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Menopause Related Blood Pressure Increase and its Relation to Anthropometric Measurements in Saudi Females

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Hypertension is a frequently encountered multifactorial disorder and its prevalence is reported to increase in postmenopausal females. This study was carried out to identify the nature of correlation between anthropometric measures and hypertension in pre- and post menopausal Saudi females. The study group comprised of 126 females (18 to 75 years), grouped as premenopausal (94) and postmenopausal (32). The body mass index (BMI), waist/hip ratio and hip circumference were significantly lower ($p<0.001$) in the premenopausal females (27.01 ± 5.45 Kg/m^2, 0.770.06, 81.3812.4 cm, respectively) compared to their postmenopausal counterpart (29.853.63 Kg/m^2, 0.870.07 and 96.77.2 cm, respectively), though the weight and waist circumference did not differ significantly. The systolic blood pressure (bp) range (mean ±2SD) was 111.111.42 mm/Hg in the premenopausal and 124.7218.98 mm/Hg in postmenopausal females ($p<0.001$), while the diastolic bp range was 72.310.10 mm/Hg and 74.6611.35 mm/Hg in the two groups, respectively ($p>0.05$). Prevalence of abnormality of systolic and diastolic bp was significantly higher in the postmenopausal females (37.5 % and 28.13 %, respectively), compared to 4.3 % and 7.4 % in the premenopausal group. Both BMI and waist/hip ratio showed a significant and positive correlation with systolic and diastolic blood pressure ($p< 0.001$). It was concluded that the both systolic and diastolic blood pressure are higher in the postmenopausal Saudi females. There is an associated increase in the prevalence of overweight and obesity in this group and this may be an important factor contributing to blood pressure elevation. Since control in BMI can play a significant role in control of blood pressure and since there is a possibility of controlling BMI with proper life style and dietary intervention, there is an urgent need to implement programs for the control of anthropometric measurements in Saudi females, in an attempt to reduce hypertension and hence its associated complications.

Key words: Hypertension, BMI, premenopausal, postmenopausal, waist/hip ratio, systolic blood pressure, diastolic blood pressure.

The relationship between menopause and hypertension has been a topic of investigation for several years. Studies have documented that menopause is associated with a slight but significantly higher blood pressure values[1]. Some studies, implicate increase in age by itself, as a factor causing an increase in blood pressure[2]. More recently, Leuzzi and Modena[3] summarized several etiological factors resulting in an increase in the frequency of hypertension in post menopausal women. These causes include body mass index (BMI), abdominal obesity, and an unhealthy life style[1]. Cifkova and coworkers[4] suggested that the rise in blood pressure after the menopause was linked to an increase in body mass index (BMI) rather than to ovarian failure *per se*. In another

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study investigating the pathogenesis of hypertension during menopause multiple regression analysis showed that the strongest predictor of hypertension was waist circumference while menopause *per se* did not affect blood pressure values[5]. In several studies, physical inactivity has been implicated as a major contributor to weight gain and abdominal obesity in postmenopausal women[6], hence increasing the prevalence of hypertension.

Hypertension is a multifactorial disorder with both genetic and environmental etiological factors playing a role in its development[7]. It is polygenic, with several genes contributing to its development, but each with a small effect[8]. It is classified among the most common chronic disorder in developed countries and is achieving similar heights in the developing countries, such as Saudi Arabia[9,10]. It is more common among younger men compared to their female counterparts, but achieves the same prevalence in the fifth decade of life in both men and women. It is also the most common major cardiovascular risk factor in the older age groups and like men hypertensive women may develop strokes, left ventricular hypertrophy, and renal dysfunction[7].

Elevated Systolic and diastolic blood pressure (bp) are shown to be potent risk factors for development of cardiovascular disease in premenopausal women[11]. Interestingly the incidence of cardiovascular disease increases dramatically after menopause, more women than men die each year of coronary heart disease and are twice as likely as men to die within the first year after a heart attack[6]. A healthy lifestyle with regular physical activity has been strongly associated with decrease in bp and evidences have shown that physically active subjects have more longevity with reduction of morbidity and mortality from cardiovascular disease or other causes. In the management of arterial hypertension exercise training is an important approach in management and play a protective effect in postmenopausal women[6].

In Saudi Arabia, obesity is frequently encountered and the frequency of hypertension is also high[9,10,12-21]. Both disorders increase in prevalence with increase in age The objective of this study was to determine the relationship between BMI, waist/hip ratio and systolic and diastolic bp in Saudi females in relation to pre- and postmenopausal state.

MATERIAL AND METHODS

This study was conducted on 126 healthy females (age range 18-75 years), 94 of them were premenopausal and 32 postmenopausal. All females were healthy and were attending outpatients' clinics at King Khalid University Hospital, Riyadh. The aim of the study was explained and their consent to participate was taken. The personal information was obtained and all the information was recorded on special form. Height (in meter) and weight (in kilograms) were recorded on a measuring scale. The data was used to calculate the BMI using the formula: BMI = weight (Kg)/ height^2 (m^2). The hip and waist were measured using a measuring tape and waist/hip ratio was calculated. The systolic and diastolic bp was measured using sphygmomanometer, which was regularly standardized. The data was entered on personal computer and analyzed using Statistical Package for Social Sciences (SPSS) program version 9.0. The mean, and standard deviation, and parametric ranges and frequency distribution histograms were obtained. The females were grouped as pre- and post menopausal. The data was separately analyzed for the different groups. The females were also grouped into normal weight, overweight and obese groups on the basis of their BMI and the results of different groups were compared using students 't' test. To determine the difference in prevalence of abnormality in the pre- and post-menopausal groups chi square (χ^2) analysis was carried out and $p<0.05$ was considered statistically significant. Odds ratio were calculated and relative risk (RR) were obtained.

Using the cutoff values of BMI indicating overweight (25-29.9 Kg/m^2) and obesity (≥30 Kg/ χ^2); abdominal obesity (waist/hip ≥ 0.8); and bp (systolic ≥140mm/Hg and/or diastolic ≥ 90 mm/Hg), the prevalence of abnormality were calculated in the pre- and post-menopausal groups separately. The results in the two groups were compared using χ^2 analysis. Odds ratio (OR) was obtained and relative risks (RR) were calculated. $P < 0.05$ was considered statistically significant.

Correlation studies were carried out between different parameters and Pearson's

correlation coefficient (r) and p values were obtained. Correlation was considered statistically significant at values of $p<0.05$.

RESULTS

There were 94 premenopausal females with age range 30.53 7.28 years and 32 postmenopausal females with age range 58.349.16 years and the difference in age between the two groups was statistically significant. The weight, height, BMI, waist and hip circumference, waist/ hip ratio, systolic and diastolic bp values for the two groups and for the total females are presented in Table 1. All parameters showed a statistically significant elevation in the postmenopausal females, except weight, waist circumference, diastolic bp and height ($p>0.05$). The later was significantly lower in the postmenopausal group compared to the premenopausal group.

Using the normal values as asserted by WHO, the females in the two groups were grouped as normal weight, overweight and obese, with abdominal obesity i.e. waist/hip ratio >0.8, high bp i.e. systolic bp ≥140 mm/Hg and/or diastolic bp ≥90 mm/Hg. The prevalence of abnormality in the total females and separately in the two groups is presented in Table 2. Obesity was significantly more in the postmenopausal group compared to the premenopausal females as judged by the BMI values. The waist/hip ratio, the systolic bp and diastolic bp were significantly higher in the postmenopausal group compared to their premenopausal counter parts. With

Table 1. Demographic parameters in Saudi females

Mean ± SD	Total group (126)	Pre-menopausal group (94)	Post-menopausal group (32)	p
Age (years)	37.6 14.42	30.53 7.28	58.34 9.16	0.0001
Weight (Kg)	67.53 13.44	66.39 14.31	70.87 9.92	0.054
Height (m)	1.56 0.06 ±	1.57 0.06	1.54 0.07	0.041
BMI (Kg/m)	27.73 5.19	27.01 5.45	29.85 3.63	0.001
Waist circumference (cm)	106.18 10.01	105.62 9.9	111.3 10.06	0.088
Hip circumference (cm)	82.88 12.81	81.38 12.4	96.7 7.2	0.0001
Waist/ hip	0.78 0.07	0.77 0.06	0.87 0.07	0.0001
Systolic blood pressure (mm/Hg)	114.56 14.89	111.1 11.42	124.72 18.98	0.0001
Diastolic blood pressure (mm/Hg)	72.9 10.43	72.3 10.10	74.66 11.35	0.271

Table 2. Prevalence of abnormalities in Saudi females

Parameter	Parameter Value	Total group (126) No. (%)	Pre-menopausal group (94) No. (%)	Post-menopausal group (32) No. (%)	χ^2 p	Odds Ratio	RR
BMI (kg/m^2)	>25-29.9	44 (34.92)	31 (32.98)	13 (40.63)	χ^2=1.07 p>0.05	1.39	1.23
	≥30	44 (34.92)	27 (28.7)	17 (53.13)	χ^2=6.25 P=0.012	2.81	1.85
Waist/hip ratio	>0.8	51 (40.47)	25 (26.6)	26(80)	χ^2=7.56 P=0.006	11.96	3.06
Systolic BP (mm/Hg)	≥140	16 (12.7)	4 (4.3)	12 (37.5)	χ^2=23.8 P=0.0001	13.5	8.7
Diastolic BP (mm/Hg)	≥90	16 (12.7)	7 (7.4)	9 (28.13)	χ^2=9.21 P=0.002	4.86	3.8

RR= Relative risk.

postmenopausal state, waist/hip ratio and systolic bp showed the maximum elevation as judged from the OR and RR values.

In an attempt to investigate the influence of age, weight, BMI, waist and hip and waist/hip ratio on systolic and diastolic bp, correlation studies were conducted and Pearsons correlation coefficient (r) and significance of correlation (p values) were obtained. Table 3 presents the results of the correlation studies and shows that age, weight, BMI, hip circumference, waist circumference and waist/hip ratio correlated positively with systolic and diastolic bp.

Table 3. Correlation studies between demographic parameters in total Saudi females

		Age	Weight	BMI	Hip	Waist	Waist/hip	Systolic BP	Diastolic BP
Age	r	1.000	.204	.276	.302	.483	.514	.415	.176
	p	.	.022	.002	.002	.000	.000	.000	.049
Weight	r	.204	1.000	.911	.909	.876	.506	.313	.287
	p	.022	.	.000	.000	.000	.000	.000	.001
BMI	r	.276	.911	1.000	.884	.871	.527	.394	.300
	p	.002	.000	.	.000	.000	.000	.000	.001
Hip	r	.302	.909	.884	1.000	.825	.335	.316	.310
	p	.002	.000	.000	.	.000	.001	.001	.002
Waist	r	.483	.876	.871	.825	1.000	.806	.429	.388
	p	.000	.000	.000	.000	.	.000	.000	.000
Waist/hip	r	.514	.506	.527	.335	.806	1.000	.390	.326
	p	.000	.000	.000	.001	.000	.	.000	.001
Systolic BP	r	.415	.313	.394	.316	.429	.390	1.000	.676
	p	.000	.000	.000	.001	.000	.000	.	.000
Diastolic BP	r	.176	.287	.300	.310	.388	.326	.676	1.000
	p	.049	.001	.001	.002	.000	.001	.000	.

DISCUSSION

Increase in blood pressure is closely related to cardiovascular abnormalities and is considered a major factor in increasing morbidity and mortality in both men and women. Though younger men are at a higher risk of developing hypertension, as the females approach the menopausal state the prevalence of hypertension increases and reaches the same prevalence as in men[6,11]. The results of this study on pre- and post-menopausal females show increase in systolic and diastolic bp accompany menopausal status in Saudi females. As the females enter the post-menopausal stage weight gain becomes more evident and the BMI increases significantly. Increase in weight in menopausal females has been reported in several other studies and is believed to be a result of physiological changes accompanying menopausal states which result in weight gain[22-23]. In addition, the life style changes accompanying the menopausal state also influence the body weight[23, 24], where decrease in physical activity significantly influences weight gain[10]. In Saudi Arabia, several studies have shown an increase in the prevalence of obesity with age and this has been attributed to sedentary life style, excessive consumption of dates, hot climate which prevents people to perform physical activities outside and excessive socializing[9,12,13]. Interestingly, a study on the sleep pattern showed that decrease in the number of sleeping hours per day is also a contributing factor in hypertension[25]. The results of this study also showed that both systolic and diastolic bp was higher in the post-menopausal females compared to the pre-menopausal group, but the difference was statistically significant for systolic blood pressure only, by applying both student t test and Mann-Whitney test. The results of this study showed that the prevalence of hypertension in the total females, with age ranging from 18 to 75 years, was 15.1 % (19/126 females). Of the hypertensive females, 14 females (73.7 %) were obese and the other 5 females (26.3 %) were

overweight. So it is clear that bp is strongly affected by body weight. In addition, 63.2 % of the hypertensive females were postmenopausal. This could be an effect of overweight and obesity in the older age females.

Waist/hip ratio is an important anthropometric indicator to distinguish apple shaped from pear shaped fat distribution. The cutoff points are 0.8 for women and 1.0 for men (26). During this study on females, the mean waist to hip ratio in total females was 0.78. A significant difference was found in the waist/hip ratio in the pre- and post-menopausal females. Where in the premenopausal females waist/hip ratio was 0.77 and in postmenopausal females it was 0.87. Applying the cut-off value as 0.8, 51 of the total females in this study were apple shaped and the rest were pear shaped. In postmenopausal group, (80 %) were apple shaped.

Waist/hip ratio may have special value in reflecting diseases, which involve muscle reduction as well as fat deposition[27]. Many studies have shown that women in their mid-life tend to gain weight, with a shift to visceral fat distribution[23, 28]. It was reported in a previous study that a waist circumference of 80 cm in women and 94 cm in men is associated with an increased overall morbidity risk[29]. Our results confirm that increase in age and a transition from pre-menopausal state to a post-menopausal state is accompanied by significant weight gain and increase in central weight distribution. Correlation studies conducted during this study have clearly shown that age, BMI and waist/hip correlate positively and significantly with all the anthropometric parameters and with each other. All anthropometric parameters show a srong and significant positive correlation with systolic and diastolic bp, Hence confirming the role played by these parameters in elevating bp during menopause.

Since it is well established that abdominal obesity is closely linked to hypertension and cardiovascular diseases in women[30], and since both can be controlled by changes in life style, dietary control, increasing physical activity[31-34], it is strongly advocated that the awareness of females, regarding the control of anthropometric parameters for achieving long term health benefits, is increased and such programs are implemented that will help alleviate the long term sufferings of the population of Saudi Arabia. The current practices and changing pattern of the Saudi diet[35], has to be monitored to prevent excessive weight gain due to unhealthy practices.

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Disclosure of competing interests

Authors declare that they do not have any competing interests with any group.

Authors' Contributions

ASW and NO designed the experiment, analyzed the data and wrote the manuscript. [2] ZB, and MH collected samples from their patients and contributed to discussion of results and preparation of the manuscript. AA and MA helped in data analysis, discussion of results and preparation of the manuscript. All authors read and approved the final manuscript.

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