ORIGINAL RESEARCH PAPER

Anthropology

ASSOCIATION BETWEEN MENOPAUSAL STATUS AND CENTRAL ADIPOSITY AMONG THE TWO CASTE GROUPS OF CHANDIGARH POPULATION, INDIA

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ABSTRACT

Introduction: The transition from premenopause to post menopause status has been associated with changes in body composition. Mostly, there is an increase in central adiposity, particularly in visceral fat, but the findings are not consistent for weight gain. There are relatively few data on changes in adiposity and fat distribution associated with menopause in women. This is an important issue because of the relationships that have been noted between obesity and cardiovascular diseases and obesity and certain cancers in postmenopausal women.

Material and Methods: The data consists of a cross-sectional sample of 615 women ranging in age between 40-60 years. The sample was selected through snow ball sampling technique.

Results: The mean age at menopause is found to be 47.48 ± 3.19 years among Brahmin women and 47.94 ± 3.22 years among Khatri women. The menopause status among Brahmin women on central adiposity is independent of BMI, another multivariate logistic regression analysis has been performed which shows the magnitude of association between postmenopause and abdominal adiposity became greater for waist-hip ratio (p<0.001), and for waist circumference it is p<0.05. There was no association between the perimenopausal status and abdominal adiposity for waist-hip ratio while statistically significant difference (p<0.05) for waist circumference in >88 cm cut-off was observed after the adjustment of BMI. Multivariate regression analysis among Khatri women shows that postmenopausal women are 197 times more likely than premenopausal women to have waist-hip ratio greater than 0.85. On the other hand, no positive association is detected for different cut-offs for waist circumference. Perimenopausal women are only 5.3 times more likely to have a waist circumference of >88 cm as compared to premenopausal women; whereas no association was seen for waist-hip ratio. The magnitude of the association between postmenopausal status and abdominal adiposity became slightly less after the adjustment of BMI though still showing statistically significant difference.

Discussion: In this study, both Brahmin and Khatri women, the anthropometric assessment showed that compared with postmenopausal women, premenopausal women are taller and had a thinner waist and lower waist-hip ratio. Postmenopausal women had five times the chance of having central adiposity than premenopausal women, even after controlling for BMI and other confounding factors. Other studies conducted in Sweden and Australia also reported similar findings.

INTRODUCTION

Menopause is characterized endocrinologically by evidence of decreasing ovarian activity, biologically by decreasing fertility and clinically by alteration in menstrual cycle intervals (World Organization, 1981). In fact menopause is the final stage of what may be gradual process that can take many months or years before the actual cessation of menstruation.

The transition from premenopause to post menopause status has been associated with changes in body composition. Mostly, there is an increase in central adiposity, particularly in visceral fat, but the findings are not consistent for weight gain (Ley, Lees, & Stevenson, 1992; Tremollieres, Pouilles, & Ribot, 1996). It is still unclear whether the central deposition of fat and weight gain are continuous processes from premeno pause to post menopause period, or if they occur at menopause transition or in early post menopause (Bjorkelund, Lissner, Andersson, Lapidus, & Bengtsson, 1996; Toth, Tchernof, Sites, & Poehlman, 2000a). There are relatively few data on changes in adiposity and fat distribution associated with menopause in women. This is an important issue because of the relationships that have been noted between obesity and cardiovascular diseases (J. Manson et al., 1995), and obesity and certain cancers (Austin, Austin, Partridge, Hatch, & Shingleton, 1991; Colditz, 1993) in postmenopausal women.

Numerous studies carried out in diverse populations have demonstrated a relationship between body weight and /or Body mass index (BMI) and age at natural menopause. Most of these studies indicate that thinner and shorter women report a slightly earlier age at menopause as compared with heavier and taller women(Brand & Lehert, 1978; MacMahon & Worcester, 1966; J. E. Manson et al., 1995; Neri, Bider, Lidor, & Ovadia, 1982; Sherman, Wallace, Bean, Chang, & Schlabaugh, 1981). When an age at menopause is shown to have a positive correlation with body weight/ BMI, it is said that menopause

occurred later in heavier women because of increased conversion of an adrenal androgen to estrone in adipose tissue (Mole, Rae, & Paterson, 1989)(Poortman, Thijjsen, & Waard, 1981). There is a tendency to put on weight after menopause which is predisposing factor for several other chronic diseases like Cardiovascular diseases (CVD), Hypertension, etc. Seventy percent women of age 45-54 years are overweight or obese. Before the age of 50, majority of women tend to increase their weight slowly, whereas after menopause there appears to be an accelerated increase in fat mass and a change in preferential fat storage to a central part of body that is abdominal locations (DJ., 1998).

As noted above, body weight reaches its maximum in women very near the time of menopause, and there is an increase in relative adiposity for any given weight or BMI. While some studies find that the increase in weight accompanying menopause is more related to age than menopause itself. (Wang Q, Hassager C, Ravn P, Wang S, 1994; Wing RR, Mathews KA, Kuller LH, Meilahn EN, 1991), others have noted specific menopause-related increase in BMI, overall adiposity and intra-abdominal adiposity (Espeland et al., 1997; Ley et al., 1992)

MATERIAL AND METHODS

Sampling: The sample was selected through snow ball sampling technique, in which first contacts were made with two or three Punjabi Brahmin and Kharti women falling in selected age range. Only those Punjabi Brahmin women were considered whose parents and grandparents as well as husband's parents and grandparents were Punjabi Brahmin, and similar criterion was followed for Punjabi Khatri women. Field work was conducted from May 2006 to December 2007. Care was taken to include only apparently healthy individuals; those suffering from any chronic disease or physical deformity were excluded from the study. The decimal age (in years) of each individual was calculated as

the difference between date of investigation and date of birth, using Decimal Age Calendar (JM., 1962). The data consists of a cross-sectional sample of 615 women ranging in age between 40-60 years.

Table 1: Distribution of total sample

Menopausal Status/categories	Brahmin		Khatri	
	N	(%)	N	(%)
Premenopause	65	21.24	66	21.35
Perimenopause	65	21.24	65	21.03
Postmenopause	176	57.52	178	57.60
Natural	160	52.29	160	51.78
Surgical	16	5.23	18	5.82
Total Sample	306	49.76	309	50.24

Data collection involved personal interview based on structured schedule, anthropometric measurements and physiological parameters. The structured schedule includes information on personal details of the subject, economic background, reproductive parameters, menopausal status, lifestyle characteristics, health history, dietary habits and physical activity. The anthropometric measurements include height, weight, body fat percentage, upper arm circumference, waist circumference, hip circumference, calf circumference. The derived anthropometric indices are body mass index (BMI) and waist-hip ratio (WHR). For recording various measurements and to collect other information regarding menopause, each subject was contacted individually at her residence or at her place of work and was interviewed. Each subject was asked to report whether her menopause has occurred or not. Beside this women were also requested to provide other information regarding menopause, and various other parameters as per the schedule.

Anthropometric Measurements:
All anthropometric measurements were taken on each subject following the standard techniques as recommended by (Weiner JS, 1981). All the instruments were checked for zero error before each measurement and procedure for taking measurements was practiced before hand to reduce personal error. The following measurements and instrument were used, Height, Weight, BMI, Waist circumference, Hip Circumference, waist-hip ratio. The following classification for BMI, WHR, Waist Circumference has been used according to the standards of (Bray GA, 1988; Organization., 2000).

Menopausal Status:
In determining the age of menopause the *status quo* as well as the retrospective methods was used. The *status quo* method was used to know whether menopause had occurred or not. This leads to a record of the percentage of affirmative answer at each successive age. To this percentage distribution, a probit or logit transformation is applied. This method is used for estimating the median and variance for the population (Fisher RA, 1964). The retrospective or recall method was used to calculate the mean age of menopause. In case menopause had occurred, then the subject was asked to recall the precise date of its occurrence. If the subject could not recall the precise date, then she was led to recall the approximate month or her age at the time of cessation of periods. After obtaining the age at last menstruation the age at menopause was derived as per (Organization, 1996) definition; which happens to be 12 months after the last menstrual period. In the present sample, almost all women could remember the precise date of the last menstrual period; a few women who could not recall the exact date were able to remember the month, and for these women the middle of month (15th) was taken as the date for calculating the age at menopause. The multivariate statistics include, Kaplan-Meier cumulative survivorship estimates, Cox proportional hazards regression, Linear/multiple regression, and multivariate

logistic regression. Significance of various tests were seen at P value of 0.05 and 0.01.

Obesity is defined by Body Mass Index (BMI), whereas, central adiposity is defined by waist circumference and waist-hip ratio. In this part of the result, the association between menopause status and central adiposity is measured using three different cut-offs of waist circumference (<79cm, 80-87 cm and >88cm) and waist-hip ratio (<0.80, 0.81-0.85, >0.85) as recommended by WHO (2000). In addition to this, the risk of central adiposity by menopausal status are studied, while controlling for BMI and other confounding factors. The sample of 290 Brahmin women and 291 Khatri women were studied separately excluding the hysterectomy cases from both the caste groups. Menopausal status was divided into premenopausal, perimenopausal and posmenopausal groups. Linear regression was used to analyze the association between BMI and waist circumference / waist-hip ratio and the coefficient of determination (R square) was calculated for each category of menopausal status. The associations between menopause status and adiposity were tested through multivariate logistic regression, and odd ratios and 95% confidence intervals (CI) were calculated after adjustment for decimal age, education, employment, occupation, parity (confounding factors) and BMI. The results are presented separately for Brahmin and Khatri women as follows.

OBJECTIVES
To study the association between the menopausal status and the central adiposity among the Punjabi Brahmin and Punjabi Khatri women of Chandigarh

RESULTS
Out of total sample of 615 women, 160 Brahmin and 160 Khatri women (excluding the hysterectomy and oophorectomy cases, i.e. 16 Brahmin and 18 Khatri women) had experienced menopause, at the time of investigation. The mean age at menopause is found to be 47.48 ± 3.19 years among Brahmin women and 47.94 ± 3.22 years among Khatri women. Student's t-test shows statistically insignificant difference in the mean age at menopause in the two samples.

Table 2: Mean age at menopause in Brahmin and Khatri women

	N	Mean ± S.D	Minimum	Maximum	t-value
Brahmin	160	47.48 ± 3.19	37.48	54.55	- 1.26
Khatri	160	47.94 ± 3.22	38.01	54.59	

Anthropometric Characteristics
The Punjabi Brahmin and Khatri women have been studied for a total 6 of anthropometric measurements. The averages of each of these measurements in the two caste groups as well as their comparisons are presented as follows. The mean age of women in both the samples of the present study is about 50 years.

Height: The average height of Punjabi Brahmin and Punjabi Khatri women is almost similar, i.e., 155.25 cms and 155.58 cms, respectively.

Weight: Mean values for weight among the two caste groups show statistically significant difference, with Khatri women having greater weight as compared to Brahmin women.

Body mass index (BMI): BMI also shows statistically significant differences between the two caste groups.

Circumferences: Except for calf circumference, all other circumference, i.e., upper arm, waist and hip, and the sum of the four circumferences show statistically significant differences in the two groups of women, with Khatri women having higher mean values.

Waist-hip ratio (WHR): Both, Punjabi Khatri and Brahmin women reveal almost similar mean values for waist-hip ratios, i.e., 0.832 and 0.828, respectively.

Table 3: Anthropometric characteristics of Punjabi women

Variables	Brahmin (N=306) Mean ± S.D	Khatri (N=309) Mean ± S.D	t- value
Age	49.95 ± 4.93	50.13 ± 4.98	- 0.470
Height (cms)	155.25 ± 5.41	155.58 ± 4.92	- 0.780
Weight (Kgs)	68.32± 10.23	70.73± 10.64	- 2.864**
Body Mass Index (BMI)	28.36± 4.01	29.35± 4.44	- 2.898**
Sum of circumferences (cms)	250.12 ± 21.58	256.67 ± 23.21	- 3.623**
Upper arm	30.54 ± 3.57	31.14 ± 3.60	- 2.050*
Calf	36.54 ± 3.48	36.97 ± 3.64	-1.527
Waist	83.14 ± 9.28	86.06 ± 9.12	- 3.930**
Hip	100.59 ± 8.30	103.56 ± 8.78	- 4.306**
Waist-hip ratio (WHR)	0.828± 0.06	0.832 ± 0.06	- 0.832

* Significant at 5 % level, ** Significant at 1% level

Brahmin women
The anthropometric assessment (Table 4) results show that when compared with premenopausal and perimenopausal women, postmenopausal women possess of higher waist circumference and waist-hip ratio. Among premenopausal women, 29.2% are obese (BMI >30.0) in comparison to 43.1% in perimenopausal and 30.6% in postmenopausal women. The results of linear regression models to evaluate association between BMI and waist circumference/ waist-hip ratio for each category of menopause status are shown in Table 5. Regarding the results of these models both waist circumference and waist-hip ratio are positively related to BMI. The determination of coefficient (R-square) for premenopausal is 0.78, perimenopausal is 0.52 and postmenopausal is 0.68. According to these results 78%, 52% and 68% of premenopausal, perimenopausal and

postmenopausal women, respectively, could be explained by waist circumference and waist-hip ratio.

The results of multivariate logistic regression analyses are summarized in Table 6. There is a strong association between menopausal status and abdominal adiposity, even while considering confounding factors (decimal age, education, employment, occupation, parity). Postmenopausal women are 43.8 times more likely than premenopausal and perimenopausal women to have a waist circumference of >88cm. The same positive association is detected for different cut-offs of waist-hip ratio, and the CI for WHR (>0.85) is 8.423 – 120.845 i.e., 31.905 times more than premenopausal women.

To assess whether the effect of menopause status on central adiposity is independent of BMI, another multivariate logistic regression analysis has been performed (Table 7). The magnitude of association between postmenopause and abdominal adiposity became greater for waist-hip ratio (p<0.001), and for waist circumference it is p<0.05. There was no association between the perimenopausal status and abdominal adiposity for waist-hip ratio while statistically significant difference (p<0.05) for waist circumference in >88 cm cut-off was observed after the adjustment of BMI. On the whole, postmenopausal Brahmin women had a significantly greater waist circumference and waist-hip ratio than premenopausal women independent of decimal age, education, employment, occupation, parity. Moreover, the additional control for the effect of BMI increased the risk of central obesity in postmenopausal Brahmin women.

Table 4: Distribution of anthropometric characteristics of adiposity by menopausal status in Brahmin women

Characteristics	Premenopausal (N= 65)	Perimenopausal (N= 65)	Postmenopausal (N=160)
Waist Circumference	76.66 ± 7.32	80.09 ± 8.03	87.06 ± 8.67
< 79 cm	55.8%	47.7%	21.2%
80-87M	43.1%	35.4%	28.8%
> 88 cm	3.1%	16.9%	50.0%
Waist-hip ratio	0.778 ± 0.04	0.793 ± 0.04	0.864 ± 0.04
< 0.80	76.9%	55.4%	9.4%
0.81-0.85	15.4%	38.5%	25.0%
> 0.85	7.7%	6.1%	65.6%
BMI	27.34 ± 4.08	28.63 ± 3.75	28.61 ± 4.14
< 24.9	26.2%	73.8%	16.2%
25.0-29.9	44.6%	43.1%	53.2%
> 30.0	29.2%	43.1%	30.6%

Table 5: Linear regression models representing the association between BMI and waist circumference/ waist-hip ratio in Brahmin women

Status		Unstandarized coefficients B	t-value	95% Confidence interval for B		P value
Premenopause	Waist Circumference	0.535	15.154	0.464	0.605	p< 0.001
	Waist-hip ratio	- 27.865	- 5.291	- 38.93	17.337	p< 0.001
Perimenopause	Waist Circumference	0.362	8.282	0.274	0.449	p< 0.001
	Waist-hip ratio	18.872	- 2.335	- 35.018	- 2.726	p< 0.05
Postmenopause	Waist Circumference	0.028	16.870	0.414	0.524	p< 0.001
	Waist-hip ratio	- 30.239	- 5.312	- 41.485	18.993	p< 0.001

Table 6: Multivariate logistic regression to analyze association between menopausal status and anthropo metric measurements of adiposity[a] in Brahmin women

Characteristics	Premenopause	Perimenopause		Postmenopause	
		Exp (B)	95% CI	Exp (B)	95% CI
Waist Circumference					
< 79 cm	1.00	1.00		1.00	
80-87 cm	1.00	0.694	(0.248 – 1.940)	1.539	(0.480 – 4.935)
> 88 cm	1.00	5.243	(0.726 – 37.870)	**67.893**	**(7.004 - 658.151) ****
Waist- hip ratio					
< 0.80	1.00	1.00		1.00	
0.81-0.85	1.00	2.152	(0.830 – 5.577)	**10.911**	**(3.547 – 33.564) ****

> 0.85	1.00	0.808	(0.195 – 3.337)	31.905	(8.423 – 120.845) **
BMI					
< 24.9	1.00	1.00		1.00	
25.0-29.9	1.00	1.570	(0.566 – 4.353)	0.492	(0.158 – 1.532)
> 30.0	1.00	2.034	(0.548 – 7.548)	0.077	(0.013 – 0.470) **

** Significant at 1% level

[a] **Odd ratios (95% CI) adjusted for age, education, employment, occupation and parity**

Table 7: Multivariate logistic regression to analyze association between menopausal status and indicators of central adiposity after adjustment for BMI [a] in Brahmin women

Characteristics	Premenopause	Perimenopause Exp (B) 95% CI		Postmenopause Exp (B) 95% CI	
Waist circumference					
< 79 cm	1.00	1.00		1.00	
80-87 cm	1.00	0.895	(0.375 – 2.134)	0.743	(0.275 – 2.002)
> 88 cm	1.00	8.060	(1.500 – 43.296) *	8.985	(1.692 – 47.703)*
Waist- hip ratio					
< 0.80	1.00	1.00		1.00	
0.81-0.85	1.00	1.976	(0.782 – 4.993)	12.719	(4.347 – 37.216)**
> 0.85	1.00	0.723	(0.184 – 2.844)	48.337	(13.410 – 174.231)**

* Si* Significant at 5% level, ** Significant at 1% level

[a] Odd ratios (95% CI) adjusted for age, education, employment, occupation, parity and BMI

Khatri women

The anthropometric assessment for Khatri women is shown in Table 8. As observed for Brahmin, here also postmenopausal women shown higher waist circumference and waist-hip ratio than those of premenopausal and perimenopausal women. Among premenopausal women, 34.8% are obese (BMI > 30) in comparison to 40% in perimenopausal and 41.2% among the postmenopausal women. The linear regression results (Table 9) reveal that waist circumference and waist-hip ratio are highly related to BMI in all the three menopausal categories. The determination of coefficient is 0.73, 0.80 and 0.69 for premenopausal, perimenopausal and postmenopausal women, respectively. According to these results, 73% premenopausal, 80% perimenopausal and 69% postmenopausal women could be explained by waist circumference and waist-hip ratio.

Multivariate regression analysis (Table 10) shows that postmenopausal women are 197 times more likely than premenopausal women to have waist-hip ratio greater than 0.85. On the other hand, no positive association is detected for different cut-offs for waist circumference. Perimenopausal women are only 5.3 times more likely to have a waist circumference of >88 cm as compared to premenopausal women; whereas no association was seen for waist-hip ratio. The magnitude of the association between postmenopausal status and abdominal adiposity became slightly less after the adjustment of BMI (Table 11) though still showing statistically significant difference. On the whole, postmenopausal Khatri women show significantly greater waist-hip ratio than their premenopausal and perimenopausal counterparts.

Table 8: Distribution of anthropometric characteristics of adiposity by menopausal status in Khatri women

Characteristics	Premenopausal (N= 66)	Perimenopausal (N= 65)	Postmenopausal (N=160)
Waist Circumference	80.35 ± 7.54	84.28 ± 9.88	89.51 ± 7.93
< 79 cm	54.5%	38.5%	12.5%
80-87 m	30.3%	24.6%	21.3%
> 88 cm	15.2%	36.9%	66.2%
Waist-hip ratio	0.780 ± 0.05	0.803 ± 0.05	0.870 ± 0.03
< 0.80	62.1%	53.8%	2.5%
0.81-0.85	31.8%	32.3%	38.7%
> 0.85	6.1%	13.8%	58.7%
BMI	28.65 ± 3.90	29.63 ± 5.72	29.48 ± 4.10
< 24.9	19.7%	18.5%	11.9%
25.0-29.9	45.4%	41.5%	46.9%
> 30.0	34.8%	40.0%	41.2%

Table 9: Linear regression models representing the association between BMI and waist circumference/ waist-hip ratio in Khatri women

Status		Unstandardized coefficients B	t- value	95% Confidence interval for B		p- value
Premenopause	Waist Circumference	0.479	13.113	0.406 –	0.552	p< 0.001
	Waist-hip ratio	- 42.949	- 7.760	-54.009 –	- 31.899	p< 0.001
Perimenopause	Waist Circumference	0.617	15.488	0.537 –	- 0.696	p< 0.001
	Waist-hip ratio	- 44.778	-5.418	- 61.304 –	- 28.273	p< 0.001
Postmenopause	Waist Circumference	0.446	18.505	0.416 –	0.516	p< 0.001
	Waist-hip ratio	- 6.131	-6.131	56.461 –	- 28.943	p< 0.001

Table 10: Multivariate logistic regression to analyze association between menopausal status and anthropom etric measurements of adiposity[a] in Khatri women

Characteristics	Premenopause	Perimenopause Exp (B) 95% CI		Postmenopause Exp (B) 95% CI	
Waist Circumference					

< 79 cm	1.00	1.00		1.00	
80-87 cm	1.00	1.606	(0.509 – 5.067)	1.068	(0.298 - 3.827)
> 88 cm	1.00	**5.361**	**(1.186 – 24.243)***	2.200	(0.430 – 11.262)
Waist- hip ratio					
< 0.80	1.00	1.00		1.00	
0.81-0.85	1.00	1.311	(0.547 – 3.145)	**16.229**	**(4.640 – 56.760)****
> 0.85	1.00	1.264	(0.271 – 5.891)	**197.846**	**(36.873 – 1061.551)****
BMI					
< 24.9	1.00	1.00		1.00	
25.0-29.9	1.00	0.734	(0.237 – 2.266)	1.105	(0.282 – 4.330)
> 30.0	1.00	0.408	(0.088 – 1.895)	1.438	(0.245 – 8.425)

* Significant at 5% level, ** Significant at 1% level

[a] Odd ratios (95% CI) adjusted for age, education, employment, occupation and parity

Table 11: Multivariate logistic regression to analyze association between menopausal status and indicators of central adiposity after adjustment for BMI in Khatri women

Characteristics	Premenopause	Perimenopause Exp (B)	95% CI	Postmenopause Exp (B)	95% CI
Waist circumference					
< 79 cm	1.00	1.00		1.00	
80-87 cm	1.00	1.072	(0.422 – 2.728)	1.226	(0.339 – 3.765)
> 88 cm	1.00	**2.772**	**(1.018 – 7.548) ***	2.992	(0.950 – 8.980)
Waist- hip ratio					
< 0.80	1.00	1.00		1.00	
0.81-0.85	1.00	1.445	(0.614 – 3.401)	**15.870**	**(4.614 – 54.584)****
> 0.85	1.00	1.860	(0.462 – 7.481)	**173.032**	**(37.333 – 801.965)****

* Significant at 5% level, ** Significant at 1% level

[a] Odd ratios (95% CI) adjusted for age, education, employment, occupation, parity and BMI

DISCUSSION

The transition from premenopausal to postmenopausal status has known to be associated with changes in body composition (Bjorkelund et al., 1996; Douchi et al., 1998; Guthrie, Dennerstein, & Dudley, 1999; Ley et al., 1992; Toth, Tchernof, Sites, & Poehlman, 2000b). Mostly there is an increase in central adiposity, particularly visceral fat (Toth et al., 2000b; Turcato et al., 1997) but the findings are not found to be consistent for weight gain (Sternfeld et al., 2004; Tremollieres et al., 1996). The results on Punjabi Barhmin and Khatri women of the present study have shown that, upper arm circumference, waist circumference, sum of all four circumferences, sum of all four skinfolds and waist-hip ratio are significantly different in premenopausal, perimenopausal and postmenopausal women. Korean women (Cho GJ, Lee JH, Park HT, Shin JH, Hong CH, Kim T, Hur YJ, Lee KW, Park YK, 2000) also show significant increase in BMI, weight, waist circumference from pre- to post- menopausal women. The studies on American (Sonnenschein, Kim, Pasternack, & Toniolo, 1993) and Dutch women (Den Tonkelaar I, Seidell JC, 1990) observed that waist circumference and waist-hip ratio of middle age women are influenced by menopausal status. However, a study on Italian women(Zamboni M, Armellini F, Miliani MP, Dc. Marachi M, Todexo T, Bergano R, Andreis IA, 1992) did not find significant differences between menopausal categories for weight, height, BMI and waist-hip ratio. In present study, body weight does not show any significant increase from premenopausal to postmenopausal categories. Weight gain, particularly after the menopausal transitions, is thought to be a common occurrence (Wing RR, Mathews KA, Kuller LH, Meilahn EN, 1991), however; few studies have simultaneously considered both age and menopausal status in relation to weight gain (O, 1992; S, 1993).

Both Brahmin and Khatri women of present study describe an association between menopausal status and central adiposity for different cut-offs of waist circumference and waist-hip ratio for pre-, peri-, and post- menopausal women. Postmenopausal women have a significantly greater waist circumference and waist-hip ratio than pre- and peri-menopausal women, independent of age, education, employment, occupation, parity and BMI. Moreover, the

additional control for the effect of BMI increased the risk of central adiposity for postmenopausal women. The findings of the present study confirm the changes in central adiposity as described in a cross-sectional study on Southern Brazilian women (Donato, Fuchs, Oppermann, Bastos, & Spritzer, 2006). In this study, anthropometric assessment showed that compared with postmenopausal women, premenopausal women are taller and had a thinner waist and lower waist-hip ratio. Postmenopausal women had five times the chance of having central adiposity than premenopausal women, even after controlling for BMI and other confounding factors. Other studies conducted in Sweden and Australia also reported similar findings. Women from Sweden whose status changed from premenopausal to postmenopausal had a 5 cm increase in waist circumference and 0.06 units increase in waist-hip ratio (Bjorkelund et al., 1996), whereas, Australian women had an increase of 1.5 cm in waist circumference and 0.005 unit in waist hip ratio (Guthrie et al., 1999). Among American women, waist circumference tended to be greater in those whose status progressed from premenopausal to postmenopausal (Sternfeld et al., 2004). Waist circumference and the waist-hip ratio offer an estimate of intra-abdominal fat and both have been used as indicator for cardiovascular disease risk, diabetes, hypertension and other chronic disease risk (Krauss CM, Turksoy RN, 1987; Organization., 1995) respect to the analysis of abdominal obesity and parity, the literature shows the multiparous women have a larger value of waist circumference (Gunderson et al., 2004). (Lassek & Gaulin, 2008) determined that WC was 3.26 cm greater in multiparous compared with nulliparous women, and also found that parity was associated with a relative decrease in hip circumference and an increase in WC after adjustment for age and BMI.

CONCLUSIONS:

Both Brahmin and Khatri women show an association between menopausal status and central adiposity for different cut-offs of waist circumference and waist-hip ratio. Postmenopausal women have significantly greater waist circumference and waist-hip ratio than pre- and peri- menopausal women, independent of age, education, employment, occupation, parity and BMI. The findings of present study confirm the changes in central adiposity as described in studies on

Southern Brazilian, Swedish and Australian women. If central adiposity is associated with the menopause, it is important to consider that several different factors may be involved in increasing body weight, BMI during this phase of women's life. One limitation of the present study was the cross-sectional design of the study. Further analyses are needed to evaluate these points, ideally through longitudinal prospective studies.

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