

A Study on Nutrient Intake and Energy Balance of Women- Home Makers, Gainfully Employed Non-Executives and Executives

Research Article

Sowmya G Rao* and Shashikala Puttaraj

Department of Studies in Food Science and Nutrition, Manasagangotri, University of Mysore, Mysore 570 006, Karnataka, India.

***Corresponding author:** Dr. Sowmya G Rao, Department of Studies in Food Science and Nutrition, Manasagangotri, University of Mysore, Mysore 570 006, Karnataka, India; E-mail: raosowmya23@gmail.com

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Abstract

The present study was conducted in Mysore city of Karnataka, on 250 Normal women in the age group of 20-60 yrs consisting of Home makers who were not employed (NE) as well as women gainfully employed. The gainfully employed group of women was subdivided into Non-executives (NEX) and Executives (EX) comprising of 75 subjects for each of the category. A preformed questionnaire was used to record personal data, anthropometric measurements, dietary intake and activity record of the selected women. Majority of women in the study belonged to nuclear type of family with a dietary pattern similar to that prevalent in Mysore city, Karnataka. The mean heights of women irrespective of age group were similar. Body weights gradually showed an increase over the age gradient with both the employed groups of women - NEX and EX gaining higher weight than the NE women. The dietaries of these women revealed an intake below the suggested amounts in DDP except for the sugar/ jaggery, fats and oils. The intake of pulses and vegetables was considerably low particularly in EX women. As the age advanced, the energy and protein intake was found to be reduced. The study concluded that nutritional status of the women continues to be unsatisfactory despite having a satisfactory socio economic status in an acceptable demographic frame as women showed low protein and high fat status with a sedentary life style and increasing WHR values over the age gradient.

Key words: Women; Food intake; Nutrient intake; Somatic status; Activity pattern, Energy balance

Introduction

Over the last five decades, there has been considerable progress in social and economic development in India [1]. The unprecedented population growth has imposed enormous demands on all fronts particularly food production, distribution and food security in order to promote nutrition and health. Considering the enormous hurdle that India has faced the progress that has been achieved in the field of nutrition and health on the whole is commendable [2].

The Indian population is passing through a transition phase where subsistence conditions are being replaced by plentiful food but reduced physical work and therefore, an understanding of the changing nutritional scene is critical [1].

Women play a central role in child care and food processing even when their economic roles require extensive time and physical energy [3]. Poor health has repercussions not only for women but also their families [4].

Affluence, progressive aging of the population, upward socio-economic conditions and changed lifestyles lead to an increase in Non-communicable diseases. It has been projected that while the infectious diseases would decline from 56% in 1999 to 25% in 2020, non-communicable diseases would increase from 29% in 1990 to over 57% in 2020 [5].

Women work twice as much as men equally at home as well as the work place [6]. However, it is been argued that while the women's

additional work is helpful to increase the household income, it may not always lead to an improved diet due to change in priorities [7]. Hence, the present study was undertaken to determine the nutrient intake and energy balance of women.

Materials and Methods

The study was conducted in Mysore city of Karnataka, India. Permission from Human Ethical Committee of University of Mysore was obtained to conduct the study on human subjects. The random sampling procedure was employed to select the subjects for the study based on their willingness to participate and being available for collecting data on study needs. 250 Normal women in the age group of 20-60 years with BMI above 19 and below 25 were randomly selected from different areas of Mysore city. Women- both working outside (n=150) and confined to household work only (n=100) were included. The gainfully employed group of women was subdivided into Non-executives and Executives comprising of 75 subjects for each of the category.

Non-executive comprised of women who were working in colleges and schools as lecturers and teachers, clerks and accountants in bank and other firms. Executives comprised of Professors, Principals, and engineers working for software companies. The criteria for selecting executives were their income level which was higher compared to non-executives.

A preformed questionnaire was used to record personal data, anthropometric measurements, dietary intake, and activity record of the selected women.

The food intake of all the women was assessed by interviewing the women with the help of household measures relevant to Indian cuisine models to construct the individual women's 24-hour food intake. Raw amounts for the cooked food items were derived by standardizing the preparatory methods of different menu items. The total energy intake was derived by the amount of macronutrients included in the diet [8]. The energy intake of the women was compared against recommended dietary intake for ensuring the appropriateness of intake derived based on the Recommended Dietary Allowances for age, gender and activity [9].

Anthropometric measurements- Height (cm), Weight (kg), Arm circumference (cm), Waist (cm), Hip(cm), Triceps Skin Fold (mm), measurements using the standard procedure [10,11] were recorded for all the 250 subjects.

Energy expended in different activities for two consecutive days was computed using the data on time use recalls of the subjects as per the Food and Agriculture Organization/World Health Organization estimates [12] of energy required per minute for specified class of activities.

The data was tabulated and subjected to appropriate statistical analysis.

Results

Demographic characteristics of the women - Employed Executives (EX) and Non-executives (NEX) and not gainfully employed outside

(NE) are presented in Table 1 and the Socio economic characteristics are given in Table 2. Majority of the study group (80%) belonged to nuclear type of family. The age distribution was highly skewed with more than 60% being adults in the age group of 20-60 years. The demographic features of the study group were found to be more or less similar between the employed and not employed groups of women.

An appraisal of marital status of women in the study group revealed that 95% were found to be married. Age at menarche, marriage and menopause was found to be in the acceptable range generally indicated for women in India (Table 3). Most of the women (79%) reported having a regular menstrual cycle. The mean age at

Table 1: Demographic Features of the Families of Selected Women.

Features	NE n= 100	NEX n= 75	EX n= 75	Total
Family type				
Nuclear	79(79)	66(88)	61(81)	206(82)
Joint	21(21)	9(12)	14(18)	44(18)
$X^2 = 2.936$ $CC = 0.108$ $p = 0.230^a$				
Family composition (Age group in years)				
Children $\leq 6-12$	79(22)	64(21)	59(21)	202(22)
Adolescents 13-19	31(9)	24(9)	11(4)	66(7)
Adults >20	211(59)	176(62)	186(68)	573(62)
>60	39(10)	22(8)	19(7)	80(9)
Total	360(100)	286(100)	275(100)	921(100)
$X^2 = 228.341$ $CC = 0.691$ $p = 0.0001^c$				
Mean Family Size	3.6 \pm 1.4	3.8 \pm 1.1	3.6 \pm 1.0	3.6 \pm 1.2
Mean age of Women	36.7 \pm 8.6	39.1 \pm 7.8	38.6 \pm 6.8	37.9 \pm 7.9

Figures in parenthesis indicate percentages

CC = Contingency co-efficient.

a = not significant at 5% level of significance

c = highly significant at 1% level of significance

marriage was found to be higher for EX (25 y) than for NE or NX (21y). The mean number of pregnancies was significantly higher in NEX than NE or EX. However, mean number of children in the families indicated a smaller family among these women. Mean age at menopause was in the range of 44 to 46 y for these women.

The Somatic status of women was assessed for all the 250 women selected for the study and is presented in Table 4 and 5. The mean heights of women irrespective of age group were similar. Body weights gradually showed an increase over the age gradient with both the employed groups of women - NEX and EX gaining higher weight than the NE women. While MUAC indicator of lean body mass significantly decreased over the age range in case of EX women. The decrease was not significant in NE and EX women. Fat mass as indicated by TSF showed a significant increase in all the three groups of women over the age gradient. While hip measurements were showing a similar pattern of increase as that of TSF over the age gradient, the waist measurements were not consistent either with the

Table 2: Socio Economic Characteristics of the Selected Women.

Characteristics	NE	NEX	EX	Total
Religion				
Hindu	94(94)	66(88)	70(93)	230(92)
Christian	2(2)	7(9)	3(4)	12(5)
Muslim	4(4)	2(3)	2(3)	8(3)
$X^2 = 5.466$ $CC = 0.146$ $p = 0.243^a$				
Educational status				
Non- literate	9(9)	0(0)	0	9(4)
Primary Level	6(6)	0	0	6(2)
PUC	22(22)	0	0	22(9)
Graduate	63(63)	40(53)	8(11)	111(44)
Post-Graduate	0	35(47)	67(89)	102(41)
$X^2 = 168.594$ $CC = 0.635$ $p = 0.0001^c$				
Total Family income	12435±5698	13366±1896	54480±22720	25328±23045
Sources of income				
Salary	92(92)	75(100)	75(100)	242(97)
House rent	1(1)	5(5)	0	6(2)
Business	7(7)	6(6)	0	13(5)
Lands	3(3)	10(10)	0	13(5)
Any other (Pension)	1(1)	5(5)	0	6(2)
Income range				
5000-10,000	19(19)	2(3)	0	21(8)
10,000-20,000	77(77)	73(97)	0	150(60)
>20,000	4(4)	0	75(100)	79(32)
$X^2 = 247.381$ $CC = 0.705$ $p = 0.0001^c$				
Nature of income				
Monthly	100(100)	75(100)	75(100)	250(100)
Annual	3(3)	8(11)	0	11(4)

Figures in parenthesis indicate percentages ,

CC = Contingency co-efficient,

Superscripts indicates

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c = highly significant at 1% level of significance.

group or the age brackets.

The anthropometric indices - Body mass index (BMI) showed a gradual significant increase over the age range of 20-60 y whereas, WHR showed an increase up to 40 y and further decreased. However, in case of EX women WHR showed a gradual decrease over the age gradient. MUAMC, an indicator of protein status also showed a significant decrease over the age gradient much higher compared to MUAC.

Between the groups while the heights of these women were similar, body weights were found to be higher in case of EX women as compared to NE and NEX. On an average, the women in the three groups were 155.4 to 155.1 cm tall and weighed 57.3 to 59.1 Kgs. BMI

of NEX and EX were significantly higher than that of NE group.

Compared to the reported values [10], these women had higher MUAC but similar TSF. The NE women were showing higher MUAC and MUAMC followed by EX and NEX with significant differences between the groups. However, these were much lower than the standards indicating a decrease lean body mass thus, a low protein status. TSF was found to be higher in both NEX and EX women than that of NE group. Both waist measurements found to be higher in NE

Table 3: Marital Status and Reproductive History of the selected women.

Criteria	NE	NEX	EX	Total
Marital status				
Married	99(99)	72(96)	67(89)	238(95)
Unmarried	0	3(4)	6(9)	9(4)
Widow	1(1)	0	0	1(0.4)
Divorcee	0	0	2(2)	2(0.8)
$X^2 = 11.230$ $CC = 0.209$ $p = 0.024^b$				
Reproductive history				
Age at Menarche	12±1	13±1	13±2	12.9±1.5
Age at Marriage	21±3	21±5	25±3	22.0±4.2
Mean No. of still births	0.05±0.21	0.01±0.11	0	0.03±0.18
Mean No. of abortions	0.09±0.28	0.12±0.31	0.14±0.35	0.18±0.47
Mean No of children	2±1	2±1	2±1	2±1
Mean age at menopause	45±3	44±3	46±2	45±3
No. of women undergone hysterectomy	7(7)	3(4)	8(11)	18(7)
Number of pregnancies				
None	8(8)	4(6)	14(19)	26(10)
One	39(39)	29(38)	28(37)	96(38)
Two	41(41)	42(56)	33(44)	116(46)
Three	4(4)	0	0	4(2)
>three	8(8)	0	0	8(3)
$X^2 = 13.852$ $CC = 0.229$ $p = 0.031^b$				
Menstrual cycle				
Regular	77(77)	62(83)	59(79)	198(79)
Irregular	23(23)	13(17)	16(21)	52(21)
$X^2 = 7.900$ $CC = 0.175$ $p = 0.095^a$				
Method of family planning used				
Tubectomy	3(3)	0	0	3(1)
Natural	10(10)	10(33)	2(3)	22(9)
Copper -T	6(6)	9(12)	4(5)	19(8)
Condom	57(57)	23(30)	37(49)	117(47)
Pills	7(7)	10(13)	9(12)	26(10)
$X^2 = 29.597$ $CC = 0.325$ $p = 0.0001^c$				

Figures in parenthesis indicate percentages

CC = Contingency co-efficient

a = not significant at 5% level of significance

b= significant at 5% level of significance

c = highly significant at 1% level of significance.

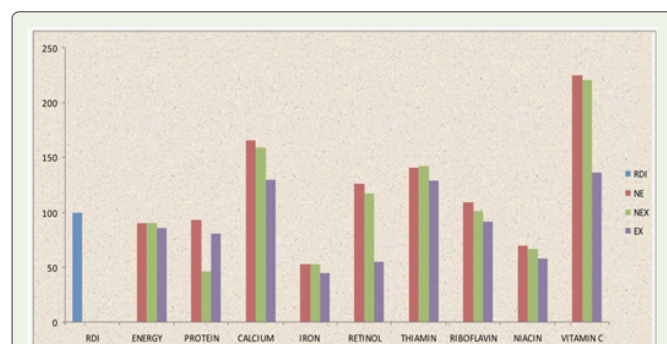


Figure 1: Percent adequacy of Diets consumed by the selected women.

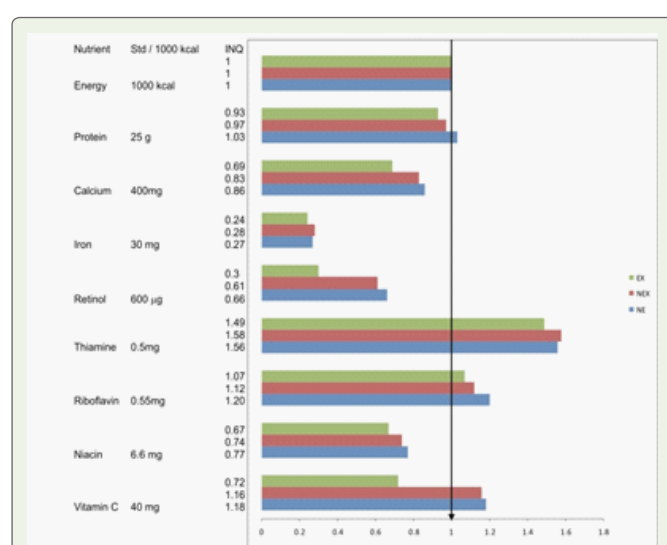


Figure 2: INQ of diets consumed by selected women.

women followed by EX and NEX with significant difference between the groups. However, WHR was similar in NE and NEX women; it was significantly higher in EX women.

The data on the mean food intake of women- NE, NEX and EX are presented in Table 6 and 7. Cereals were the major items of food included in the diet. The other major items were found to be milk and milk products, other vegetables, roots and tubers and fleshy foods (in case of NE). The consumption of green leafy vegetables was found to be low in all the three groups with nil intakes in case of EX women in the age brackets of 31-40 y and 51-60y. However, differences existed in the intake of some foods over the age range of 20-60 y in each of the groups. In case of NE the consumption of other vegetables, roots and tubers, milk and milk products, nuts, oilseed and coconut was significantly different between the age brackets. In case of NEX among all the foods the intake of only milk and milk products was significantly different over the age gradient. In case of EX seven out of eleven foods – pulses, GLV, other vegetables, milk and milk products, sugar and jaggery, fruits, nuts and oilseeds were significantly different for women in the four age brackets. The intake of milk and milk products over the age range was significantly different for all the women irrespective of the groups- NE, NEX and EX. As compared to

DDP except for milk and milk products, sugar and jaggery, fats and oils and intake of fruits in EX women 51-60 y, the intake of all other foods including cereals was low.

Between the three groups of women except for the intake of cereals all other foods were found to be significantly different over the age range with differences in the amounts of foods consumed by the women in each of the group. While the intake of pulses, GLV, roots and tubers were found to be higher in NE, the intake of 'other vegetables' was higher in NEX. EX women showed a higher intake of milk and milk products, sugar and jaggery, fruits, nuts oilseeds and coconut. It was interesting to note that the intake of green leafy vegetables was almost negligible (5 ± 15 g) and so also the other vegetables which was half of the amount that was being consumed by the other two groups NE and NEX. The cereal pulse ratio was found to be 6:1 in NE and NEX groups which are similar to the ratio as recommended by the ICMR where as in case of EX women it was 8:1 which is much below the recommendations.

Thus, the dietaries of these women revealed an intake below the suggested amounts in DDP except for the sugar/ jaggery, fats and oils. The intake of pulses and vegetables was considerably low particularly in EX women.

The intake of energy and macronutrients of women in the three groups are presented in Table 8 and 9. Though, cereal intake was satisfactory being $\geq 90\%$ of the DDP it fell short of RDI. Over the age gradient- 20-60 y the energy intake showed a decrease which was not significant in all the three groups of women. Significant differences were seen in the protein intake over the age range in case of EX followed by NE but not in NEX women except for the younger women in the age bracket of 20-30 y of NE and EX all other women irrespective of age brackets or groups showed a decreased protein intake. In case of EX the differences seen in the intake of carbohydrate and fat was significantly different between the age brackets whereas, it was not significant in NEX.

NE women showed differences in the intakes of carbohydrate but the intake of fat remained similar over the age gradient. As the age advanced, the energy and protein intake reduced. Overall, the energy and protein intake were much lower in the ≥ 30 age range irrespective of the group. Between the three groups- NE, NEX and EX the intake of energy and protein was much lower in EX followed by NEX women. The intake of fat was found to be similar between the groups with differences in the carbohydrate intake which was significant at 5% level of significance. The distribution of woman's intake of cereals, roots and tubers reflected the energy intake from macronutrients. The pattern of mean percent energy contributed from carbohydrate protein and fat ranged from 62:10:28 in NE, 63:10:27 in NEX and 63:9:28 in EX women. The protein from the animal source constituted more than one fourth of the total protein intake which is similar to the recommendation of ICMR. The diets were found to be high in poly unsaturated fatty acids due to the usage of sunflower oil. Since few women were also using ground nut oil occasionally, some amount of monounsaturated fat is expected to be a component of total fat intake.

The micronutrient intake (Table 10 and 11) was found to be

Table 4: Mean Anthropometric Measurements and Indices of Women in the Three Groups- Age Wise

Anthropometric measurements and Indices	NE Age group (y)				p-value	NEX Age group (y)				p-value	EX Age group (y)				p-value
	20-30	31-40	41-50	51-60		20-30	31-40	41-50	51-60		20-30	31-40	41-50	51-60	
Height (cm)	156.8±4.9	154.8±4.6	154.1±4.4	154.5±5.1	0.260 ^a	155.2±3.3	154.1±3.6	154.4±3.2	156.6±5.3	0.236 ^a	153.5±3.9	154.0±0.0	156.7±2.0	154.9±2.5	0.109 ^a
Weight (Kgs)	56.0±4.4	57.4±4.4	58.2±3.8	58.9±4.4	0.231 ^a	54.2±6.0	56.9±3.4	58.4±3.2	62.6±5.3	0.0001 ^{ac}	56.3±2.0	58.0±2.5	62.2±3.4	63.0±1.9	0.0001 ^c
BMI	22.4±1.6	23.9±1.6	24.4±0.8	24.6±0.8	0.0001 ^c	22.4±2.0	24.0±1.3	24.4±0.7	25.4±0.8	0.0001 ^c	23.9±1.5	24.4±0.9	25.3±0.8	26.2±0.4	0.0001 ^c
MUAC (cm)	27.2±1.7	27.1±1.3	26.4±1.9	24.5±0.6	0.145 ^a	26.6±2.6	25.6±1.5	24.9±1.9	24.4±1.1	0.019 ^a	28.1±0.7	26.8±1.2	24.0±1.1	24.8±0.8	0.0001 ^c
TSF (mm)	15.7±2.9	18.7±1.2	19.4±1.0	20.9±2.6	0.0001 ^c	17.2±1.8	18.8±1.1	20.2±1.3	21.6±1.2	0.0001 ^c	16.6±1.3	18.4±1.4	20.0±0.8	22.0±1.4	0.0001 ^c
MUAMC (cm)	22.5±2.4	21.2±1.3	20.3±2.2	17.9±0.8	0.0001 ^c	21.2±2.5	19.7±1.6	18.5±1.7	17.6±1.1	0.0001 ^c	22.9±0.8	21.0±1.2	17.7±1.1	17.9±0.6	0.0001 ^c
Waist (cms)	76.8±6.7	85.7±7.4	85.5±3.9	84.8±3.8	0.001 ^c	70.8±10.8	76.5±6.3	78.7±6.7	84.6±4.0	0.0001 ^c	80.3±5.7	80.9±4.7	85.4±3.7	84.5±4.4	0.042 ^b
Hip (cm)	93.5±6.8	99.7±7.3	109.5±8.5	110.8±8.5	0.001 ^c	85.4±10.4	90.6±7.6	96.9±8.8	107.0±5.5	0.0001 ^c	92.0±5.5	93.8±5.8	102.2±4.8	104.0±6.5	0.0001 ^c
WHR	0.82±0.05	0.84±0.12	0.78±0.07	0.76±0.04	0.043 ^b	0.83±0.05	0.84±0.04	0.81±0.06	0.79±0.03	0.007 ^b	0.85±0.10	0.84±0.03	0.83±0.05	0.81±0.06	0.017 ^b
n	25	49	14	12		12	35	17	11		6	50	7	12	

Superscripts indicate-

a : Not significant at 5% level of significance,

b: Significant at 5% level of significance,

c :Highly significant at 1% level of significance

Table 5: Mean Anthropometric Measurements and Indices of the selected Women.

	NE	NEX	EX	p-value
Height (cm)	155.1±4.7	154.6±3.8	154.4±2.9	0.442 ^a
Weight (Kg)	57.3±4.3	57.6±3.8	59.1±3.3	0.022 ^b
BMI	23.7±1.6	24.0±1.5	24.7±1.1	0.0001 ^c
MUAC (cm)	27.0±1.6	25.4±1.9	26.7±1.1	0.0001 ^c
TSF (mm)	18.3±2.5	19.3±1.8	19.0±2.0	0.0001 ^c
MUAMC (cm)	21.2±2.1	19.4±2.0	20.4±1.9	0.0001 ^c
Waist (cms)	83.3±7.4	77.3±7.9	81.8±4.9	0.0001 ^c
Hip (cm)	100.9±9.5	93.6±10.4	96.1±7.1	0.0001 ^c
WHR	0.82±0.06	0.82±0.05	0.84±0.05	0.057 ^d
n	100	75	75	

Superscripts indicate-

a : Not significant at 5% level of significance,

c :Highly significant at 1% level of significance,

d : Significant at 1% but not at 5% level of significance

deficient in iron and Niacin. In addition, EX and NEX women in the age brackets of 51-60y were also showing deficient intake of retinol. Since, the intake of green leafy vegetable the main sources of iron was low it resulted in a deficient intake of iron. Over the age gradient significant differences in the intake was seen case of thiamine in NE women, iron, retinol riboflavin and vitamin C in case of EX women. None of the NEX women showed differences in the intake of micronutrient over the age gradient. Between the groups significant differences existed in the intake of all micronutrients with EX women showing greater deficiency in all the micronutrients. The most deficient micronutrients were iron, retinol, niacin in case of EX, iron and niacin in case of NE and NEX. However, the data indicated that among the micronutrients retinol was showing a wide variation in the SD implying that a few women might have had a normal intake of this nutrient. The results indicated that cereals, roots and tubers, fruits, milk and milk products were the main sources of energy, protein, calcium and vitamin C. Milk and milk products was the main sources of protein, retinol and riboflavin. Though the diet promoted adequate intake of thiamine it fell short in niacin.

Percent nutrient adequacy and nutrient quality index (INQ) of the diets consumed by the women in the study group are represented in Figure 1 and Figure 2. Nutrients as proportion of energy were more than sufficient with respect to thiamine riboflavin and vitamin C but fell short in calcium, iron, retinol, niacin in all the women irrespective of their employment status and also in case of protein in case of EX women.

Energy balance of the women in the study group is presented in Table 12 and 13. Energy intake of these women regardless of the group showed a lower intake of energy when compared to RDI with an energy expenditure similar to that of the intake tending towards a slight excess ranging from 5 to 30 kcal in the four age brackets in each of the group. Resting metabolic energy was found to be satisfactory adequate to meet the internal functional demands. Between the groups except for the resting metabolic energy which was found to be different with EX showing a higher value followed by NEX and NE. Though energy intake was lower than the RDI, it matched the energy expenditure. Thus all the women regardless of age brackets or groups based on the employment status were found to be in energy balance.

Table 6: Mean \pm SD Food Intake of Women Over the Age Range

Food Groups	NE Age group (y)				p-value	NEX Age group (y)				p-value	EX Age group (y)				p-value	*DDP
	20-30	31-40	41-50	51-60		20-30	31-40	41-50	51-60		20-30	31-40	41-50	51-60		
Cereals	255 \pm 45	260 \pm 20	245 \pm 10	250 \pm 15	0.365 ^a	250 \pm 35	260 \pm 25	260 \pm 35	265 \pm 20	0.495 ^a	255 \pm 30	255 \pm 20	255 \pm 5	245 \pm 20	0.724 ^a	300-250
Pulses	40 \pm 10	40 \pm 10	40 \pm 5	30 \pm 5	0.008 ^b	50 \pm 10	40 \pm 5	40 \pm 5	35 \pm 10	0.001 ^b	35 \pm 5	30 \pm 0	25 \pm 10	30 \pm 0	0.0001 ^c	60-50
Green leafy vegetables	45 \pm 40	50 \pm 40	50 \pm 5	45 \pm 25	0.806 ^a	40 \pm 20	60 \pm 45	30 \pm 25	20 \pm 25	0.006 ^b	35 \pm 25	0	30 \pm 30	0	0.0001 ^c	175-150
Other vegetables	115 \pm 40	110 \pm 20	140 \pm 10	135 \pm 20	0.0001 ^c	130 \pm 25	125 \pm 25	145 \pm 15	145 \pm 15	0.007 ^b	50 \pm 10	50 \pm 0	70 \pm 30	90 \pm 20	0.0001 ^c	200-150
Roots & tubers	115 \pm 20	120 \pm 25	130 \pm 20	140 \pm 20	0.0001 ^c	115 \pm 20	125 \pm 25	110 \pm 20	100 \pm 20	0.013 ^b	100 \pm 20	20 \pm 25	120 \pm 30	140 \pm 20	0.016 ^b	150-100
Milk/ products	250 \pm 10	225 \pm 25	200 \pm 25	200 \pm 15	0.0001 ^c	230 \pm 25	240 \pm 20	200 \pm 10	210 \pm 20	0.0001 ^c	200 \pm 50	245 \pm 20	250 \pm 50	250 \pm 0	0.0001 ^c	250
Sugar / Jaggery	30 \pm 5	30 \pm 5	30 \pm 0	30 \pm 0	-	30 \pm 0	30 \pm 0	30 \pm 0	30 \pm 0	-	30 \pm 10	40 \pm 5	35 \pm 5	30 \pm 0	0.0001 ^c	30-25
Fats & oils	30 \pm 5	30 \pm 5	30 \pm 0	30 \pm 0	-	30 \pm 0	30 \pm 0	30 \pm 0	30 \pm 0	-	30 \pm 0	30 \pm 5	30 \pm 0	30 \pm 0	0.168 ^a	30-25
Fruits	80 \pm 70	60 \pm 30	50 \pm 20	40 \pm 20	0.047 ^b	75 \pm 45	70 \pm 45	75 \pm 60	60 \pm 70	0.884 ^a	100 \pm 0	95 \pm 15	100 \pm 50	150 \pm 0	0.0001 ^c	150-125
Fleshy foods	115 \pm 45	135 \pm 50	190 \pm 35	105 \pm 65	0.128 ^a	40 \pm 70	15 \pm 45	20 \pm 55	30 \pm 60	0.390 ^a	65 \pm 50	20 \pm 40	65 \pm 80	15 \pm 60	-	-
Nuts/ oilseeds/ coconut	30 \pm 5	20 \pm 5	20 \pm 5	20 \pm 5	0.0001 ^c	25 \pm 10	20 \pm 10	30 \pm 5	25 \pm 10	0.075 ^a	30 \pm 5	30 \pm 0	25 \pm 10	15 \pm 10	0.0001 ^c	-
n	25	49	14	12		12	35	17	11		6	50	7	12		

*Desirable dietary pattern computed based on RDA of ICMR for adult women with an ideal body weight (IBW) to give 1900-2000 kcal and 50-60 grams of Protein per day.

Superscripts indicate-

a : Not significant at 5% level of significance,

b: Significant at 5% level of significance,

c :Highly significant at 1% level of significance

Table 7: Mean Food Intake of Women in the Three Groups.

Normal Group	NE	NEX	EX	*DDP	p-value
Food groups (g/ml)					
Cereals	255 \pm 30	260 \pm 30	255 \pm 20	300-250	0.147 ^a
Pulses	40 \pm 5	40 \pm 10	30 \pm 5	60-50	0.0001 ^c
Green leafy vegetable	50 \pm 35	45 \pm 40	5 \pm 15	175-150	0.0001 ^c
Other vegetable	120 \pm 30	130 \pm 25	60 \pm 20	200-150	0.0001 ^c
Roots & tubers	125 \pm 25	115 \pm 25	120 \pm 25	150-100	0.068 ^d
Milk	225 \pm 25	225 \pm 25	240 \pm 25	250	0.0001 ^c
Sugar & jaggery	30 \pm 0	30 \pm 5	35 \pm 5	30-25	0.0001 ^c
Fats & oils	30 \pm 0	30 \pm 10	30 \pm 5	30-25	0.0001 ^c
Fruits	60 \pm 40	70 \pm 50	105 \pm 30	150-125	0.0001 ^c
Fleshy foods	130 \pm 50	20 \pm 55	30 \pm 50	-	0.307 ^a
Nuts and oilseeds/Coconut	25 \pm 5	25 \pm 10	30 \pm 5	-	0.031 ^b
n	100	75	75		

*Desirable dietary pattern computed based on RDA of ICMR for adult women with an ideal body weight (IBW) to give 1900-2000 kcal and 50-60 grams of Protein per day.

Superscripts indicate-

a : Not significant at 5% level of significance,

c :Highly significant at 1% level of significance

Daily work pattern of women and the time spent on daily activities of each group of the women by their age brackets is presented in Table 14. The work pattern and the time spent by the women in the three groups- NE, NEX and EX are shown in Table 15. Between the two working groups of employed women, NEX women were found to

be spending more time on the household chores than the EX women. Thus, the time spent on household activities was comparatively less than the work outside. Hence, between the groups as expected NE women were spending more time on the household chores like dish washing, house cleaning, food preparation, child care etc. The

Table 8: Daily Intake of Energy and Macronutrients of Women.

Dietary constituents	Age group (y)				p-value
	20-30	31-40	41-50	51-60	
NE					
Energy (Kcal)	1950±30	1915±60	1895±60	1810±25	0.188 ^a
	(2130±170)	(2175±165)	(2095±140)	(2005±150)	
Protein (g)	53.6±14.6	49.3±11.7	49.4±17.4	41.8±10.0	0.010 ^b
	(53±4)	(54±4)	(52±3)	(50±4)	
Total Fat (g)	58.8±3.0	56.5±5.6	56.1±3.3	51.3±2.2	0.132 ^a
Carbohydrate (g)	297.1±17.1	296.8±13.8	293.2±9.7	289.5±10.2	0.035 ^b
n	25	49	14	12	
NEX					
Energy (Kcal)	1920±80	1915±60	1900±50	1885±100	0.577 ^a
	(2060±230)	(2150±120)	(2100±130)	(2130±180)	
Protein (g)	50.3±15.9	46.4±10.4	44.0±9.9	45.4±15.9	0.590 ^a
	(52±6)	(54±3)	(52±3)	(53±5)	
Total Fat (g)	55.8±2.2	54.9±5.9	55.8±3.1	54.7±4.9	0.874 ^a
Carbohydrate (g)	299.9±14.8	303.8±9.5	301.8±17.6	298.1±19.8	0.655 ^a
N	12	35	17	11	
EX					
Energy (Kcal)	1900±105	1895±105	1890±95	1830±165	0.319 ^a
	(2140±78)	(2195±105)	(2240±125)	(2140±65)	
Protein (g)	57.0±8.2	41.8±8.9	54.2±2.5	39.7±10.3	0.001 ^c
	(54±2)	(55±3)	(56±3)	(53±2)	
Total Fat (g)	55.3±0.4	58.2±4.1	54.2±2.5	53.0±10.0	0.001 ^c
Carbohydrate (g)	290.2±25.5	297.2±22.5	294.3±27.7	295.6±20.3	0.0001 ^c
n	6	50	7	12	

Figures in Parenthesis indicates RDI,

* RDI - Recommended dietary intake – Values are mean of RDI computed using ICMR recommendations for each of the woman based on Desirable body weight (DBW).

** No recommended dietary intake

Superscripts indicate-

a : Not significant at 5% level of significance,

c :Highly significant at 1% level of significance,

b: Significant at 5% level of significance

actual time spent in household work by the NEX women was almost double that of the EX women. Over the age group the time spent in household work gradually decreased still the older women (51-60 y) were also found to spend considerable time in the household work.

The women in the age group of 51-60 y reported spending more time in recreation. The total time spent in sleep by all the three groups of women irrespective of age brackets was more or less similar ranging from 480- 500 min (≥8 hrs). The time spent for personal care and physical activity was similar over the age brackets in all the three groups - NE,NEX,EX except for NEX women in the age range of 41-50y, 51-60y, spending less time for the personal care.

Time spent in the physical exercise by the women in three

groups over the age range of 20-60 y was found to be low ranging from 20-45 min, with younger women (20-30 y) spending more time in exercising. Daily work pattern of NEX and EX women indicated that more time was being spent at the work place rather than the household. The time spent by the employed women in office work including commutation ranged from 440 min (7hrs) to 600 min (10 hrs) highest time being spent by EX women in the younger age group 20-30, 31-40 y. The working environment of most of the employed women could be termed as sedentary as it involved mostly 'table' work. Moreover, most of the women irrespective of their employment status reported having engaged the services of domestic helpers in carrying out the household works. Between the groups it was noted

Table 9: Daily Intake of Energy and Macronutrients of Women.

Dietary constituents	NE	NEX	EX	Mean	p-value
Energy (Kcal)	1910±65 (2130±170)	1905±65 (2120±155)	1885±115 (2185±100)	1900±85 (2155±150)	0.188 ^a
Protein (g)	49.5±13.4 (53±4)	46.3±12.1 (53±4)	43.7±11.2 (55±3)	50±10 (54±4)	0.010 ^b
**Total Fat (g)	56.4±4.9	55.2±4.7	56.8±5.6	55±5	0.132 ^a
**Carbohydrate (g)	295.5±13.9	301.9±14.1	296.1±22.5	300±20	0.035 ^b
N	100	75	75	250	

Figures in Parenthesis indicates RDI,

* RDI - Recommended dietary intake – Values are mean of RDI computed using ICMR recommendations for each of the woman based on Desirable body weight (DBW).

** No recommended dietary intake

Superscripts indicate-

a : Not significant at 5% level of significance,

c :Highly significant at 1% level of significance,

b: Significant at 5% level of significance

Table 10: Mean ±SD Daily Intake of Micro Nutrients of the Women.

Dietary constituents	Age group (yrs)				p-value
	20-30	31-40	41-50	51-60	
NE					
*Calcium (mg)	675±155	680±215	630±65	590±80	0.372 ^a
*Iron (mg)	16.2±1.5	15.9±0.9	16.4±1.4	14.8±0.9	0.004 ^b
*Retinol(µg)	745±515	775±430	775±95	695±315	0.934 ^a
Thiamine(mg)	1.52±0.06 (1.06±0.08)	1.50±0.07 (1.08±0.08)	1.48±0.05 (1.04±0.06)	1.42±0.04 (1.00±0.07)	0.0001 ^c
Riboflavin(mg)	1.36±0.29 (1.17±0.09)	1.28±0.28 (1.19±0.09)	1.22±0.37 (1.15±0.07)	1.08±0.18 (1.10±0.08)	0.061 ^a
Niacin(mg)	9.6±1.6 (14.0±1.1)	10.1±1.6 (14.3±1.0)	9.3±1.3 (13.8±0.9)	8.8±1.0 (13.2±1.00)	0.041 ^b
*Vitamin C (mg)	90±50	90±40	95±5	90±30	0.918 ^a
N	25	49	14	12	
NEX					
*Calcium (mg)	620±130	700±195	570±90	560±90	0.011 ^b
*Iron (mg)	16.5±1.7	15.9±1.1	15.7±1.1	15.5±2.2	0.355 ^a
*Retinol(µg)	625±350	870±540	560±330	470±390	0.025 ^b
Thiamine(mg)	1.53±0.10 (1.03±0.11)	1.51±0.03 (1.07±0.06)	1.50±0.05 (1.04±0.06)	1.49±0.11 (1.06±0.09)	0.098 ^a
Riboflavin(mg)	1.26±0.39 (1.13±0.27)	1.18±0.21 (1.18±0.06)	1.11±0.28 (1.15±0.07)	1.15±0.28 (1.17±0.10)	0.553 ^a
Niacin(mg)	9.5±1.4 (13.6±1.5)	9.2±0.5 (14.1±0.8)	9.3±1.04 (13.8±0.8)	9.4±1.3 (14.0±1.2)	0.855 ^a
*Vitamin C (mg)	80±30	100±50	80±35	70±40	0.061 ^a
N	12	35	17	11	
EX					
*Calcium (mg)	540±55	485±25	590±10	605±310	0.012 ^b
*Iron (mg)	15.1±1.1	13.2±0.6	14.4±1.2	13.4±1.1	0.0001 ^c
*Retinol(µg)	695±265	260±60	645±325	280±4.2	0.0001 ^c
Thiamine(mg)	1.46±0.11 (1.07±0.03)	1.39±0.07 (1.09±0.05)	1.44±0.09 (1.12±0.06)	1.41±0.10 (1.07±0.03)	0.223 ^a
Riboflavin(mg)	1.28±0.14 (1.17±0.04)	1.07±0.13 (1.2±0.05)	1.31±0.22 (1.23±0.06)	1.03±0.04 (1.17±0.03)	0.0001 ^c
Niacin(mg)	8.6±0.9 (14.1±0.5)	8.2±0.5 (14.4±0.7)	8.44±0.39 (14.7±0.8)	8.3±0.7 (14.1±0.4)	0.600 ^a
*Vitamin C (mg)	75±20	45±5	75±7	65±5	0.0001 ^c
n	6	50	7	12	

Figures in Parenthesis indicate RDI, * RDI for calcium-400mg, Iron -30mg, Retinol-600 µg, Vitamin C- 40mg

Superscripts indicate-

- a : Not significant at 5% level of significance,
c :Highly significant at 1% level of significance,
b: Significant at 5% level of significance

Table 11: Daily Intake of Energy and Macronutrients of Women.

Dietary constituents	NE	NEX	EX	Mean	p-value
*Calcium (mg)	660±65	635±160	520±130	610±170	0.0001 ^c
*Iron (mg)	15.9±1.2	15.9±1.4	13.5±1.0	15.2±1.6	0.0001 ^c
*Retinol(µg)	760±405	700±470	330±200	615±420	0.0001 ^c
Thiamine(mg)	1.49±0.07 (1.06±0.08)	1.51±0.06 (1.06±0.07)	1.41±0.08 (1.09±0.05)	1.47±0.08 (1.07±0.07)	0.0001 ^c
Riboflavin(mg)	1.27±0.29 (1.17±0.09)	1.17±0.27 (1.16±0.08)	1.10±0.15 (1.20±0.05)	1.19±0.26 (1.17±0.08)	0.00001 ^c
Niacin(mg)	9.76±1.58 (14.0±1.1)	9.34±0.96 (13.9±1.0)	8.33±0.62 (14.4±0.6)	9.2±1.3 (14.1±0.9)	0.0001 ^c
*Vitamin C (mg)	90±38	88±40	55±13	78±38	0.0001 ^c
n	100	75	75	250	

Figures in Parenthesis indicate RDI

* RDI for calcium-400mg, Iron -30mg, Retinol-600 µg, Vitamin C- 40mg

Superscripts indicate-

- a : Not significant at 5% level of significance,
c :Highly significant at 1% level of significance,
b: Significant at 5% level of significance

Table 12: Energy Balance of Women Over the Age Range Of 20-60 Years.

Particulars	NE Age group (y)				p-value	NEX Age group (y)				p-value	EX Age group (y)				p-value
	20-30	31-40	41-50	51-60		20-30	31-40	41-50	51-60		20-30	31-40	41-50	51-60	
RDI	2130±170	2175±165	2095±137	2005±150	0.167 ^a	2060±230	2150±120	2100±130	2130±180	0.0001 ^c	2140±80	2195±105	2240±50	2140±65	0.0001 ^c
RME	1255±60	1265±35	1270±30	1280±35	0.056 ^a	1230±85	1260±30	1270±30	1310±45	0.001 ^c	1260±30	1270±20	1305±30	1310±15	0.0001 ^c
EI	1950±30	1915±60	1895±60	1810±25	0.188 ^a	1920±80	1915±60	1900±50	1885±100	0.577 ^a	1900±105	1895±105	1890±95	1830±165	0.319 ^a
EE	1940±75	1900±65	1880±90	1805±70	0.0001 ^c	1915±15	1905±40	1900±10	1880±15	0.013 ^a	1900±15	1875±15	1860±30	1825±30	0.0001 ^c
Deficit/ Excess (-) (+)	+10	+15	+15	+5		+5	+10	0	+5		0	+20	+30	+5	
N	25	49	14	12		12	35	17	11		6	50	7	12	

RDI-Recommended Dietary Intake (Kcal/day)

RME- Resting Metabolic Energy (Kcal/day)

EI-Energy Intake (Kcal/day)

EE-Energy Expenditure (Kcal/day) .

Superscripts indicate-

- a : Not significant at 5% level of significance,
c :Highly significant at 1% level of significance

all the EX women utilised the help of domestic helpers to a maximum extent than the NEX or NE. Thus, the daily activity pattern was found to be 'sedentary' in case of all the three groups of women.

Energy cost of different daily activities of women in the three groups -NE, NEX, and EX are presented in Table 16 and 17. The total energy expended per day over the age brackets of 20-60 y ranged from

1805 kcal to 1940 kcal with the energy expended showing a decrease in the older women (51-60 y). The total energy expended daily by the three groups of women were found to be 1895 (NE), 1900 (NEX), 1865 (EX) kcal/day. While the energy expended in household work, recreation were significantly higher in NE the energy expended in office work was significantly higher in EX (740 min) followed by NEX.

Table 13: Energy Balance of the selected Women.

Normal group	NE	NEX	EX	p-value
Recommended Dietary Intake (Kcal/day)	2130±170	2120±155	2185±100	0.167 ^a
Resting Metabolic Energy (Kcal/day)	1265±45	1270±50	1280±30	0.056 ^a
Energy Intake (Kcal/day)	1910±65	1905±65	1885±115	0.188 ^a
Energy Expenditure (Kcal/day)	1895±80	1900±30	1865±30	0.0001 ^c
Deficit/Excess (-) (+)	+15	+5	+20	

Superscripts indicate-

a : Not significant at 5% level of significance,

c :Highly significant at 1% level of significance

Table 14: Mean Time (Minutes) Spent by Women on Daily Activities.

Work pattern	NE Age group (y)				p-value	NEX Age group (y)				p-value	EX Age group (y)				p-value
	20-30	31-40	41-50	51-60		20-30	31-40	41-50	51-60		20-30	31-40	41-50	51-60	
Personal care	60±0	60±0	60±5	55±5	0.0001 ^c	55±10	60±10	40±0	40±5	0.0001 ^c	70±0	65±5	60±5	60±0	0.0001 ^c
Household work*	295±60	275±60	285±70	180±70	0.0001 ^c	220±115	210±90	190±30	185±30	0.042 ^b	120±10	120±40	125±30	105±20	0.485 ^a
Recreation	530±60	575±60	580±70	670±55	0.0001 ^c	205±35	210±40	250±45	265±30	0.0001 ^c	125±55	160±45	240±55	295±25	0.0001 ^c
Sleep	500±20	485±10	490±15	505±20	0.0001 ^c	480±0	495±20	490±20	480±0	0.019 ^b	480±0	480±5	495±10	500±5	0.0001 ^c
**Physical exercise	40±5	30±5	20±5	20±5	0.0001 ^c	30±0	30±5	30±0	30±0	0.565 ^a	45±5	30±5	30±5	30±0	0.0001 ^c
Office work+ Commutation	15±5	15±5	5±5	10±0	0.0001 ^c	450±30	440±50	440±5	440±0	0.015 ^b	600±55	585±60	490±45	450±10	0.0001 ^c
Total	1440	1440	1440	1440		1440	1440	1440	1440		1440	1440	1440	1440	
n	25	49	14	12		12	35	17	11		6	50	7	12	

*Includes all household work- cooking, cleaning, child care, Ironing, sweeping, washing cloths and washing dishes.** Walking

Superscripts indicate- a : Not significant at 5% level of significance, b: Significant at 5% level of significance, c :Highly significant at 1% level of significance

Table 15: Mean Time (Minutes) Spent by Women on Daily Activities.

Work pattern	NGE	NEX	EX	p-value
Personal care	60±5	50±10	65±5	0.0001 ^c
*Household work	275±70	200±40	115±30	0.0001 ^c
Recreation	575±70	230±45	190±70	0.0001 ^c
Sleep	490±15	490±15	485±10	0.080 ^a
**Physical exercise	30±10	30±5	30±5	0.003 ^b
Office work + Commutation	10±5	440±35	555±75	0.0001 ^c
Total	1440	1440	1440	

*Includes all household work- cooking, cleaning, child care, Ironing, sweeping, washing cloths and washing dishes.

** Walking

Superscripts indicate-

a : Not significant at 5% level of significance,

b: Significant at 5% level of significance,

c :Highly significant at 1% level of significance

Though energy expended for personal work was found to be higher in EX than NEX it was more or less similar to the energy expended by NE for personal care. The energy expended in sleep was similar in all

women irrespective of the age brackets or employment status.

Discussion

The results of the study are indicative of the fact that the nutritional

Table 16: Work Pattern of Women and Mean Energy Spent on Various Activities.

Work pattern	NE Age group (y)				p-value	NEX Age group (y)				p-value	EX Age group (y)				p-value
	20-30	31-40	41-50	51-60		20-30	31-40	41-50	51-60		20-30	31-40	41-50	51-60	
Personal care	70±0	70±0	70±5	65±5	0.0001 ^c	65±10	70±10	50±0	50±5	0.0001 ^c	85±0	75±5	70±5	70±0	0.0001 ^c
Household work *	590±150	540±140	550±160	345±145	0.0001 ^c	430±45	410±90	390±55	355±50	0.034 ^b	240±20	250±65	255±65	210±50	0.386 ^a
Recreation	640±75	690±70	695±85	805±70	0.0001 ^c	250±40	255±50	300±50	320±40	0.0001 ^c	150±65	195±55	290±70	350±30	0.0001 ^c
Sleep	500±20	485±10	490±15	505±20	0.0001 ^c	480±0	495±20	490±15	480±0	0.019 ^b	480±0	480±5	495±10	500±5	0.0001 ^c
**Physical exercise	120±25	95±10	70±15	70±10	0.0001 ^c	100±0	100±10	100±0	100±0	0.565 ^a	140±10	100±10	105±10	100±0	0.0001 ^c
Office work +Commutation	20±10	20±10	5±10	15±0	0.0001 ^c	590±30	575±65	570±10	575±0	0.015 ^b	805±80	775±85	645±60	595±10	0.0001 ^c
Total	1940±75	1900±65	1880±90	1805±70		1915±15	1905±40	1900±10	1880±15		1900±15	1875±15	1860±30	1825±30	
n	25	49	14	12		12	35	17	11		6	50	7	12	

*Includes all household work- cooking, cleaning, child care, Ironing, sweeping, washing cloths and washing dishes.

** Walking

Superscripts indicate- a : Not significant at 5% level of significance, b: Significant at 5% level of significance, c :Highly significant at 1% level of significance

Table 17: Work Pattern of Women and Mean Energy Cost of Activities.

Work pattern	NGE	NEX	EX	p-value
Personal care	70±5	60±10	75±5	0.0001
*Household work	530±160	400±75	235±60	0.0001
Recreation	690±85	275±55	225±80	0.0001
Sleep	490±15	490±15	485±10	0.107
**Physical exercise	95±25	100±10	100±15	0.002
Office work	20±10	575±45	740±105	0.0001
Total	1895±80	1900±30	1865±30	0.0001

*Includes all household work- cooking, cleaning, child care, Ironing, sweeping, washing cloths and washing dishes.

** Walking

Superscripts indicate-

a : Not significant at 5% level of significance,

b: Significant at 5% level of significance,

c :Highly significant at 1% level of significance

status of the women continues to be unsatisfactory despite having a satisfactory socio economic status in an acceptable demographic frame. The family income was similar for all the women regardless of their employment status. However, the women differed in their education levels with women EX having high level of education as compared to NEX or NE. The educational levels of these women were better to the reported figures of women in India [13-15]. Research evidence indicates a positive correlation between female literacy / education on health, nutrition and family size [16].

It has been shown that increasing educational levels result in better personal hygiene, improved child rearing, small families, increased income, adaptation of better diets to cite a few [16-19]. Household size of the families of these women was small, age at menarche (13y), mean age at marriage (21-25 y), mean age of menopause (45y) was similar to the reported figures [17-21].

It is a fact that food diversity results when all the basic needs are

satisfied [22]. The findings indicated a higher intake of milk and milk products as compared to other groups and preference for processed foods, fast foods and eating out particularly in EX and NE women. In fact, the energy from fat component was high (28%). Food behaviour as these are generally associated with prosperity may lead to dietary imbalances and at risk for developing NCD – hypertension, DM, CVD etc [12,23-26].

The characteristic dietary pattern of women was essential that of high fat, moderate CHO and low protein with adequate energy levels as indicated by energy balance. The actual food intake on daily basis showed diversity with NE and NEX women showing similar pattern. Though, the intake of green leafy vegetables was low in all women, it was negligible in EX women. The better income and educational status did not appear to translate to acceptable nutrient intakes as the energy and protein was much lower in EX and NEX women. In fact, women NE were having a better intake due to consumption of pulses, green leafy vegetables and other vegetables being higher in this

group. The low intake of green leafy vegetable and pulses reflected in low intake of iron and niacin in all women, which fell short of RDI. The low intake of iron reflected in most of the women having low haemoglobin levels, a most common nutritional problem in India [27]. The dietaries being high in fat - low in protein reflected in the body size of these women.

Body size of adults notably indicates the overall nutrition and health status, also serve as pointers to the changes in SES and demographic structure of the population [27]. Over the last century, clear cut increments in higher and weights of population groups have been noted in the developed and some of the developing countries [28]. However, in India, secular trends in heights are not seen among the low and middle income groups showing the effect of SES [29]. The increasing trend in body weights, MUAC, TSF, MUAMC and WHR against the age gradient is described as an age related phenomenon independent of menopause effects [27,30]. This is attributed to a combination of reduced energy requirement, low intake of protein, reduced physical activity (sedentary lifestyle) and altered hormonal profile both due to stress and related to menopause.

In the present study, though the secular trends in increments in heights were absent, the increments in weights showing an increasing trend with advancing years indicated the effect of satisfactory income levels [31-33]. The women were showing high TSF and low MUAC, MUAMC values indicating a high fat and low protein status reflecting the dietary intake patterns. Though, the BMI was within the range, WHR was higher particularly in EX women indicating increased centralized fat. Research evidence has shown a positive correlation between abdominal obesity and the risk of developing NCD [34]. Both childhood malnutrition and stress due to nutrient deficiencies and environment through the life span is reported to predispose excess deposition of fat tissue, particularly leading to central obesity at the expense of muscle mass [35]. The possible mechanisms are changes in the hypothalamic, autonomic nervous system and hormonal profile during the period of malnutrition, with perturbation of the hypothalamic - pituitary axis [34,36], secondary to stress being deemed as an important factor. An increased waist circumference itself has been associated with elevated risk factors because of its relation with visceral fat accumulation and the mechanism may involve excess exposure of the liver to fatty acid [37] though still being debated.

It has been demonstrated that increasing physical activity may decrease the amount of intra-abdominal fat and further mitigate the risk of NCD both in pre and post menopausal women [30]. Women in the present study were less active leading a sedentary lifestyle. Thus, relative physical inactivity with inappropriate diets high in fat resulted in increase body fat as indicated by WHR and TSF. It was observed that only 27% of the study group women had attained menopause. The effects of menopause on body composition changes towards increase in fat and increase risk for NCD are well known [38]. It is reported that decreased energy expenditure after menopause may deteriorate the central body fat distribution further [30].

It is reported that an individual may remain normal despite having a BMI above the normal range as long as the vital parameters - blood pressure, blood glucose / lipid levels are within the homeostatic range, as these processes are finely regulated and operate within the range of biological variability [1]. The individual is stated to be under

physiological stress only when the body's homeostatic limits are crossed. Thus, in a normal individual, shifting to a high fat diet and lower physical activity is liable to disturb the body's homeostasis leading to a risk of increase body fat and related adult diseases subsequently [1].

Conclusion

From the results and the observations made in the study, it could be stated that these women were still under homeostatic control of vital processes as the biological risk factors - hypertension, dyslipidemia, IGT were still not apparent but still, these women could be at risk for developing NCD due to the fact that they had increased fat attributable to unhealthy dietary patterns and physical activity. The findings from the study are important as they suggest that it is necessary to initiate a program combining physical activity measures with dietary modification- adequate protein, low fat and high fibre, increased green leafy vegetables and pulses for the retention of lean body mass particularly at the entry of menopausal stage.

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