

NUTRITIONAL AND HEALTH STATUS OF PRE-MENOPAUSAL AND POST-MENOPAUSAL WOMEN IN RURAL BENGAL POPULATION OF MAHISHADAL, WEST BENGAL, INDIA.

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Abstract: Background & objectives: The present investigation was made to find out the nutritional status, serum iron level, Haemoglobin (Hb) concentration and anthropometric characteristics among the pre-menopausal and post-menopausal women. It was also aimed to study the interrelationships among the parameters. **Methods:** A total of 140 women subjects having the age range of 30-60 years were selected at random for the study. The subjects were further classified into pre-menopausal group (30- 40 years) and post-menopausal group (50- 60 years). Serum iron level and Hb concentration were measured by using biochemical method and anthropometric parameters were measured by using standard techniques. Nutritional status was taken from 24 hours dietary recall method. **Results:** The results showed that there was a significant difference (** $p < 0.001$) of serum iron levels, Hb concentration and nutritional status between pre-menopausal and post-menopausal women. The higher percentage of pre-menopausal women belongs to normal category, whereas in post-menopausal women belong to overweight category. Energy, carbohydrate and protein intake was significantly correlated (** $p < 0.001$, * $p < 0.01$) with serum iron level and Hb concentration. The post-menopausal women reported a higher percentage of irritability (75%), arthritis (60%), aching of joints and muscles (70%).

Interpretation & conclusion: In the present study, we found that the post-menopausal women were suffering most from some of the health and symptomatic problems compared to the pre-menopausal women due to lack of awareness. Hence, an intensive orientation and education is absolutely necessary.

Key Words: Menopause, nutritional status, menopausal problems, menopausal obesity, menopausal BMI.

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INTRODUCTION: In India the number of menopausal women comes in around 43 million and would include between the age of 40 to 60 ¹. Worldwide, the estimates for the median age at menopause range from 45 to 55 years ^{2,3}. There are three phases of menopause viz., pre-menopause, peri-menopause and post menopause ⁴.

Most women menstruate about 400 times between menarche and menopause, using all responsive ova. When all these ova become atretic, the ovary is no longer capable of responding to pituitary gonadotropins, and the production of oestrogen and progesterone, and the other ovarian hormones is reduced then permanent cessation of menstruation occurs ⁵. The result of these low levels of hormones is often manifested by

deleterious physical, psychological and sexual changes in postmenopausal phase. The post-menopausal phase is now recognized as a time which associated with problems that reduce the quality and length of life for a large number of women ⁶.

Common psychological symptoms of menopause include mental stress, mood disturbances, panic attacks, depression, irritability, crying spells, anxiety, sleep disturbances, concentration difficulties, feeling of stress, fatigue, confusion, lowered judgement, lowered motor coordination, forgetfulness, insomnia, distractibility, restlessness, tension and loneliness ⁷. Behavioural changes of menopausal women include avoiding social activities, lowered work performance, staying at home and in bed ^{8,9}. Menopause leads to a variety of emotional and physiological symptoms ¹⁰. Physiological changes associated with menopause are hot flushes, cold sweats, dizziness, faintness,

nausea, vomiting, breast tenderness, bloating, weight gain, skin and hair disorders, anorexia nervosa, oedema, swelling, pelvic discomfort, headaches or migraines, changes in bowel habit and reduced coordination^{11, 12}. These in turn are thought to increase the risks of various chronic diseases, including heart diseases^{4, 13} and osteoporosis¹⁴. A woman's risk of heart disease grows to almost equal the risk of a man after menopause^{15, 16}. Falling oestrogen levels may lead to high cholesterol levels¹⁷.

All the psychological and physiological changes discussed above have an impact on food intake and food choices of menopausal women. It is an established fact that a well-balanced diet is important for good health and to combat some of the complications of menopause to a certain extent^{18, 19}. Those women, who are entering into the menopause, have insufficient knowledge of dietary requirement which results in either oversupply or lack of nutrients. As a result an unbalanced diet, low physical activity and emotional stress altogether can intensify the symptoms of menopause¹⁹. There is an importance of a balanced diet and healthy eating habits for better management of the symptoms, improvement of health and nutritional status²⁰. It was observed from previous studies that a high incidence of overweight and obesity in women during menopause transition and beyond have become important public health concerns. Prevalence of obesity is increasing worldwide and growing more rapidly in postmenopausal women^{21, 22}. In the present study an attempt was made to evaluate overweight and obesity among the menopausal women.

The literature says that menopause is associated with a decrease in red cell indices. However, in menopausal women there is a significantly higher MCV, which indicating a probable risk for developing anaemia²³.

AIMS AND OBJECTIVES

In India there is a lack of researches among the rural menopausal women. However India faces a variety of challenges which deals with menopause for several decades. So there is a need of evaluation of different aspects of the said population. In the present study an attempt was made to evaluate the nutritional status, prevalence of obesity,

haemoglobin concentration and serum iron levels along with health problems in pre-menopausal and post-menopausal women among different rural areas of the Indian Bengali population.

MATERIALS AND METHODS

Selection of site and Subject: The present study was conducted in different rural areas of Mahishadal of Purba Medinipur district, West Bengal, India. About 140 the number of women subjects were selected at random for the study having age range 30-60 years. The total age group was further classified into two groups, i.e.; pre-menopausal (having regular menstrual bleeding) group 30-40 years (n=70) and post-menopausal (had last menstrual bleeding at least 1 year before) group 50-60 years (n=70). Most of the selected women participants were house wives, however some of them were also engaged in different sections of farming. The study protocol was approved by the Human Ethical Committee of the institution (Mahishadal Girls' College, Rangibasan, Mahishadal, Purba Medinipur, West Bengal, India), and the experiment was performed in accordance with the ethical standards of the committee and with the Helsinki Declaration. The study protocol was explained to the subjects and written consent was obtained from the subjects during the study.

Inclusion and Exclusion criteria: Rural Indian Bengali healthy women subjects aged 30-60 years were included in the study. Peri-menopausal, pregnant and lactating women were excluded from the study.

Anthropometric measurements:

Standard techniques and appropriate landmarks were followed to measure the anthropometric dimensions. Height was taken with the help of an anthropometer (Hindustan Minerals)²⁴.

The weight of the subject was taken by a portable weighing machine (Libra)²⁴.

The body mass index (BMI) was calculated from the collected height and weight data by a standardized method²⁵.

$$\text{BMI} = \text{Weight (kg)} / \text{Height}^2 \text{ (m)}$$

Measurement of hemoglobin (Hb) concentration:

The hemoglobin concentration is measured by the Cyanmethemoglobin method. At first test tubes were marked with blank (B), and test samples (such as T1 and T2 etc.). In blank tube only 5 ml of

Drabkin's solution was taken. But in the other test tubes for test samples, 0.02 ml of blood was diluted with the 5 ml of Drabkin's solution that was taken by the 5 ml pipette. For 15 minutes waiting was required for proper mixing of the blood sample with the solution. Finally the optical density of different test samples was measured in a spectrophotometer (shimadzu-1601, Japan) using a length of 540 mm. The machine was set to zero with the blank. The concentration of Hb present in the blood samples (gm/dl) was calculated by the following formulae.

Hb concentration in gm/dl = Absorbance of the test solution / Absorbance of the Standard $\times 15$

Measurement of serum iron levels:

The investigation was performed on venous blood samples drawn into plain tubes, then centrifuge at 20°C, 1500g for 10 minutes to collect the serum sample, then estimated the iron spectrophotometrically (shimadzu-1601, Japan) due to colour that performed by this method in which transferrin bound ferric iron in the sample are released by guanidinium and reduced to ferrous by mean of hydroxylamine, ferrous iron react with ferrozine forming a coloured complex.

Nutritional status:

Nutritional status of the women subjects was evaluated by 24-hrs recall method²⁶. In this method four meals i.e., breakfast, lunch, snacks and dinner were evaluated by discussion with the subjects. In this regard recipes, ingredients and amount of dishes consumed by the family members were also evaluated to find out the actual amount of food consumed by the women subject of the age range selected. From that quantity of the food the amounts of energy, carbohydrate, protein, fat, minerals and vitamins were calculated by using the Indian Council of Medical Research (ICMR) food composition table²⁷.

Evaluation of different health related problems:

Health related problems of the women subjects were assessed by questionnaire method. A detailed questionnaire was prepared for the said purpose to evaluate different psychological and physiological problems among the pre and post-menopausal women subjects.

Statistical analysis:

Data are expressed as mean \pm SEM. Two tail t-test, co-relation coefficient determined by product moment correlation coefficient and chi-square test were employed to compare the data of pre and post-menopausal women using the statistical package for social science software (SPSS software: 20.0.0, USA). $p \leq 0.05$ was considered as a significant difference.

RESULTS:

1. Height, weight and body mass index (BMI):

It was observed from the results that the weight and BMI were significantly higher ($p < 0.001$) in post-menopausal women compared to pre-menopausal women. However no significant difference was observed in case of height (Table 1).

Table 1: The height, weight and BMI among pre-menopausal (n=70) and post-menopausal women (n=70).

Parameters	Pre-menopausal women	Post-menopausal women	t values
Height (cm)	143.7 ± 11.0	141.0 ± 8.28	1.876 NS
Weight (kg)	46.3 ± 8.79	53.4 ± 4.07	5.799**
BMI (kg/m ²)	22.4 ± 3.57	27.1 ± 3.69	7.645**

Values are expressed as mean \pm standard deviation (SD). Significant at ** $p < 0.001$, NS=Not significant

2. The prevalence of obesity:

It was observed from the results that in case of pre-menopausal women a higher percentage (57.1%) of subjects belongs to normal category where as in case of post-menopausal women a higher percentage (58.6%) of subjects belongs to overweight category (Table 2).

Table 2: Prevalence of Frequency (percentage) of the subjects according to different BMI categories (based on WHO defined BMI cutoff values) between pre-menopausal (n=70) and post-menopausal women (n=70).

Parameters	Frequency (percentage)	
	Pre-menopausal women	Post-menopausal women
Under weight (BMI < 18.5 kg/m ²)	7 (10.0)	0 (0.00)
Normal (BMI 18.5 - 24.9 kg/m ²)	40 (57.1)	18 (25.7)
Over weight (BMI 25 - 29.9 kg/m ²)	19 (27.1)	41 (58.6)
Obese (BMI ≥ 30 kg/m ²)	4 (5.71)	11 (15.7)

3. Nutritional status:

Nutritional status was compared between pre and post-menopausal women and it was observed from the results that the nutritional intake was significantly higher ($p < 0.001$) in post-menopausal than that of the pre-menopausal women (except in case of calcium intake) (Table 3).

Table 3: Comparison of nutritional status between pre-menopausal (n=70) and post-menopausal women (n=70).

Parameters	Pre-menopausal women	Post-menopausal women	t values
Energy (kcal)	1833.4±412.8	2124.5±220.0	5.301**
CHO (gm)	322.3±83.3	384.8±63.3	4.908**
Protein (gm)	54.1±12.9	61.9±8.89	3.680**
Fat (gm)	32.2±10.6	41.3±11.0	6.566**
Calcium (mg)	691.2±220.2	653.1±327.6	0.836 NS
Iron (gm)	21.6±5.97	26.3±5.52	5.926**

Values are expressed as mean ± standard deviation (SD). Significant at ** $p < 0.001$, NS=Not significant

4. Hemoglobin (Hb) concentration and serum iron levels:

It was observed from the results that the Hb concentration and serum iron level was significantly higher ($p < 0.001$) in post-menopausal women compared to pre-menopausal women (Table 4).

Table 4: Comparison of hemoglobin concentration (Hb. conc.) and serum iron levels between pre-menopausal (n=70) and post-menopausal women (n=70).

Parameters	Pre-menopausal women	Post-menopausal women	t values
Hb. conc. (gm/dl)	10.4±0.965	12.0±0.894	12.020**
Serum iron levels (µg/dl)	66.8±1.81	71.4±5.54	7.284**

Values are expressed as mean ± standard deviation (SD). Significant at ** $p < 0.001$, NS=Not significant

5. Correlation between nutritional status and height, weight, BMI, serum iron level and Hb concentration:

No significance correlation was observed between nutritional status and height, weight and BMI parameters (Table 5). It was observed from the results that there was a significant correlation (** $p < 0.001$, * $p < 0.01$) of energy, carbohydrate and protein intake with the serum iron level and Hb concentration. But no significant correlation was observed in case of fat, calcium and iron intake (Table 6).

Table 5: Correlation between nutritional status and height, weight and BMI of women (n=140) subjects.

Nutritional parameters	Height (cm)	Weight (kg)	BMI
Energy (kcal)	0.06	0.07	-0.01
CHO (gm)	0.04	-0.09	-0.16
Protein (gm)	0.01	0.10	0.06
Fat (gm)	0.08	0.02	-0.08
Calcium (mg)	0.03	0.07	0.06
Iron (mg)	-0.04	0.04	0.11

No significant result was observed

Table 6: Correlation between nutritional status and Hb concentration and Fe levels of women (n=140) subjects.

Nutritional parameters	Hb conc. (gm/dl)	Serum iron levels (gm %)
Energy (kcal)	0.33**	0.23*
CHO (gm)	0.37**	0.26*
Protein (gm)	0.31**	0.22*
Fat (gm)	0.16 NS	0.05 NS
Calcium (mg)	-0.05 NS	-0.04 NS
Iron (mg)	0.10 NS	0.07 NS

Significant at **p< 0.001, *p<0.01, NS= Not significant

6. Psychological and physiological problems:

Different psychological and physiological problems were compared between pre and post-menopausal women. It was observed from the results that a significantly higher percentage of post-menopausal women were reported irritability (75%, p<0.05), arthritis (60%, p<0.05), aching joints and muscles (70%, p<0.001), spondylosis (50%, p<0.05), visual disability (30%, p<0.05), constipation (30%, p<0.05) when compared to pre-menopausal women (Table 7).

Table 7: Comparison of different Psychological and Physiological problems between pre-menopausal and post-menopausal women subjects.

Different Psychological and Physiological problem	Frequency (percentage)		Chi square value (x ²)
	Pre-menopausal women (n=70)	Post-menopausal women (n=70)	
Irritability	35 (50.0)	53 (75.0)	9.91#
Heart diseases	18 (25.7)	21 (30.0)	0.32NS
Respiratory dysfunction	14 (20.0)	14 (20.0)	0.00NS
Arthritis	28 (40.0)	42 (60.0)	5.60#
Aching joints and muscles	21 (30.0)	49 (70.0)	22.4**
Spondylosis	18 (25.7)	35 (50.0)	8.77#
Hypertension	18 (25.7)	28 (40.0)	3.23NS
Dizziness	21 (30.0)	21 (30.0)	0.00NS

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Visual disability	11 (15.7)	21 (30.0)	4.05#
Auditory disability	7 (10.0)	11 (15.7)	1.88NS
Headaches/migraines	14 (20.0)	21 (30.0)	1.87NS
Sleep disturbances	18 (25.7)	21 (30.0)	0.31NS
Breast tenderness	7 (10.0)	14 (20.0)	2.74NS
Diabetes	7 (10.0)	11 (15.7)	1.88NS
Mental illness	11 (15.7)	14 (20.0)	0.44NS
Constipation	7 (10.0)	21 (30.0)	8.75#

Significant at **p< 0.001, #p<0.05, NS= Not significant

DISCUSSION:

The present study found out that the weight and BMI significantly higher in post-menopausal women compared to pre-menopausal women. This can be explained by the significantly higher consumption of carbohydrate and fat rich nutrients. It was observed from the results that nutritional intake was higher in post-menopausal women than that of the pre-menopausal women. This study was in agreement with the study of Montero et al (2000)²⁸ who stated that women aged >50 years had higher nutrient consumption of carbohydrate and fat and that may have some impact upon the increasing age. For this reason the weight and BMI was maximum in post-menopausal women when compared to pre-menopausal women. A similar trend of results has been reported by some previous studies²⁹.

The prevalence of obesity when compared between pre and post-menopausal women, it was observed from the findings that in pre-menopausal women a higher percentage of subjects belong to normal category whereas in post-menopausal women a higher percentage of subjects belongs to overweight category. Previous studies reported that after menopause, many women begin a slow but steady weight gain due to the hormonal imbalance, possibly declining of the oestrogen levels^{22, 30}. Yannakoulia et al (2007)³¹ reported that the increased body fat in post-menopausal women is

associated with the frequent eating habit. Which might be a cause for the present study as it was noted from the results that post-menopausal women were eating higher dietary fat compared to the pre-menopausal women.

Nutritional status was evaluated among the pre and post-menopausal women subjects and it was observed from the results that there was a significant difference of nutritional status between pre-menopausal and post-menopausal women. The results also showed that all the energy and related nutrient intake value like carbohydrate, protein and fat intake, were higher in post-menopausal women than in pre-menopausal women. In this study, post-menopausal women were eating higher dietary fat compared to the pre-menopausal women. The fat content of the diet was shown to affect body fat as a function of dietary fat on energy intake whereby lowering the fat content of diet also reduces energy intake³². Due to this the prevalence of obesity was common among the women studied. It was reflected from the results that though there was no significant difference observed in case of calcium intake, however the mean value of calcium intake was lower in post-menopausal women than pre-menopausal women. Calcium is the most important nutrient in bone health; it can be deleterious for bone health³³. Post-menopausal women in this study, having dietary calcium intakes below the recommendation for their age, may be at risk of osteoporotic fractures in later life. Celotti and Bignamini, (1999)³⁴ reported that the calcium supplementation of 1000 mg/day attenuates the bone loss in post-menopausal women. After menopause the amount and type of dietary protein are of great importance for both bone metabolism and cardiovascular system. In the present study it was observed that the consumption of dietary protein is higher in post-menopausal women compared to pre-menopausal women. The lower calcium intake observed in this study might cause difficulties adapting to the acid load resulting from high-protein diet³⁵.

The serum iron level and the Hb concentration were also significantly higher in post-menopausal compared to the pre-menopausal women. This finding was in agreement with the study of Obeagu et al, (2016)³⁶ who reported a higher percentage of

Hb concentration in post-menopausal women compared to pre-menopausal women. The probable cause for this finding might be due to the estrogen hormone which has been previously implicated as an inhibitor of erythropoiesis along with that a diminished level of this hormone in menopause was associated with increased hemoglobin levels^{23, 36}. The increased of serum iron level in post-menopausal period might be due to stoppage of menstrual time in which the iron is loss during menstrual cycle. In justification, Zimmermann and Hurrell, (2007)³⁷ reported that the iron is accumulated in the body of post-menopausal women due to the cessation of menstruation and the iron are no longer lost through the menstruation. The pre-menopausal women are prevalent with iron deficiency due to loss of iron through the monthly blood loss in menstrual cycle. On the contrary, Shrivastava et al, (2005)³⁸ reported that there was no significant difference of Fe level between pre-menopausal and post-menopausal women.

These changes of body weight, BMI, serum iron level and Hb concentration in pre and post-menopausal women might be affected by their nutritional intake and could have contributed the finding of higher body weight, BMI, serum iron level and Hb concentration in the post-menopausal women.

The nutritional intake was significantly higher in post-menopausal women than that of the pre-menopausal women (except in case of calcium intake). No significant correlation was observed between the nutritional intake and anthropometric measurements and the findings of this study was in agreement with the study of Devi et al. (2003)³⁹. A significant correlation was observed among energy, carbohydrate and protein intake with the serum iron level and Hb concentration.

The results of the present study showed that there was a significant difference of psychological and physiological problems between pre and post-menopausal women. A higher percentage of post-menopausal women reported irritability (75%) and aching joints and muscles (70%). These are the most severe symptoms in post-menopausal women's. These findings of the present study are similar to the several previous studies^[2, 5, 40, 41]. These

severities of symptoms may be reduced by the physical activity or exercise activity. Moilanen et al, (2012)⁴² reported that the women who had suffered from the menopausal symptoms, if they had physical activity or exercise four times in a week, menopausal symptoms were reduced. The endorphin is released into the blood during exercise which helps to reduce the different menopausal symptoms and/or it had also some positive effect on the different menopausal symptoms⁴³.

In our study we experienced the following limitations. The sample size of the study is moderate and the socio-economic status has not been assessed. The hormonal levels in pre and post-menopausal phases has not been assessed. So the study opens the scope for future research by incorporating the above said points in a well-designed experimental protocol.

CONCLUSION

The findings of the present study concluded that menopausal phase has been a problem in the studied population. The post-menopausal women were suffering mostly from some of the health and symptomatic problems compared to the pre-menopausal women. Hence, an intensive orientation and education is absolutely necessary. There is a future scope of the study among different women population of India as these kinds of studies are lacking in India. The health care services should pay more attention towards the women's health in the post-menopausal period. Menopause can become a time of beginning, rather than an end.

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REFERENCES

1. Pallikadavath S, Ogollah R, Singh A, Dean T, Dewey A, Stones W. Natural menopause among women below 50 years in India: A population-based study. *Indian J Med Res* 2016; 144: 366-377.
2. Sidhu S, Kaur A, Sidhu M. Age at menopause in educated women of Amritsar (Punjab). *J Hum Ecol* 2005; 18: 49-51.
3. Nelson H. Menopause. *The Lancet* 2008; 371: 760-70.
4. Rees M, Stevenson J, Hope S et al. Management of the menopause. London: The Royal Society of Medicine Press. 2009.
5. Dutta R, Dcruze L, Anuradha R., Rao S, Rashmi MR. A Population Based Study on the Menopausal Symptoms in a Rural Area of Tamil Nadu. *Indian Journal of Clinical and Diagnostic Research* 2012; 6: 597-601.
6. Hoda AEM, Sahar ML, Luma GAZ. Quality of life among menopausal women. *Int J Reprod Contracept Obstet Gynecol* 2014; 3: 552-561.
7. Peters M. British Medical Association: A-Z Family Medical Encyclopedia. 5th Ed. London: Dorling Kindersley Limited. 2008.
8. Sadock BJ, Sadock VA. Kaplan & Sadock's Synopsis of Psychiatry: Behavioural Sciences/Clinical Psychiatry. 10th Ed. Philadelphia, USA: Lippincott Williams & Wilkins. 2007.
9. Jarvis S. Women's Health for Life. London: Dorling Kindersley Ltd. 2009.
10. North American Menopause Society (NAMS). The role of calcium in peri- and postmenopausal women: consensus opinion of the North American Menopause Society. *Menopause* 2001; 8: 84-95.
11. Brockie J. Managing menopausal symptoms: Hot flushes and night sweats. *Nursing Standard* 2013; 28: 48-53.
12. Hunter MS, Chilcot J. Testing a cognitive model of menopausal hot flushes and night sweats. *Journal of Psychosomatic Research* 2013; 74: 307-312.
13. Muka T, Williams CO, Colpani V, Kunutsor S, Chowdhury S, Chowdhury R, et al. Association of vasomotor and other menopausal symptoms with risk of cardiovascular disease: A systematic review and meta-analysis. *PLoS ONE* 2016; 11: 1-15.
14. Assaf AR, Bushmakin AG, Joyce N, Louie MJ, Flores M, Moffatt M. The Relative Burden of Menopausal and Postmenopausal Symptoms versus Other Major Conditions: A Retrospective Analysis of the Medical Expenditure Panel Survey Data. *Am Health Drug Benefits* 2017; 10: 311-332.

15. Rocca W, Miller V, Shuster L, Brown R. Premature menopause or early menopause and risk of ischemic stroke. *Menopause* 2012; 19: 272-277.
16. Mahendru A, Morris E. Cardiovascular disease in menopause: Does the obstetric history have any bearing? *Menopause international* 2013; 19: 115-120.
17. Menon V, Vongpatanasin W. Effects of transdermal estrogen replacement therapy on cardiovascular risk factors. *Treatments in Endocrinology* 2006; 5: 37-51.13.
18. Goyal S, Malagi U, Naik R, Kasturiba B. Menopausal symptoms and nutritional status of perimenopausal women. *Karnataka J Agric Sci* 2012; 25: 506-509.
19. Tursunović S, Jašić M, Beganlić A, Hot N. Nutritional status and dietary habits of menopausal women: Food in health and disease. *Scientific-professional journal of nutrition and dietetics* 2014; 3: 116-125.
20. Kaur G, Chawla P. Impact of Nutritional Counselling on Nutritional Status of Postmenopausal Women. *Food and Nutrition Sciences* 2015; 6: 429-436.
21. Wang YC, Colditz GA, Kuntz KM. Forecasting the obesity epidemic in the aging US population. *Obesity (Silver Spring)* 2007; 15: 2855-65.
22. Lizcano F, Guzmán G. Estrogen deficiency and the origin of obesity during menopause. *Biomed Res Int* 2014; 2014: 757461.
23. Achie LN, Olorunshola KV, Mabrouk M. A study of some red cell indices in menopausal women in Zaria. *Nigeria Asian Journal of Medical Sciences*. 2011; 3(4): 154-7.
24. Sodhi HS. Sports Anthropometry (A Kinanthropometric Approach). Mohali: ANOVA Publications; 1991: 176-185.
25. Jhonson BL, Nelson JK. Practical measurement for evaluation in physical education. Macmillan Publishing Company, New York; 1986: 174-200.
26. Swaminathan M. Advanced Text-Book on Food and Nutrition. 1999; 2: 496-511.
27. ICMR. Nutrient Requirement and Recommended Dietary Allowance for Indians. New Delhi; 2009.
28. Montero P, Bernis C, Varea C, Arias S. Lifetime dietary change and its relation to increase in weight in Spanish women. *Int J Obes Relat Metab Disord*. 2000; 24: 14–19.
29. Javoor D, Malagi U, Naik R, Kasturiba. Nutritional Status of Menopausal Women: Karnataka. *J Agric Sci*. 2008; 21 (1): 152-154.
30. Dubnov-Raz G, Pines A, Berry EM. Diet and lifestyle in managing postmenopausal obesity. *Climacteric*. 2007; 10(2): 38–41.
31. Yannakoulia M, Melistas LE, Solomou E, Yiannakouris N. Association of eating frequency with body fatness in pre and post menopausal women. *Obesity (Silver Spring)*. 2007; 15(1): 100-106.
32. Key TJ, Davey GK. Prevalence of obesity is low in people who do not eat meat. *BMJ*. 1996; 313: 816-17.
33. Hejazi JJ, Mohtadinia SK, Ebrahimi-Mamaghani M. Nutritional status among postmenopausal osteoporotic women in North West of Iran. *Asia Pac Clin Nutr*. 2009; 18: 48- 53.
34. Celotti F, Bigamini A. Dietary calcium and mineral / vitamin supplementation: A controversial problem. *J Int Med Res*. 1999; 27(1): 1-14.
35. Draper HH, Piche LA, Gibson RS. Effects of a high protein intake from common foods on calcium metabolism in a cohort of postmenopausal women. *Nutr Res*. 1991; 11(4): 273-281.
36. Obeagu EI, Obarezi HC, Ochei KC, Okafor CN, Iwegbulam CP, Obeagu GU, Esseini UC. Evaluation of Variations of Haematological Profile of Menopausal Women in Umuahia. *Nigeria Sch Acad J Biosci*. 2016; 4(12):1109-1112.
37. Zimmermann MB, Hurrell RF. Nutritional iron deficiency. *Lancet*. 2007; 370: 511–520.
38. Shrivastava V, Singh S, Singh N, Sapre S. Status of antioxidant enzymes and trace metals in postmenopausal women. *J Obstet Gynecol India*. 2005; 55(1): 64- 66.
39. Devi AM, Singh JN, Singh GY. A study of age of menopause and menarche among Manipuri women of urban areas. *Indian Medical Journal*. 2003; 97(5): 133-135.
40. Chedraui P, Miguel GS, Avila C. The quality of life impairment during the female menopausal transition is related to personal and partner

- factors. *Gynecological Endocrinology*. 2009; 25(2): 130-35.
41. El Shafie K, Al Farsi Y, Al Zadjali N, Al Adawi S, Al Busaidi Z, Al Shafae M. Menopausal symptoms among healthy, middle-aged Omani women as assessed with the Menopause Rating Scale. *Menopause*. 2011; 18(10): 1113-9.
 42. Moilanen JM, Mikkola TS, Raitanen JA, Heinonen RH, Tomas EI, Nygard CH, et al. Effect of aerobic training on menopausal symptoms a randomized controlled trial. *Menopause*. 2012; 19(6): 691-6.
 43. Duff SM. Effect of physical activity on menopausal symptoms in non-vigorously active postmenopausal women: University of Saskatchewan; 2009.

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