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Original Article

Association between hypertension and adiposity indicators: A study among the Muslim population of Uttar Pradesh

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ABSTRACT

Background: Hypertension and obesity have become a global issue and an important public health concern due to an unhealthy lifestyle. The present study aims to determine the prevalence of hypertension and its association with various adiposity indicators among Sunni Muslim population of Lucknow, Uttar Pradesh.

Materials and methods: A cross-sectional study was conducted among 214 individuals using purposive sampling method. Somatometric measurements were taken using the ISAK protocol. Correlation analysis and odds ratio were calculated to determine the best predictor of hypertension.

Results: 41% of males and 42.1% of females were found to be in Stage-II hypertension. BMI and WC were found to have the highest correlation with SBP among males and females, respectively. WHR followed by WC and BMI, was found to be the strongest predictor of hypertension in males. In the case of females, WHtR Followed by, BMI and WHR were found to be the strongest predictors of hypertension.

Conclusion: Among the presently studied Muslim population of Lucknow, a high prevalence of hypertension was found among both males and females. Also, WHR among males and WC among females were found to be better predictors of hypertension. Thus, for better prediction of risk of hypertension, sex and ethnicity-specific adiposity indicator should be used in clinical practice.

1. Introduction

Hypertension is one of the major risk factors for various non-communicable diseases like chronic heart disease, stroke, coronary heart disease etc., and is rapidly increasing among all age groups worldwide [1,2]; Singh et al., 2017). Hypertension itself is no longer considered as a disease of its own but rather it is usually recognized with a combination of various lifestyle diseases such as obesity, diabetes, kidney disease and many others [3]. Globally, hypertension causes more than 9 million deaths and affects about 1 billion adults annually (WHO, 2013). It was also predicted that this rate will increase by 60% to a total of 1.56 billion by 2025 [4]. Hypertension is not only prevalent in developed countries but is also continuously increasing in developing countries like India [5]. In India, it has been reported that 32.2% of Indian men and 31.7% of Indian women suffer from hypertension (WHO, 2011).

Obesity (general and abdominal obesity) has been considered as one of the major risk factors for hypertension [6–8]. There has been a number of population-based studies conducted, documenting the association between hypertension and various adiposity indicators such as Body mass index, Waist circumference, Waist-to-hip ratio, Waist-to-Height ratio and Percent body fat indicating that excess adiposity is a major risk factor for hypertension [9]; [3,10–13]. Throughout the world, hypertension and obesity are increasing at an alarming rate which has become one of the most challenging areas in public health sectors. It has become essential to identify individuals and populations who are at increasing risk for raised blood pressure. As unlike, any other disease hypertension and obesity do not show any immediate symptoms or appear as life-threatening diseases at the initial stage but they develop slowly into progressive chronic diseases [3]. Thus, the present study aims to determine the prevalence of hypertension and its association with various adiposity indicators among Sunni Muslim population of Lucknow, Uttar Pradesh.

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2. Materials and methods

2.1. Study population and setting

A cross-sectional study was conducted in two villages namely, Auranggabad Khalsa and Chillawa of Lucknow district, Uttar Pradesh, India. These inter-caste villages are co-inhabited by Sunni and Shia Muslims. For this particular research, the adults of the Sunni Muslim population were recruited as they were the dominant group in both the villages. Their staple food is mainly wheat and rice with high consumption of meat, oil, tobacco and fewer intakes of vegetables and pulses.

2.2. Data collection

The data were collected using purposive sampling method, from a total of 214 individuals (M = 100; F = 114) in the age group of 18–73 years.

2.3. Interview schedule

General information about the participants was collected using pre-tested and modified interview schedules. Informed written consent was taken from each and every individual. The study was approved by the Ethical Committee of the Department of Anthropology, University of Delhi, Delhi, India.

2.4. Somatometric measurements

8 Somatometric measurements were carried out such as height (cm), body weight (kg), waist circumference (cm), hip circumference (cm), skinfolds at biceps, triceps, sub-scapular and supraspinale locations using standardized protocols established by the International Society for the Advancement of Kinanthropometry (ISAK). Body density was calculated using the age and sex-specific Durnin and Womersley equation [14] and, after that, the Siri equation [15] was used to determine Percent body fat. Blood pressure (both systolic and diastolic blood pressure) was measured using standard mercury sphygmomanometer in millimetres in sitting position.

2.5. Individual classifications

Body mass index (BMI)- Individuals with BMI <18.5 kg/m^2 were considered as underweight; ≥ 18.5 kg/m^2 but < 23 kg/m^2 as normal; ≥ 23 kg/m^2 but < 27.5 kg/m^2 as overweight; and ≥27.5 kg/m^2 as obese (WHO, 2000; WHO, 1998; [16].

Waist circumference(WC) - > 90 cm for males and >80 cm for females were considered to be at risk [17].

Waist-to-hip ratio (WHR) - was calculated as waist circumference divided by hip circumference. High WHR was defined as ≥ 0.90 in males and ≥0.80 in females [17].

Waist-to-height ratio (WHtR) - was calculated as waist circumference divided by height. In the present study, WHtR was classified into 4 categories: 1) < 0.40 as underweight; 2) ≥ 0.40 to < 0.50 as normal; 3) ≥ 0.50 to <0.60 as high risk; 4) ≥ 0.60 as morbidly high [18,19].

Percent body fat (PBF) - was classified into 4 categories: 1) 10–13% in females and 2–5% in males as underweight; 2) 14–24% in females and 6–17% in males as normal; 3) 25–31% in females and 18–24% in males as at risk/overweight; 4) >32% in females and >25% in males as obese [20].

Blood pressure/Hypertension(HTN) was classified into four categories as 1) normal <120 mm Hg and <80 mm Hg; 2)Elevated-120–129 mm Hg and <80 mm Hg; 3)stage I - 130–139 mm Hg and/or 80–90 mm Hg; 4) stage II - 140 mm Hg and/or 90 mm Hg [21].

2.6. Statistical analysis

Data were entered and analyzed using Microsoft Excel 2010, and SPSS version 20. Descriptive statistics were expressed as mean and standard deviation and was used to understand the diversity in adiposity indicators and hypertension among males and females of the studied population. Student t-test was used to find the statistical significance between males and females. Partial correlation analysis was done to find out the association between hypertension and adiposity indicators controlled for age and tobacco. Binary logistic regression analysis was done to determine the odds ratio (95% confidence interval) in order to identify predictors of hypertension which was presented as adjusted odds ratio with a 95% confidence interval.

3. Results

The somatometric and physiological characteristics of the studied population are presented in Table 1. Of all the ten variables considered, females had almost higher mean values of all the variables except height, weight, WHR and SBP. Also, the mean values of all adiposity indicators in females were higher than the normal ranges. On the other hand, the mean values of systolic and diastolic blood pressure in both males and females were found to be higher than the normal ranges.

The prevalence of hypertension among males and females is presented in Table 2. Overall the highest number of individuals among both males (41%) and females (42.1%) were found to be in stage-II hypertension. In the case of SBP, a maximum number of individuals were found to be in stage-I hypertension and elevated category among males and females, respectively. In the case of DBP, the highest number of individuals was found to be in stage-II hypertension among both males and females.

Partial correlation analysis between SBP, DBP and various adiposity indicators is presented in Table 3. After controlling for age, it was found that all the adiposity variables were found to be positively associated with SBP and DBP among both males and females and this correlation was statistically significant. In terms of individual adiposity indicators, BMI and WC were found to have the highest correlation with SBP among males and females, respectively. In the case of DBP, no significant association was found among males with all adiposity indicators. However, among females, BMI and WHtR were found to have the highest correlation with DBP.

The Adjusted odds ratio (95% confidence interval) of hypertension with adiposity indicators in males and females are given in Table 4 respectively. Binary logistic regression was done to find out the better predictor for hypertension. In case of males WHR followed by WC and BMI was found to be the strongest predictor of hypertension with an adjusted odds ratio of 1.476 (CI -0.585-3.723), 1.155 (CI-0.365–3.654) and 1.114 (0.111–11.198), respectively. Though, this risk was not statistically significant. In the case of females, WHtR had more than 6 fold chances of developing hypertension and this result was statistically significant. Followed by WHtR, BMI and WHR were found to be the strongest predictors for hypertension with adjusted odds ratios of 6.821(CI-2.675–17.390), 1.312 (CI - 0.325-5.301) and 1.062 (0.207–3.172), respectively.

4. Discussion

According to the findings of this study, all the adiposity indicators (BMI, WC, WHR, WHtR and PBF) and blood pressure (SBP, DBP) were found to have a differential distribution among males

Table 1
Somatometric and Physiological characteristics of the study population.

Variables	Normal range	Males (N = 100) (Mean ± S.D)	Females (N = 114) (Mean ± S.D)	P-value
Age (years)	–	33.99 ± 16.07	33.71 ± 11.39	0.882
Height (cm)	–	166.12 ± 7.66	151.68 ± 5.83	0.001***
Weight (kg)	–	57.75 ± 9.60	55.84 ± 11.33	0.189
BMI(kg/m^2)	≥18.5 - < 23.0	20.96 ± 3.65	24.26 ± 5.35	0.001***
WC(cm)	M – < 90; F- < 80	78.97 ± 10.48	80.07 ± 11.33	0.498
WHR	M – < 0.90; F- < 0.80	0.87 ± 0.07	0.85 ± 0.06	0.015*
WHtR	≥0.40 - ≤ 0.50	0.47 ± 0.06	0.52 ± 0.09	0.001***
PBF (%)	M – < 25; F- < 32	25.40 ± 6.29	35.10 ± 4.77	0.001***
Systolic (mm/Hg)	<120	131.48 ± 15.47	127.37 ± 15.68	0.056*
Diastolic (mm/Hg)	<80	85.72 ± 12.08	86.42 ± 13.43	0.690

Table 2
Prevalence of hypertension among males and females of the study population.

Hypertension status	Systolic				Diastolic				Total Hypertension			
	Males		Females		Males		Females		Males		Females	
	N	%	N	%	N	%	N	%	N	%	N	%
Normal	22	22.0	29	25.4	29	29.0	33	29.0	14	14.0	19	16.7
Elevated	22	22.0	35	30.7					13	13.0	9	7.9
Stage-I	33	33.0	27	23.7	36	36	40	35	32	32.0	38	33.3
Stage-II	23	23.0	23	20.2	35	35	41	36	41	41.0	48	42.1

Table 3
Partial correlation coefficients between adiposity indicators and blood pressure variables among the study population.

Adiposity indicators	Males		Females	
	SBP	DBP	SBP	DBP
BMI	0.349**	0.047	0.236*	0.316**
WC	0.275**	0.040	0.270**	0.298**
WHR	0.226*	0.090	0.167	0.152
WHtR	0.335**	0.018	0.260**	0.316**
PBF	0.222*	0.015	0.184	0.247**

*Significant at p-value < 0.01; ** Significant at p-value < 0.001.
BM BMI; body mass index; WC: waist circumference; WHR: waist-to-hip ratio; WHtR: waist-to-height ratio; PBF: percent body fat; SBP: systolic blood pressure; DBP: diastolic blood pressure.

Table 4
Adjusted odds ratio (95% confidence interval) of hypertension with adiposity indicators in males and females.

Adiposity indicator	Hypertension	
	Females	Males
BMI	1.312 (0.325–5.301)	1.114 (0.111–11.198)
WC	0.077*** (0.338–0.6337)	1.155 (0.365–3.654)
WHR	1.062 (0.207–3.172)	1.476 (0.585–3.723)
WHtR	6.821***(2.675–17.390)	0.558 (0.229–1.360)
BPF	0.380* (0.147–0.986)	0.366*(0.149–0.912)

*Significant at p-value < 0.05; *** Significant at p-value <0.001.

and females. Females were found to have higher mean values of all adiposity indicators than males except for WHR and this result was consistent with previous studies where a higher mean value of BMI, WC and WHR were found among females (Gupta et al., 2014; Dua et al., 2014; Wenlong et al., 2016; Dhall et al., 2018). This prevalence of higher adiposity among females may be attributed to the fact that females tend to have greater fat accumulation than males due to reproductive reasons [22–24]. Now, when it comes to the prevalence of hypertension in this population, it was found that females were found to be more hypertensive than males. However, this result was found to be in contrast with other previous studies where higher numbers of males were found to be suffering from hypertension than females (Kapoor et al., 2000; Dhall et al., 2018).

All adiposity indicators (BMI, WC, WHR, WHtR and PBF) were statistically significantly correlated with both systolic and diastolic blood pressure among both males and females and this observation was consistent with previous studies conducted among different adult populations. However, when each adiposity variable is considered independently then, BMI was found to have a positive correlation with blood pressure among both males and females. This high association of BMI with hypertension may be explained through the process of dysfunction of general adipose tissue, or activation of the sympathetic nervous system [25]; Kalil et al.., 2012). However, in the study population, BMI and WHR were found to have a stronger association with Hypertension among males and WC and WHtR in females and this result was similar to other previous studies [6]. Specifically, in terms of SBP, BMI and WC were found to have the highest association among males and females, respectively and this result was consistent with the previous study conducted among a North Indian population of Delhi (Dhall et al., 2018).

It has been previously found that the risk of hypertension increases with an increase in adiposity among females and similar results were found in the present study where the risk of hypertension is increasing with an increase in BMI of females [6,26]. However, among males a reverse trend was observed, where hypertension was found to be more prevalent among normal and underweight individuals. Similar findings were reported in previous studies where hypertension was not only restricted to overweight and obese participants but was also found among individuals having normal BMI [3]. Recently there is growing evidence of hypertension for being associated with a neurological system of the body as well where stress, depression and other neurological factors are associated with raised blood pressure (Hall et al., 2001). Moreover, females in this population are restricted to household work and thus have a less physical activity which leads to obesity and further making them more prone to hypertension. On the other hand, since the economic burden of the family is only on the males of this population, therefore, this might trigger the neurological pathway of hypertension resulting in a higher

prevalence of hypertension among them despite having underweight and normal BMI. As it has been found in previous studies that experience of perceived stress is accompanied by an increase in blood pressure, which is considered as a physiological adaptation [27].The binary logistic regression analysis revealed that WHR followed by WC and BMI, was found to be the strongest predictor of hypertension among males and a similar result was reported in a previous study (Dhall et al., 2018). However, in some previous studies, it was stated that the reliability of WHR as a predictor of hypertension is doubtful [28,29] and thus some researchers recommend WC as an important tool for assessing blood pressure [30–33].

5. Conclusion

In conclusion, among the presently studied Muslim population of Lucknow, a high prevalence of hypertension was found among both males and females. Also, WHR among males and WHtR among females were found to be better predictors of hypertension. Thus, for better prediction of risk of hypertension, sex and ethnicity-specific adiposity measures should be used in clinical practice.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.dsx.2019.05.016.

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