Original Research Article

A Study of Relationship between Arterial Blood Pressure and Mid Arm Circumference in Young Adults

Vesti Randa Solanki[1], Shivnarayan Lahariya[2], Vandana Varma[3], Ajay Soni[4*]

[1]Associate Professor, Department of Physiology, MGM Medical College, Indore, Madhya Pradesh, India
[2]Associate Professor, Department of Biochemistry, MGM Medical College, Indore, Madhya Pradesh, India
[3]Associate Professor, Department of Biochemistry, MGM Medical College, Indore, Madhya Pradesh, India
[4]Demonstrator, Department of Physiology, MGM Medical College, Indore, Madhya Pradesh, India

Received: 15-08-2021 / Revised: 10-09-2021 / Accepted: 04-11-2021

Abstract:
The present study was done to find out the correlation between mid-arm circumference (MAC)and blood pressure, {systolic blood pressure (SBP), diastolic blood pressure (DBP); pulse pressure(PP) and mean arterial pressure (MAP)} values. There is paucity of information on the variation in blood pressure and pulse rate parameters of normal individuals. The aim of the study was to assess the correlation between MAC and BP. The study was conducted in 184 healthy young adults. There were 119 male and 65 female participants. In view of gender differences in autonomic regulation, data of male and female subjects were analyzed separately. We used analysis of variance to compare differences between Mean± SD, maximum, minimum values and correlations of MAC and blood pressure values. **Conclusion:** The Mean±SD of blood pressure values were higher in those subjects who had high mid arm circumference and least in those subjects who had lower mid arm circumference. A p value *0.05 and * 0.01 were considered statistically significant for both male as well as in female subjects. There was significant spearman`s correlation between MAC and BP in both male as well as in female subjects.

Keywords: Systolic blood pressure, Diastolic blood pressure, Pulse pressure, Mean arterialpressure and mid arm circumference.

Introduction

The world is rapidly modernizing so the life is becoming more fast, competitive and stressful. This has a direct impact on the health status of the population. In large cross sectional study of young adults, MAC has also been shown to be a better index of body fatness.Hypertension is a common cardiovascular disease. It is as prevalent in developing countries as in industrialized developed ones, affecting at least 10% of the adult population in most countries. Hypertension is an entity associated with high morbidity and mortality. This disease is a silent threat to the health of people all over the world. It is suggested that hypertension has its origin in childhood or adulthood but goes undetected unless specifically looked for, during this period. Blood pressure is one of the most important physiological characters. It is related to socioeconomic conditions, urbanization, activity patterns, diet, body weight and fat, other physical and cultural conditions apart from having a strong genetic as well as physiological components .[1]Blood pressure(BP) is regulated by autonomic nervous system.[2] Obesity if associated with sympathetic activation, it is the leading risk factor for the development of hypertension. [3]Hypertension is a major problem, affecting both developed and developing countries; and it may lead to irreversible damages in vital organs, including central nervous system, cardiovascular system, and kidney. Besides being a major cause of morbidity and mortality, uncontrolled high blood pressure has a heavy impact on patients and families.[4]

*Correspondence
Dr. Ajay Soni
Demonstrator, Department of Physiology, MGM Medical College, Indore, Madhya Pradesh, India.
E-mail: drajay.soni141178@gmail.com

The price we are paying for an affluent and developed society is a sedentary life style and faulty dietary habits which result in an imbalance between energy intake and energy expenditure, which, in turn leads to obesity. Overweight and obesity represent a rapidly growing threat to the healthy population in many countries.[5] Obesity is becoming a global epidemic and in the past 10 years in Europe and the United States, dramatic increases in obesity have occurred in both children and adults [6]. Mid Arm Circumference (MAC) is a reliable indicator of health and nutritional status of human beings. The aim of present study is to assess the correlation between MAC and BP.

Aims and objectives

To assess the correlation between MAC and BP in young adults

Material and method

This cross sectional study was done in Mahatma Gandhi Memorial Medical College, and Maharaja Yashwantrao Hospital, Indore. The study population was 184 healthy young adults, of which 119 were males and 65 were females of 17 to 26 years age group. After obtaining ethical clearance and satisfying the inclusion and exclusion criteria; written consent was taken from every subject. Blood pressures were determined by standard calculation of 184 subjects.

Inclusion Criteria

- Healthy young adults who gave written consent to participate in the study.
- Subjects free from serious illness.
- Healthy, non-smoker and non-alcoholic subjects were selected for the study.

Exclusion Criteria

- Subjects who didn't give consent.
- Subjects having systemic disorder including hypertension, diabetes

mellitus, any sign and symptoms related torenal or endocrinal diseases and any acute illness during the past 1 month.

Anthropometric Measurements

Anthropometric measurements were also taken. Height (In cm)was measured by a vertical measuring scale, body weight (In kg) by portable weighing machine, mid arm circumference (MAC in cm) was also taken. All anthropometric measurements were taken in light clothing.

Mid upper arm Circumference

The mid-arm circumference (MAC) was measured with the subject standing erect. The subject's elbow was flexed to 90º and the midpoint between the tip of acromion and olecranon process was located. The tape was placed around the armat the midpoint, with the arm relaxed and elbow extended and the circumference was measured.

Measurement of Blood Pressure

Standardization of instrument was done. Blood pressure Measurements were taken on right arm with a mercury sphygmomanometer and a standard stethoscope placed at the heart level of the subject who has been rested at least 5 minutes in relaxed and supine position ona couch. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were recorded to the nearest mmHg as the appearance (phase I) and disappearance (phase V) of Korotkoff's sound, respectively, since the main target of the study was to examine the relationship between MAC and blood pressure. Blood pressure was recorded in Morning at 8 to 9 Am.Pulse pressure (PP) and mean arterial pressure (MAP) have been calculated from systolic and diastolic blood pressures values, as follows. PP is SBP-DBP and MAP = DBP+1/3 PP.

Statistical analysis

A detailed database was prepared using Microsoft Excel Software.The statistical analysis included calculation of mean, standard deviation; maximum, minimum value, Spearman's correlation and p value were performed using the statistical package for socialsciences (SPSS - 25) software.

Results

In view of the possibility that there could be gender differences in regulation of cardiovascular autonomic function, we have analyzed data in males and females separately. [7, 8]

*.Correlation is significant at the 0.05 level.

**.Correlation is significant at the 0.01 level.

In Male Subjects

There was a significant difference in the various variables (Pulse, SBP, DBP, PP, MAP) with mid arm circumference. Whereas Mean±SD of SBP, DBP and MAP were higher in those subjects who had highest mid arm circumference and low in those subjects who had least mid arm circumference.

Female Subjects

There were significant differences in the various variables (Pulse, SBP, DBP, PP and MAP) with mid arm circumference. It was highest in those subjects who had high mid arm circumference and low in those subjects who had least mid arm circumference. However, differences in the DBP and MAPdid similar; these were lower in subjects with less MAC (underweight) and high in subjects with high MAC (overweight) subjects.

Table 1: Anthropometric characteristics and various variables values (Pulse, SBP, DBP, PP, MAP and MAC) of male subjects. Data are expressed as Minimum, Maximum & Mean±SD

Variables	N	Minimum	Maximum	Mean	Std. Deviation
AGE	119	17	26	21.03	±1.741
WT. (kg)	119	40	85	60.05	±8.921
HT.(cm)	119	152.4	189.0	171.095	±7.2184
BMI	119	14.7	26.5	20.451	±2.5512
Pulse	119	66	94	77.24	±3.888
SBP	119	100	140	118.89	±8.775
DBP	119	60	90	75.03	±6.177
PP	119	28	70	43.78	±7.451
MAP	119	73	106	89.23	±6.277
MAC (cm)	119	19.0	31.0	25.15	±2.344

Table 2: Anthropometric characteristics and various variables values (Pulse, SBP, DBP, PP, MAP and MAC) of female subjects Data are expressed as Minimum, Maximum & Mean±SD

Variables	N	Minimum	Maximum	Mean	Std. Deviation
AGE	65	17	24	19.62	±1.354
WT. (kg)	65	36	75	50.00	±8.278
HT.(cm)	65	142	181	158.39	±6.726
BMI	65	12.9	30.8	19.989	±3.2247
Pulse	65	70	90	75.29	±2.860
SBP	65	90	128	109.05	±8.412
DBP	65	60	88	70.86	±4.430
PP	65	20	50	38.18	±6.536
MAP	65	75	101	83.60	±5.291
MAC (cm)	65	19.0	35.0	23.93	±3.230

Table 3: Spearman's Correlation, r value and p values of various variables (pulse, SBP, DBP and MAC) of both male as well female subjects

Sex	Variable 1	Variable 2	r	p-value (<0.05)
Male	Pulse	SBP	0.302	0.001
		DBP	0.298	0.001
		MAC	.028	0.766
	SBP	DBP	0.474	<0.0001

		MAC	0.210	0.022
	DBP	MAC	0.236	0.010
Female	Pulse	SBP	0.185	0.140
		DBP	0.078	0.538
		MAC	0.013	0.918
	SBP	DBP	0.553	<0.0001
		MAC	0.310	0.012
	DBP	MAC	0.175	0.164

Table 4: Independent t-test P values of Mean±SD of various variables ((pulse, SBP, DBP and MAC) of both male as well as female subjects

Variable	Sex	N	Mean±SD	p-value
Pulse	Male	119	77.24±3.888	<0.0001
	Female	65	75.29±2.860	
SBP	Male	119	118.89±8.775	<0.0001
	Female	65	109.05±8.412	
DBP	Male	119	75.03±6.177	<0.0001
	Female	65	70.86±4.430	
MAC (cm)	Male	119	25.15±2.344	<0.0001
	Female	65	23.93±3.230	

Correlations

In male subjects, spearman's correlation MAC with various parameters was;For pulse r=0.028(p=0.766), for SBP r=0.210 (p=0.022), for DBP r=0.236 (p=0.010).

In female subjects, spearman correlation was for pulse r=0.013 (p=0.918), for SBP r=0.310 (p=.012),for DBP r=0.175 (p=.164). There was statistically significant correlation between MAC and all BP indices in all male as well as in female subjects.

In independent t-test p values of Mean±SD(pulse, SBP, DBP and MAC) of both male as well as female subjects are significant.

Discussion

In both males and in females we found that SBP, DBP, PP and MAP were highest inthose subjects who had high mid arm circumference and low in those subjects who had least mid arm circumference. This is possibly due to sympathetic tone between underweight and overweight subjects. Differences in BP could be largely due to peripheral resistance which in turn is greatly influenced bytonic sympathetic control of resistance vessels, our results indirectly suggest that the higher BP inthose subjects had high MAC is due to heightened sympathetic vascular tone. [9] According to CL Ghai ,overweight individuals tend to have higher blood pressure. Since resistance to blood flow through ablood vessel depends on its length, increased length of blood vessels is bound to increase theresistance and hence blood pressure. (Each extra kg of adipose tissue is associated with the development of an additional 400 km of blood vessels).[10]Similar finding were reported by various investigators (D R Labarthe et al., 1984 [11], K R Ledwaba et al., 2014 [12], Sandin et al., 1990 [13]; Roche andSiervogel, 1991;[14] Chen et al., 1995;[15] Roberto J. Rona et al., 1996;[16] Kaufman et al., 1997;[17]Venkataramana et al., 2001;[18] Mufunda et al., 2006[19] Singal, P., et al 2008[20] and Zuhul 2008[21]in all studies they found as association between height, weight, mid arm circumference, body mass index and blood pressure).

Conclusion

In both males and females; Mean±SD of blood pressure were higher in those, who had high mid arm circumference and those with low mid arm circumference had low blood pressure. There was significant spearman's correlation between MAC and BP (PR, SBP, DBP, PP and MAP) in both male and female subjects. Our results indicate that SBP, DBPand MAP were linearly related to MAC in male as well as in female subjects.

References

1. Sudip Banik Datta. Age-Sex and Diurnal Variation of Blood Pressure in different nutritional states among the Adult Telegas. Coll. Antropol. 2007;31(3): 717.
2. Ravishankar and E. Sankaranarayanan Prakash"Correlation between body mass index and blood pressure indices, handgrip strength andhandgrip endurance in underweight, normal weight and overweight adolescents".Indian JPhysiology Pharmacology 2005; 49 (4): 455-461.
3. Rahmouni K, Correia MLG, Haynes WG, Mark AL. obesity associated hypertension. Hypertension2005;45:9-14.
4. HamidehShajari, Ahmad Shajari, Mohsen AkhavanSepahi, Amir and Mohammad HoseinAtaeeNakhaei. Relationship between Arterial Blood Pressureand Body Mass Index of School Age Children of Southern Region of Iran Acta Medica Iranica,2011;49(11):9.
5. Kanavi Roopa Shekharappa, SmileeJohncy S, Mallikarjuna P T, Vedavathi K J, MaryPremJayarajan. Correlation between body mass index and ardiovascular parameters in obeseand non-obese in different age groups.Int J Biol Med Res. 2011; 2(2): 551-555.
6. Mokdad AH, Serdula MK, Dietz WH, Bowman BA, Marks JS, Koplan JP. The spread of the obesityepidemic in the United States, 1991-1998. JAMA. 1999;282:1519-1522.
7. Bseke SD, alvarez GE, ballard TP, and davy KP, "gender difference cardiovagalbaroreflex gain inhumans. JAPPI physiol2001;91:2088-2092.
8. Tank J, Diedrich A, Szezeeh E, Luft FC, and Jordan J. "baroreflex regulation of heart rate andsympathetic vasomotor tone in women and men". Hypertension 2005; 45: 1159-1164.
9. Sorof J Daniels S. obesity hypertension in children. A problem of epidemic proportions.Hypertension2002;40:441-447.
10. CL Ghai. A textbook of practical physiology, 8th edition. New Delhi: Jaypee Brothers MedicalPublishers (p) Ltd; 2013. Page no. 177.
11. D R labarthe, DL morris, BS Freyer blood pressure during growth and development. Ann Clin Res. 1984;16 suppl 43:35-43.
12. K R Ledwaba, F N Kalanga, K D Monyeki and M. Van staden. The relationship between mid arm circumference and blood pressure of private schoolchildren aged 6-12 years. Ann Pediatr Child Health 2(4):1026.
13. Sandin, M., Ugalde, M., Montero, P. and Sanchez, C. Relationship between blood pressure and variable of body

composition in 6 to 15 years olds longitudinal study.J. Hum. Ecol. 1990; 1: 37-48.
14. Roche, A.F. and Siervogel, R.M. Measure of body composition: their relationship to bloodpressure and use in epidemiologic research.Ann. Epidemiol. 1991;1: 313-320.
15. Chen, Y., Rennie, D.C. and Reeder, B.A. Age related associations between body mass index andblood pressure. The Humboldt study.Int. J. Obesity 1995;19: 825-831.
16. Roberto, Sameena Qureshi and Susan Chinn. Factors related to total cholesterol andblood pressure in British 9 year olds.Journal of Epidemiology Community Health, 1996;50:512-518.
17. Kaufman, J.S., Asuzu, M.C., Mufunda. J., Forrester, T., Wilks, R., Luke, A., Long, A.E. and Cooper,R.S. Relationship between blood pressure and body mass index. Hypertension 1997;30: 1511-1516.
18. Venkatramana, P., Vam, C. and Chenga Reddy, P. Association of body mass index, body fatdistribution and fat patterning with blood pressure in two populations of Andhra.J.Hum. Ecol.2001; 12: 63-68.
19. Mufunda, J., Mebrahtu, G., Usman, A., Nyarango, P., Kosia, A., Ghebrat, Y. et al. The prevalence ofhypertension and its relationship with obesity: results from a national blood pressure survey inEritsea. J. Hum. Hypertens 2006; 20:59-65.
20. Singal, P., Bhatnagar, D.P., Kaur, I., Kaur, V. and Kaur, K. Body Mass Index, Blood Pressure andHaemoglobin in Jat Sikh Children Ranging in Age from 10 to 16 Years.Journal of exercise scienceand physiotherapy 2008; 4(1): 44-49.
21. ZuhalGundogdu. Relationship Between BMI And Blood Pressure In Girls and boys.PublicHealthNutrition 2008; 11(10):1085-1088.

Conflict of Interest: Nil Source of support: Nil