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Impact of Hypertension on Morpho-physiological Traits in Rural and Urban Jat Females of Haryana, North India

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ABSTRACT The aim of the present cross-sectional study was to assess the impact of hypertension on morpho-physiological traits in rural and urban Jat females of Haryana (North India). For this 300 rural (normotensive=230, hypertensive=70) and 300 urban (normotensive=213, hypertensive= 87) females in the age range of 40 to 70 years were studied for nine morphological (anthropometric) and four physiological traits. Comparison revealed that rural normotensive females were taller and heavier than hypertensive females, whereas among urban subjects, normotensive females were taller and significantly ($p<0.05$) lighter than hypertensive females. All the five skinfold thicknesses at biceps, triceps, supra-iliac, subscapular and calf showed greater values among normotensive females than hypertensive females in both the rural and urban subjects. Rural and urban Jat females demonstrated higher haemoglobin concentration and manual strength among normotensives as compared to hypertensive subjects. Pulse rate of hypertensive females was significantly ($p<0.001$) higher than normotensives in both the rural as well as urban groups of Jat females. Binary logistic regression analysis of urban Jat females suggested that BMI (OR=5.06, CI=1.15-22.18), waist circumference (OR=2.89, CI=0.83-10.10) and pulse rate (OR=1.17, CI=1.11-1.24) were important predictors of hypertension, whereas for rural Jat females important determinants of hypertension were BMI (OR=1.26, CI=0.44-3.59) and pulse rate (OR=1.15, CI=1.08-1.22).

INTRODUCTION

Hypertension is probably the most important public health problem in developed as well as in developing countries. It generally does not produce very prominent symptoms, especially in the early stages. According to Murray and Lopez (1997), out of a total 9.4 million deaths in India in 1990, cardiovascular diseases caused as many as 2.3 million deaths. Blood pressure is directly associated with risks of several types of cardiovascular diseases, and the association of blood pressure with disease risk is continuous, indicating that large proportions of most populations have nonoptimal blood pressure values (Deedwania and Gupta 2002). Several recent studies highlighted prevalence of hypertension and age related changes in blood pressure (Kaul and Tandon 2002; Agyemang 2006; Chaturvedi et al. 2007; Todkar et al. 2009; Kaur and Talwar 2010), while little work has been done to assess the impact of hypertension on morpho-physiological traits of elderly females as well as predictors of hypertension. The current study is an attempt to investigate the impact of hypertension on morphological and physiological traits in elderly Jat females residing in rural and urban areas of Haryana, a north Indian state.

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MATERIAL AND METHODS

A total of 600 Jat females ranging in age from 40 to 70 years were selected from rural and urban areas of Haryana. Of these, 300 rural (normotensive=230, hypertensive=70) and an equal number of urban (normotensive=213, hypertensive=87) females were selected by purposive sampling method. The data were collected during the years 2006 and 2007. All the subjects were physically and mentally normal and were not suffering from any chronic disease at the time of data collection, pregnant and lactating women were excluded from the study. Age in years had been obtained from the date of birth, which most of the aged rural females could not recall. Therefore age had to be ascertained by recollection with some important socio-cultural and historical events like age at marriage, age of the first child, any important festival and India-Pakistan partition etc. With this cross-questioning, it was possible to ascertain nearly the correct age of the subject.

Weight (kg) and height (cm) were taken by weighing machine and anthropometer respectively. Waist circumference (cm) and hip circumferences (cm) were measured with a steel tape. Skinfold thickness (mm) was taken using Harpenden skinfold caliper at biceps, triceps, supra-iliac, subscapular and calf following standard techniques as recommended by Weiner and Lourie (1969). Hand grip strength (kg) of all the subjects was measured with Dynamometer (Analogue model, range 0-100 kg). Measurements of systolic and diastolic blood pressures (mm of Hg) of each subject were taken using mercury sphygmomanometer and a stethoscope, after the subject had rested at least for 15-20 minutes. An individual with raised blood pressure values of systolic blood pressure above 140 mm of Hg and diastolic blood pressure above 90 mm of Hg was classified as hypertensive (Based on JNC -VII criteria). Haemoglobin estimation was done by the Cyannethaemoglobin method using a photoelectric colorimeter with green filter (500-570 nm wave length). BMI (kg/m^2) was calculated as weight in kilograms divided by squared height in meters. Data were analyzed using the Statistical Package for Social Sciences (SPSS) version 14.0. Student's t-test was used to find out the difference, if any, between normotensive and hypertensive subjects for each variable. Binary logistic regression analysis was used to estimate odds ratio (OR) with 95% confidence interval (95%CI).

RESULTS

Table 1 presents mean, standard deviation and t-values of morpho-physiological traits of normotensive and hypertensive rural and urban Jat females of Haryana. Normotensive rural females were heavier and significantly ($p<0.05$) taller than hypertensive females. Body mass index of hypertensive subjects was found to be higher than their normotensive counterparts. Both the circumferential body dimensions, that is, waist and hip circumferences of hypertensive females were higher than the normotensive females. All the skinfolds measurements at biceps, triceps, supra-iliac, subscapular and calf showed slightly higher values among normotensives compared to hypertensive females, but statistically significant ($p<0.05$) differences were observed for biceps and calf skinfolds only. Mean values for right and left hand grip strength as well as haemoglobin concentration of normotensive females were significantly ($p<0.001$) higher than hypertensive females. Pulse rate of hypertensives revealed significantly ($p<0.001$) greater mean values than rural normotensives.

Normotensive urban Jat females were taller and significantly ($p<0.05$) lighter than hypertensive females (Table 1). Body mass index of hypertensive females was significantly ($p<0.001$) higher than normotensive females. Waist and hip circumferences of hypertensive Jat females were

Table 1: Mean and standard deviation (S.D.) values of morpho-physiological traits of normotensive and hypertensive rural and urban Jat females of Haryana, alongwith t values

Morpho-physiological traits	*Rural Jat females*			*Urban Jat females*		
	Normotensive Mean±S.D	*t-value*	*Hypertensive Mean±S.D*	*Normotensive Mean±S.D*	*t-value*	*Hypertensive Mean±S.D*
Height (cm)	153.84 ± 6.12	2.02*	152.19 ± 5.35	155.43 ± 5.08	0.52	155.07 ± 5.90
Weight (kg)	56.22 ± 8.89	0.54	55.56 ± 9.26	56.37 ± 9.96	-2.69*	59.95 ± 11.13
BMI (kg/m2)	23.77 ± 3.70	-0.51	24.04 ± 4.35	23.32 ± 3.85	-3.10***	24.93 ± 4.40
Waist circumference (cm)	78.82 ± 7.57	-0.10	79.72 ± 6.56	80.24 ± 8.52	-3.41***	84.13 ± 9.58
Hip circumference (cm)	89.22 ± 8.94	-0.44	89.76 ± 8.99	89.36 ± 10.69	-4.00***	95.03 ± 11.69
Biceps skinfold (mm)	16.51 ± 3.26	2.65*	15.33 ± 3.29	16.41 ± 3.86	0.53	16.14 ± 4.13
Triceps skinfold (mm)	20.35 ± 3.52	1.15	19.80 ± 3.43	20.89 ± 4.01	0.89	20.41 ± 4.44
Subscapular skinfold (mm)	28.45 ± 5.24	1.55	27.33 ± 5.45	29.97 ± 4.28	1.00	29.41 ± 4.43
Supra-iliac skinfold (mm)	23.05 ± 4.19	0.99	22.47 ± 4.47	24.03 ± 3.79	0.04	24.01 ± 4.05
Calf skinfold (mm)	21.36 ± 4.40	2.13*	20.13 ± 3.45	22.35 ± 4.59	1.70	21.36 ± 4.27
Right hand grip strength (kg)	20.90 ± 5.29	3.34***	18.54 ± 4.71	19.04 ± 4.60	0.95	18.45 ± 5.35
Left hand grip strength (kg)	17.74 ± 5.06	4.33***	14.79 ± 4.73	15.90 ± 4.68	1.26	15.11 ± 5.26
Haemoglobin concentration (g/dl)	10.04 ± 1.40	3.50***	9.37 ± 1.39	10.26 ± 1.34	0.62	10.17 ± 1.35
Pulse rate (beats/ minute)	79.51± 9.25	-5.15***	85.63 ± 6.53	80.24 ± 5.39	-7.14***	85.59 ± 6.79

Table 2: Comparison of morpho-physiological traits of rural and urban hypertensive Jat females of Haryana

Morpho-physiological traits	*Rural hypertensive Jat females*		*Urban hypertensive Jat females*
	Mean±S.D	*t-value*	*Mean±S.D*
Height (cm)	152.19 ± 5.35	-3.14***	155.07 ± 5.90
Weight (kg)	55.56 ± 9.26	-2.62***	59.95 ± 11.13
BMI (kg/m2)	24.04 ± 4.35	-1.25	24.93 ± 4.40
Waist circumference (cm)	79.72 ± 6.56	-3.25***	84.13 ± 9.58
Hip circumference (cm)	89.76 ± 8.99	-3.08***	95.03 ± 11.69
Biceps skinfold (mm)	15.33 ± 3.29	-1.32	16.14 ± 4.13
Triceps skinfold (mm)	19.80 ± 3.43	-0.93	20.41 ± 4.44
Sub scapulars kinfold (mm)	27.33 ± 5.45	-2.61***	29.41 ± 4.43
Supra-iliacs kinfold (mm)	22.47 ± 4.47	-2.24*	24.01 ± 4.05
Calf skinfold (mm)	20.13 ± 3.45	-1.93	21.36 ± 4.27
Right hand grip strength (kg)	18.54 ± 4.71	0.10	18.45 ± 5.35
Left hand grip strength (kg)	14.79 ± 4.73	-0.39	15.11 ± 5.26
Haemoglobin concentration (g/dl)	9.37 ± 1.39	-3.63***	10.17 ± 1.35
Pulse rate (beats/ minute)	85.63 ± 6.53	0.03	85.59 ± 6.79

$p<0.05^{*}$; $p<0.01^{**}$; $p<0.001^{***}$

Table 3: Determinants of hypertension: Binary logistic regression analysis for rural and urban Jat females of Haryana

Morpho-physiological traits	*Rural Jat females*	*Urban Jat females*
	Odds ratio (95% CI)	*Odds ratio (95% CI)*
Height	1.22 (0.65-2.28)	0.85 (0.52-1.41)
Weight	0.92 (0.58-1.47)	0.52 (0.29-0.96)
BMI	1.26 (0.44-3.59)	5.06 (1.15-22.18)
Waist circumference	0.85 (0.27-2.59)	2.89 (0.83-10.10)
Hip circumference	0.96 (0.86-1.06)	1.16 (0.86-1.57)
Biceps skinfold	0.99 (0.87-1.13)	1.05 (0.95-1.16)
Triceps skinfold	1.06 (0.92-1.21)	0.98 (0.87-1.24)
Subscapular skinfold	1.03 (0.94-1.12)	0.94 (0.85-1.05)
Supra-iliac skinfold	1.02 (0.90-1.16)	1.06 (0.91-1.05)
Calf skinfold	0.95 (0.84-1.06)	0.94 (0.85-1.05)
Right hand grip strength	1.11 (0.99-1.25)	1.01 (0.88-1.16)
Left hand grip strength	0.82 (0.73-0.93)	0.95 (0.82-1.11)
Haemoglobin concentration	0.65 (0.51-0.83)	1.11 (0.88-1.39)
Pulse rate	1.15 (1.08-1.22)	1.17 (1.11-1.24)

found to be significantly ($p<0.001$) higher as compared to their normotensive counterparts. Normotensive females demonstrated higher mean values for skinfolds at biceps, triceps, supra-iliac, subscapular and calf than hypertensive females, although differences were statistically non-significant. Grip strength (both right and left hand) and haemoglobin concentration of normotensive Jat females revealed higher mean values than hypertensive Jat females, although differences were non-significant. Hypertensive Jat females showed significantly ($p<0.001$) higher mean values of pulse rate compared to normotensive Jat females.

Table 2 reveals comparison of morpho-physiological traits of rural and urban hypertensive Jat females. Urban hypertensive Jat females were significantly ($p<0.001$) taller and heavier than rural hypertensive Jat females. Circumferential measurements at waist and hip as well as skinfold thicknesses at all the selected sites were more developed among urban hypertensive Jat females compared to their rural hypertensive counterparts. Table 3 shows binary logistic regression analysis for rural and urban Jat females. For rural females, odds of having hypertension was 1.26 (CI=0.44-3.59) for BMI, 1.15 (CI=1.08-1.22) for pulse rate and 0.65 (CI=0.51-0.83) for haemoglobin_concentration. For urban females strongest predictor for hypertension was BMI (OR=5.06; CI=1.15-22.18), followed by waist circumference (OR=2.89; CI=0.83-10.10) and pulse rate (OR=1.17; CI=1.11-1.24).

DISCUSSION

The present study documented that normotensive rural and urban Jat females of Haryana were taller (rural OR=1.22; CI 0.65-2.28 - urban OR=0.85; CI 0.52-1.41) than their hypertensive counterparts. Normotensive rural females were heavier than hypertensives, whereas in urban females normotensives were significantly lighter (rural OR=0.92; CI 0.58-1.47 - urban OR=0.52; CI 0.29-0.96) than hypertensives. In the present study mean value of BMI (rural OR=1.26; CI 0.44-3.59 - urban OR=5.06; CI 1.15-22.18), waist circumference (rural OR=0.85; CI 0.27-2.59 - urban OR=2.89; CI 0.83-10.10) and hip circumference (rural OR= 0.96; CI 0.86-1.06 - urban OR=1.16; CI 0.86-1.57) of hypertensive Jat females were higher than both the rural and urban normotensive females. Ghosh et al. (2000) compared normotensive and hypertensive elderly subjects and reported that weight, body mass index, and waist and hip circumferences of hypertensive subjects were slightly higher than normotensives. Masaki et al. (1997) showed a significant association of body mass index with hypertension in elderly Japanese American men. Guagnano et al. (2001) reported that waist circumference is the most important anthropometric measurement associated with the hypertensive risk and females with waist circumference > 88 cm had a risk of hypertension twice that of females with waist circumference <80 cm. Dong et al. (2007) found that BMI (23.6 ± 3.3 vs 22.8 ± 2.8) and waist circumference (82.5 ±9.6 vs 79.9± 8.7) were significantly ($p<0.001$) greater in hypertensives than in normotensives. Deshmukh et al. (2006) also suggested that BMI and waist circumference were important predictor of hypertension. Similar findings have been reported in some earlier studies on elderly populations (Pi-Sunyer 1993; Melendez-Velasquez et al. 2002; Martins and Marinho 2003). Normotensive rural and urban Jat females demonstrated slightly higher mean values for skinfolds at biceps, triceps, supra-iliac, subscapular and calf than hypertensive Jat females, although differences were statistically non-significant**.** Rural and urban Jat females of the present study displayed stronger manual strength, that is, right hand grip strength (rural OR=1.11; CI 0.99-1.25 - urban OR=1.01; CI 0.88-1.16) and left hand grip strength (rural OR=0.82; CI 0.73-0.93 - urban OR=0.95; CI 0.82-1.11) in normotensive compared to hypertensive subjects. Rantanen et al. (1998) and Gale et al. (2007) found poorer grip strength was significantly associated with risk of death from cardiovascular diseases.

Haemoglobin concentration of normotensive Jat females (rural OR=0.65; CI 0.51-0.83; urban OR=1.11; CI 0.88-1.39) revealed higher mean values than hypertensive Jat females for this physiological trait, although differences were non-significant only in urban subjects. It was observed that decrease in haemoglobin concentration reduces the availability of oxygen to the tissues, which in turn affects the cardiac output among anaemic subjects (Beaton et al. 1989).The comparative investigation of normotensive and hypertensive subjects of the present study revealed pulse rate with significantly higher mean values (rural OR=1.15; CI 1.08-1.22; urban OR=1.17; CI= 1.11-1.24) in hypertensive than normotensive in both the rural and urban Jat females. Domanski et al. (1999) reported that increased conduit vessel stiffness results in increased characteristic impedance of the aorta and decreased arterial compliance, which causes an increase in systolic blood pressure and pulse rate as well as decrease in diastolic blood pressure. Fang et al. (1995) and Darne et al. (1989) also reported an association between increased pulse pressure and adverse cardiovascular events presumably due to detrimental influence of increase in stiffness of the conduit vessels in normotensive and hypertensive patients.

Comparative investigation of rural and urban hypertensive Jat females of Haryana (Table 2) revealed that impact of hypertension was more pronounced on urban hypertensive Jat females, thereby indicating urban life style as an environmental adversity from the cardiovascular point of view. These findings derive strength from the observations of Trowel and Burkett (1981) and Waldron et al. (1982) who reported that raised blood pressure is related to several aspects of modern life style including western diet, lack of exercise and increased psychological stress. In conclusion, the present study suggests that hypertension adversely affects the morpho-physiological traits of hypertensive rural and urban Jat females of Haryana compared to normotensives females. Thus there is a need for such nationwide surveys for detection, awareness and treatment of hypertension particularly among elderly Indian females.

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