 10948 nurses work in sequential and night shift [8]. Mongolian night shift nurses work 16 to 24 hours in every shift of work. The present study aimed to compare the risk factors that might be associated with arterial HTN, including physical inactivity, BMI, central obesity, test blood glucose and blood cholesterol between day and shift work nurses.

Materials and Methods

1. Survey design and method

The prevalence of latent HTN risk factors among nurses were assessed by a cross sectional analytical study. Health care facilities which operate in UB and other regions with the mandate to provide secondary and tertiary level health care services were included in the study. Secondary and tertiary level health care organizations in UB and other regions were selected randomly for this survey. The Mongolian National University of Medical Sciences Medical Ethic Controlling Committee granted ethical permission during meeting №13-16/1A on 24.05.2013.

2. Sample size calculation

The sample size was calculated using OpenEpi program and was made on the basis of other survey findings (with 95% confidence interval and assumption of 1.2 design effect). The following formula was used for calculation of sample size:

$$n= (NP*(1-P))/(d^2/z^2(N-1)+P(1-P))$$

in which, n = sample size, P = 0.2 (hypothesized % frequency of outcome factor in the population), d = 0.05 (standard error), and z = 1.96 (95% confidence interval).

The calculated number of nurses to include in the survey was 235 among 5500 currently-employed shift nurses in UB city and other regions. Our study involved 7 central hospitals, 5 secondary hospitals, 8 diagnosis centers and integrated hospitals, and 3 maternity hospitals for a total of 23 health organizations with 528 day and shift nurses. We selected 264 day-shift only nurses and 264 shift nurses randomly.

3. Survey

Using quantitative method specially developed standard questionnaires, the survey for identifying latent HTN risk factor was made administered to the nurses. The standard questionnaire consisted of 90 questions which were divided into12 parts assessing general information, four particular behaviors (tobacco use, physical inactivity, unhealthy diet, and the harmful use of alcohol), and personal health. The questionnaires were ordered starting from simple to complicated and the questions related to personal health were put in the last section. The standard questionnaire consisted of 25 open and 65 closed questions. This study followed ethical protocols, including obtaining written permission from participants and sharing information about the study to participants at the completion of the study. The questionnaire was completed within 35-40 minutes.

4. Laboratory testing

Blood glucose levels (mmol/L) were measured with INFOPIA Glucose Analyzer (INFOPIA, Japan) and cholesterol levels with Accutrend Plus Cholesterol Analyzer (Accutrend Plus, USA). Blood glucose and cholesterol fast tests were measured between 07:00 and 09:00 AM. Fast blood glucose and cholesterol reference values of the American Diabetes Association were applied for glucose measurement (below 5.6 mmol/L normal, 5.6-6.1 mmol/L prediabetes, above 6.1 mmol/L diabetes) and cholesterol (below 5.2 mmol/L desirable, 5.2-6.2 mmol/L borderline high, above 6.2 mmol/L high).

5. Anthropomorphic measurements

Weight and height measurements were taken during the assessment. Waist circumference was measured as per WHO guidelines; at the mid-point between the lower border of the rib cage and the iliac crest. Hip circumference was measured at the widest point of the hips and the maximal protrusion of the gluteal muscles [12]. BMI was calculated as weight (kg) divided by height squared (m^2). Overweight was defined as a BMI ≥25–29.9 kg/m^2 and obese was defined as a BMI ≥30 kg/m^2. Waist-to-hip ratio was computed as the ratio of waist circumference to hip circumference. Central obesity distribution was defined as a waist-to-hip ratio of ≥0.9 for men or ≥0.85 [12-13].

Blood pressure (BP) was measured three consecutive times (OMRON Model HEM 7111; Omron Company, China), and the mean value was used in the analysis. BP was measured after a minimum of five minutes rest in the sitting position, recommended by the Mongolian HTN guideline and standard. Participants whose average BP levels were ≥140/90 mmHg or those who were taking antihypertensive medication were classified as being hypertensive [14].

Body fat percentages and visceral obesity were measured with Karada Scan 356 Scale (Karada Scan 356, Japan). Body fat percentage distribution was defined as high above 35%, average at 30-35%, normal at 20-30%, low below 10% and visceral obesity was defined as normal at 1-9, average at 10-14, and high above 15.

6. Data analysis

Survey data was analyzed with SPSS 19.0 software including error review, descriptive statistics, analysis, and distribution. Basic characteristics of the study groups by their current night shift work status were compared with Student's t-test for the continuous, and chi-square test for the categorical variables. Regression analyses showing the relationships between shift work duration and HTN risk factors were performed using simple and multivariate models stratified by abdominal obesity, BMI, visceral obesity and adjusted for smoking, drinking, blood glucose, cholesterol and physical activity. For definition of HTN risk factors, logistical

analysis was made on nominal or categorical variables and estimated by the odds ratio (OR) and 95% confidence interval.

Results

Participants' mean age was 39.6±0.42 years, with 38.8% of participants between the ages of 40 to 49. We divided participants into three age categories, 21-30 years old (18.9%), 31-40 years old (21.3%), and 41-50 years old (32.6%), and found arterial HTN statistically higher in older participants ($p<0.0001$). 62.9% of participants were from Ulaanbaatar, and 37.1% of participants were from rural areas, with 12.1% from the central region, 9.8% from the Khangai region, 11.4% from the western region, and 3.8% from the eastern region. HTN 1st stage and 2nd stage was statistically shown to be regionally influenced, with 20.4% detected in the central region, 25.4% in the Khangai region, 22.4% in the western region, 37.5% in the eastern region, and 15.3% in UB ($p<0.022$, Table 1).

Table 1. Prevalence of arterial hypertension by location

Indices	**Arterial hypertension**								**p-value**
	Normal		**Prodromal period**		**1st stage**		**2nd stage**		
Region	n	%	n	%	n	%	n	%	
Central region	34	57.6	13	22.0	8	13.6	4	6.8	
Khangai region	42	66.7	5	7.9	13	20.6	3	4.8	p<0.022
West region	32	65.3	6	12.2	10	20.4	1	2.0	
East region	11	45.8	4	16.7	6	25.0	3	12.5	
UB	228	68.5	54	16.2	47	14.1	4	1.2	
Total	347	65.7	82	15.5	84	15.9	15	2.8	

When nurses were divided by department, stage and 2nd stage arterial HTN 1st was at a total of 20.4% for those in surgery, 19.0% in intensive care, 20.2% in internal medicine, 30.8% in neurology, 35.7% in traditional care, 19.7% in infant care, 20.7% in communicable disease care, 23.7% in pediatrics, 10.0% in oncology, and 12.5% in maternity. Arterial HTN was not statistically significant for a particular clinical department ($p<0.36$, Table 2). Comparing day-shift only nurses and shift-work nurses, arterial HTN was detected as normal for 72.3% and 59.1%, prodromal for 14.4% and 16.7%, 1st stage for 12.1% and 19.7%, 2nd stage for 1.2% and

4.5% for each group, respectively (p<0.03). Shift nurses have higher occurrences of arterial HTN than day-shift only nurses (p<0.03, Table 2).

Table 2. Day time working, considering working departments and hypertension

Indices	Arterial hypertension								p-value
	Normal		Prodromal period		1st stage		2nd stage		
	n	%	n	%	n	%	n	%	
Work time									
Day-shift nurses	191	72.3	38	14.4	32	12.1	3	1.1	p<0.03
Shift-work nurses	156	59.1	44	16.7	52	19.7	12	4.5	
Total	**347**	**65.7**	**82**	**15.5**	**84**	**15.9**	**15**	**2.8**	
Department									
Surgery	70	61.9	20	17.7	12	10.7	11	9.7	p<0.36
Intensive care	50	59.6	18	21.4	6	7.1	10	11.9	
Internal medicine	51	60.7	16	19.1	8	9.5	9	10.7	
Neurology	13	50	5	19.2	4	15.4	4	15.4	
Traditional	7	50	2	14.3	4	28.5	1	7.2	
Infant care	40	60.6	13	19.7	7	10.6	6	9.1	
Communicable disease care	17	58.6	6	20.7	4	13.8	2	6.9	
Pediatric	16	42.1	13	34.2	5	13.2	4	10.5	
Oncology	6	60	3	30	1	10	0	0	
Maternity	40	62.5	16	25	5	7.8	3	4.7	

Nurses were divided into two groups (shift and day shift only) and compared for normal BMI (42.1% and 36.4%), overweight (39.7% and 43.9%), obese (18.2% and 19.7%) (p=0.2);

normal central obesity (39.4% and 34.5%), central obesity ≥ 80 (60.6% and 65.5%) (p=0.2); normal body fat percentage (29.2% and 16.1%), elevated body fat percentage (70.8% and 73.9%) (p=0.4); normal visceral obesity (65.9.2% and 63.3%) and elevated visceral obesity (34.1% and 36.7%) (p=0.5). We found indicators higher for shift nurses, though they were not statistically significantly different (Table 3).

Table 3. BMI and body fat percentages for day-shift and shift-work nurses

Indices	Total		Day-shift nurses		Shift-work nurses	
	n	%	n	%	n	%
BMI kg/m^2						
18.5-24.9 (normal)	207	39.2%	111	42.0%	96	36.4%
25-29.9 (overweight)	221	41.9%	105	39.8%	116	43.9%
≥30 (obese)	100	18.9%	48	18.2%	52	19.7%
Central Obesity ≥85						
Normal	195	36.9%	104	39.4%	91	34.5%
≥80	333	63.1%	160	60.6%	173	65.5%
Body fat percentages						
Normal	146	27.7%	77	29.2%	69	26.1%
Elevated	382	73.3%	187	70.8%	195	73.9%
Visceral obesity						
Normal	341	64.6%	174	65.9%	167	63.3%
Elevated	187	35.4%	90	34.1%	97	36.7%

Day-shift only and shift nurses had normal glucose levels at 54.9% and 48.1% (p<0.12), prediabetes at 30.7% and 34.5% (p<0.12), and diabetes at 14.4% and 17.4% (p<0.12), respectively. Though shift nurses have more prediabetes and diabetes than day-shift only nurses, the difference is not statistically significant (Table 4).

Table 4. Blood glucose for day-shift and shift-work nurses

Indices	Total		Day-work nurses		Shift-work nurses		p-value
	n	%	n	%	n	%	
< 5.6 Normal	272	51.5%	145	54.9%	127	48.1%	p<0.12
5.6-6.1 Prediabetes	172	32.6%	81	30.7%	172	34.5%	
> 6.1 Diabetes	84	15.9%	38	14.4%	46	17.4%	

8% of night-shift nurses and 7.2% of day-shift only nurses were smokers, which is a significantly significant difference (p<0.0001). 3.2% of shift nurses and 3.8% of day shift only nurses binge drank, but is not a significant difference (p=0.6). Physical exertion movement of day shift only nurses is higher than night shift nurses and is a statistically significant difference (p=0.022). By multivariate logistical regression analysis, being overweight (OR=3.2 [95% Cl:1.8-5.7]), elevated blood glucose level (OR=1.6 [95% Cl:1.08-2.55]), eating fewer than 5 servings of fruits and vegetables per day (OR=1.77 [95% Cl:0.9-3.4]) or central obesity (OR=3.5[95% Cl:1.9-6.1]), are significant risk factors for increased HTN in day and night shift nurses (Table 5).

Table 5. Logistic regression between hypertension and risk factors

Indication	p-value	OR	95%CI	
			Highest	Lowest
Physical inactivity	0.8	0.964	0.638	1.457
Visceral obesity	0.4	1.201	0.752	1.917
Body fat percentages	0.6	1.327	0.358	4.911
Overweight and obese (BMI)	0.0001	3.238	1.830	5.729
Central obesity	0.0001	3.567	1.90	6.125
Smoking	0.6	0.849	0.410	1.754
Alcohol	0.7	0.997	0.975	1.019

Eating fewer than 5 servings of fruits/ vegetables	0.03	1.776	0.909	3.470
Blood glucose	0.02	1.663	1.084	2.551
Blood cholesterol	0.4	1.362	0.656	2.830

Discussion

Our study involved 264 day-shift only nurses and 264 shift nurses, for a total of 528 participants, and focused on their HTN risk factors and HTN prevalence. We identified influencing risk factors of arterial HTN to be age, region of workplace, and shift work. Also, overweight and obese BMI, central obesity, eating fewer than 5 fruit or vegetables per day, and blood glucose level were significant predictors of HTN.

In our study, we found 39.8% of day shift nurses and 43.9% of shift nurses were overweight and 18.2% of day shift nurses and 19.7% of shift nurses were obese. A study by Zapka et al. on nurses of 6 hospitals in Massachusetts, USA, 28% had an overweight BMI, and 37% were obese [15]. Our study had more overweight nurses, but fewer obese nurses than these 6 hospitals in Massachusetts. A comparative study of Asians, which involved 257 Mongolians, 719 Japanese, and 408 Koreans for a total of 1384 people, showed the Korean female BMI to be 23.6±3.2 kg/m^2, Korean male to be 24.4±2.9 kg/m^2, Japanese female to be 22.6±3.4 kg/m^2, Japanese male to be 23.2±3.1 kg/m^2, Mongolian female to be 25.5±4.6 kg/m^2, Mongolian male to be 26.2±4.2 kg/m^2. This study showed that the BMI of Mongolians is higher than Koreans and Japanese, regardless of gender ($p<0.001$) [16]. A Canadian study by Sfreddo et al. among 493 nurses showed that day shift nurses had a BMI of 25.1±4.6 kg/m^2 and shift nurses had a BMI of 25.8±4.7kg/m^2 ($p<0.001$) [7]. In our study, the BMI of day shift nurses was 26.3±4.2 and shift nurses was 26.2±4.6, which is similar to the studies of Asians and Sfreddo. Additionally, a study by Suvd et al. in 2002 showed central obesity at 52% for males and 35% for females [17]. However, for nurses, we found central obesity at 60.6% for day shift nurses and 65.5% for shift nurses. Our results are higher than those found by Suvd et al. [17].

The study by Sfreddo et al. showed 16% of day shift nurses and 24% of shift nurses to be smokers [7]. In our study, we found 7.2% of day-shift nurses and 8% of shift nurses to be smokers. Sfreddo et al. study also showed 57.2% of day shift nurses to have normal HTN levels, 27.3% to have a previous situation of HTN, and 15.4% to have HTN. Similar to Sfreddo et al., our results showed 59.1% of shift nurses to have normal levels, 16.7% to have a previous

situation of HTN, and 24.2% to have hypertension. 18.7% of all nurses had HTN (BP≥ 140/90 mmHg). With regards to 1st and 2nd levels of HTN by regions, the central region had 20.4%, Khangai region had 25.4%, western region had 22.4%, eastern region had 37.5%, and UB had 15.3%, showing region of workplace to have a statistically significant influence on HTN. Interventions to reduce the incidence of elevated BMI and central obesity in Mongolian shift nurses that focus on reducing body mass, as well as targeting other health behaviors (e.g., increasing physical activity levels, improving diet) might prove useful.

Our study was a cross-sectional observational study, which confirmed that shift nurses have a higher prevalence of risk factors for arterial HTN. However, there are some study limitations. First, as the study was cross-sectional in design, it is difficult to conclude that the relationship between shift work and risk factor HTN was causal. A longitudinal study would be needed to support causation. Second, our data were collected from self-reported questionnaires. Additional metabolic markers should be included in future research for a better understanding of the relationship between shift work and risk factor HTN. Third, nurses not currently performing shift work might be misclassified because they had not provided any information about past shift work experience. Finally, shift work exposures at multiple aspects, such as frequency of night shifts, duration of each shifts, speed and direction of shift rotation, were not collected in the current study. Accordingly, further studies will be needed to assess the relationships of different kinds of schedules and duration of shift work as risk factors for HTN.

Conflict of Interest

The authors declared no conflict of interest.

Acknowledgments

I would like to express my deepest thanks to these organizations and people for helping us perform this study: Administration of School of Nursing of the Mongolian National University of Medical Sciences, National 1st Central Hospital, Shastin Central Hospital, National Center for Child and Maternal Health, Military Hospital, National Cancer Center, National Center for Traumatology, District Hospitals of Songinokhairkhan, Khan-Uul, Bayanzurkh, Baganuur and Nalaikh, 1st, 2nd and 3rd Maternity Hospitals, Arkhangai, Khovd, Khentii, Uvs, Dornogovi, Umnugovi, Tuv, Orkhon and Darkhan-Uul aimag's Central Hospitals, other colleagues and administrators of hospitals, research co-workers, and all the nurses who participated in our study.

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