THJPH

High Normal Blood Pressure among Young Supervisors in Siracha District, Chon Buri Province

Passara Wattana[1], Orawan Kaewboonchoo[2], Patcharaporn Kerdmongkol[3]

[1] Master of Nursing Science Program in Occupational Health Nurse Practitioner Student, Faculty of Public Health, Mahidol University, Bangkok, Thailand.

[2] Faculty of Public Health, Mahidol University, Bangkok, Thailand.

[3] Faculty of Public Health, Mahidol University, Bangkok, Thailand.

Correspondence: Orawan Kaewboonchoo, Faculty of Public Health, Mahidol University, Bangkok, Thailand. E-mail: orawan.kae@mahidol.ac.th

Received: March 15 2022; Revised: May 1 2023; Accepted: May 11 2023

Abstract

High normal blood pressure can develop to hypertension and cardiovascular disease if there is inappropriate risk protection, especially for individuals less than 35 years old who had the opportunity to develop left ventricular hypertrophy. The aims of this study were to measure the prevalence of high blood pressure and to investigate the factors associated with high normal blood pressure among young construction supervisors at a construction project in the Si Racha district.

In this cross-sectional study, the subjects consisted of 117 young constructions supervisor calculated by Daniel's formula 2010. A questionnaire was used to collect data and blood pressure was measured by an automated device based on the 2020 International Society of Hypertension criteria. Data was then analyzed by descriptive statistics, Chi-Square tests ($\chi 2$ test) or Fisher's Exact test, and Binary logistic regression.

The prevalence of high normal blood pressure was 49.6 percent. The binary logistic regression analysis showed alcohol drinking (OR = 7.69, 95% CI: 2.1-28.1), smoking (OR = 6.46, 95% CI: 1.8-22.9), noise annoyance (OR = 11.83, 95% CI: 3.5-40.5), and job strain (OR = 4.5, 95% CI: 1.3-14.8) were significant with high normal blood pressure at *P*-value < 0.05.

This study showed the prevalence of high normal blood pressure in young construction supervisors. The behavioral risk factors including alcohol drinking, smoking and environmental

factors including noise annoyance and job strain were associated with high normal blood pressure among the study population. There is a need to develop activities screening and health surveillance to decrease the risk factors of high normal blood pressure.

Keywords: High normal blood pressure, Young adult, Construction supervisor, Risk factors, Prevalence, Environment

What was Known

- High normal blood pressure means systolic blood pressure 135–139 mmHg or diastolic blood pressure 85–89 mmHg.
- Hypertension disease are non-communicable disease can develop to cardiovascular disease.

What's New and Next

- Perception noise annoyance associated with high normal blood pressure.
- To develop policies for screening blood pressure level individual age below 35 years old and the recommend guidelines to prevent hypertension development.

Introduction

World Health Organization reported that in 2021, there was an estimated 17.9 million people who died from cardiovascular disease. Cardiovascular disease is the leading cause of death globally, and other non-communicable diseases are responsible for the deaths of 41 million people each year— equivalent to 71 percent of all population[1]. In Thailand, the Ministry of public health statistics showed that non-communicable diseases killed 114 people/100,000 persons in 2016 and the death rate increased in 2019, 52.79 people/100,000 persons suffered from a stroke, 31.36 people/100,000 persons had ischemic heart disease, and 14.31 people/100,000 persons had hypertension, the death rate population 15–39 years suffer from cardiovascular disease 2.16% in 2021. In Chon Buri, the death rate increased in 2021, especially among 15–39 years with 0.79 to 1.54 from cardiovascular disease and 0.22 to 0.32 from hypertension in Sri Racha district reported hypertension among 15–39 year steadily increasing from 1.06 to 1.28 in 2021[2].

High normal blood pressure means blood pressure level 130–139/85–89 mmHg[3,4] which can increase the risk of developing hypertension, cardiovascular disease, myocardial infarction, and coronary artery disease[5]. Young adults with high normal blood pressure and

hypertension had higher rates of abnormalities on heart, brain health, increased rates of cardiovascular disease and mortality than normotensive at the same age[6,7,8]. A study in Sweden found that individuals less than 35 years old had the opportunity to develop left ventricular hypertrophy with stress echocardiogram examination[7]. Whereas these days the guidelines practiced to screening and preventing for high normal blood pressure was restricted effect diagnosis rates are lower, and treatment is often delayed in young people[8]. However, Chon Buri an industrial area affected individual especially young adult moved in to find their work and spending full-time office work especially in construction project has chance to exposed to a hazard and worked overtime 12 hours/day to accelerate the process. Construction supervisors have a responsibility to properly supervise all construction activities, safety on a construction site through subcontractors affected their exposed to a hazard at work affect their health

There are many studies regarding the factors predicting hypertension in various groups of people[9,10]. High normal blood pressure in young adult were associated with a greater risk of cardiovascular disease compared to normal blood pressure[11], a study found age, gender, and body mass index associated with high normal blood pressure to continued increased risk of hypertension, myocardia infraction, and coronary artery disease[12]. A study conducted on blue-collar workers in Japan suggested that education and gender were associated with hypertension in males, and other factors including marital status, smoking behavior, drinking behavior, and job strain were also associated with hypertension[9]. Moreover, environments with noise pollution are associated with hypertension[10]. A study from China found that age and body mass index are associated with high normal blood pressure[13]. These findings were relevant to a study from India mentioning that from ages 20-30 years, body mass index, and eating behaviors, especially sodium intake— is associated with prehypertension[14]. However, few studies investigate the associated factors with high normal blood pressure.

Thailand's current population structure is an aging society[15]. The number of young workers vital to the country's economy and development is declining and may affect the labor market in the future. Promoting the health of the new generation of workers is therefore important in maintaining the longevity of workers' health until retirement age. There are a few studies of high normal blood pressure in young adults concerned occupational health hazards. The purpose of this study was to determine the prevalence of high normal blood pressure and its associated factors in young workers exposed to multiple risk factors in the work environment.

The results of this study could be used to develop a program aimed at promoting and preventing hypertension and cardiovascular disease among young workers.

Materials and Methods

A cross-sectional study was conducted from May 15th, 2022 until June 30th, 2022 among young construction supervisors aged between 25-35 years in a construction project in the Si Racha district, Chon Buri province. Construction supervisors have a responsibility to properly supervise all construction activities on a construction site through subcontractors. The sample size was calculated by Daniel's formula 2010 as follows:

$$n = \frac{Z2\alpha/2\ NP(1-P)}{Z2\alpha/2\ P(1-P) + (N-1)d2}$$

where the level of confidence (Z) is 1.96, the expected prevalence (P) is 0.5, and the precision (d) is 0.05, [16] which suggested 90 participants and researcher collected data within the whole of population were considered to prevent uncompleted, missing data, and non-responsive rate the final 117 participants were recruited in this current study.

The study was approved by the ethical board of research involving humans, Mahidol University (MUPH-2021-138). The inclusion criteria were those who were a construction supervisor, 25-35 years of age, and willing to participate in completing the interview forms. The exclusion criteria were those who were pregnant, diagnosed with hypertension or systolic and diastolic blood pressure of 140/90 mmHg or above. Data were collected using the self-reported questionnaires 5 sections and blood pressure measurement with record were taken by researcher following ISH 2020 guidelines[3]. Researchers made an appointment to blood pressure measure through sample email address including the details date for collect the data between 06.30-08.00 a.m. at the work department, preparation before measure the blood pressure following by ISH 2020 guidelines[3] and after blood pressure examined research keep record in envelope with questionnaire to participant with instructs returned to researcher within 14 days at medical center. However, the sample has high blood pressure and will have to make an appointment to consult with Doctor of Construction Project at medical center.

Research instrument

The instrument was a questionnaire from a literature review 5 sections were examined by 3 experts and try out 30 participants. The tool used for collecting data was divided into 5 sections as follows:

The Demographic characteristic questionnaire consisted of gender, age, educational level, marital status, genetic disease, salary including overtime, and body mass index. Marital status was categorized as single and married. Participants' educational level was classified as undergraduate and bachelor's degree or above. Body mass indexes were classified into two, underweight/normal and overweight/obese. The content validity index was calculated as 0.95.

Behavioral risk factors consisting of alcohol drinking were defined as any alcohol usage. Participants were considered smokers if they reported smoking or had a history of smoking any type of tobacco product. The participants who had reported exercise in the past 1 month were considered to be currently exercising, and eating behavior and sleep were classified into three groups: low, medium, and high[17]. The reliability was tested with the Cronbach's coefficient and delivered a total reliability score of 0.75. The content validity index was calculated as 0.95.

Job characteristic factors consisted of position (Senior, Junior), and work hours— included overtime (≤ 48 hrs/week, < 48 hrs/week). The content validity index was calculated as 1.00.

Environmental factors consisting of temperatures were applied to the ASHRAE's thermal sensation (TS) scale [18]. Dust annoyance had a question with a numerical scale of 0 to 10 classified two categories as not annoyance (0-5) and annoyance (6-10)[19]. Noise annoyance had the scale points "not at all," "slightly," "moderately," "very," and "extremely use the upper two categories (the verbal marks "very" and "extremely") as indicators of "high annoyance[20]. Fear of COVID-19 was measured using a scale consisting of 5 scale points— extremely agree to extremely disagree with a cutoff point of 16.5 score the reliability was tested with the Cronbach's coefficient and delivered a total reliability score of 0.80[21]. Job strains were applied to the job content questionnaire, which were classified into two categories— high job strain and low job strain the reliability was tested with the Cronbach's coefficient and delivered a total reliability score of 0.76[22]. The content validity index was calculated as 1.00.

The health service system factors questionnaire was developed based on the concept of access to health[23], consisting of access to health care with the social security scheme and health care in the workplace. The questionnaire ranged from 5 scale points —extremely agree to extremely disagree. The median of all rankings was used as a cutoff point to divide the group into easy access and difficult access. The content validity index was calculated as 1.00. The reliability was tested with the Cronbach's coefficient and delivered a total reliability score of 0.93.

Outcomes

Blood pressure was measured by using the non-invasive automated sphygmomanometer model OMRON HEM-7120 based on the ISH 2020 guidelines [3] SBP < 135 mmHg or DBP < 85 mmHg was considered as normotensive, SBP 135-139 mmHg or DBP 85-89 mmHg was considered as high normal blood pressure, and SBP ≥ 140 mmHg or DBP ≥ 90 mmHg was considered as hypertension.

Statistical analysis

The SPSS version 26 was used for statistical analysis. Descriptive statistics including frequencies, percentages, mean, and standard deviation were employed to describe the data of the participants. The chi-square test and Fisher exact test were used to analyze the association of demographic data, health risk behaviors, characteristic of work, environment, and health service system with high normal blood pressure. In univariate analysis, variables with *p*-value < 0.3 were included in binary logistic regression, adjust odd ratio was applied, and *p*-value at 0.05 was considered significant.

Results

The total samples included 117 participants. Table 1 shows the prevalence of normotensive and high normal blood pressure in young construction supervisors at a construction project in Si Racha district, Chon Buri province. The overall prevalence of normotensive was 50.43% and high normal blood pressure was 49.57%.

Table 1 The prevalence of normotensive and high normal blood pressure among young construction supervisors

Category	Total%
Normotensive	50.43
High normal blood pressure	49.57

Table 2 shows descriptive univariate analysis; the findings show that most were male at 54.70%, and 45.30% were women. The age of participants that were 30-35 years and 20-35 years is 50.43% and 49.57%, respectively. Almost all graduated with a bachelor's degree or above, the majority of participants were single (71.79%), and the majority report a net income of less than 60,000 bath/month at 71.79%. More than half of the participants had a body mass index showing underweight/normal. The behavioral risk factors found that more than half of participants drinking, smoking, and exercise and sleep low level were 61.54%, 50.43%, 67.62% and 51.30%, respectively. Most participants had reported low levels of sugars, lipids, and sodium. The participants with work positions in the junior level were 60.68%, and most worked more than 48 hours/week. Work environment conditions reported included cold temperature, noise annoyance, and dust annoyance at 97.44%, 37.61%, and 32.48%, respectively. More than half feared COVID-19 and potential job strains. Most opinions of health service systems in the social security scheme and health care in the workplace were that they are difficult to access, at 66.96% and 70.09%.

Summarization using the univariate analysis found that high normal blood pressure was significant within gender, alcohol drinking, smoking, position, noise annoyance, and job strain at p-values <0.001, and body mass index at p-value <0.05.

Table 2 The prevalence and factors association with high normal blood pressure

Factors	Total	Prevalence%		*p*-value
	Proportion%	Normotensive	High normal BP	
Characteristic factors				
Gender				.001**
Male	54.70	35.94	64.06	
Female	45.30	67.92	32.08	
Age (year)				.165
25-29	49.57	56.90	43.10	
30-35	50.43	44.07	55.93	
Mean 29.76 Standard deviation 3.06 Minimum-Maximum 25.0-35.0				
Education level				.971
Undergraduate	13.68	50.00	50.00	
Bachelor degree or post-graduate	86.32	50.50	49.50	
Marital status				.576
Single	71.79	48.81	51.19	
Married	28.21	54.55	45.45	
Income/month (THB)				.277
≤ 60,000	71.79	53.57	46.43	
＞ 60,000	28.21	42.42	57.58	
Mean 50491.03 Standard deviation 20520.97Minimum-Maximum 20000-100000				
Genetics history				.512
Yes	46.15	53.70	46.30	
No	53.85	47.62	52.38	
Body mass index				.025*
Underweight/Normal	66.67	57.69	42.31	
Overweight/Obese	33.33	35.90	64.10	

[a] (Fisher Exact test) *(*P*-value <0.05) **(*P*-value <0.01)

Table 2 The prevalence and factors association with high normal blood pressure (Cont.)

Factors	Total	Prevalence%		*p*-value
	Proportion%	Normotensive	High normal BP	
Behavior risk factors				
Alcohol drinking				.000**
Yes	61.54	37.50	62.50	
No	38.46	71.11	28.89	
Exercise				.129
Yes	67.52	45.57	54.43	
No	32.48	60.53	39.47	
Smoking				000**
Yes	50.43	18.64	81.36	
No	49.57	82.76	17.24	
Eating behaviors				
Sugar level				.545
Low	97.37	51.46	48.54	
Medium	2.63	42.91	57.09	
Lipid level				.717[a]
Low	94.00	50.87	49.13	
Medium	6.00	42.91	57.09	
Sodium level				1.000[a]
Low	88.00	50.00	50.00	
Medium	12.00	66.74	33.26	
Sleep				.817
Low	51.30	50.00	50.00	
Medium	46.18	51.87	48.13	
High	2.52	66.63	33.37	
Job characteristic factors				
Position				.000**
Senior	39.32	28.26	71.74	
Junior	60.68	64.79	35.21	

[a] (Fisher Exact test) *(*P*-value <0.05) **(*P*-value <0.01)

Table 2 The prevalence and factors association with high normal blood pressure (Cont.)

Factors	Total	Prevalence%		*p*-value
	Proportion%	Normotensive	High normal BP	
Work hour (hrs/week)				.084
≤ 48	5.13	83.33	16.67	
> 48	94.87	48.65	51.35	
Mean 55.22 Standard deviation 5.35 Minimum-Maximum 48.0-84.0				
Environment factors				
Temperature perception				.619[a]
Hot	2.56	33.33	66.67	
Cold	97.44	50.88	49.12	
Noise annoyance				.000**
Yes	37.61	20.45	79.55	
No	62.39	68.49	31.51	
Dust annoyance				.949
Yes	32.48	50.00	50.00	
No	67.52	50.63	49.37	
Fear of COVID-19				.794
Yes	88.89	50.00	50.00	
No	11.11	53.85	46.15	
				.000**
Job strain				
High	44.44	30.77	69.23	
Low	55.56	66.15	33.85	
Health service system factors				
Social security scheme access				.608
Easy	35.04	53.66	46.34	
Difficult	64.96	48.68	51.32	
Health care in workplace				.585
Easy	29.91	54.29	45.71	
Difficult	70.09	48.78	51.22	

[a] (Fisher Exact test) *(*P*-value <0.05) **(*P*-value <0.01)

Table 3 shows the binary logistic regression analysis. Alcohol drinking was significantly associated with a high normal blood pressure. In fact, results show that alcohol drinkers are 7.6 times more likely than individuals who report no alcohol drinking to have high normal blood pressure (95% CI 2.10-28.12). Similarly, those who were smoking had a 6.4 times higher risk of high normal blood pressure (95% CI 1.82-22.91). Those who perceived noise annoyance were 11.8 times more likely to have high normal blood pressure than individuals who reported no perceived noise annoyance (95% CI 3.45-40.53). In addition, those who had high job strain were 4.4 times more likely to have high normal blood pressure than individuals who had low job strain (95% CI 1.34-14.76). However, gender, age, income, body mass index, exercise, position, and work hours were not significantly associated with high normal blood pressure.

Table 3 Binary logistic regression for association of high normal blood pressure

Factor	Beta	S.E.	Adjust OR	*p*-value	95%CI
Gender	-.184	.628	.832	.770	.243-2.849
Age	-.128	.605	.880	.832	.269-2.881
Income	.314	.694	1.369	.651	.351-5.339
Body mass index	.128	.627	1.136	.838	.332-3.885
Alcohol drinking	2.040	.662	7.688	.002**	2.101-28.126
Exercise	1.288	.627	4.425	.072	.922-16.210
Smoking	1.866	.646	6.462	.004**	1.823-22.914
Position	-.833	.603	.413	.143	.127-1.349
Work hour	.328	.795	1.389	.679	.293-6.590
Noise annoyance	2.471	.628	11.831	.000**	3.453-40.534
Job strain	1.493	.612	4.450	.015*	1.341-14.764

* (*p*-value <0.05) ** (*p*-value <0.01) Reference variable: female, 25-29 years, > 60,000 baht, underweight/normal, no drinking, no exercise, no smoking, junior position, ≤48 hrs/week, no noise annoyance, low job strain

Discussion

Prevalence of high normal blood pressure

Individuals who are less than 35 years old and have high normal blood pressure are at an increased risk of heart failure and cerebrovascular disease due to atherosclerosis. This study reported the prevalence of high normal blood pressure is 49.6% in young construction supervisors in Si Racha district, Chon Buri province. The prevalence was slightly higher in compared with Ministry of public health statistics reported age 15-35 years old were 1.2 % (200,000 person) diagnosed hypertension and Chon Buri province has 1.27% (5,617 person)[2].

Alternative studies have reported a higher prevalence of high normal blood pressure in comparison to our study findings[24,25]. These differences in the prevalence of high normal blood pressure in contrast to other studies might be because of various socioeconomic an important role in hypertension prevalence, individuals low socioeconomic has higher hypertension especially with no education than high socioeconomic[26], participants lifestyle factors , beliefs, regulations and health care system some countries covers all health expenditures with free access to general practitioners, environment and the different study settings.

Risk factors associated with high normal blood pressure.

In our study, the binary logistic regression analysis showed that alcohol drinking, smoking, noise annoyance, and job strain were significantly associated with the risk of having high normal blood pressure.

The study found that drinking alcohol can increase the risk of high normal blood pressure when compared to non-alcohol drinking, which was in concordance with other studies[27,28]. These pathophysiological mechanisms that affects baroreceptor function, stimulates the sympathetic nervous system, and influences angiotensin II to increase cortisol and catecholamine secretion leading to decreased urine, vasoconstriction, and blood pressure level increase[29,30].

Similarly, smoking is correlated to having high normal blood pressure in comparison to non-smokers. Other studies have confirmed these findings[25,28]. Tobacco use influenced endothelium dysfunction, peripheral vascular resistance, and increase blood pressure levels[31]. A cigarette contains nicotine that directly affects a smoker, stimulates catecholamine secretion, and causes vasoconstriction that increases blood pressure levels, heart rate, and circulation system, and increases the risk for cardiovascular disease[32,33].

The present study showed that noise annoyance is associated with an increased risk of high normal blood pressure, which was in concordance with other studies[34,35]. Furthermore, there is evidence that supports that traffic noise annoyance every 5 decibels increases blood pressure levels[36], and 50-60 dB(A) affects health problems[37] and these factors can be explained through the mechanism of perceived noise indirect pathways increased vasoconstriction and blood pressure level[38] relevant to study in rats found that a suddenly loudly sound that affected the stress mechanism stimulated cortisol, catecholamine, and renin-angiotensin-aldosterone secretion to increase pulse, vasoconstriction, and blood pressure level[38,39,40].

In addition, job strain has a significant association with high normal blood pressure and is relevant in other studies[41,42,43] and increases SBP and DBP[44]. Job strain, resulting from a combination of high demand with low decision latitude in the workplace will lead to negative physical health outcomes such as hypertension and cardiovascular disease[45]. The demand of workplace comprises both job (work schedules, time pressure, physical condition, repetitive work, etc.) and human (job satisfaction, organization, job security, reward, self-confidence, ability to cope with stress, etc.)[45]. These can be explained through the mechanism of job strain contributes to high blood pressure, is through chronic physiological with the stimulation of the sympathetic nervous system to enhance adrenocorticotropic hormone (ACTH) and Cortisol synergistic catecholamine function to bind Alpha 1-Adrenergic receptor affects an increased peripheral resistance and raised blood pressure level[46]. Additionally, the previous studies showed an association between job strain and blood pressure of newly diagnosed hypertensive subjects exposed to high job strain[45].

Conclusion

The prevalence of high normal blood pressure in this study was 49.6%. A significant association was found between high normal blood pressure and alcohol drinking, smoking, noise annoyance, and job strain —which can be explained by pathophysiological mechanisms. The research results may be applied to develop the policy and regulations that may prevent the risk of high normal blood pressure by conducting activities screenings of all individuals aged above 35 years and perform health surveillance, promote health, and prevent the risk for employees by occupational health nurse or health sectors. This study has a few limitations is data collected on a questionnaire was self-reported which could have led to a misunderstanding and bias, this is a cross-sectional study design cannot establish cause-effect relationship and had a small sample size due to establish in young adult supervisor level maybe cannot representation of the whole young adults.

Ethical Approval Statement

The study was approved by the ethical board of research involving humans, Mahidol University on December 30th, 2022 approval number MUPH-2021-138

Author Contributions

PW conceived the objective of the study, created questionnaire, collect the data, data analysis, and wrote manuscripts under supervision and guidance from OK and PK. PW wrote the manuscript and created the translated English abstract, and OK the helped to revise it. All authors read and approved the manuscript before submission.

Acknowledgements

The authors would like to thank the construction manager and all participants of this construction project for allowed to be collecting the data.

Source of Funding

This research received no external funding.

Conflicts of Interest

The authors did not have any conflicts of interest.

References

1. World Health Organization. Cardiovascular disease. Geneva: WHO; 2021.
2. Hdcservice.moph.go.th. Bangkok. Non-communicable disease. Available from: https://hdcservice.moph.go.th/hdc/main/index.php, accessed 5 October, 2021.
3. Unger T, Borghi C, Charchar F, Khan NA, Poulter NR, Prabhakaran D, et al. 2020 International society of hypertension global hypertension practice guidelines. Hypertension. 2020; 75(6): 1334-57. DOI: 10.1161/HYPERTENSIONAHA.120.15026
4. Williams B, Mancia G, Spiering W, Rosei AE, Azizi M, Burnier M, et al. ESC/ESH Guidelines for the management of arterial hypertension: The task force for the management of arterial hypertension of the European Society of Cardiology (ESC) and the European Society of Hypertension (ESH). Eur Heart J. 2018; 39(33): 3021-104. DOI: 10.1093/eurheartj/ehy339
5. Qureshi IA, Suri KFM, Kirmani FA, Divani AA, Mohammad Y. Is Prehypertension a Risk factor for Cardiovascular Diseases?. Stroke 2005; 36(9): 1859-63. DOI: 10.1161/01.STR.0000177495.45580.f1

6. Jennifer S, Drukteinis, Mary JR, Fabsitz RR, Lee ET, Best LG, et al. Cardiac and systemic hemodynamic characteristics of hypertension and prehypertension in adolescents and young adults. Circulation. 2007; 115(2): 221–7. DOI: 10.1161/CIRCULATIONAHA.106.668921
7. Suvila K, McCabe LE, Lehtonen A, Ebinger EJ, Lima CAG, Cheng S, et al. Early onset hypertension is associated with hypertensive end-organ damage already by MidLife. Hypertension. 2019; 74(2): 305–12. DOI: 10.1161/HYPERTENSIONAHA.119.13069
8. Hinton TC, Adams ZH, Baker RP, Hope KA, Paton JFR, Hart EC, et al. Investigation and treatment of high blood pressure in young people too much medicine or appropriate risk reduction?. Hypertension. 2020; 75(1):16–22. DOI: 10.1161/HYPERTENSIONAHA.119.13820
9. Tsutsumia A, Kayabab K, Tsutsumic K, Igarashi M. Association between job strain and prevalence of hypertension: a cross sectional analysis in a Japanese working population with a wide range of occupations: the Jichi Medical school cohort study. Occup Environ Med. 2001; 58(6): 367–73. DOI: 10.1136/oem.58.6.367
10. Lercher P, HÖrtnagl J, Kofler WW. Work noise annoyance and blood pressure: combined effects with stressful working conditions. Int Arch Occup Environ Health. 1993; 1993(65): 23–8. DOI: 10.4103/ijoem.IJOEM_259_19
11. Luo D, Cheng Y, Zhang H, Ba M, Chen P, Li H, et al. Association between high blood pressure and long term cardiovascular events in young adults: systematic review and meta-analysis. The BMJ. 2020: 1–15. DOI: 10.1136/bmj.m3222
12. Qureshi IA, Suri KFM, Kirmani FA. Divani AA, Mohammad Y. Is prehypertension a risk factor for cardiovascular diseases?. Stroke. 2005; 36(9): 1859–63. DOI: 10.1161/01.STR.0000177495.45580.f1
13. Hu L, Huang X, You C, Li J, Hong K, Li P, et al. Prevalence and risk factors of prehypertension and hypertension in Southern China. PLoS One. 2017; 12(1): 1–15. DOI: 10.1371/journal.pone.0170238
14. Kar SS, Selvaraj K, Ramaswamy G, Premarajan CK, Saya KG, Kalidoss V. High prevalence of prehypertension and its association with modifiable risk factors: Findings of household

STEPS survey from urban puducherry, South India. Int J Prev Med. 2020; 11(162): 1-9. DOI: 10.4103/ijpvm.IJPVM_6_19

15. Institute for Population and Social Research Mahidol University. Situation of the thai older persons 2021. 1st ed. Bangkok. Amarin Printing and Publishing Public Company Limited. 2022. (In thai)
16. Daniel WW, Biostatistics: a foundation for analysis in the health sciences. 9th ed. John Wily&Sons; 2010.
17. Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The pittsburgh sleep quality index: A new instrument for psychiatric practice and research. Psychiatry Res. 1989; 28(2): 193-231. DOI: 10.1016/0165-1781(89)90047-4
18. Schweiker M, Fuchs X, Becker S, Shukuya M, Dovjak M, Hawighorst M, et al. Challenging he assumptions for thermal sensation scales. Building Research & Information. 2016; 45(5): 572-89. DOI: 10.1080/09613218.2016.1183185
19. Oglesby L, Künzli N, Monn C, Schindler C, Ackermann-Liebrich U, Leuenberger P, et al. Validity of Annoyance Scores for Estimation of Long Term Air Pollution Exposure in Epidemiologic Studies: The Swiss Study on Air Pollution and Lung Diseases in Adults (SAPALDIA). Am J Epidemiol. 2000; 152(1): 75-83. DOI: 10.1093/aje/152.1.75
20. Community response to noise team of ICBEN, Jong RG, Gjestlnd T, Flindell IH, Jo RFS, Kurra S, et al. Standardized general-purpose noise reaction questions for community noise surveys: Research and a recommendation. J Sound Vib. 2001; 4(10): 641-79. DOI: 10.1006/jsvi.2000.3384
21. Ahorsu KD, Ying Lin C, Imani V, Saffarim M, Griffiths DM, Pakpour HA. The fear of COVID-19 scale: Development and initial validation. Int J Ment Health Addict. 2020: 1537-45. DOI: 10.1007/s11469-020-00270-8
22. Pitchaya P, Nualta A. Psychometric properties of the Thai version of the 22-Item and 45-Item karasek job content questionnaire. Int J Occup Med Environ Health. 2008; 21(4): 331-44. DOI: 10.2478/v10001-008-0036-6
23. Penchansky R, Thomas JW. The concept of access: Definition and relationship to consumer satisfaction. Medical Care 1981; 19(2):12. DOI: 10.1097/00005650-198102000-00001

24. Aldiab A, Shubair MM, Al-Zahrani MJ, Aldossari KK, Al-Ghamdi S, Househ M, et al. Prevalence of hypertension and prehypertension and its associated cardioembolic risk factors; a population based cross-sectional study in Alkharj, Saudi Arabia. BMC Public Health 2018; 18(1327): 1-9. DOI: 10.1186/s12889-018-6216-9
25. Udayar SE, Thatuku S, Jevergiyal DP, Meundi A. Prevalence and predictors of prehypertension and hypertension in adult population of rural Southern India-An epidemiological study. J Family Med Prim Care. 2021; 10(7): 1-8. DOI: 10.4103/jfmpc.jfmpc_2415_20
26. Sebastiaana B, Sabinea H, Didiera C, Linden VD, Ea L, Henrikeb G, et al. The association between socioeconomic status and prevalence, awareness, treatment and control of hypertension in different ethnic groups: the Healthy Life in an Urban Setting study. Journal of hypertension. 2022; 40(5): 897-907. DOI: 10.1097/HJH.0000000000003092
27. Lin Y, Lai X, Chen G, Xu Y, Huang B, Chen Z, et al. Prevalence and risk factors associated with prehypertension and hypertension in the Chinese She Population. Kidney Blood Press Res. 2012; 2012(35): 305-13. DOI: 10.1159/000336085
28. Xu T, Liu J, Zhu G, Liu J, Han S. Prevalence of prehypertension and associated risk factors among Chinese adults from a large-scale multi-ethic population survey. BMC Public Health. 2016; 16(775): 1-8.
29. Potter JF, Watson RD, Skan W, Beevers DG. The pressor and metabolic effects of alcohol in normotensive subjects. Hypertension. 1986; 8(7): 625-31. DOI: 10.1161/01.hyp.8.7.625
30. Okuno F, Arai M, Ishii H, Ebihara Y, Takagi S, Tsuchiya M. Mild but prolonged elevation of serum angiotensin converting enzyme (ACE) activity in alcoholics. Alcohol 1986; 3(6): 357-9. DOI: 10.1016/0741-8329(86)90053-4
31. Winniford. Smoking and cardiovascular change. Journal of International Society of Hypertension. 1990; (8): S17-S23.
32. Kalkhoran S, Benowitz LN, Rigotti AN. Prevention and treatment of tobacco use: JACC health promotion series. J Am Coll Cardiol. 2018; 23(72): 2964-79. DOI: 10.1016/j.jacc.2018.06.036

33. Byrne JC, Khurana S, Kumar A, Tai TC. Inflammatory signaling in hypertension: regulation of adrenal catecholamine biosynthesis. Front Endocrinol (Lausanne). 2018; 8(343): 1-25. DOI: 10.3389/fendo.2018.00343
34. Kim GM, Ahn YS, Jin Z. The relationship between occupational noise exposure and hypertension using nearest age-matching method in South Korea male workers. Cogent Eng. 2021; 8(1): 1-10. DOI: 10.1080/23311916.2021.1909798
35. Baudin C, Lefèvre M, Babisch W, Cadum E, Champelovier P, Dimakopoulou K, et al. The role of aircraft noise annoyance and noise sensitivity in the association between aircraft noise levels and hypertension risk: Results of a pooled analysis from seven European countries. Environ Res. 2020; 191: 1-10. DOI: 10.1016/j.envres.2020.110179
36. Kempem V, Babisch E, Wolfgangb. The quantitative relationship between road traffic noise and hypertension a meta-analysis. J Hypertens. 2012; 30(6): 1075-86. DOI: 10.1097/HJH.0b013e328352ac54
37. Blair B, Brindley S, Dinkeloo E, McKenzie L, Adgate J. Residential noise from nearby oil and gas well construction and drilling. J Expo Sci Environ Epidemiol. 2018; 28(1): 538-47. DOI: 10.1038/s41370-018-0039-8
38. World Health Organization. Environmental noise for the European Region. Europe: WHO; 1999.
39. European Environment Agency. Noise in Europe 2014. Available from https://www.eea.europa.eu/ publications/noise-in-europe-2014, accessed 1 October, 2022.
40. Hahad O, Jimenez MTB, Kuntic M, Frenis K, Steven S, Daiber A, et al. Cerebral consequences of environmental noise exposure. Environ Int. 2022; 165. 1-14. DOI: 10.1016/j.envint.2022.107306
41. Markovitz JH, Matthews KA, Whooley M, Lewis CE, Greenlund KJ. Increases in job strain are associated with incident hypertension in the CARDIA Study. Annals of Behavioral Medicine. 2004; 28(1): 4-9. DOI: 10.1207/s15324796abm2801_2
42. Hu B, Jiu X, Yin S, Fan H, Feng F, Yuan J. Effects of psychological stress on hypertension in middle-aged chinese: A cross-sectional study. PLOS ONE 2005; 10(6): 1-13. DOI: 10.1371/journal.pone.0129163

43. Owolabi AO, Owolab MO, OlaOlorun AD, Olofin A. Work-related stress perception and hypertension amongst health workers of a mission hospital in Oyo State, south-western Nigeria. Afr J Prim Health Care Fam Med. 2012; 4(1): 1-7. DOI: 10.4102/phcfm.v4i1.307

44. SÖderberg M, Rosengren A, HillstrÖm J, Lissner L, TorÉn K. A cross-sectional study of the relationship between job demand-control, effort-reward imbalance and cardiovascular heart disease risk factors. BMJ Public Health 2012; 12(1120): 1-11. DOI: 10.1186/1471-2458-12-1102

45. Ducher M, Cerutti C, Chatellier G, Fauvel J. Is high job strain associated with hypertension genesis?. American Society of Hypertension. 2006; 19(7): 694-700. DOI: 10.1016/j.amjhyper.2005.12.016

46. Spruil MT. Chronic psychosocial stress and hypertension. National Institutes of Health. 2012; 12(1): 10-16. DOI: 10.1007/s11906-009-0084-8