JRH
Jrh.gmu.ac.ir

The survey of hypertension and its risk factors among industrial male workers

Hadi Daneshmandi[1], Alireza Choobineh[1], Abdolreza Rajaee Fard[2], Mina Babashahi[3]

Journal of Research & Health
Social Development & Health Promotion Research Center
Vol. 8, No.6, Nov & Dec 2018
Pages: 485- 491
DOI: 10.29252/jrh.8.6.485
Original Article

1. Research Center for Health Sciences, School of Health, Shiraz University of Medical Sciences, Shiraz, Iran
2. Department of Epidemiology, School of Health, Shiraz University of Medical Sciences, Shiraz, Iran
3. Department of Food and Nutrition Policy and Planning Research, School of Nutrition Sciences and Food Technology, Shahid Beheshti University of Medical Sciences, Tehran, Iran
Correspondence to: Alireza Choobineh, Research Center for Health Sciences, School of Health, Shiraz University of Medical Sciences, Shiraz, Iran.
Email: alrchoobin@sums.ac.ir

Received: 9 Jul 2014
Accepted: 24 Oct 2016

How to cite this article: Daneshmandi H, Choobineh A, Rajaee Fard A, Babashahi M. The survey of hypertension and risk factors among industrial male workers. *J Research & Health*2018; 8(6): 485- 491.

Abstract
Hypertension is nowadays increasingly observed among the workforce population. There are many risk factors for hypertension. This study was conducted to survey hypertension and its associated risk factors among male workers of the industrial sector in Shiraz city. 500 male workers employed in Shiraz city industries participated voluntarily (age range of 20 to 59 years). A questionnaire and direct measurements were used to collect required data. The questionnaire consisted of two parts including a) demographic and occupational and b) anthropometric (height, weight, BMI, WHtR) and physiological (blood pressure and VO_2-max) characteristics of the subjects. Mean (standard deviation) of systolic and diastolic Blood Pressure (BP), and Mean Arterial Pressure (MAP) in workers were 128.37±14.78, 83.13±13.10, and 98.21±13.36 mmHg, respectively. The results showed that systolic and diastolic BP, and MAP significantly were related to BMI, shift work, and smoking. Also, statistical analysis revealed that mean values of VO_2-max between workers with normal and high blood pressure are significantly different. The results of this study demonstrated that domestic and occupational life style and cardio-respiratory fitness are the risk factors for hypertension in the studied workers.

Keywords: Body Mass Index, Exercise Test, Hypertension

Introduction
Cardiovascular diseases are the most important cause of mortality in many countries. For example, in the United States of America (USA), these diseases are the cause of more than 40 percent of all deaths. Hypertension (high blood pressure) is a kind of cardiovascular diseases [1]. Blood pressure is the pressure that blood exerts to vessel walls which is expressed predominantly by millimeter of mercury unit (mmHg) [2].
High blood pressure causes heart to work more than normal. In long period, the pressure exerted on heart can lead to cardiac enlargement, heart injury, hardening, and loss of elasticity of the arteries. In fact, this issue can lead to atherosclerosis, heart attacks, heart failure, stroke, and kidney failure [1]. Usually, the cause of hypertension is unknown in 90 percent of cases (intrinsic hypertension). Intrinsic hypertension can be a result of factors such as hereditary factors (genetic), high sodium intake, obesity, insulin resistance,

lack of physical activity, mental load, or a combination of the above factors and even other factors that are remained yet unknown [1].

Nowadays, for various reasons (e.g. earning more money, self-actualization etc.), individuals are employed in various industries. On the other hand, the lifestyle has changed to sit work and lower physical activity. This issue (unhealthy lifestyle) can increase in people the risk of obesity and cardiovascular diseases, especially high blood pressure [3]. Lack of physical activity is one of the risk factors for developing the cardiovascular diseases (hypertension etc.) [4]. Some studies have shown that physical fitness can increase cardio-respiratory capacity such as maximum aerobic capacity (VO_2-max: Maximal Oxygen Consumption) [5,6].

Maximum aerobic capacity or VO_2-max is the maximum amount of oxygen that can be absorbed by the respiratory system and receive to the muscles via the blood [7-13]. This parameter (VO_2-max) is regarded as a golden standard for the measurement of practical cardio-respiratory fitness [9,11]. VO_2-maxvaries largely in different individuals and is influenced by various factors such as the physical, mental [13], environmental [1,13], and physiological characteristics [13]. In literature, it has been shown that exercise and physical activity can increase a person's VO_2-max [1,5].

Also, the results of some studies have revealed that the prevalence rate of cardiovascular diseases such as high blood pressure is higher in shift workers than day workers [14]. On the other hand, some studies have shown that smoking is another risk factor for hypertension in people [15].

Hypertension can be effectively controlled by weight loss, lifestyle change to healthy, proper diet, exercise, no smoking, and no alcohol drinking [1,3].

The prevalence rate of hypertension is different in various parts of the world. The lowest prevalence of this disease (hypertension) has been reported in rural areas of India (3.4% in men and 6.8% in women) and the highest prevalence has been related to Poland (68.9 % in men and 72.5% in women) [16]. Also, the results of some studies have revealed that hypertension is a risk factor for mortality in Iran. This disease (hypertension) in 2005 caused 80,000 deaths in Iran [17].

Providing the health of workers is essential to enhancing productivity and improving competitiveness in the labor market. Hypertension is one of the diseases with an increasing prevalence rate among worker population. So far, a comprehensive study has not been performed to survey the hypertension and its associated risk factors in the industries of Shiraz city, south Iran. This study was conducted to survey hypertension and its associated risk factors among workers of the industrial sector of Shiraz city. The findings of this study can provide useful information on hypertension and it's affecting factors among the studied population.

Method

This cross-sectional study was conducted from September to December. 440 was calculated at 95 percent confidence level according to the study of Choobineh et al. [18]. In order to higher validity of the study, the sample size was increased to 500. The participants were randomly selected from those referred to a governmental clinic for periodic medical examinations. All participants voluntarily partook in the study after receiving oral information about the aims and protocol of the study. Additionally, the study was conducted in accordance with the Helsinki Declaration of 1964 as revised in 1984. All the participants signed an informed consent form before the commencement of the study. The study was approved by ethics committee of Shiraz University of Medical Sciences.

Data were gathered by the following tools:

Demographic characteristics

participants completed a self-administered questionnaire containing some questions about demographic and job related variables (i.e. age, job title, work experience, marital status, level of education, static or dynamic nature of work, shift working, smoking, and weekly exercise hours).

VO_2-max measurement

To estimate aerobic capacity, participants performed a 6-minute sub-maximal exercise test on a cycle-ergometer (MONARK 839E) based on the Astrand protocol [2]. During the test, heart rate was monitored and a wireless transmitter was used to transmit the heart beat data to the base unit. Using acquired data, special-purpose software installed on a system to calculate the VO_2-max of the individual expressed asl.min-1and $ml.kg^{-1}.min^{-1}$. All tests were performed from 8 a.m.to 2 p.m. in the lab with an average temperature of 20.5 °C, 41% relative humidity, and 857 mbar barometric pressure.

Measurement of height, weight, waist circumference, systolic, and diastolic Blood Pressure (BP):

- Individuals' stature was measured by a tape under the standard conditions [2].
- Weight of the participants was measured using a digital scale.
- Waist Circumference (WC) of the workers was measured by a tape.

It should be noted that height, weight, and waist circumference were measured while the subject worn light clothing without shoes, hat, and gloves.

- Body Mass Index (BMI) was calculated for each subject using $BMI=\frac{Weight^2}{Height^2}$ formula.
- WHtR was calculated using $WHtR=\frac{\text{Waist circumference}}{\text{Height}}$ formula.
- Systolic and diastolic blood pressure was measured by a Beurer BC 16 pulsemeter.
- Mean Arterial Pressure (MAP) was calculated using the following formula [2]:

$$MAP=DBP+\frac{1}{3}(SBP-DBP)$$

In this formula, MAP, DBP (Diastolic Blood Pressure), and SBP (Systolic Blood Pressure) are in mmHg. It should be noted that a person with a MAP greater than 110 mmHg is considered to be hypertensive [5].

Statistical analyses were performed by SPSS-16 using Kruskal-Wallis (comparison of means among several groups) and Mann-Whitney U (comparison of means among two groups) tests. p-values less than 0.05 were considered a sign of significance. The Kolmogorov-Smirnov test showed that data on systolic blood pressure ($p=0.001$), diastolic blood pressure ($p<0.001$), mean arterial pressure ($p<0.001$), and VO_2-max ($p<0.001$) were not normally distributed. Therefore, the analysis of data was performed using non-parametric statistical tests (Kruskal-Wallis and Mann-Whitney U).

Results

The mean±standard deviation of age and job tenure of participants was 32.01±7.66 and 8.5±6.27 years, respectively. The results of the study showed 46.8% of participants were occupied in the shift working system and the others (53.2%) were day workers. 12% of studied workers were cigarette smokers.

Table 1 presents mean, standard deviation, minimum, and maximum values of some anthropometric and physiologic characteristics of the participants under the study.

Table 1 *Some anthropometric and physiologic characteristics of the study participants (n=500)*

Variables	Mean	SD†	Min	Max
Weight (kg)	77.10	12.41	50	110.2
Height (cm)	176.10	5.93	159	190
Waist circumference (cm)	78.17	9.83	60	112
BMI* ($kg.m^{-2}$)	24.82	3.58	15.90	33.57
WHtR**	0.49	0.05	0.35	0.63
Systolic blood pressure (mmHg)	128.37	14.78	98	163
Diastolic blood pressure (mmHg)	83.13	13.10	57	128
Mean arterial pressure (mmHg)	98.21	13.36	71.33	135.67
VO_2-max ($ml.kg^{-1}.min^{-1}$)	35.94	7.39	19.50	58.04

**Body Mass Index, **Waist-to- Height Ratio, †Standard Deviation*

In Table 2, the mean values of SBP, DBP, and MAP of studied participants among different groups of BMI have been compared [20]. The results of Kruskal-Wallis test revealed that there was a significant difference between the means of SBP, DBP, and MAP in different groups of BMI ($p<0.001$). Mann-Whitney U test showed a significant association between the means of SBP in underweight and overweight groups ($p<0.001$), underweight and obese groups ($p<0.001$), normal and overweight groups ($p<0.001$), and normal and obese groups ($p<0.001$). Also, the results of Mann-Whitney U test revealed that there was a significant association between the means of DBP in underweight and overweight ($p<0.001$), underweight and obese ($p=0.001$), normal and overweight ($p<0.001$), and normal and obese groups ($p=0.002$). On the other hand, this test (Mann-Whitney U) revealed that there was a significant association between the mean of MAP in underweight and overweight ($p<0.001$), under weight and obese ($p=0.001$), normal and overweight ($p<0.001$), and normal and obese groups ($p=0.001$).

Table 2 *Comparison of mean values of SBP, DBP, and MAP of studied subjects in different groups of BMI (n=500)*

BMI group \ Blood pressure		SBP* (mmHg)		DBP** (mmHg)		MAP† (mmHg)	
		Mean	SD	Mean	SD	Mean	SD
Under weight (<18.5)	n=23	119.30	10.52	75.65	10.71	90.20	9.99
Normal (18.5-24.9)	n=254	123.74	12.82	79.32	10.79	94.13	11.19
Overweight (25-29.9)	n=196	134.22	15.09	88.18	14.24	103.53	14.17
Obese (30<)	n=36	133.75	14.33	86.27	11.91	102.10	12.52
p-value††		<0.001		<0.001		<0.001	

**Systolic Blood Pressure, **Diastolic Blood Pressure, †Mean Arterial Pressure, ††Kruskal-Wallis test*

In Table 3, the mean values of SBP, DBP, and MAP among day and shift workers have been compared. Mann-Whitney U test revealed that there is a significant association between the means of SBP and DBP and MAP among day and shift workers ($p<0.05$).

Table 3 *Comparison of mean values of SBP, DBP, and MAP among day and shift workers (n=500)*

Shift working \ Blood pressure		SBP* (mmHg)		DBP** (mmHg)		MAP† (mmHg)	
		Mean	SD	Mean	SD	Mean	SD
Shift worker	n=234	129.71	14.49	84.38	13.53	99.49	13.52
Day worker	n=266	126.83	14.99	81.70	12.47	96.74	13.05
p-value††		0.027		0.048		0.034	

*Systolic Blood Pressure, **Diastolic Blood Pressure, †Mean Arterial Pressure, ††Mann-Whitney U

In Table 4, the mean values of SBP, DBP, and MAP among smoker and non-smoker participants have been compared. Mann-Whitney U test revealed that there is a significant association between the mean of SBP, DBP, and MAP among smoker and non-smoker participants ($p<0.05$).

Table 4 *Comparison of mean values of SBP, DBP, and MAP among smoker and non-smoker subjects (n=500)*

Smoking \ Blood pressure	SBP* (mmHg)		DBP** (mmHg)		MAP† (mmHg)	
	Mean	SD	Mean	SD	Mean	SD
Yes (n=60)	129.16	14.66	83.66	13.03	98.83	13.26
No (n=440)	122.57	14.51	79.20	13.01	93.65	13.29
p-value††	<0.001		0.009		0.002	

**Systolic Blood Pressure, **Diastolic Blood Pressure, †Mean Arterial Pressure, ††Mann-Whitney U*

In Table 5, mean, standard deviation, minimum, and maximum values of VO_2-max in workers with and without hypertension has been compared. Mann-Whitney U test revealed that there is a significant association between the mean of VO_2-max among workers with and without hypertension ($p<0.001$).

Also, multiple regression analysis between mean arterial pressure (mmHg), BMI, and VO_2-max ($ml.kg^{-1}.min^{-1}$) showed that there

Table 5 *Comparison of mean value of VO_2-max in workers with and without hypertension (n=500)*

Participants	VO_2-max ($ml.kg^{-1}.min^{-1}$)				p-value†
	Mean	SD	Min	Max	
Without hypertension (n=399)	36.62	7.45	19.50	58.04	<0.001
With hypertension (n=101)	33.28	6.52	22.22	56.79	

**Mann-Whitney U*

is a linear association (r=0.337) between the mentioned variables defined by the below equation:

$$MAP=70.29+(1.186\times BMI)-(0.042\times VO_2\text{-max})$$

Discussion

The results of this study showed that systolic and diastolic blood pressure and mean arterial pressure had significant differences between the groups of different BMI, shift and day workers and smokers and non-smokers. Also, the results indicated the mean value of VO_2-max in subjects with and without hypertension statistically had a significant difference. According to the results of this study, MAP in %20.2 of the subjects was greater than 110 mmHg (high blood pressure group), while %79.8 of the workers were without hypertension (healthy group).

The mean values of systolic (128.37±14.78) and diastolic (83.18±13.10) blood pressure in the studied workers were more than the values obtained for systolic (119.7±15.4) and diastolic (76.7±9.3) blood pressure in Tohidi et al. study which was conducted on Shiraz adult public population [21]. The reason for this issue may be related to the exposure of studied workers to blood pressure risk factors in work place, such as noise, unsuitable diet, and so on.

The results of this study indicated that the mean values of systolic and diastolic blood pressure and mean arterial pressure in different BMI groups had a significant difference, as in people with a higher BMI the blood pressure was higher. This result was in agreement with the findings of Bartsias et al. [22]. Since the BMI is used for assessing obesity in people, it can be concluded that there is a relationship between obesity and blood pressure disease. This finding is in line with other studies [1,23,24].

Also, the mean values of systolic and diastolic blood pressure and mean arterial pressure among shift and day workers had a significant difference, as in day workers all three mentioned parameters were less than in shift workers. This result is in agreement with Sfreddo et al. findings [25]. In some studies, it has been shown that the shift work is one of the risk factors for cardiovascular diseases as in shift workers cardiovascular outbreak is more than day workers [14].

It was also revealed that the mean values of systolic and diastolic blood pressure and mean arterial pressure between smoker and non-smoker groups had a significant difference, as the means systolic and diastolic blood pressure and mean arterial pressure in smokers were higher than non-smokers. This finding is in line with the results of Kearney et.al study [15]. Also, it seems necessary to be mentioned that in Ahmed et.al study [26], it has been reported that smoking just had an effect on diastolic blood pressure and it had no effect on systolic blood pressure.

The mean of VO_2-max between subjects with and without hypertension was different, as the mean of VO_2-max in people without hypertension significantly was higher than in people with hypertension. This result is close to Sadhan et al. [27], findings conducted a study on Hindi students and recognized a strong relationship between blood pressure and VO_2-max among male students. Also, in Parkhand and Palve study [28], it was gained a significant relationship between VO2-max and mean arterial pressure. That is, people with higher fitness have lower blood pressure than others. This is in agreement with other studies' findings [29,30]. By using the final equation of mean arterial pressure, BMI, and VO_2-max (multiple regression), the mean arterial pressure can be calculated by BMI and VO_2-max and hence, we can judge whether the person is healthy or has high blood pressure. The results of this section showed that by adding 1 unit of BMI, MAP increases 1.186 units and by adding 1 unit VO_2-max, MAP decreases 0.042 units.

This study was carried out on men workers who work in different industries in Shiraz city; so, the obtained results could not be generalized to women workers or workers in industries in other parts of our country (Iran).

Conclusion

The results of this study indicated that hypertension had a relationship with BMI, shift working, smoking, and VO2-max. So, it is necessary to consider obesity, shift working, smoking, and physical activity of workers who work in different industries.

Weight loss through physical activity and nutritional regime changes is one of the most effective lifestyle changes for controlling high blood pressure. On the other hand, aerobic exercise such as running/jogging, swimming, cycling and so on can be helped to improve of VO_2-max. Also, reduction of smoking among workers and implementation of proper schedule shift working in different industries decrease amount of blood pressure and risk of cardiovascular disease.

At the end, the authors suggest that blood pressure should be assessed in workers who work in different industries.

Acknowledgements

This study is part of a master thesis in ergonomics (by Mr. Daneshmandi). The authors would like to thank the personnel of Nader-Kazemi clinic specially Dr. Mostafavie and Mrs. Hosseini for their valuable cooperation in data gathering and VO2-max measuring.

Contribution

Study design: HD, ACh, ARF

Data collection and analysis: HD, MB, ARF

Manuscript preparation: HD, ACh, ARF, MB

Conflicts of Interest

The authors declare that they have no competing interests.

Funding

Shiraz university of medical sciences financially supported this study (grant No. 89- 5301).

References

1- Kenney WL, Wilmore JH, Costill DL. Physiology of sport and exercise. Champaign: Human kinetics; 2011.

2- Dwyer G, Davis SE. ACSM's health-related physical fitness assessment manual. Philadelphia: Lippincott Williams & Wilkins; 2008.

3- Divan V, Chauhan V, Panchal S, Bansal R. Prevalence of hypertension amongst workers of A fertilizer company in surat district. *National Journal of Community Medicine*2010; 1(2): 153-5.

4- Mazloom Z, Hejazi N, Ekramzadeh M. Anthropometric measurements and its relation to hypertension in cardiovascular disease patients. *Pars Journal of Medical Sciences*2010; 7(3): 15-22.

5- Guyton A, Hall JE. Textbook of medical physiology. New York: Elsevier Saunders; 2010.

6- Brauer RL. Safety and health for engineers. New Jersey: John Wiley & Sons; 2006.

7- Mououdi MA, Choobineh AR. Ergonomics in practice: selected ergonomics topics. Tehran: Nashr-e-Markaz; 1999.

8- Akalan C, Robergs RA, Kravitz L. Prediction of VO_2-max from an individualized submaximal cycle ergometer protocol. *J Exerc Physiol Online*2008; 11(2): 1-17

9- Huggett DL, Connelly DM, Overend TJ. Maximal aerobic capacity testing of older adults: a critical review. *J Gerontol A Biol Sci Med Sci*2005; 60(1): 57-66.

10- Hepple RT, Hagen JL, Krause D. Oxidative capacity interacts with oxygen delivery to determine maximal O_2 uptake in rat skeletal muscles in situ. *J Physiol*2002; 541(3): 1003-12.

11- Astorino TA, Willey J, Kinnahan J, Larsson SM, Welch H, Dalleck LC. Elucidating determinants of the plateau in oxygen consumption at VO_2-max. *Br J Sports Med*2005; 39(9): 655-60.

12- Hale T. Exercise physiology. London: JohnWiley & Sons; 2003.

13- Tayyari F, Smith JL. Occupational ergonomics. London: Chapman & Hall; 1997.

14- Monk TH, Folkard S. Making shiftwork tolerable. London: Taylor & Francis; 1992.

15- Primatesta P. Survey for england association between smoking and blood pressure: evidence from the health. *Hypertension*2001; 37(2): 187-93.

16- Kearney PMM, Reynolds WK, Muntner P, Whelton PK, He J. Global burden of hypertension: analysis of worldwide data. *Lancet*2005; 365(9455): 217-23.

17- Farzadfar F, Danaei G, Namdaritabar H, et al. National and subnational mortality effects of metabolic risk factors and smoking in Iran: a comparative risk assessment. *Popul Health Metr*2001; 9(1): 55.

18- Choobineh AR, Barzideh M, Gholami T, Amiri R, Tabatabaei HR, Almasi Hashyani A. Estimation of aerobic capacity (VO_2-max) and study of its associated factors among male workers of industrial factories in Sepidan/Fars province, 2009. *Jundishapur Scientific Medical Journal*2011; 10(1): 1-12.

19- Kroemer KHE, Grandjean E. Fitting the task to the human: a textbook of occupational ergonomics. New York: Taylor & Francis Routledge; 1997.

20- Lee RD, Nieman DC. Nutritional assessment. New York: McGraw-Hill; 2003.

21- Mazloom Z, Hejazi N, Ekramzadeh M. Anthropometric measurements and its relation to hypertension in cardiovascular diseased patients. *Pars Journal of Jahrom University of Medical Sciences*2010; 7(4): 16-22.

22- Bertsias G, Mammas I, Linardakis M, Kafatos A. Overweight and obesity in relation to cardiovascular disease risk factors among medical students in Crete, Greece. *BMC Public Health*2003; 3: 3.

23- Bermudez OI, Tucker KL. Total and central obesity among elderly Hispanics and the association with Type 2 diabetes. *Obes Res*2001; 9(8): 443-51.

24- Hubert HB, Feinleib M, McNamara PM, Castelli WP. Obesity as an independent risk factor for cardiovascular disease: a 26-year follow-up of participants in the Framingham Heart Study. *Circulation*1983; 67(5): 968-77.

25- Sfreddo C, Fuchs SC, Merlo AR, Fuchs FD. Shift work is not associated with high blood pressure or prevalence of hypertension. *PLoS One*2010; 5(12): e15250.

26- Ahmed ST, Memon MA. Smoking and fits relationship with blood pressure, blood glucose, and blood parameters in patients with coronary heart disease. *Pakistan Journal of Physiology*2008; 4(1): 5-7.

27- Sadhan B, Koley Sh, Sandhu JS. Relationship between cardiorespiratory fitness, body composition and blood pressure in punjabi collegiate population. *J Hum Ecol*2007; 22(3): 215-19.

28- Parkhad SB, Palve SB. Association of physical activity and physical fitness with blood pressure profile in Maharashtrian adolescent boys and girls. *Internet Journal of Medical Update*2014; 9(1):4-9.

29- Hirai T, Kusaka Y, Suganuma N, Seo A, Tobita Y. Physical work load affects the maximum oxygen uptake. *Ind Health*2006; 44(2): 250-7.

30- Wallace JP. Exercise in hypertension. A clinical review. *Sports Med*2003; 33(8): 585-98.