Trends and Determinants of Blood Pressure and its Association with Clusters and Sub-Clusters of Menopausal Symptoms among Rural Women of Kanpur, Uttar Pradesh

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ABSTRACT: The present study tends to observe the trends and determinants of blood pressure and its association with clusters and sub-clusters of menopausal symptoms among rural women of Uttar Pradesh. The study consisted of 351 women from 35 to 55 years of age from rural area of Kanpur (India). The menopausal symptoms were evaluated using the Greene Climacteric Scale and JNC VII criteria was used to assess the blood pressure status of the participants. Analysis of data revealed that the mean scores of psychological, anxiety, depression, somatic and loss of interest in sex menopausal symptoms were significantly higher among hypertensive women as compared to their normotensive counterparts except vasomotor symptoms. In multivariate regression analysis, women with age above 45 years, lower middle class, postmenopausal status, osteoporosis and overweight were shown to be possible risk factors of occurrence of hypertension. Menopausal transition was one of the important determinants of developing hypertension with the perimenopausal women had 1.2 folds and postmenopausal women had 3.9 folds higher risk of developing hypertension than their premenopausal counterparts.

INTRODUCTION

High blood pressure or hypertension is one the cause of cardiovascular disease and an important public health issue in developed as well as in developing countries (Kearney *et al.*, 2004). According to Kearney *et al.* (2005) total estimated hypertensive population was 60.4 million males and 57.8 million females in 2000, which is estimated to increase 107 million males and 106 million females in year 2025.

The burden of cardiovascular disease is higher in developing countries and the situation in India is not very encouraging. It was observed by the Anchala *et al.* (2014) that the prevalence of hypertension was 25% in rural and 33% in urban areas of India. According to WHO, (2008) estimates, 33.2% Indian men and 31.7% Indian women were suffering from hypertension (non-communicable diseases country profiles, 2011).

Previous research (Bhagat *et al.*, 2010; Tandon *et al.*, 2010; Zilberman *et al.*, 2015) have established that the postmenopausal women are at greater risk of

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developing cardiovascular problems in India as well as across the globe. According to Staessen *et al.* (2001) in aging women systolic blood pressure increases abruptly and it could be due to the hormonal changes during the menopause. Most of the studies have shown significant prevalence of increased systolic and diastolic blood pressure after menopause (Skrzypczak and Szwed, 2005; Nwankwo *et al.*, 2013). A study performed by Crews and Williams (1999) have illustrated that the variability in blood pressure trend could be due to various environmental, physiological and socio-cultural stimuli, but the relation between blood pressure and menopause is complex. Studies conducted on Australian women concluded that during menopausal transition phase, hormonal changes directly or indirectly affect the risk of developing the cardiovascular disease (Guthrie *et al.*, 2004).During the menopause, women experienced the depression, anxiety and vasomotor symptoms which are also associated with the progression and incidence of hypertension (Yusuf *et al.*, 2004; Lima *et al.*, 2012; Herber Gast *et al.*, 2015). It was also found that women with hypertension could report complaints of having sleep disturbances, hot flushes, anxiety, depression, headaches, palpitations, tiredness etc (Fletcher *et al.*, 1998; Ikeda *et al.*, 2006).

Menopause is a natural biological process, which is also influenced by psychological and social factors. In India the numbers of menopausal women are approximately 43 million which is expected to increase 103 million till year 2026 (Unni, 2010). Due to the increasing life expectancy significant proportion of mid-life women would experience the menopausal transition phase and also vulnerable to various negative health outcomes such as cardiovascular disease, osteoporosis, severe menopausal symptoms, hypertension etc. Data regarding association of menopausal symptoms with hypertension and determinants of hypertension is sparse from rural area of North India. Hypertension is considered one of the major risk factors of the cardiovascular diseases and affects women during their postmenopausal life, therefor it is imperative to understand its epidemiology and determinants during the menopause which would help to promote the therapeutic strategies and health safety well before to improve the quality of life. Thus, this study was carried out with the objectives (i) to describe trends of blood pressure in different menopausal stages (ii) to gauge the possible determinants of high blood pressure (iii) to ascertain the association of blood pressure with menopausal symptoms among rural women of Kanpur, India.

MATERIAL & METHODS

Land and people: Uttar Pradesh, is a state situated in northern part of India. Kanpur district is considered as the commercial and industrial centre of Uttar Pradesh. The present cross-sectional study was carried out on six villages namely Chandula, Lodhar, Bachipur, Etra, Dilwarpur Tuswa, and Kursauli of Kanpur, India (Figure 1).

Fig 1: Study area (Kanpur, Uttar Pradesh, India)

Participants: A sample of 351 rural Indian women, with ages between 35-55 years was enrolled for the study. The pilot study was conducted from December 2015 to January 2016 in the rural area of Kanpur to improve the questionnaire. Participants who were pregnant/ lactating, unmarried and had undergone to oophorectomy or hysterectomy were excluded from the study.

Initially, women were asked about their age, marital status, age at menarche and menopause, education level, parity, working or non-working, number of members in a family, type of family whether joint or

nuclear, use of oral contraceptive, consumption of tobacco. Mean age at menarche was ascertained by using Kaplan Meier survival curve. The sample was divided into three categories according to their menopausal status: premenopause (menstruating regularly), perimenopause (menstruation becomes irregular but has occurred once during the past twelve months) and postmenopause phase (after the menopause when there are no periods) following the definition given by WHO (1996). Prior to gathering the data, all the participants were informed about the purpose of the study and their verbal informed consent was taken. Ethical clearance for the study was obtained from the ethical committee of the institution.

Two anthropometric measurements i.e. height (cm) and weight (kg) of all the participants were taken following the standard techniques described by Weiner and Lourie (1981) and calculated their body mass index (kg/m^2). T-score of each subject was measured from the calcaneus by using ultrasound based bone densitometer (McCue C.U.B.A. clinical). This is a clinical manual graded T-score value into three categories. The value for T-score – 1.0 SD designated as normal, T-score between -1.0 and -2.0 SD mentioned as osteopenia and T-score less than -2.0 SD considered as osteoporosis. Age was ascertained from their date of birth. Most of the women were able to recall their date of birth and this was verified from their voter ID and Aadhar card (Government documents of Republic of India).

Instruments: Socio-demographic characteristics (age, education level, occupational status, family structure and use of oral contraceptives) of the participants were recorded. To record the socio-economic status (SES), Aggarwal scale was used (Aggarwal *et al.*, 2005). It consists of 22 items and has a scale ranging from 0 to 7. The scale is divided into six socio-economic categories: upper high (more than 76), High (61-75), Upper middle (46-60), Lower middle (31-45), Poor (16-30) and very poor (less than 15) (Aggarwal *et al.*, 2005).

Greene Climacteric scale (Greene, 2008) which includes 21 symptoms was used to appraise the menopausal symptoms of the participants. This scale was translated into regional language. These symptoms were divided into four clusters and 2 sub-clusters: psychological where anxiety sub-cluster and depression sub-cluster, somatic, vasomotor and loss of interest in sex. Respondent's response was computed for each symptom according to its current condition on four-point scale: not-at-all (0); a little (1); quite a bit (2); extremely (3). The mean value for each symptom was calculated by the addition of all individual values which was divided by the total number of participants and the total mean value of each symptom shows the total mean scores of each cluster and total mean value of each cluster represents total Greene scale.

Blood pressure of each subject was recorded three time susing electronic sphygmomanometer (Trustcheck ACE model-HL868ZA). The subject was asked to sit relaxed on a chair and free from any stressful activities. The pressure cuff was wrapped closely to the upper arm and its lower portion above the elbow. Then blood pressure was recorded after the subject had rested at least for 15-20 minutes. The average of the last two readings was used in the analyses. The 7th Report of the Joint National Committee (JNC VII) on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure was used to categorize the blood pressure (Chobanian *et al.*, 2003). All the respondents were stratified into 2 categories according to their blood pressure level i.e., normotensive (254) and hypertensive (97).

Statistical analysis: The data thus collected were entered into the SPSS. Quantitative data were presented as mean $\pm$SD, whereas qualitative data were expressed as percentage. Student t-test was applied to determine between group comparisons i.e. between hypertensive and normotensive participants. The categorical variables were compared between hypertensive and normotensive participants using chi-square analysis. Univariate and multivariate regression analysis were employed to find out the possible determinants of hypertension among rural women.Hypertension was considered as dependent variable, while age, education, age at menarche, socio-economic status, family structure, use of oral contraceptive, menstrual status, body mass index (BMI) and T-score were the independent variables. Significance of $p < 0.05$ and a confidence interval of 95% were taken for all tests. All of these statistical considerations were conducted using SPSS (version 19.0, SPSS Inc.).

RESULTS

Socio-demographic profile and physiological variables among normotensive and hypertensive rural women of Kanpur are summarized in Table (1). Prevalence percentage of hypertensive women was highest in the oldest age group 51-55. The mean age of normotensive and hypertensive women was 43.5±6.5 years and 47.5±6.5 years respectively. Mean age at menarche was 14.1±1.2 years and 14.2±1.2 years in normotensive and hypertensive women respectively. Very few normotensives (13%) and hypertensive women (9.2%) used oral contraceptives. Concerning their family structure, majority of normotensive women (57.1%) were from nuclear family, while a large proportion of hypertensive women (50.5%) were belonging to joint family.

TABLE 1

Socio-demographic and physiological variables among normotensive and hypertensive rural women of Kanpur

	Socio-demographic and physiological variables	Normotensive women (N=254)	Hypertensive women (N=97)
Age-group	35-40	102 (40.2%)	20 (20.6%)
	41-45	54 (21.2%)	16 (16.5%)
	46-50	48 (18.8%)	16 (16.5%)
	51-55	50 (19.7%)	45 (46.3%)
Age (years)		43.5±6.5	47.5±6.5
Age at menarche (years)[a]		14.1±1.2	14.2±1.2
Parity[a]		3.72±1.5	4.18±1.9
Oral contraceptive ever used (%) [b]	Yes	33 (13%)	9 (9.2%)
	No	221 (87%)	88 (90.7%)
Family structure (%) [b]	Joint	109 (42.9%)	49 (50.5%)
	Nuclear	145 (57.1%)	48 (49.5%)
Education (%) [b]	Illiterate	145 (57.1%)	61 (62.9%)
	Literate	109 (42.9%)	36 (37.1%)
Tobacco consumption (%) [b]	Yes	135 (53.1%)	42 (43.3%)
	No	119 (46.8%)	55 (56.7%)
Socio-economic status (SES) (%) [b]	Upper Middle class	13 (5.1%)	9 (9.2%)
	Lower middle class	185 (72.8%)	32 (33.0%)
	Poor	56 (22.0%)	56 (57.7%)
Body Mass Index [a]	Underweight	105 (41.3%)	25 (25.8%)
	Normal	111 (43.7%)	49 (50.5%)
	Overweight	38 (14.9%)	23 (23.7%)
T-score (g/cm²)	Normal	49 (19.3%)	14 (14.4%)
	Osteopenia	99 (38.9%)	20 (20.6%)
	osteoporosis	106 (41.7%)	63 (64.9%)

A considerable proportion of illiterate women (62.9%) were in hypertensive category. Highest number of normotensive women (72.8%) belonged to lower-middle class family, while 33% hypertensive women were from lower middle class. About 22% normotensive women and 57.1% hypertensive women belonged to poor socio-economic status. Prevalence of normotensive and hypertensive women in underweight category was 41.3% and 25.8% respectively, while overweight category of BMI noted 14.9% normotensive and 23.7% hypertensive. In normotensive women about 19.3% women had normal T-scores, 38.9% and 41.7% were osteopenic and osteoporotic respectively. Whereas in hypertensive category only 14.4% women exhibited normal T-scores, 20.6% women were osteopenic and most of the women (64.9%) were osteoporotic.

TABLE 2

Frequency distribution in different categories of blood pressure as per JNC VII criteria

in different menopausal stages among rural women of Kanpur

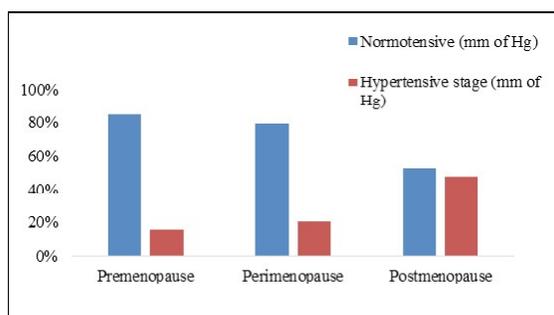|	Normal	Hypertension Prehypertensive	Stage I	Stage II
DBP	<80	80-89	90-99	≥100
SBP	<120	120-139	140-159	≥160
Premenopause	70 (59.3%)	30 (25.4%)	17 (14.4%)	1 (.8%)
Perimenopause	53 (45.2%)	40 (34.1%)	14 (11.9%)	10 (8.5%)
Postmenopause	21 (18.1%)	40 (34.4%)	38 (32.7%)	17 (14.6%)
Totalp<.05*, p<.01**, p< .001***	144 (41%)	110 (31.4%)	69 (19.6%)	28 (7.9%)

Fig 2: Frequency distribution of the normotensive and hypertensive women in different menopausal stages

The frequency distribution of the normotensive and hypertensive women in different menopausal stages is portrayed in Figure 2. It is evident from the figure that the proportion of hypertensive women increased significantly with menopausal transition i.e., from premenopausal stage to postmenopausal stage. Table (2) presented that 25.4% premenopausal women, 34.1% perimenopausal and 34.4% postmenopausal women were present in pre-hypertensive category, while maximum number of postmenopausal women were present in stage I (32.7%) and stage II (14.6%) category of hypertension. Hypertensive women had higher mean scores of psychological symptoms anxiety sub-cluster, depression sub-cluster symptoms, somatic symptom, vasomotor symptoms and loss of interest in sex symptoms than their normotensive counterparts displayed in Table (3).

TABLE 3

Descriptive statistics of normotensive and hypertensive rural women in all cluster and sub-clusters of

menopausal symptoms among rural women

Clusters and sub-clusters of symptoms	Normotensive(Mean ± SD)	Hypertensive(Mean ± SD)	t-test
Psychological	8.07±4.0	9.14±4.0	2.07 *
Anxiety	4.27±2.2	4.90±2.2	2.10 *
Depression	4.49±2.1	5.08±2.4	1.9 *
Somatic	4.90±2.7	5.47±2.9	1.4 *
Vasomotor	2.28±1.2	2.40±1.0	0.56
Loss in sex interest	1.84±.66	2.18±0.7	3.94 ***

TABLE 4

Univariate regression analysis between hypertension and various bio-social factors of rural women

	Variables	Hypertensive OR(95%CI)	p-value
Age (years)	>45 years	3.3(2.0-5.5)	.000***
	≤ 45 years [R]	1	
Education	Literate [R]	1	.04*
	Illiterate	1.6(1.0-271)	
Socio-economic status (SES)	Upper middle class[R]	1	.04*
	Lower middle class	2.3(1.0-5.4)	
Family structure	Joint	1.6(1.0-2.5)	.05*
	Nuclear [R]	1	
Age at menarche (years)	>14 years	1.2(.7-2.0)	.4
	≤ 14 years [R]	1	
Oral contraceptive ever use	Yes[R]	1.4(.6-3.1)	.3

	No	1	
Menopausal Status	Premenopause[R]	1	.03*
	Perimenopause	1.7(1.0-2.9)	.000***
	Postmenopause	4.1(2.5-6.7)	
T-score	Normal [R]	1	.000***
	Osteoporosis	2.5(1.5-4.2)	
Body mass index (kg/m^2)	Normal[R]	1	.03*
	Underweight	1.7(1.0-2.8)	.05*
	Overweight	1.7(.9-3.1)	

p<.05*, p<.01 **, p< .001***OR: Odd ratios, 95% CI: Confidence Interval, R Reference category

Univariate and multivariate regression analysis have been performed to ascertain determinants of hypertension (Table 4). It is evident from the Table 4 that as per univariate analysis, advancing age (above 45), illiteracy, lower middle class, joint family structure, postmenopausal phase and low T-scores were the possible risk factors of developing hypertension. No significant association of hypertension was recorded with age at menarche and use of oral contraceptives. Menopausal transition was one of the important predictors of developing hypertension. Results of the multivariate logistic regression analysis revealed that the perimenopausal women had 1.2 folds and postmenopausal women had 3.9 folds higher risk of developing hypertension than their premenopausal counterparts (Table 5). Women with lower T-score were 2.3 times (95% CI_1.3-4.0, p<.000) more likely to have hypertension than their counterparts with normal T-scores. Women who were underweight as well as overweight revealed 1.7 times and 2.3 times respectively higher probability of developing hypertension as compared to women with normal weight.

TABLE 5

Multivariate logistic regression analysis of hypertension with age, education, socio-economic status, family type, menstrual status, body mass index (BMI) and t-score among rural women

Variables	Hypertensive OR(95%CI)	p-value
Age (years) (median)		
>45 years	1.7(.8-3.4)	.05*
≤ 45 years [R]	1	
Education		
Illiterate	1.0(.5-2.0)	.8
Literate [R]	1	
Socio-economic status (SES)		
Lower middle class	2.8(1.1-7.1)	.02*
Upper middle class[R]	1	
Family structure		
Joint	1.0(.6-1.9)	.7
Nuclear [R]	1	
Menopausal Status		
Premenopause[R]	1	
Perimenopause	1.2(.8-3.5)	.1
Postmenopause	3.9(2.2-6.9)	.000***
T-score		
Normal [R]	1	
Osteoporosis	2.3(1.3-4.0)	.004**
Body mass index, (kg/m^2)		
Normal[R]	1	
Underweight	1.7(.8-3.5)	.1
Overweight	2.3(1.3-4.0)	.001***

p<.05*, p<.01**, p< .001***OR: Odd ratios, 95% CI: Confidence Interval, R Reference category

DISCUSSION

Rural women revealed an age-related increment in the prevalence of hypertension, whereas frequency of hypertensive women was highest in the oldest age group (51-55 years). Results of multivariate regression analysis confirmed that probability of the hypertension was 1.7 times more prevalent among women above 45 years than the younger ones i.e., below 45 years. A trend of age-related increase in systolic and diastolic blood pressure was registered by a range of previous studies (Malhotra *et al*., 1999; Benetos *et al*., 2000; Pinto, 2007; Rockwood *et al*., 2012; Chu *et al*., 2015; Buford, 2016). Current findings were in consensus with the report of Kaur et al. (2014) they noticed higher systolic blood pressure (131.10 vs 126.56 mm of Hg) and diastolic blood pressure (88.34 vs 87.79 mm of Hg) among females after menopause as compared to before menopause. A study of Skrzypczak and Szwed (2005) also reported systolic and diastolic blood pressure increase after the menopause. A cross-sectional study of Zanchetti *et al*. (2005) on Italian women assessed an age associated increment in mean values of blood pressure, exhibiting a higher prevalence of hypertension in postmenopausal women (64.1%) as compared to the perimenopausal and premenopausal women. Several population studies (Staessen *et al*., 1989 and Amigoni *et al*., 2000) demonstrated that the menopause increased the probability of hypertension by two fold, even after adjusting for factors such as age and body mass index. This may be attributed to endogenous estrogens regulate vasodilation and thus control blood pressure in premenopausal women, whereas during postmenopausal phase the loss of endogenous estrogen production coupled with aging contribute to increment in blood pressure, thus the high prevalence of hypertension in older women (Barton and Meyer, 2009).

Lower educational level was found to be a significant predictor of hypertension among rural women of the present study. In convergence with the findings of the current study Tyagi *et al*. (2015) while examining the association of various biological and social factors with progression of hypertension among menopausal and post-menopausal women recognised that the lower educational attainment was more likely to be a risk factors for prehypertension or

hypertension among women. Our findings showed compatibility with many other past cross-sectional studies (Ibrahim, 2011; Tyagi *et al*., 2015).

In our study women with low socio-economic status (SES) had 2.3 times more probability of the occurrence of hypertension as compared to upper middle-class women. A similar relationship between hypertension and socio-economic status was reported by numerous studies (Colhoun *et al*., 1998; Mackenbach *et al*., 2003; Fernald and Adler, 2008). In systematic review, Colhoun *et al*. (1998) found the lower socio-economic status was associated with higher blood pressure in the developed countries. A cross-sectional survey of Fernald and Adler (2008) recorded that the women with lower socio-economic status were associated with the higher systolic blood pressure. Interestingly, Olatunbosum *et al*. (2000) observed a higher prevalence of hypertension in both the extremes of socio-economic status. In contrast to the reports of the present study Tyagi *et al*. (2015) also found women with higher socio-economic status had more chance to get hypertension. Education is one of the major determinants of socio-economic status and a considerable proportion of rural women of present study were illiterate which may be associated with greater prevalence of hypertension.

Analysis of data in the present study documented that the participants with lower T-score (95% CI_1.3-4.0, p<.000) had 2-3 folds higher probability of having hypertension than their counterparts with normal T-scores. In convergence with our finding, Varenna *et al*. (2013) noted greater prevalence of hypertension among osteoporotic Italian postmenopausal women as compared to their premenopausal counterparts and these hypertensive women were more affected by osteoporosis. These findings are in agreement with those reported by Tsuda *et al*. (2001) they found that reduced BMD in the hypertensive females might be associated with high blood pressure in Japanese women and concluded that the increased urinary calcium may lead to reduced BMD in the hypertensive female. A study conducted by Popovic and Tasic (2009) advocated an increment in the systolic and diastolic blood pressure caused a significant decrease in the bone mineral density among postmenopausal women from Serbia. Results from the earlier studies (Afghani and Johnson, 2006;

Yazici *et al*., 2011; Kaur, 2014; Lee, 2015) have also shown higher blood pressure and hypertension were significantly and positively correlated with osteoporosis in postmenopausal women. It is well established by earlier researches (Bonjour *et al*., 1997; Oparil and Arthur, 1999; Tsuda *et al*., 2001) that the estrogen hormone played a significant role in the regulation of bone mineral density and various cardiovascular functions. Estrogen deficiency associated with menopause might accelerate abnormalities in the calcium metabolism at both the cellular and systemic levels, which would explain, in part, osteoporosis and hypertension in aged women.

In our findings, body mass index was one of the important predictors of high blood pressure. Women who were underweight (95% CI_1.0-2.8, p<.03) as well as overweight (95% CI_0.9-3.1, p<.05) revealed 1.7 times and 2.3 higher likelihood of developing hypertension. These observations are consistence with the findings of previous researches (Stevens *et al*., 2002; Harris *et al*., 2000; Aiyer *et al*., 2007). Cross-sectional study of Aiyer *et al*. (2007) found baseline BMI and increased weight during one year significantly associated with the increased blood pressure. Our results confirm these findings and demonstrated that two extremes of BMI are the predictor for hypertension. The high prevalence of obesity, lack of regular physical exercise and dietary salt-intake were major factors which contribute to aggravating the postmenopausal hypertension (Barton *et al*., 2009).

Present findings demonstrated that mean score of all the clusters and sub-clusters of menopausal symptoms was significantly higher among hypertensive as compared to their normotensive counterparts except for somatic symptoms where differences were not statistically significant. Existing literature also showed psychological symptoms such as anxiety (Pan *et al*., 2015; Jackson *et al*., 2016) and depression (WassertheilSmoller *et al*., 2004; Yusuf *et al*., 2004; Machado *et al*., 2012) were closely related to the progression of hypertension. A case-control study of Yusuf *et al*. (2004) established that the psychosocial symptoms increased the hypertension, which in turn contributes to increased risk of having cardiovascular disease. In Women's Health Initiative-Observational Study (WHI-OS) Wassertheil *et al*.

(2004) stated that depression symptom displayed a positive linear association with hypertension while in divergence to these reports Zambrana *et al*. (2016) concluded no association between baseline depressive symptoms and hypertensive among postmenopausal Hispanic women. Anxiety was another major factor related to progression of hypertension in the rural women of the present study.

In conformity to our findings Raikkonen *et al*. (2001) noticed that the psychological symptoms increased the risk of developing hypertension and fluctuation of blood pressure occurred due to the psychological changes in women. Bajkó *et al*. (2012) studied the effect of depression and anxiety on hypertension and found that anxiety played important role in the development of hypertension than depression. They concluded pathophysiological changes in autonomic control of heart could be one of the links between hypertension and psychological factors.

Present findings investigated the prevalence of vasomotor symptoms in hypertension and normotensive and found that the mean score of vasomotor symptoms in hypertensive women were significantly higher as compared to normotensive women. In consistent to our findings the meta-analysis and systematic review conducted by Muka *et al*. (2016) explained that vasomotor and other menopausal symptoms have greater probability to develop the risk of cardiovascular disease. A study of Gast *et al*. (2008) confirmed vasomotor menopausal symptoms were associated with cardiovascular risk profile including high systolic and diastolic pressure among Dutch women. According to Kagitani *et al*. (2014) Japnese women aged between 40 to 59 years who currently experiencing hot flushes symptoms had significantly higher systolic blood pressure than those experiencing hot flushes in earlier month. Reports of Leal *et al*. (2000) illustrated that the woman with menopausal symptoms have a minimum level of plasma antioxidant activity and an enhanced cardiovascular reactivity to stressful situations. It has been postulated (Gragasin *et al*., 2003) that increased reactive oxygen species which contribute to vasoconstriction and hypertension associated with the postmenopausal estrogen-deficient state.

Sexual dysfunction is a sexual disorder of desire,

orgasm, pain, arousal and satisfaction (Aslan and Fynes, 2008). In the current cross-sectional study, hypertensive women presented significantly higher (p<.001) mean scores for symptom loss of interest in sex (2.18±.7) than their normotensive counterparts (1.84±0.66). Earlier studies on American women and Chilean women correlated prevalence of sexual dysfunction with an advancing age (Castelo Branco *et al*., 2003; Ford *et al*., 2005). It has been found that hypertension can directly or indirectly affects various aspects of the sexual activities (Valadares *et al*., 2008). A report of Doumas *et al*. (2006) found that the greater prevalence of sexual dysfunction among hypertensive Greek women as compared to normotensive women. Recently in a prospective and cross-sectional study among Brazilian women, Nascimento *et al*. (2015) found greater prevalence of arterial hypertension caused the sexual dysfunction. This was explained by Doumas *et al*. (2006) that increase in systolic blood pressure and the use of beta blockers to treat hypertension may be noxious to sexual activities.

CONCLUSION

In the present study, women with age above 45 years, lower middle class, postmenopausal status, osteoporosis and overweight were found to be the possible determinants of occurrence of hypertension as per multivariate regression analysis. Hypertensive women with menopausal symptom i.e psychological, anxiety, depression, somatic and loss of interest in sex demonstrated higher mean scores than the normotensive women.

REFERENCES CITED

Afghani, A. and C. A. Johnson 2006. Resting blood pressure and bone mineral content are inversely related in overweight and obese Hispanic women. *American Journal of Hypertension,* 19(3):286-292.Doi: https://doi.org/10.1016/j.amjhyper.2005.10.024

Aggarwal, O. P., S. K. Bhasin, A. K. Sharma, P. Chhabra, K. Aggarwal and O. P. Rajoura 2005. A new instrument (scale) for measuring the socio-economic status of a family: Preliminary study. *Indian Journal of Community Medicine,* 30(4):111-114.

Aiyer, A. N., K. E. Kip, S. R. Mulukutla, O. C. Marroquin, L. Hipps Jr and S. E. Reis 2007. Predictors of significant short-term increases in blood pressure in a community-based population. *American Journal of Medicine,* 120(11): 960-967. Doi: https://doi.org/10.1016/j.amjmed.2007.06.021

Amigoni, S., P. Morelli, F. Parazzini and L. Chatenoud 2000. Determinants of elevated blood pressure in women around menopause: Results from a cross-sectional study in Italy. *Maturitas*, 34(1):25-32.Doi: https://doi.org/10.1016/s0378-5122(99)00089-4

Anchala, R., N. K. Kannuri, H. Pant, H. Khan, O. H. Franco, E. Di Angelantonio and D. Prabhakaran 2014. Hypertension in India: A systematic review and meta-analysis of prevalence, awareness, and control of hypertension. *Journal of Hypertension,* 32(6):1170. Doi:https://doi.org/10.1097/hjh.0000000000000146

Aslan, E. and M. Fynes 2008. Female sexual dysfunction. *International Urogynecology Journal,* 19(2):293-305.Doi:https://doi.org/10.1007/s00192-007-0436-3

Bajko, Z., C. C. Szekeres, K. R. Kovács, K. Csapó, S. Molnár, P. Soltész, E. Nyitrai, M. T. Magyar, L. Oláh, D. Bereczki and L. Csiba 2012. Anxiety, depression and autonomic nervous system dysfunction in hypertension. *Journal of Neurology,* 317(1-2):112-6.Doi:https://doi.org/10.1016/j.jns.2012.02.014

Barton, M. and M. R. Meyer 2009. Postmenopausal hypertension: Mechanisms and therapy. *Hypertension,* 54(1):11-8.Doi: https://doi.org/10.1161/hypertensionaha.108.120022

Benetos, A., M. Zureik, J. Morcet, F. Thomas, K. Bean and M. Safar, P. Ducimetiere and L. Guize 2000. A decrease in diastolic blood pressure combined with an increase in systolic blood pressure is associated with a higher cardiovascular mortality in men.*JACC: CardioOncology*. 35(3):673-680.Doi: https://doi.org/10.1016/s0735-1097(99)00586-0

Bhagat, N., M. Agrawal, K. Luthra, N. K. Vikram, A. Misra and R. Gupta 2010. Evaluation of single nucleotide polymorphisms of Pro12Ala in peroxisome proliferator-activated receptor-ã and Gly308Ala in tumor necrosis factor-á genes in obese Asian Indians: A population-based study. *Diabetes Metabolic Syndrome and Obesity,* 3:349. Doi: https://doi.org/10.2147/dmsott.s13514

Bonjour, J. P., A. L. Carrie, S. Ferrari, H. Clavien, D. Slosman, G. Theintz and R. Rizzoli 1997. Calcium-enriched foods and bone mass growth in prepubertal girls: A randomized, double-blind, placebo-controlled trial. *Journal of Clinical Investigation,* 99(6):1287-94.Doi: https://dx.doi.org/10.1172%2FJCI119287

Buford, T. W. 2016. Hypertension and aging. *Ageing Research*

Reviews, 26:96-111.Doi: https://doi.org/10.1016/j.arr.2016.01.007

Castelo-Branco, C., J. E. Blümel, M. E. Roncagliolo, J. Haya, D. Bolf, L. Binfa, X. Tacla and M. Colodron 2003. Age, menopause and hormone replacement therapy influences on cardiovascular risk factors in a cohort of middle-aged Chilean women. *Maturitas,* 45(3):205-12.Doi:https://doi.org/10.1016/s0378-5122(03)00140-3

Chobanian, A. V., G. L. Bakris, H. R. Black, W. C. Cushman, L. A. Green, J. L. Izzo Jr, D. W. Jones, B. J. Materson, S. Oparil, J. T. Wright and E. J. Roccella 2003. Seventh report of the joint national committee on prevention, detection, evaluation, and treatment of high blood pressure. *Hypertension,* 42(6):1206-52.Doi: https://doi.org/10.1161/01.hyp.0000107251.49515.c2

Chu, S. H., J. W. Baek, E. S. Kim, K. M. Stefani, W. J. Lee, Y. R. Park, Y. Youm and H. C. Kim 2015. Gender differences in hypertension control among older Korean adults: Korean social life, health, and aging project. *Journal of Preventive Medicine and Public Health*, 48(1):38.Doi: https://dx.doi.org/10.3961%2Fjpmph.14.043

Colhoun, H. M., H. Hemingway and N. R. Poulter 1998. Socio-economic status and blood pressure: An overview analysis. *Journal of Human Hypertension,* 12(2):91-110.Doi: https://doi.org/10.1038/sj.jhh.1000558

Crews, D. E. and S. R. Williams 1999. Molecular aspects of blood pressure regulation. *Human biology,* 1:475-503.PMID: 10453099

Doumas, M., S. Tsiodras, A. Tsakiris, S. Douma, A. Chounta, A. Papadopoulos, K. Kanellakopoulou and H. Giamarellou 2006. Female sexual dysfunction in essential hypertension: A common problem being uncovered. *Journal of Hypertension,* 24(12):2387-92.Doi: https://doi.org/10.1097/01.hjh.0000251898.40002.5b

Fernald, L. C. and N. E. Adler 2008. Blood pressure and socio-economic status in low-income women in Mexico: A reverse gradient?*Journal of Epidemiology & Community Health*, 62(5):e8.Doi: https://doi.org/10.1136/jech.2007.065219

Fletcher, A. E., C. J. Bulpitt, J. Tuomilehto, J. Browne, A. Bossini, K. Kawecka-Jaszcz, P. Kivinen, E. O'Brien, J. Staessen, L. Thijs and O. Vanska 1998. Quality of life of elderly patients with isolated systolic hypertension: Baseline data from the Syst-Eur trial. *Journal of Hypertension*, 16(8):1117-24.Doi: https://doi.org/10.1097/00004872-199816080-00006

Ford, E. S., H. W. Kohli, A. H. Mokdad and U. A. Ajani 2005. Sedentary behavior, physical activity, and the metabolic syndrome among US adults. *Obesity Research*, 13(3):608-14.Doi: https://doi.org/10.1038/oby.2005.65

Gast, G. C., D. E. Grobbee, V. J. Pop, J. J. Keyzer, C. J. Wijnands-van Gent, G. N. Samsioe, P. M. Nilsson and Y. T. Van der Schouw 2008. Menopausal complaints are associated with cardiovascular risk factors. *Hypertension*,

51(6):1492-8.Doi: https://doi.org/10.1161/hypertensionaha.107.106526

Gragasin, F. S., Y. Xu, I. A. Arenas, N. Kainth and S. T. Davidge 2003. Estrogen reduces angiotensin II–induced nitric oxide synthase and NAD (P) H oxidase expression in endothelial cells. *Arteriosclerosis, Thrombosis, and Vascular Biology,* 23(1):38-44.Doi: https://doi.org/10.1161/01.ATV.0000047868.93732.B7

Greene, J. G. 2008. Constructing a standard climacteric scale. *Maturitas,* 61(1-2):78-84.Doi: https://doi.org/10.1016/j.maturitas.2008.09.011

Guthrie, J. R., J. R. Taffe, P. Lehert, H. G. Burger and L. Dennerstein 2004. Association between hormonal changes at menopause and the risk of a coronary event: A longitudinal study. *Menopause,* 11(3):315-22.Doi: https://doi.org/10.1097/01.gme.0000094208.15096.62

Harris, M. M., J. Stevens, N. Thomas, P. Schreiner and A. R. Folsom 2000. Associations of fat distribution and obesity with hypertension in a bi ethnic population: The ARIC study. *Obesity Research.* 8(7):516-24.Doi: https://doi.org/10.1038/oby.2000.64

Herber Gast, G. C., W. J. Brown and G. D. Mishra 2015. Hot flushes and night sweats are associated with coronary heart disease risk in midlife: A longitudinal study. *International Journal Obstetrics and Gynaecology,* 122(11):1560-67.Doi: https://doi.org/10.1111/1471-0528.13163

Ibrahim, A. 2011. Prevalence and related risk factors of essential hypertension in Jazan region, Saudi Arabia Saudi. *Sudanese Journal of Public Health*, 6(2): 45-51.

Ikeda, H., T. Inoue, S. Uemura, R. Kaibara, H. Tanaka and K. Node 2006. Effects of candesartan for middle-aged and elderly women with hypertension and menopausal-like symptoms. *Hypertension Research*, 29(12):1007-12.Doi: https://doi.org/10.1291/hypres.29.1007

Jackson, C.A., T. Pathirana and P. A. Gardiner 2016. Depression, anxiety and risk of hypertension in mid-aged women: A prospective longitudinal study. *Journal of Hypertension,* 34(10):1959-66.Doi: https://doi.org/10.1097/hjh.0000000000001030

Kagitani, H., Y. Asou, N. Ishihara, S. Hoshide and K. Kario 2014. Hot flashes and blood pressure in middle-aged Japanese women. *American Journal of Hypertension,* 27(4):503-7.Doi: https://doi.org/10.1093/ajh/hpt125

Kaur, M. 2014. Association between ABO blood group and hypertension among post-menopausal females of North India. *The Anthropologist,* 17(2):677-80.Doi: https://doi.org/10.1080/09720073.2014.11891477

Kaur, M., I. Talwar, J. Kaur and P. Kamal 2014. Blood pressure and its association with body mass index among pre and postmenopausal women of Kalpa valley, district Kinnaur (Himachal Pradesh).*Indian Journal of Physical Anthropology and Human Genetics,*33 (1):83-89.

Kearney, P. M., M. Whelton, K. Reynolds, P. K. Whelton and J. He 2004. Worldwide prevalence of hypertension: A systematic review. *Journal of Hypertension*, 22(1):11-

19. Doi:http://dx.doi.org/10.1097/01.hjh.0000098149.7095679

Kearney, P. M., M. Whelton, K. Reynolds, P. Muntner, P. K. Whelton and J He 2005. Global burden of hypertension: Analysis of worldwide data. *Lancet,* 365(9455):217-23. Doi: https://doi.org/10.1016/s0140-6736(05)17741-1

Leal, M., J. Díaz, E. Serrano, J. Abellán and L. F. Crbonell 2000. Hormone replacement therapy for oxidative stress in postmenopausal women with hot flushes. *Obstetrics and Gynecology,* 95(6):804-9.Doi: https://doi.org/10.1016/s0029-7844(00)00822-x

Lee, K. 2015. Metabolic syndrome and osteoporosis in relation to muscle mass. *Calcified Tissue International,* (5):487-94.Doi: https://doi.org/10.1007/s00223-015-0033-2

Lima, R., M. Wofford and J. F. Reckelhoff 2012. Hypertension in postmenopausal women. *Current Hypertension Reports,*14 (3): 254-60. Doi: https://doi.org/10.1007/s11906-012-0260-0

Machado, V. D., A. L. Valadares, L. Costa-Paiva, S. S. Morais and A. M. Pinto-Neto 2012. Morbidity and associated factors in climaeteric women: A population based study in women with 11 or more years of formal education. *Revista Brasileira de Ginecologia e Obstetrícia,* 34:215-20.

Mackenbach, J. P., V. Bos, O. Andersen, M. Cardano, G. Costa, S. Harding, A. Reid, O.Hemström, T. Valkonen and A.E. Kunst 2003. Widening socioeconomic inequalities in mortality in six Western European countries. *International Journal of Epidemiology,* 32(5):830-7. Doi: https://doi.org/10.1093/ije/dyg209

Malhotra, P., S. Kumari, R. Kumar, S. Jain and B.K. Sharma 1999. Prevalence and determinants of hypertension in an un-industrialised rural population of North India. *Journal of Human Hypertension,* 13(7):467-72.Doi: https://doi.org/10.1038/sj.jhh.1000864

Muka, T., C. Oliver-Williams, V. Colpani, S. Kunutsor, S. Chowdhury, R. Chowdhury, M. Kavousi, and O. H. Franco 2016. Association of vasomotor and other menopausal symptoms with risk of cardiovascular disease: A systematic review and meta-analysis. *PloS One.* 11(6):e0157417.Doi: https://dx.doi.org/10.1371%2Fjournal.pone.0157417

Nascimento, E. R., A. C. Maia, A. E. Nardi and A. C. Silva 2015. Sexual dysfunction in arterial hypertension women: The role of depression and anxiety. *Journal of Affective Disorder,* 181:96-100.Doi: https://doi.org/10.1016/j.jad.2015.03.050

Nwankwo, T., S. S. Yoon and V. L. Burt 2013. Hypertension among adults in the United States: national health and nutrition examination survey, 2011-2012. US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics.

Olatunbosun, S. T., J. S. Kaufman, R. S. Cooper and A. F. Bella 2000. Hypertension in a black population: prevalence and biosocial determinants of high blood pressure in a group of urban Nigerians. *Journal of Human Hypertension,* 14(4):249-57.Doi: https://doi.org/10.1038/sj.jhh.1000975

Oparil, S. and C. Arthur 1999. Corcoran memorial lecture. Hormones and vasoprotection. *Hypertension,* 33:170-6.Doi: https://doi.org/10.1161/01.hyp.33.1.170

Pan, Y., W. Cai, Q. Cheng, W. Dong, T. An and J. Yan 2015. Association between anxiety and hypertension: A systematic review and meta-analysis of epidemiological studies. *Neuropsychiatric Disease and Treatment,* 11:1121. Doi: https://dx.doi.org/10.2147%2FNDT.S77710

Pinto, E. 2007. Blood pressure and ageing. *Postgraduate Medical Journal,* 83(976):109-14.Doi: https://doi.org/10.1136/pgmj.2006.048371

Popovic, M. R. and I. Tasic 2009. Association between hypertension and osteoporosis in postmenopausal women. *Acta Medica Medianae*, 48 (2):8-13.

Raikkonen, K., K. A. Matthews and L. H. Kuller 2001. Trajectory of psychological risk and incident hypertension in middle-aged women. *Hypertens*ion, 38(4):798-802.PMID: 11641289

Rockwood, M. R., S. E. Howlett and K. Rockwood 2012. Orthostatic hypotension (OH) and mortality in relation to age, blood pressure and frailty.*Archieves of Gerontology Geriatrics,* 54(3):e255-60.Doi: https://doi.org/10.1016/j.archger.2011.12.009

Skrzypczak, M. and A. Szwed 2005. Assessment of the body mass index and selected physiological parameters in pre-and post-menopausal women. *Homo,* 56(2):141-52.Doi: https://doi.org/10.1016/j.jchb.2005.05.002

Staessen, J. A., J. G. Wang and L. Thijs 2001. Cardiovascular protection and blood pressure reduction: A meta-analysis. *Lancet*, 358(9290):1305-15.

Staessen, J., C. J. Bulpitt, R. Fagard, P. Lijnen and A. Amery 1989. The influence of menopause on blood pressure. *Journal of Human Hypertension*, (6):427-33. PMID: 2607517

Stevens, J., L. E. Chambless, H. A. Tyroler, W. Rosamond, F. J. Nieto, P. Schreiner, D. W. Jones and D. Arnett 2002. Associations between weight gain and incident hypertension in a bi-ethnic cohort: The atherosclerosis risk in communities study. *International Journal of Obesity,* 26(1):58-64.Doi: http://dx.doi.org/10.1038/sj.ijo.0801846

Tandon, V. R., A. Mahajan, S. Sharma and A. Sharma 2010. Prevalence of cardiovascular risk factors in postmenopausal women: A rural study.*Journal of Midlife Health*, 1(1):26.Doi: https://dx.doi.org/10.4103%2F0976-7800.66993

Tsuda, K., I. Nishio and Y. Masuyama 2001. Bone mineral density in women with essential hypertension. *American Journal of Hypertension,* 14(7):704-707.Doi: https://doi.org/10.1016/s0895-7061(01)01303-6

Tyagi, R., M. Dhall and S. Kapoor 2015. Bio-social predictors of hypertension among premenopausal and postmenopausal women. *SAGE Open*, 3:5(1). Doi:https://doi.org/10.1177%2F2158244015574227

Unni, J. 2010. Third consensus meeting of Indian menopause society (2008): A summary. *Journal of Midlife Health*, 1(1):43.Doi: https://dx.doi.org/10.4103%2F0976-7800.66987

Valadares, A. L., A. M. Pinto-Neto, M. J. Osis, D. M. Conde, M. H. Sousa and L. Costa-Paiva 2008. Sexuality in Brazilian women aged 40 to 65 years with 11 years or more of formal education: Associated factors. *Menopause,* 15(2):264-69.https://doi.org/10.1097/gme.0b013e31813c687d

Varenna, M., M. Manara, L. Galli, L. Binelli, F. Zucchi and L. Sinigaglia 2013. The association between osteoporosis and hypertension: the role of a low dairy intake. *Calcified Tissue International,* 93(1):86-92.Doi: https://doi.org/10.1007/s00223-013-9731-9

Wassertheil-Smoller, S., S. Shumaker, J. Ockene, G. A. Talavera, P. Greenland, B. Cochrane, J. Robbins, A. Aragaki and J. Dunbar-Jacob 2004. Depression and cardiovascular sequelae in postmenopausal women: The Women's Health Initiative (WHI). *Archives of International Medical,* 164(3):289-98. Doi:https://doi.org/10.1001/archinte.164.3.289

Weiner, J. S. and J. A. Lourie 1981. *Practical Human Biology.* Academic Press.

World Health Organisation 1996. Research on the menopause in the 90s. Technical Report Series 866.World Health Organization, Geneva; Switzerland. Doi: https://apps.who.int/iris/handle/10665/41841

World Health Organization 2008. The world health report 2008: Primary health care now more than ever.

Yazici, S., M. Yazici, U. Korkmaz, M. E. Erkan, A. E. Baki, I. Erden, H. Ozhan and S. Ataoglu 2011. Relationship between blood pressure levels and bone mineral density in postmenopausal Turkish women. *Archives of Medical Science,* 7(2):264.Doi: https://doi.org/10.5114/aoms.2011.22077

Yusuf, S., S. Hawken, S. Ounpuu, T. Dans, A. Avezum, F. Lanas, M. McQueen, A. Budaj, P. Pais, J. Varigos and L. Lisheng 2004. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): Case-control study. *Lancet*, 364(9438):937-52.Doi: https://doi.org/10.1016/s0140-6736(04)17018-9

Zambrana, R. E., L. López, G. Y. Dinwiddie, R. M. Ray, C. B. Eaton, L. S. Phillips and S. Wassertheil-Smoller 2016. Association of baseline depressive symptoms with prevalent and incident pre-hypertension and hypertension in postmenopausal Hispanic women: Results from the Women's health initiative. *PloS One,* 11(4):e0152765.Doi: https://doi.org/10.1371/journal.pone.0152765

Zanchetti, A., R. Facchetti, G. C. Cesana, M. G. Modena, A. Pirrelli and R. Sega 2005. Menopause-related blood pressure increase and its relationship to age and body mass index: The SIMONA epidemiological study. *Journal of Hypertension*, 23(12):2269-76.Doi: https://doi.org/10.1097/01.hjh.0000194118.35098.43

Zilberman, J. M., G. H. Cerezo, M. Del Sueldo, C. Fernandez Pérez, N. Martell Claros and A. Vicario 2015. Association between hypertension, menopause, and cognition in women.*The Journal of Clinical Hypertension*, 17(12):970-76.Doi: https://doi.org/10.1111/jch.12643