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ASSESSMENT OF NUTRITIONAL ANTHROPOMETRY OF POST-MENOPAUSAL WOMEN

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Menopause is the period, at which women stop ovulating. Most of the women experience this around the age of fifty and usually lasts upto fifty five years. Anthropometry is used to assess compromised health or nutrition well being. Anthropometric data from a single assessment provide a snapshot of current nutrition status within a community, and helps to identify groups at risk in terms of morbidity and mortality. In the present study, the association between anthropometric indices and different age groups of all the subjects indicated that the anthropometric measurements like weight mid-arm circumference, fat fold thickness, waist circumference and hip circumference were positively correlated with Brokas Index and only fat fold thickness was positively correlated with waist hip ratio. Similarly anthropometric measurements like height, weight, mid-arm circumference, waist circumference and hip circumference were negatively correlated with waist hip ratio of the subject. The correlation coefficient between anthropometric measurements with nutrient intake indicated weight, fatfold thickness and hip circumference were positively correlated with nutrients like fat. Hence, Nutritional anthropometry is relatively easy technique to determine the nutritional status of the individuals thereby providing a means for women to manage their existing problems like obesity by following good dietary pattern and lifestyle.

Keywords: Menopause, Nutritional anthropometry, Dietary intake, Assessment

INTRODUCTION

Anthropometry is the study of the measurement of the human body in terms of the dimensions of bone, muscle, and adipose (fat) tissue. Measures of subcutaneous adipose tissue are important because individuals with large values are reported to be at increased risks for hypertension, adult-onset diabetes mellitus, cardiovascular disease, gallstones, arthritis, and other disease, and forms of cancer. Combined with the dietary and related questionnaire data, and the biochemical determinations, anthropometry is essential and critical information needed to assist in describing the data collected from persons in

the sample (Anonymous, 1988). Measurements of weight, height (or length) and, less frequently, subcutaneous fat and muscle, are the usual data collected. Nutritional anthropometry is relatively easy technique to employ as it is non-invasive in nature.

At the individual level, anthropometry is used to assess compromised health or nutrition well being, need for special services, or response to an intervention. A one-time assessment is used during emergency situations to screen for individuals requiring immediate intervention. Under nonemergency conditions, single assessments are used to screen for entry into health or nutrition intervention

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programs either as an individual or as a marker for a household or community at risk.

At the population level, anthropometric data from a single assessment provide a snapshot of current nutrition status within a community, and should help to identify groups at risk of poor functional outcomes in terms of morbidity and mortality (Gorstein, *et al.*, 1994). Under emergency conditions, these static measurements are used to identify priority areas for assistance. The advantages of anthropometry indicate-Anthropometric measurements to be non-invasive and relatively economical to obtain; objective; and comprehensible to communities at large. Data produced that can be graded numerically, used to compile international reference standards, and compared across populations. They can also supply information on malnutrition to families and health care workers prior to the onset of severe growth failure (or excessive weight gain).

Menopause is the stage at which women stop ovulating and it each women differently. However, most of the women experience this around the age of fifty and usually lasts upto fifty five years. The major endocrinal changes occur in women between 45 to 50 years of age with a decline in the ovarian function resulting in lower estrogen production responsible for menopausal changes. The acute symptoms experienced during menopause include dizziness, headache, difficulty in breathing and heart palpitations, vasomotor disturbances, perspiration, night sweats, irregular bleeding, hot flushes, vaginal thinning and dryness, mood changes, changes in sexuality and insomnia. Further, the chronic changes that occur includes vascular diseases and skeletal osteoporosis. In addition, orthopaedic ailments like chronic back pain, stiffness and osteoporosis are commonly observed. Hence, the study was designed on nutritional and clinical evaluation of post-menopausal women with orthopaedic ailments with the sub objective of evaluation of nutritional Anthropometry of women.

MATERIAL AND METHODS

Locale of the study

The study was conducted at Bangalore district, Karnataka state, India. The subjects included for the study were from both rural and urban background.

Anthropometry

The Anthropometric measurements taken were height, weight, mid-arm circumference, waist circumference, hip

circumference and fatfold thickness at triceps as per the guidelines specified by Jelliffe (1966). The anthropometric indices like body mass Index, waist hip ratio and arm muscle circumference were calculated from the above measurements. The cut off levels of the Body Mass Index as per Anonymous (2003) were used to classify subjects as malnourished, normal and obese.

Statistical Analysis

The data was classified, tabulated using SPSS office package windows 2003, expressed as percentage, mean. The results were analysed statistically using Correlation test to determine whether there was any correlation between the parameters (Kothari, 2004).

RESULTS AND DISCUSSION

Anthropometric Measurements

The mean anthropometric measurements are presented in Table 1. The mean height and weight of the subjects was found to be 152 cms and 58 Kg respectively which was more than the average weight of a reference women. The mean waist and hip circumference of the subjects was 82.7 and 98.9 cms respectively.

Table 2 indicated the anthropometric measurements of the menopausal women at different age groups. The mean height was highest among the subjects in the age group of 51-55 years with 154.8 cms followed by 56-60 years age group with 153.7 cms and lowest being in subjects belonging to 60-65 years with 146.8 cms. However, there was no significant difference in mean height between the age groups.

The mean weight was highest among the subjects from the age group of 51-55 years with mean weight of 61.2 kgs followed by 56-60 years age group with 59.5 kgs. Lowest being in subjects belonging to 60-65 years with 53.8 kgs. However, there was significant difference in the mean weight between the age groups. On an average, irrespective of the age, the weight was higher than the reference weight for indian adult female.

The mean Mid Upper Arm Circumference (MUAC) was highest of 30.45cms in the age group of 51-55 years and lowest of 28.79 cms among subjects of 46-50 years of age group. However, the standards for adult females (Jelliffe, 1966) being 28.5 cms that was lesser than the values of the present study. Statistically, there was no significant difference in mid upper-arm circumference between different

Table 1: Mean Anthropometric Measurements of the Subjects (n = 200)

Anthropometric Measurements	Mean ± SD	Z- Score
Height (cms)	152.0 ± 8.2	1.76
Weight (Kgs)	57.9 ± 10.0	0.39
Mid-upper arm circumference (cms)	29.4 ± 2.9	-1.04
Fat fold thickness at Triceps (mm)	29.2 ± 7.7	-1.04
Waist circumference (cms)	82.7 ± 8.9	0.17
Hip circumference (cms)	98.9 ± 10.0	0.54

Table 2: Anthropometric Measurements of Menopausal Women at Different Age Groups

Parameters	46-50 yrs	51-55 yrs	56-60 yrs	60-65 yrs	F-test
	(n = 60)	(n = 56)	(n = 54)	(n = 30)	
Height (cms)	150.53 (±8.57)	154.86 (±7.29)	153.73 (±5.71)	146.8 (±9.70)	8.69*
Weight (kgs)	55.58 (±8.85)	61.17 (±7.72)	59.49 (±12.51)	53.87 (±8.90)	5.47*
Mid-arm circumference (cms)	28.79 (±2.8)	30.45 (±2.8)	28.99 (±3.10)	29.4 (±2.64)	3.77*
Fat Fold thickness (mm)	27.95 (±7.68)	30.52 (±6.98)	29.56 (±8.06)	28.7 (±8.38)	0.94 ^{NS}
Waist circumference (cms)	81.73 (±9.61)	81.63 (±7.97)	85.5 (±7.20)	81.61 (±10.87)	2.50*
Hip circumference (cms)	98.28 (±9.45)	101.27 (±6.70)	100.62 (±9.97)	92.95 (±13.57)	5.55*

Note: ** Significant at 1% level. NS - Non-significant. Within the parenthesis standard deviation values are indicated.

age groups. The Mean fat fold at triceps was found to be highest among 51-55 years of age, the value being 30.52 mm while lowest of 27.9 mm was among subjects in the age group of 46-50 years. However, there was no significant difference in fat fold at triceps between the age groups. The mean waist circumference was highest in subjects of 56-60 years age group with 85.5 cms lowest of 81.61 cms among 60-65 years age group. The mean hip circumference was 101.27 cms in the age group of 51-55 years which was highest among all age groups. However, the lowest was found to be in the age group 60-65 years with value of 92.9 cms. There

was significant difference at five percent level for waist and hip circumference between different age groups.

Anthropometric Indices

The mean anthropometric indices calculated based on anthropometric measurements is indicated in the Table 3. It was observed that the body mass index was found to be 25.2 and the brokas index was 113.31. However, the Lean body mass index was 409.9. The waist hip ratio and the arm muscle circumference of the subjects were 0.83 and 6.81, respectively. As per the Z-distribution, there was no statistical significance among all anthropometric indices.

The anthropometric indices of the menopausal women at different age groups is indicated in Table 4. It was observed that the anthropometric indices like Brokas index, Lean body mass index, Waist hip ratio and arm muscle circumference was found to be highest in the age group of 61-65 years and the values being 115.65, 416.83, 0.87 and 22.26 cms, respectively. The lowest values of Brokas index and arm muscle circumference was observed in the age group of 46-50 yrs with values being 112.23 and 19.99 cms respectively. The anthropometric indices like Lean body mass index and Waist hip ratio was found to be lowest in the age group of 51-55 years with 397.31 and 0.8 respectively. On the whole, there was no significant difference between the anthropometric indices and age groups but it was known that there was significant difference at five percent level for arm muscle circumference among all the age groups of post-menopausal women.

Body Mass Index (BMI) and Waist Hip Ratio (WHR)

The classification of subjects as per the anthropometric indices is shown in Table 5. The results revealed that 49% of the subjects in the study were found to be over weight by BMI classification, 47% were normal and 4% were undernourished. The finding of the present study with respect to subjects being normal by BMI classification was higher compared with finding of Visweswara Rao *et al.* (1993), Yadav and Padam Singh (1999) and Gopalan (2002). The high percentage of obese postmenopausal women as per WHR was found to be 77%. This was found to be in par with the investigation of Deepti *et al.* (2004). The results indicated the higher percentage of post menopausal women were obese as per Body Mass Index (BMI) and Waist Hip Ratio (WHR) comparison to pre-menopausal women. Also similar trend was observed by Deepa *et al.* (2008), with

Table 3: Mean Anthropometric Indices of the Subjects

Anthropometric Indices	Mean ± SD	Z- Score
Body Mass Index	25.2 ± 4.23	-0.57
Brokas Index	113.3 ± 20.57	-0.01
Lean Body Mass Index	409.9 ± 65.51	1.89
Waist Hip Ratio	0.83 ± 0.06	-0.73
Arm Muscle Circumference	6.81 ± 24.71	-0.56

Table 4: Anthropometric Indices of the Menopausal Women at Different Age Groups

Anthropometric Indices	46-50 yrs	51-55 yrs	56-60 yrs	61-65 yrs	F-test
	(n = 60)	(n = 56)	(n = 54)	(n = 30)	
Body Mass Index	25.1 (±5.03)	25.54 (±2.961)	25.16 (±4.429)	24.8 (±4.34)	0.2187 ^{NS}
Brokas Index	112.23 (±23.67)	112.26 (±14.17)	113.13 (±20.36)	115.65 (±24.84)	0.2188 ^{NS}
Lean Body Mass Index	415.37 (±65.27)	397.31 (±46.73)	413 (±72.83)	416.83 (±81.52)	0.9813 ^{NS}
Waist Hip Ratio	0.82 (±0.050)	0.8 (±0.068)	0.84 (±0.069)	0.87 (±0.071)	0.9813 ^{NS}
Arm Muscle Circumference	19.99 (±2.47)	20.2 (±3.20)	19.97 (±2.73)	22.26 (±3.31)	3.799*

Note: * Significant at 5% level. NS - Non-significant. Within the parenthesis standard deviation values are indicated.

higher BMI in post-menopausal women (29.15) followed by peri-menopausal women (26.8) and pre-menopausal women. However, difference between mean values of BMI were found to be significant (P < 0.01).

Brokas Index and Lean Body Mass Index

Seventy percent of subjects were classified as normal where as 21% were found to be obese and 9% were found to be overweight. According to Lean body mass Index 91% were classified as normal and 8% were found to suffer from chronic energy deficiency. However, only 1% of the women were found to be overweight.

Waist-Hip Ratio

Waist Hip Ratio (WHR) classification indicated 23% of the subjects to be normal while remaining 77% to be obese.

Table 5: Classification of Subjects According to Anthropometric Indices

Anthropometric Indices	n	Percentage
Body Mass Index		
Undernutrition (≤ 18.5)	8	4
Normal (18.5-25)	94	47
Overweight (≥ 25)	98	49
Broka's Index		
Normal (80-120)	140	70
Overweight (120-130)	18	9
Obese (130-140)	42	21
Lean Body Mass Index		
Chronic energy deficiency (>500)	16	8
Normal (300-500)	182	91
Overweight (<300)	2	1
Waist Hip Ratio		
Normal (≤ 0.8)	46	23
Obese (>0.8)	154	77
Mid arm Circumference		
Standard 100% (>28.5)	119	59.5
Standard 90% (25.7-28.5)	73	36.5
Standard 80% (22.8-25.7)	7	3.5
Standard 70% (20-22.8)	1	0.5
Standard 60% (17.1-20)	0	0
Arm Muscle Circumference		
Standard 100% (>23.2)	24	12
Standard 90% (20.9-23.2)	74	37
Standard 80% (18.6-20.9)	41	20.5
Standard 70% (16.2-18.6)	53	26.5
Standard 60% (14-16.2)	8	4

Percent of normal subjects judged by WHR were lower compared with Gopalan (2002). However, higher percent of females were in the category of obesity. However, it was observed by Deepa *et al.* (2008) in a study conducted on nutritional status of 100 menopausal women that the mean

waist hip ratio was found to be higher in pre-menopausal women compared to post-menopausal and the difference was found to be significant.

Mid-Arm Circumference

It was observed that 59.5% of the subjects were meeting 100% of the standard, 36.5% were meeting 90% standard and remaining 3.5% were meeting 80% of the standard. Almost 41.5% of the subjects were not meeting the standard (100%).

Arm Muscle Circumference

As far as arm muscle circumference was concerned only 12% of the subjects were meeting 100% of the standard, 37% were meeting 90% standard, 26.5% were meeting 70% of the standard and 20.5% were meeting 80% of the standard. Almost 88% of the subjects were not meeting the standard which indicates lower protein status.

Age-Wise Classification of Subjects According to Anthropometric Indices

The subjects in the study were in the age group of 46-65 years. There was an interval of 5 years among the age groups. Age-wise classification of subjects according to anthropometric indices is indicated in Table 6. The anthropometric indices indicated a wide variation among the age groups. According to the classification of Subjects (46-50 years) according to body mass Index, it was observed that as much as 61.7% of the subjects were found to be normal, 36.7% of the subjects to be overweight and 1.7% of them were found to be undernourished. In the age group of 51-55 years it was observed that 60.7% of the subjects were overweight followed by 37.5% of the subjects to be normal and only 1.8% to be under nourished. In the age group of 56-60 years, it was observed that 7.4% of the subjects were undernourished, 44.4% of the subjects were normal and 48.1% of the subjects were overweight. It is evident from the results that in the age group of 61-65 years, 53.3% of the subjects were found to be over weight, 40% were normal and only 6.66% were undernourished.

As per the Brokas Index, it was found that 80.35% subjects were found to be normal in the age group 51-55 years and 63.33 subjects were found to be normal in age group of 61-65 years. Nine subjects (16.7%) were found to be overweight in the age group of 56-60 years and only 3.33% were overweight in the age group of 61-65 years.

As per the lean body mass index classification, 96.4% of the subjects were classified as normal in the age group of

51-55 years and 3.6% of the subjects were classified as chronic energy deficient. The WHR classification of subjects showed 75% of the subjects to be normal and 25% of the subjects to be obese in the age group of 46-50 years.

As far as arm muscle circumference was concerned, in the age group of 46-50 years, only 6.7% of the subjects were meeting 100% of the standard, 33.3% were meeting 90% of the standard, 26.66% were meeting 80% of the standard, 28.3% were meeting 70% of the standard and only 5% of them were meeting 60% standard. Almost 70 to 80% of the subjects were not meeting the standard which indicated lower protein status among menopausal women. The Chi-square test was applied to test the independentness between the anthropometric indices versus the different age groups of the subjects. As per the analysis it was found that that there was an association between anthropometric indices and different age groups of all the subjects.

Relationship Between Anthropometric Measurements with Waist Hip Ratio and Brokas Index

To know the relationship between anthropometric measurements with Waist Hip Ratio (WHR) and Brokas Index (BI), the correlation co-efficients of anthropometric measurements with waist hip ratio and brokas index are presented in Table 7.

It was observed that the anthropometric measurements like weight, mid-arm circumference, fat fold thickness, waist circumference and hip circumference were positively correlated with Brokas Index and only fat fold thickness was positively correlated with waist hip ratio. Similarly anthropometric measurements like height, weight, mid-arm circumference, waist circumference and hip circumference were negatively correlated with waist hip ratio of the subjects. The reason can be attributed due to condition of menopausal women being different from normal women.

Correlation Between Nutrients with WHR and BMI of Menopausal Women

It was observed that all the nutrients except fat were negatively correlated with Body mass index. It was also noticed that all nutrients except carbohydrates and energy were negatively correlated with waist hip ratio (Figure 1). Hence, it can be concluded that among the nutrients, the intake of fat had an increasing tendency of body mass index and the intake of carbohydrates had an increasing tendency with waist hip ratio.

Table 6: Age-Wise Classification of Subjects According to Anthropometric Indices (n = 200)

Anthropometric Indices	46-50 yrs		51-55 yrs		56-60 yrs		61-65 yrs		² value
	n	%	n	%	n	%	n	%	
Body Mass Index									
Under nutrition (?18.5)	1	1.7	1	1.8	4	7.4	2	6.7	11.55*
Normal (18.5-25)	37	61.7	21	37.5	24	44.4	12	40	
Overweight (?25)	22	36.7	34	60.7	26	48.1	16	53.3	
Brokas Index									
Normal (80-120)	43	71.6	45	80.35	33	61.1	19	63.3	23.81*
Overweight (120-130)	4	6.7	4	7.14	9	16.7	1	3.3	
Obese (130-140)	13	100	7	12.5	12	22.2	10	33.3	
Lean Body Mass Index									
Chronic Energy Deficiency (>500)	6	10	2	3.6	4	7.4	4	13.3	11.39*
Normal (300-500)	52	86.7	54	96.4	50	92.6	26	86.7	
Overweight (<300)	2	3.3	-	-	-	-	-	-	
Waist Hip Ratio									
Normal (?0.8)	15	25	31	55.4	12	22.2	3	10	10.66*
Obese (>0.8)	45	75	25	44.6	42	77.8	27	90	
Mid Arm Circumference									
Standard 100% (>28.5)	29	48.3	37	66	26	48.1	25	83.3	33.08*
Standard 90% (25.7-28.5)	25	41.7	19	33.9	24	44.4	3	10	
Standard 80% (22.8-25.7)	6	10	-	-	4	7.4	-	-	
Standard 70% (20-22.8)	-	-	-	-	-	-	2	6.7	
Standard 60% (17.1-20)	-	-	-	-	-	-	-	-	
Arm Muscle Circumference									
Standard 100% (>23.2)	4	6.7	6	10.7	4	7.4	9	30	27.82*
Standard 90% (20.9-23.2)	20	33.3	25	44.6	17	31.5	12	40	
Standard 80% (18.6-20.9)	16	26.8	9	16	12	22.2	5	16.7	
Standard 70% (16.2-18.6)	17	28.3	11	19.6	21	38.9	3	10	
Standard 60% (14-16.2)	3	5	5	8.9	-	-	1	3.3	

Note: * Significant at 5% level.

Correlation Between Anthropometric Measurements and Nutrient Intake

The correlation coefficient between anthropometric measurements with nutrient intake is represented in Table VIII. As per the results obtained based on karlpearson's coefficient of correlation, weight, fatfold thickness and hip circumference were positively correlated with nutrients like fat. It was also noticed that waist circumference was

positively correlated with carbohydrates as well as with energy. However, the rest of the anthropometric measurements were negatively correlated.

The correlation coefficient between anthropometric indices and nutrient intake is represented in the Table 9. The anthropometric indices have a great influence on the nutritional intake and hence the relationship between anthropometric indices and nutrient intake was found out.

Table 7: Correlation Co-efficient Between Anthropometric Measurements with Waist Hip Ratio and Brokas Index (n = 200)

Anthropometric Measurements	Correlation Co-efficient Waist Hip Ratio	Brokas Index
Height (cms)	-0.2096	-0.4301
Weight (Kgs)	-0.1331	0.5344
Mid upper arm circumference (cms)	-0.0305	0.3376
Fat fold thickness (mm)	0.3841	0.4387
Waist circumference (cms)	-0.2983	0.3226
Hip circumference (cms)	-0.0188	0.4029

It was observed that (LBMI) lean body mass index was positively correlated with protien, crude fibre, carbohydrate, energy, calcium and iron. As the intake of nutrients like Protien, crude fibre, carbohydrate, energy, calcium and iron

Figure 1: Correlation Coefficient Between Nutrients with WHR and BMI of the Subjects

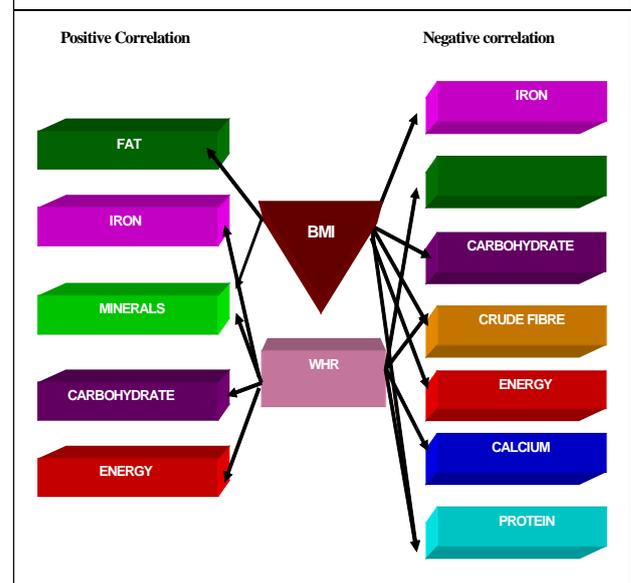


Table 8: Correlation Coefficients Between Anthropometric Measurements and Nutrient Intake of the Subjects (n = 200)

Anthropometric Measurements	Nutrient Intake					
	Protein (g)	Fat (g)	Carbohydrate (g)	Energy (Kcal)	Calcium (mg)	Iron (mg)
Height (cm)	-0.0899	-0.0326	-0.1344	-0.0905	-0.0264	-0.1844
Weight (kg)	-0.1199	0.0481	-0.1436	-0.075	-0.1054	-0.1594
Mid arm Circumference (cm)	-0.1931	-0.0917	-0.1358	-0.1619	-0.1491	-0.0794
Fat fold thickness (mm)	-0.0048	0.041	-0.0192	-0.003	0.0057	0.0144
Waist Circumference (cm)	-0.0584	-0.015	0.036	0.0236	-0.0866	-0.0976
Hip Circumference (cm)	-0.0373	0.04783	-0.0283	0.0018	-0.0305	-0.1276

Table 9: Correlation Between Anthropometric Indices and Nutrient Intake of the Subjects (n = 200)

Anthropometric Measurements	Protein (g)	Fat (g)	Carbohydrate (g)	Energy (Kcal)	Calcium (mg)	Iron (mg)
Body Mass Index	-0.0676	0.06063	-0.054	-0.015	-0.0495	-0.0179
Brokas Index	-0.0274	0.0806	-0.0141	0.0011	-0.0425	0.0474
Lean Body Mass Index	0.0851	-0.06	0.0937	0.0445	0.0414	0.0291
Waist Hip Ratio	-0.0636	-0.0908	0.0678	0.0096	-0.0926	0.0338
Arm Muscle Circumference	0.0279	0.0275	0.0447	0.0453	-0.1268	0.009

were increased it was observed that there was increase in LBMI of the subjects. Similarly arm muscle circumference was positively correlated with Carbohydrate, energy and iron. Similarly arm muscle circumference was positively correlated with Carbohydrate, energy and iron.

CONCLUSION

Nutritional Anthropometry is one of the simplest technique that is economical and easy to utilise for assessment of the nutritional status of women. They serve as the ready reckoner for assessment of the condition of women there by precaution and care can be taken to manage the prevailing condition of menopausal women. The Anthropometric measurements and indices aid in classification of women as per their age and nutritional status. The present investigation indicated an association between anthropometric indices and different age groups of all the subjects. There was positive correlation between Anthropometric measurements as well as Anthropometric indices with nutrient intake.

Hence, it can be concluded that the intake of dietary fat had an increasing tendency of body mass index and the intake of carbohydrates in diet had an increasing tendency with waist hip ratio. As the intake of nutrients like Protein, crude fibre, carbohydrate, energy, calcium and iron was increased, it was observed that there was increase in LBMI of the subjects. Similarly arm muscle circumference was positively correlated with Carbohydrate, energy and iron. Therefore, counseling and awareness programmes about menopausal problems, orthopaedic ailments, nutritional foods and dietary intake could be encouraged so that the nutritional status can be maintained in good condition by the post-menopausal women.

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