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EFFECT OF ABDOMINAL OBESITY ON BONE MINERAL DENSITY IN PRE AND POST MENOPAUSAL DIABETIC WOMEN

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ABSTRACT
Diabetes and menopause pose a twin challenge. Women may gain weight during the transition stage of menopause which may poses a risk for osteoporosis. The investigation aimed to assess the effect of body mass index (BMI), waist circumference (WC), hip circumference (HC), waist hip ratio (WHR), waist height ratio (WHtR) and Glycosylated hemoglobin (HbA1C) on Bone Mineral Density (BMD) in diabetic pre and postmenopausal women. Type 2 diabetic women, 100 premenopausal, 111 postmenopausal were selected by purposive sampling from Diabetes Care n Research Center, Nagpur. Anthropometric measurements, HBA1c and BMD were assessed by standard methods.. Mean age was 46±5.64 and 60 ±6.30 respectively in pre and postmenopausal women. Significantly higher (p=0.0001) BMI of pre menopausal subjects (28.69 ±5.261) than post menopausal subjects (28.02 ±4.599) was observed. WHR was higher than the WHO criteria (<0.85) in more than 80% of the subjects. High percentage of both pre (94%) and postmenopausal subjects (95.5%) had a WHtR above 0.6. Insignificant difference (p=0.1230) in HbA1c between the two group of subjects (8.71 ±2.10 & 8.40 ±1.69 in pre and post menopausal subjects respectively) was observed. Low mean BMD T scores of pre (-1.43±0.94) and post menopausal subjects (-1.80 +-0.94) was suggestive of osteopenia. A higher value of WHR and WHtR is correlated with abdominal obesity. Pre menopausal diabetic subjects with abdominal obesity are therefore prone to changes in bone density and need to be cautioned to prevent entering menopausal stage with osteopenia a precursor to osteoporosis.

KEYWORDS: BMD, HbA1c, WHR, WHtR.

INTRODUCTION
The prevalence of abdominal obesity is increasing in western population due to combination of low physical activity and high energy diets and also in the developing countries associated with urbanization of population and menopausal transition for women.[1]

Menopause refers to a period in the life of women when there is a pause in the menses and a cessation of the monthly reproductive function. The **peri or pre menopause** refers to the decline of the function of the ovaries with menstrual irregularities. The **postmenopausal phase** results once there is no menses for twelve months.

Menopause is associated with changes in body composition, such as increased total body fat or abdominal fat and a decrease in lean body mass, which in turn are linked to impairments in glucose metabolism and insulin sensitivity.[2]

Diabetes and menopause pose a twin challenge to health care providers. They may result in varied effects on the body. After menopause changes in hormone levels estrogen and progesterone can trigger fluctuations in blood sugar levels. Women may gain weight during the transition stage of menopause and after menopause which can increase the need for insulin or diabetic medication.

Diabetic osteopenia is a recognized complication of diabetes mellitus which could be due to abnormal bone turnover or disturbances in the Calcium/Parathyroid hormone/Vitamin D axis or both. Genetic factor also play an important part in determining bone mass although this has not been studied.[3]

Menopause and a more sedentary lifestyle also pose a risk for osteoporosis. Low BMD is a major risk factor for osteoporosis and its related fractures. Menopause is therefore not without its share of physical challenges. However in women with diabetes these challenges can

be difficult to cope up with..Among a large number of disorders leading to osteoporosis, diabetes mellitus is of importance.

BMI is an important cause of differences in BMD values and prevalence of osteoporosis, in addition to heredity, Nutritional intake, dietary customs, height and lean mass. Low BMI is associated with decreased BMD, increased possibility of Osteoporosis and risk of fracture whereas overweight and obesity are believed to be a protective factor of BMD.[4]

Waist-to-hip ratio is widely used as indicator of abdominal obesity in population studies. It is increasingly clear that waist-to-hip ratio is a better reflection of the accumulation of intra-abdominal or visceral fat depot. Waist-to-hip ratio shows a graded and highly significant association with myocardial infarction worldwide. Redefinition of obesity based on waist-to-hip ratio instead of BMI increases the estimate of myocardial infarction attribution to obesity in most ethnic group.[5]

The prevalence of type 2 diabetes mellitus is rising globally especially in Asian Indians. Decreased BMD is an established complication of type 1 diabetes mellitus but contradictory results have been reported regarding T2DM patients.[6]

The rapid progress in diagnostic tools during the last decade has provided the opportunity to diagnose the disease before the fracture happens. As defined by the World Health Organization, osteoporosis is diagnosed based on the bone mineral density, with bone mineral densities more than -1 considered normal, densities from -1 to -2.5 considered osteopenic and amounts lower than -2.5 is defined as osteoporotic, which can also be expressed in T-score (WHO).

The present study was designed to investigate the effect of body mass index (BMI), waist circumference (WC), hip circumference (HC), waist hip ratio (WHR), waist height ratio (WHtR) and HbA1C on Bone Mineral Density (BMD) of diabetic pre and postmenopausal women.

MATERIALS AND METHODS

Present study was conducted at a renowned Diabetes Care and Research Centre (DCRC) in Nagpur, located in Central India **.**The study included 211 diabetic women, 100 premenopausal (Age-30 to 52years), 111 postmenopausal (Age-53 to 80 years) with type-2 diabetes, absence of complications of diabetes. Basic information was collected using questionnaire schedule with personal interview.

Height was measured in cms using Seca222 stadiometer, weight in kgs by Hyundai electronic weighing machine following standard postures.BMI was calculated using BMI = Wt in kgs/Ht in (m) 2. WC and HC were measured with a measuring tape. WC (cms) was measured midway between the lowest rib and the superior border of iliac crest and HC at the level of maximum posterior extension of the buttocks. The waist-hip (cms) was calculated as WC/HC and WHtR was calculated as WC/Ht.

Bone mineral density of all subjects was measured by Meyers BM Densitometer. The diagnosis of osteoporosis was done with the assistance of specialists. T- Score was calculated and results were compared to WHO criteria.

Results were tabulated and expressed as means, standard deviation and ranges for both the groups and compared statistically using" t" test of significance and one way Annova. Pearsons correlation test was applied between BMD and study parameters(Anthropometric & HbA1c).

RESULT AND DISCUSSION

Lifestyle of subjects.

Post menopause, women tend to put on weight due to hormonal changes in the body. Sedentary lifestyle may also be another factor. Exercise schedules maintained regularly will help to prevent overweight and obesity in this section of population. Exercise schedules were noted to focus on the lifestyle of the subjects.

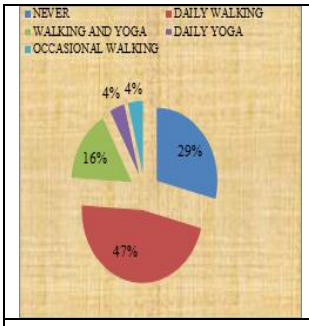

Fig- 1(a) Exercise schedule of Premenopausal Women

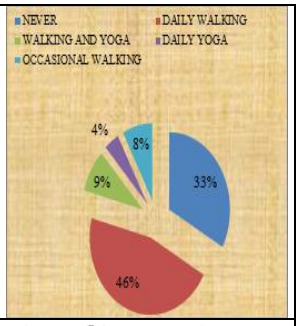

Fig- 1 (b) Exercise schedule of Postmenopausal Women

Figures 1(a) & (b) represent the exercise schedules followed by the subjects.

It is interesting to note that about 47% of pre and 46% of postmenopausal subjects follow a daily walking schedule. It is worthwhile to note that all the subjects being diabetic a daily exercise schedule may help in controlling the blood sugar levels besides weight management.

Occasional walking, yoga, walking and yoga were being followed by a lesser percentage of subjects in both the groups. It was also noted that more than 25% of the subjects in both the groups did not undertake any exercise schedule. Premenopausal subjects reflected a better exercise schedule as compared to their counterparts in the other group.

The mean base line characteristics of the study subjects is presented in table 1.

Table1: Mean baseline data of pre and post menopausal women.

Parameters		Premenopausal (n=100)	Postmenopausal (n=111)	P value
Age	M SD R	46.61 5.64 30-54	60.58 6.30 53-80	0.0001
Age of Menarche	M SD R	13.66 1.16 11-17	13.40 0.98 12-16	0.0995
Menopausal age	M SD R	NIL	48.55 4.37 35-59	------
Age of Onset of Diabetes	M SD R	40.49 7.06 22-52	50.29 8.22 30-72	0.0001
BMI	M SD R	28.69 5.261 18.9-49	28.02 4.599 13-45	0.0001
WC	M SD R	96.13 12.14 58-134	96.35 14.24 26-122	0.8957
HC	M SD R	104.5 11.45 60-140	104.1 12.67 33-128	0.8016
WHR	M SD R	0.92 11.45 0.11- 1.0	0.92 12.67 0.10- 1.90	------
WHtR	M SD R	0.62 0.08 0.35-0.85	0.63 0.10 0.17-0.78	-------
HbA1c	M SD R	8.71 2.10 5.1-18.4	8.40 1.69 5.7-13.60	0.1230
BMD	M SD R	-1.43 0.95 -3.2 to -0.9	-1.80 0.94 -3.4 to -0.50	0.014

Premenopausal group is compared with postmenopausal. Statistical analysis was done by students t-test followed by one-way ANOVA using Graph pad Prism V. 5.01., Where *** = P<0.001; ** = P<0.01; * = P< 0.05 and ns = not significant.

The total number of subjects under study was 211, with 100 premenopausal and 111 postmenopausal women. The mean age was 46±5.64 in premenopausal women and 60±6.30 in the postmenopausal women. The age range varied between 30 to 54 yrs in the former and 53 to 72 yrs in the latter.The mean age of menarche was almost similar in both the subjects (13.66 ±1.16 & 13.40 ±0.98 in pre and post menopausal subjects respectively). The age of menopause ranged between 35 – 59 yrs showing a mean of 48 ±4.37. The mean age of onset of diabetes is lower in the premenopausal subjects (40±7.06) as compared to the post menopausal subjects (50±8.22).

The mean BMI of pre menopausal subjects (28.69 ±5.261) was significantly higher (p=0.0001) than post menopausal subjects (28.02 ±4.599). The minimum to maximum range however varied widely (18.9 to 49 in premenopausal and 13 to 45 in postmenopausal subjects) showing normal weight to morbidly obese in the premenopausal subjects while underweight and morbidly obese in postmenopausal subjects. The BMI of postmenopausal diabetic women was reported to be 31.65± 4.42 kg/m2.[7]

The mean WC measurements of pre and post menopausal subjects (96.13±12.14 & 96.35 ±14.25 respectively) showed insignificant difference (p=0.8957). Similarly the mean HC measurements of pre (104.5 ±11.45) and post menopausal subjects (104.1 ±12.67) reflected insignificant difference (p=0.8016).The mean WHR is observed to be similar in both the group of subjects (0.92±11.45 & 0.92 ±12.47 in pre and post menopausal subjects respectively).

The WHtR showed a mean of 0.62±0.08 and 0.63 ±0.10 in pre and post menopausal subjects. A waist to height ratio higher than 0.5 has been proposed as a cut off point for abdominal obesity in both sexes and at all ages.[8]

The blood glucose control as assessed by HbA1c measurement showed insignificant difference (p=0.1230) between the two group of subjects (8.71±2.10 & 8.40 ±1.69 in pre and post menopausal subjects respectively). Mean BMD T scores of post menopausal subjects (-1.80 +-0.94) were significantly lower (p=0.014) than premenopausal subjects (-1.43±0.94) indicating greater bone loss in the former.Subjects in both the groups however fall in the category of osteopenic (-1 to -2.4).Osteopenia is a condition in which the BMD is lower than normal.Osteopenia is a recognized complication of diabetes mellitus which could be due to abnormal bone turnover or disturbances in the calcium, parathyroid hormone, vitamin D axis or both.[9]

The percentage distribution of subjects for prevalence of obesity is presented in table 2.

Table 2: Prevalence of Obesity in Pre and Post Menopausal women

Parameters	Premenopausal (%) (n=100).	Postmenopausal (%) (n=111)
BMI >26	66	64
WC > 80	94	94.60
WHR >0.85	82	81.08
WHtR > 0.5	94	95.5

Data from the table reveals that a large percentage ofpre (66%) and post menopausal (64%) subjects had BMI > 26.The WHR is observed to be higher than the standard ratio of WHO (<0.85) in more than 80% of the subjects indicating a high prevalence of abdominal obesity. A very high percentage of both premenopausal (94%) and postmenopausal (95.5%) subjects had a WHtR above 0.6. A waist to height ratio higher than 0.5 has been proposed as a cut off point for abdominal obesity in both sexes and at all ages (Kruger H.S.et.al., 2013). Higher values of waist to height ratio indicate higher risk of obesity related cardiovascular diseases and it is correlated with abdominal obesity.[10]

Results of Pearson's correlation test are presented in table 3.

Table 3: Correlations of mean baseline parameters with BMD T scores

Particulars	BMD T Score	Parameters	Mean±SD	r value	p value	p value summary
Premenopausal women	-1.43	BMI	28.7 ±5.63	-0.228	0.0114	*
		WC(cms)	96.1 ±12.1	-0.283	0.0022	**
		HC(cms)	105 ±11.4	-0.258	0.0048	**
		WHR	0.908 ±0.17	-0.0952	0.1729	ns
		WHtR	0.62 ±0.0808	-0.306	0.001	***
		HbA1C (mg/dl)	8.71 ±2.1	-0.107	0.1457	ns
Postmenopausal women	-1.80	BMI	28 ± 4.6	-0.00678	0.4718	ns
		WC(cms)	96.4 ±14.2	0.0258	0.394	ns
		HC(cms)	104 ±12.7	-0.0301	0.377	ns
		WHR	0.919 ±0.153	0.0633	0.2547	ns
		WHtR	0.628± 0.0958	-0.0003	0.4987	ns
		HbA1C (mg/dl)	8.4 ±1.69	0.0126	0.4476	ns

*significant at 0.05 level,** significant at 0.01 level,***significant at 0.001 level.

Results of correlation test in premenopausal subjects reflected a negative and significant correlation of BMD T score (-1.43) to BMI (r-0.228 p=0.0114), WC (r-0.283 p=0.0022), HC (r-0.258 p=0.0048) and WHtR (r-0.306 p=0.001). WHR and HbA1c showed negative and insignificant relationship.

Results of correlation test in post menopausal subjects reflected a negative and insignificant correlation of BMD T score (-1.80) to BMI (p= 0.4718), HC (P=0.377) and WHtR (p=0.4987). A positive and insignificant relationship of BMD T score to WC (p=0.394), WHR (p=0.2547) and HbA1c (0.4476) was observed.

The relation between diabetes and BMD is a complex one. Individuals with typeII diabetes had lower bone density which could be a risk for hip fracture.[11] It has been suggested that increased oxidative stress in diabetic patients have detrimental effect on osteoblast and may contribute to diabetic osteopenia.[12]

Menopause transition in multiethnic cohort of women showed little change in BMD during pre or early menopause.[13] However the results of the present study show low BMD scores suggestive of osteopenia in pre menopausal subjects.Abdominal obesity and uncontrolled blood glucose levels may possibly contribute to osteopenia pre menopause.

CONCLUSION

The major findings indicated thatWC, HC, WHR, and WHtR of premenopausal diabetic subjects did not differ significantly to postmenopausal diabetic subjects.A high percentage of subjects in obese category were surprisingly from the pre menopausal group. Both group of subjects had osteopenia.

High WHR and WHtR in both premenopausal and postmenopausal subjectsreflected abdominal obesity. It is concluded that Pre menopausal diabetic subjects with abdominal obesity are prone to changes in bone density and therefore need to be cautioned to prevent entering

menopausal stage with osteopenia a precursor to osteoporosis.

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