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Determinants of Nutrition and Risk of Developing Non-Communicable Diseases in Adult Women

Research Article

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Abstract

The present study was conducted on women in the group of 20-60 years in Mysore city of Karnataka. The study group consisted of 250 Normal women and 250 women affected by Diabetes, CVD, obesity and arthritis. A preformed questionnaire was used to record personal data, anthropometric measurements, dietary intake and activity record of the selected women. Majority of women from both the groups belonged to nuclear type of family. The dietary pattern of these women in the group irrespective of their normal or disease status followed a similar pattern comparable to that prevalent in Mysore city, Karnataka. Anthropometric data revealed that the heights and weights of the women were significantly different with women in the normal group being taller and less heavy than the women in the disease groups. Results also showed that women in the Normal group were more physically active in terms of household work, office work despite the time spent in personal care being similar in both the groups. The results of the study statistically analyzed using multiple variant analysis (correlation coefficient and regression concepts) indicated age and menopausal status to be influencing most of the dependant variables like energy intake, energy expenditure, protein and fat intake independently followed by physical activity and stress factors in the selected women. The determinants of the marriage to a greater extent. The study concluded that the negative influence of these independent variables would certainly increase the risk of NCD among the selected women.

Keywords: Non-communicable diseases; Somatic Status; Food intake; Adult women

Introduction

Nations worldwide are experiencing epidemiologic transitions with increase in the population life expectancy and chronic Noncommunicable diseases (NCDs)–such as obesity, diabetes, cardiovascular diseases, osteoporosis, arthritis etc emerging as a leading cause of morbidity and mortality [1]. The stages and patterns of epidemiologic transition may vary across nations, but several common factors are reported to underlie these trends [1].

The risk factors of today are stated to be the diseases of tomorrow. Hence, identifying these risk factors in populations occupies a central place as lagged time exist between exposure and disease in any given individual / population. Therefore, strategies of prevention of diseases need to be based on not only identifying risk factors in population, but also understanding the profile of risk factors in different settings [2,3].

Chronic diseases result from genetic, behavioral and environmental factors and the interactions between them. These factors generally termed risk factors, produce molecular and structural changes in organ system and may produce signs of disease but often after a long period of time, even decades for most chronic diseases. Several risk factors clustering together may contribute to the

development of NCDs [4].

NCDs account for most of the global burden of disease as a consequence of past and cumulative risks. Hence, the future burden will be determined by current population exposure to risk factors. Although the major risk factors for NCD epidemics are more complex than those for infectious diseases, they are well known and account for almost all such events; many are common to the main categories of NCDs and most are modifiable and operate in the same manner in all regions of the world, with some quantitative differences [5-7]. Therefore, the present study was undertaken to assess the determinants of nutrition and to analyze the risk for developing NCD in women.

Materials and Methods

The target group of the study comprised of 250 women having a normal BMI and also 250 women affected with NCD viz, Arthritis, Cardiovascular disease (CVD), Type 2 Diabetes Mellitus (DM), Obesity and cluster group with combinations of DM,CVD, arthritis and obesity in the age group of 20-60 years (y).

The study was conducted at Vikram hospital and clinic located in Mysore city. Women visiting hospital outpatient department were screened by measuring their body weight and for the presence or absence of a specific NCD.

Normal women -Executives (EX), Non- Executives (NEX) and women not gainfully employed (NE) in the age range of 20-60 y with no diagnosed disease/disorders having BMI within the normal range as far as possible were drawn from different locations which included accompanying persons with patients, working in specific institutions and from selected households in Mysore city.

Permission from Human Ethical Committee of University of Mysore as well as the concerned Hospital authorities was obtained to conduct the study on human subjects.

A preformed questionnaire was used to record personal data, anthropometric measurements, dietary intake, activity record, and stress scores 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), Mid-upper arm circumference (MUAC), Waist (cm), Hip(cm), Triceps Skin Fold (TSF)(mm), measurements using the standard procedure [10,11] were recorded for all the 500 subjects. Waist and hip measurements were used to calculate waist -hip ratio (WHR). Other Indices like Mid-upper arm muscle circumference (MUAMC), Conicity index, Broka's index, Body Fat percent (BF%), Lean body mass index (LBMI), Lean body Mass (LBM), and Body density (BD) were calculated using formulas.

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 computed data was analyzed for statistical significance using different statistical tools. These tests include mean, standard deviation and percentages, which are used in simple comparison of different categories and frequencies. Chi- square was applied to find out the significance of variance in the study groups. Multiple variant analyses - correlation coefficient and regression concepts was used to find out the significant contribution made by the different independent variables on the dependent variable.

Results and Discussion

Demographic characteristics of women in Normal and Disease group as shown in Table 1 and 2 indicated that majority of the families in both the groups were of nuclear type. Except for the family composition, other demographic characteristics were not significant in the disease group.

Socio economic characteristics of Normal women are presented in Table 3. Majority of the women (92%) in the study group belonged to 'Hindu' by religion. Educational status of the women in EX was found to be better and higher than the NEX with women in NE (63%) having only graduation. It was found that 89% of women in EX were post graduates as compared only to 47% in case of NEX. However, 53% of NEX was found to be graduates.

As shown in Table 4, 94% of the women in the Disease group,

Table 1: Demographic Features of the Families of Women- Normal Group.

Features	NE	NEX	EX	Total		
	n= 100	n= 75	n= 75	n=250		
Family type						
Nuclear	79(79)	66(88)	61(81)	206(82)		
Joint	21(21)	9(12)	14(18)	44(18)		
X ² = 2.936 C	X ² = 2.936 CC = 0.108 p=0.230 ^a					
Family composition (
Children ≤ 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 =0.000	1°			
Mean Family Size	3.6±1.4	3.8±1.1	3.6±1.0	3.6±1.2		
Mean age of Women	36.7±8.6	39.1±7.8	38.6±6.8	37.9±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

Features	Arthritis n= 50	CVD n= 50	DM n= 50	Obesity n= 50	Cluster n= 50	Total n=250
Family type	Family type					
Nuclear	33(66)	32(64)	27(54)	29(58)	37(74)	158 (63)
Joint	17(34)	18(36)	23(46)	21(42)	13(26)	92 (37)
	X ² =5.	108 C	C=0.142	p=0.2	.76ª	
Family comp	osition (Age	group in y	ears)			
Children ≤ 6-12	21(10)	13(6)	52(21)	24(10)	10(5)	120(11)
Adolescents 13-19	38(17)	34(16)	12(5)	28(12)	25(11)	137(12)
Adults>20	135(61)	143(65)	143(59)	145(63)	142(65)	708(62)
>60	27(12)	29(13)	37(15)	35(15)	43(19)	171(15)
Total	221(100)	219(100)	244(100)	232(100)	220(100)	1136(100)
X ² =64.510 CC=0.166 p=0.0001°						
Mean Family Size	4.6±1.4	4.3±1.5	4.9±1.7	4.6±1.5	4.4±1.2	4.5±1.5
Mean Age of women	43.2±11.8	52.2±8.3	54.7±3.6	45.3±9.2	54.1±7.5	48.8±9.9

Table 2: Demographic Features of the Families of the Women- Disease Group.

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.

belong to Hindu by religion. The educational status was found to be low with 34% being Nonliterate and 42% having studied up to primary level. Thus, the educational status was found to be low for this group of women.

An appraisal of marital status of women in the normal group revealed that 95% were found to be married. Distribution of women by their marital status between the groups was found to be significant. Age at menarche, marriage and menopause was found to be in the acceptable range generally indicated for women in India Table 5. The mean age at menarche was found to be significantly higher in NEX and EX group. Most of the women (79%) reported having a regular menstrual cycle. Mean age at menopause was in the range of 44 to 46 y for these women. The number of women who had undergone 'Hysterectomy' was found to be very low (7%). The information on the method of family planning used was collected only from those women who were currently using different contraceptives. The distribution of women using different methods of family planning (currently) was found to be significant with most of the couples (47%) adapting 'condom', followed by 'pills' (10%), 'copper T'- (8%).

Marital status of women (Table 6) in the Disease group showed that 87% to be married with distribution of women between the groups to be significant. While age at menarche was found to be in the normally acceptable range, age of menopause was found to occur early, at a mean age of 44.7 y. Women experiencing irregular menstrual cycle were found to be in greater percentage in OB (48%) followed by cluster group (34%). Higher percentage of women (46%) having CVD had undergone hysterectomy followed by OB and women showing cluster of diseases (30%). The most common causative factor for undergoing hysterectomy was the presence SG Rao

of fibroid. The method of family planning used as reported by the women was found to be 'pills'. Though, number of women adapting family planning methods currently was small, the distribution of women using different methods of family planning was significant.

The food intake of women in the study group-normal and diseased group is shown in Table 7. Among the food groups, except for the intake of cereals and pulses all other foods excluding fats/ oils showed considerable differences in being highly significant between the normal and disease groups. The differences were seen in the intake of green leafy vegetables, other vegetables, milk and its products and fleshy foods like chicken, fish and mutton being higher in the normal group as compared to the disease group. The exception

 $\label{eq:constraint} \begin{array}{l} \textbf{Table 3:} Socio \ \mbox{Economic Characteristics of the Selected Women-Normal Group.} \end{array}$

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= 0.243ª	
Educational stat	us			
Nonliterate	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= 0.000)1°	
Total Family income	12435±5698	13366±1896	54480±22720	25328±23045
Sources of inco	me			
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°		
Nature of incom	e			
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

a = not significant at 5% level of significance ,

b= significant at 5% level of significance,

c = highly significant at 1% level of significance.

Table 4: Socio Economic Characteristics of the Selected Women- Disease Group.

Characteristics	Arthritis	CVD	DM	Obesity	Cluster	Total
Religion	II					
Hindu	49(98)	49(98)	44(88)	49(96)	43(86)	234(94)
Christian	0	1(2)	1(2)	1(2)	2(4)	5(2)
Muslim	1(2)	0	5(10)	0	5(10)	11(4)
	''	X ² = 14.968	CC = 0.238 p = 0.	060ª		
Educational status						
Nonliterate	15(30)	18(36)	22(44)	10(20)	21(42)	86(34)
Primary Level	23(46)	21(42)	22(44)	21(42)	18(36)	105(42)
PUC	4(8)	3(6)	3(6)	5(10)	7(14)	22(9)
Graduate	5(10)	8(16)	2(4)	11(22)	4(8)	30(12)
Post-Graduate	3(6)	0	1(2)	3(6)	0	7(3)
		X ² = 23.629	CC = 0.294 p	= 0.098 ^a		
Occupation						
Home maker	44(88)	48(96)	43(86)	44(88)	49(98)	228 (91)
Non- Executives	6(12)	2(4)	6(12)	6(12)	2(4)	22(9)
X ² =7.277 CC-7.277* p= 0.122 ^a						
Total Family income	11510±9488	12150±13622	11290±4933	11420±3765	11660±4511	11606±8118
Sources of income						
Salary	27(54)	33(66)	24(48)	33(66)	29(58)	146(58)
House rent	7(14)	10(20)	6(12)	6(12)	9(18)	38(15)
Business	24(48)	19(38)	13(26)	19(38)	18(36)	93(37)
Lands	18(36)	18(36)	20(40)	14(28)	9(18)	79(32)
Any other (Pension)	-	8(16)	5(10)	4(8)	5(10)	22(9)
		X ² = 16.517	CC = 0.205 p = 0	.417ª		
Income range						
2000-5000	2(4)	0	3(6)	0	1(2)	6(2)
5000-10,000	24(48)	36(72)	21(42)	40(80)	32(64)	153(61)
10,000-20,000	24(48)	14(28)	22(44)	9(18)	15(30)	84(34)
>20,000	-	-	4(8)	1(2)	2(4)	7(3)
	`	X ² = 25.879	CC = 0.306 p=	= 0.011 ^B		
Nature of income						
Monthly	50(50)	50(50)	50(50)	50(50)	50(50)	250(100)
Annual	19(38)	16(32)	10(20)	11(22)	7(14)	63(25)
X ² = 24.254 CC = 0.297 p = 0.0001°						

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.

was nuts and oilseeds /coconut which were higher in the disease group than the normal. The mean intake of energy and nutrients of women in the normal and disease groups are shown in Table 8. The intake of energy, protein and carbohydrate were significantly higher in the normal group than the disease group. So also the intake of all micronutrients was higher in the normal group than the disease group. The micronutrients which were adequate in both the groups were calcium, thiamine and ascorbic acid. The nutrient that were deficient in both the groups were iron and niacin which were much below the RDI besides the women in the disease group were also deficient in the intake of retinol, riboflavin with ascorbic acid being just adequate. However, due to the wide variation in the SD, both retinol and ascorbic acid could be adequate in few of the women in the disease groups.

Somatic status of the women in the normal and disease groups are presented in Table 9 and 10. The heights and weights of the women were

significantly different with women in the normal group being taller and less heavy than the women in the disease groups. Both BMI and WHR were found to be higher in the disease group than the normal. Though, the indicators of protein and fat status-MUAC, MUAMC and TSF were similar between the normal and disease groups, waist and hip measurements significantly differed. However, body fat in Kg, Body fat percentage were much higher in the disease groups and body density much lower, all these additional anthropometric indices being highly significant.. Broka's index, which is similar to BMI, was higher for the women in the disease group being above the normal range. LBMI was higher in the normal women indicating higher lean body mass. Thus, somatic status indicated greater body compositional changes towards increased fat mass and decreasing lean body mass for women in the different disease groups as compared to the women in the normal group.

The findings of the study indicated that the women in the Normal group were more physically active in terms of household work, office

Table 5: Marital Status and Reproductive History of Women - Normal Group.

Criteria	NE	NEX	EX	Total		
Marital status	1		1	1		
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 =0.0	24 ^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)		
Тwo	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 =0.09	95ª					
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°						

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.

work despite the time spent in personal care being similar in both the groups (Table 11). Time spent in recreation and sleep was highly significant being higher in the disease group. However, the time spent in actual physical activity was not much different between the two groups. The energy expended in the daily work/activity reflecting the time spent (minutes) pattern showed higher energy expenditure for the normal group than the disease group (Table 12).

Mean stress scores of the women in the normal and disease group is shown in Table 13. The mean total scores were higher for the disease groups than the normal with a wide variation in the SD. The table also shows the stress scores as per the WHR class. Stress scores remained more or less constant with increasing WHR.

Multiple regression analysis and correlation co-efficient of independent variables and their influence on the dependent variables was carried out. The independent variables considered were age, education, income, size of family, age at menarche, marriage and menopause, physical activity and stress. The dependent variables were energy intake, energy expenditure, protein intake, fat intake, MUAC, BMI, WHR, TSF, body fat%, LBMI . In case of both normal and disease groups, a highly significant relationship was seen between age with energy intake and energy expenditure. As seen in Table 14, independent variables- age and education were found to be highly corelated with all the dependent variables indicating that each of these factors are independently influencing the determinants of nutrition. Age at menopause was found to be highly significant correlating with all the dependent variables except protein intake. Age at menopause with WHR and education with MUAC was found to be significant at 5% level. Both Age and age at menopause was found to be negatively related to energy intake, energy expenditure, protein and fat intake, MUAC, WHR and LMBI. While, education was found to be positively related to all the dependent variables, age and age at menopause were positively related BMI, TSF, and body fat percent.

Size of the family was found to be significant with BMI, body fat

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Table 6: Marital Status and Reproductive History of Women - Disease Group.

Criteria	Arthritis	CVD	DM	Obesity	Cluster	Total
Marital status	1	1				
Married	46(92)	45(90)	41(82)	47(94)	41(82)	220(87)
Unmarried	2(4)	1(2)	1(2)	1(2)	0	5(2)
Widow	1(2)	4(8)	8(16)	2(4)	9(18)	24(10)
Divorcee	1(2)	0	0	0	0	1(0.4)
X ² = 23.597	CC = 0.294	p= 0.023 ^b				
Reproductive history						
Age at menarche	13.1±0.9	13.3±1.1	13.9±1.3	13.0±1.1	13.0±1.3	13.2±1.2
Age at Marriage	16.2±4.1	16.1±3.0	18.0±4.8	17.7±4.0	16.0±3.0	16.8±3.9
Mean No. of still births	0.1±0.3	0.1±0.4	0.06±0.2	0.06±0.2	0.04±0.19	0.03±0.29
Mean No. of abortions	0.3±0.5	0.4±0.6	0.3±0.7	0.3±0.6	0.3±0.6	0.3±0.6
Mean No of children	2±1.0	3±1	3±2	3±1	3±1	3±1
Mean age at menopause	43.5±4.3	44.2±8.5	44.9±5.4	42.1±8.5	47.8±3.6	44.7±6.8
No. of women undergone hysterectomy	11(22)	23(46)	13(26)	15(30)	15(30)	77(31)
Number of pregnancies						
None	5(10)	2(4)	1(2)	4(8)	1(2)	13(5)
One	8(16)	1(2)	6(12)	6(12)	3(6)	24(10)
Тwo	19(38)	23(46)	17(34)	20(40)	20(40)	99(40)
Three	12(24)	15(30)	8(16)	14(28)	17(34)	66(26)
>three	6(12)	9(18)	18(36)	6(12)	9(18)	48(19)
X ² = 2 ²	L.355 CC = 0.28	89 p = 0.045 ^b				
Menstrual cycle						-
Regular	38(76)	36(72)	38(76)	26(52)	33(66)	171(68)
Irregular	12(24)	14(28)	12(24)	24(48)	17(34)	79(32)
X ² = 7.370	CC = 0.319	p = 0.118ª				
Method of family planning used						
Tubectomy	8(16)	3(6)	4(8)	2(4)	1(2)	18(7)
Natural	15(30)	1(2)	8(16)	4(8)	3(6)	31(12)
Copper -T	1(2)	2(4)	1(2)	0	3(6)	7(3)
Condom	4(8)	1(2)	3(6)	4(8)	2(4)	14(6)
Pills	0	0	0	8(16)	0	78(31)
X ² = 35.874 CC = 0.382 p = 0.0001°						

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.

percent and negatively with LBMI. Age at marriage was found to be negatively influencing the protein intake. Data indicated that the age at menopause, education, physical activity, stress were found to be independently acting as determinants of nutrition and their influence in either promoting increase in the fat stores or decrease in the LBMI was likely to determine the risk levels of developing NCD in the study group.

Results of the analysis in case of women in the disease groups indicated a similar trend, but the independent variable-age, education, age at menopause, physical activity and stress attained significance with few of the dependent variables (Table 15). Age was found to be significantly correlating with BMI, TSF and body fat percent and negatively with LBMI. However, age at menopause did not appear to be correlating with any of the dependent variables mentioned above. Education was found to be significantly correlating with energy intake and MUAC and age at marriage to be significant with energy expenditure, negatively with protein intake. Overall, among the independent variables, age appeared to be the most important determinant followed by physical activity, stress, age at menopause, education and age at marriage. Age and physical activity, with or without menopausal effect were found to be the most important independent factors determining the risk for the development of NCD in the study group.

Regression concepts between independent and dependent variables of the women in the two groups- Normal and disease are presented in Table 16 and 17. Age was found to be a determinant of all the dependent variables, negatively with energy intake, energy expenditure, protein intake, fat intake, MUAC, WHR, LBMI and positively with BMI, TSF, body fat percent thus, indicating age as a most important determinant for the increase in overall body size (> BMI) along with fat deposits (>TSF, >body fat %) while, with reducing the lean body mass and protein intake. Some of the socio-economic factors such as income, size of the family, age at marriage were also found to be influencing the factors leading

Table 7: Mean Food Intake of the Women-Normal and Disease Group.

Food groups	Normal group	Disease group	*DDP	p-value
Cereals	255±30	255±25	300-275	0.720ª
Pulses	35±10	35±10	60-50	0.051ª
Green leafy vegetable	35±40	15±30	175	0.0001°
Other vegetable	105±40	80±30	200-175	0.0001°
Roots & tubers	120±25	80±30	150-100	0.0001°
Milk and its products	230±25	195±40	250-200	0.0001°
Sugar & jaggery	30±5	25±10	30-20	0.001 ^b
Fats & oils	30±5	30±5	30-25	0.192ª
Fruits	75±45	30±35	150-100	0.0001°
Fleshy foods (Chicken, Fish, Mutton)	45±65	20±50		0.004°
Nuts & oilseeds/Coconut	25±10	30±10		0.001 ^b
n	250	250		

*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.

Table 8: Mean Energy and Nutrient Intake of Women - Normal and Disease Group.

Distant constituents	Groups				
Dietary constituents	Normal	Disease	P-value		
Energy (Kcal)	1900±85 (2155±150)	1770±140 (1965±210)	0.0001°		
Protein (g)	50±10 (54±4)	40±10 (50±5)	0.0001°		
*Total Fat (g)	55±5	55±5	0.072ª		
*Carbohydrate (g)	300±20	275±20	0.0001°		
**Calcium (mg)	610±170	480±190	0.0001°		
**Iron (mg)	15.2±1.6	13.3±1.7	0.0001°		
**Retinol (mg)	615±420	300±320	0.0001°		
Thiamine (mg)	1.47±0.08 (1.07±0.07)	1.35±0.12 (0.98±0.10)	0.0001°		
Riboflavin (mg)	1.19±0.26 (1.17±0.08)	0.95±0.21 (1.07±0.11)	0.0001°		
Niacin (mg)	9.2±1.3 (14.1±0.9)	9.0±0.2 (12.9±1.3)	0.0001°		
**Vitamin C (mg)	78±38	40±30	0.0001°		
n	250	250			

Figures in Parenthesis indicate RDI, RDI: Recommended dietary intake - Values are mean of RDI computed using ICMR recommendations for each of the Women based on Desirable body weight (DBW),

* No recommended Dietary Intake,

* *RDI for calium-400mg, Iron -30mg, Retinl-600 µg, Vitamin C- 40mg 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.

to increase in BMI, WHR and reducing the LBMI and protein intake.

Regression concepts for women in the disease group showed that age was the most significant variable determining the energy, protein and fat intake, energy expenditure, LBMI-negatively, and BMI, TSF, body fat percent positively among which the first two variables were highly significant and others significant at 5% level (Table 17). Thus, age appeared to be the most important determinant followed by physical activity, stress and age at menopause as determinants of nutrition and risk for developing disease for the women in the disease group.

 Table 9: Anthropometric Measurements and Indices of Women - Normal and Disease Group.

Anthropometric measurements / indices	Normal Group	Diseased group	p-value
Height (cm)	154.8±4.0	152.2±5.1	0.0001°
Weight (Kg)	57.9±4.0	65.9±14.0	0.0001°
BMI	24.1±1.5	28.4±5.7	0.0001°
MUAC (cm)	26.3±1.8	26.1±2.8	0.281ª
TSF (mm)	18.8±2.2	19.3±4.6	0.161ª
MUAMC (cm)	20.4±2.1	20.0±2.5	0.06ª
Waist (cms)	81.1±7.4	90.0±13.1	0.0001°
Hip (cm)	97.2±9.7	104.4±13.8	0.0001°
WHR	0.83±0.07	0.86±0.04	0.0001°
n	250	250	

Superscripts indicate-

b: Significant at 5% level of significance,

c :Highly significant at 1% level of significance.

 Table 10: Additional Anthropometric Indices of Women - Normal and Diseased
 Group.

Additional Anthropometric indices	Normal Group	Diseased group	p-value
Indices			
Broka's Index	106±8	127±26	0.0001°
Body density	0.85±0.04	0.78±0.05	0.0001°
LBMI	415±30	368±83	0.0001°
LBM%	39.0±2.1	40.8±5.7	0.0001°
Conicity index	1.44±0.12	1.49±0.15	0.0001°
BF (kg)	18.96±2.5	25.0±8.6	0.0001°
BF%(1)	32.3±3.1	39.9±7.6	0.0001°
BF% (2)	32.5±2.4	36.8±6.0	0.0001°
n	250	250	

Superscripts indicate-

a : Not significant at 5% level of significance,

c :Highly significant at 1% level of significance

Irrespective of their normal or disease status, the significant determinant of nutrition and risk for developing disease was the 'age' of the women.

Thus, the results of the study are indicative of the fact that dietary inadequacies, physical inactivity may lead to increase in fat mass over and above through the life span starting as early as in the childhood through adolescence to adulthood. Age is associated with modifications of body composition - increase in body fat mass and a decrease in protein mass [13]. The amounts of fat and fat free mass (FFM) in adults change with increasing age as a function of multiple variables from physical activity to menopausal status to nutrition and disease. The status of the fat and FFM compartments is associated with and serves as established risk factors for a range of chronic diseases affecting the persons in middle to old age and considerable differences do exist between men and women [14].

It has been evident from studies that the body composition alters during growth as the age advances [15]. It has been noted that changes in body weight generally reflect a change in the ratio of water, protein, fat and minerals. Studies have suggested that changes in body composition are dependent upon the total duration of the energy deficit and excesses [15,16]. It has been well documented that positive energy balance implies a gain in energy stores in the form of carbohydrate, fat and protein [17]. It has been found that short term day to day energy balance is mostly accounted by rapid changes in carbohydrate load whereas, long term energy balance by the fat stores [17]. Body storage of protein in fat free mass and carbohydrate storage as glycogen in liver is limited and water component is comparatively variable. Hence, weight gain has always been linked to increased protein and fat intake during adolescence [17]. It has been reported that girls having menarche at a younger age showed a marked trunk oriented fat pattern as compared with girls with an older age at menarche [18,19].

The research evidence points to the changes in body composition to be at the root of the problem for development of NCDs. The nutrition and health issues concerning women are likely to be complicated in the backdrop of low awareness / knowledge and practice of nutrition concepts. Thus, as chronic disease epidemics gather pace in India and threaten harm to individuals, families, and the society at large, a comprehensive strategy for their prevention and control is needed [20].

Summary and Conclusion

The findings of the study are indicative of the fact that prime determinants are unhealthy dietary pattern, deficient intake of protein, and other micronutrient (iron, niacin, retinol, riboflavin) along with being physically inactive. These factors contributing to body compositional changes towards increase fat is in turn most likely to position the women at risk of developing NCD - earlier or

 Table 11: Mean Time (Minutes) Spent by women on Daily Activities

 Normal and Disease Group.

Work pattern	Normal group	Diseased group	p-value
	Time spen		
Personal care	60±10	60±5	0.016ª
*Household work	205±85	100±80	0.0001°
Recreation	355±195	640±130	0.0001°
Sleep	490±15	585±65	0.0001°
**Physical exercise	30±5	20±10	0.001 ^b
Office work	300±245	35±110	0.0001°
Total	1440	1440	
n	250	250	

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

** Walking

Superscripts indicate-

c :Highly significant at 1% level of significance

a : Not significant at 5% level of significance,

b: Significant at 5% level of significance,

Table 12: Work Pattern of Women and mean Energy (kcal) spent on various activities - Normal and Disease Group.

Work pattern	Normal group	Diseased group	p-value
	Energy sp		
Personal care	70±10	70±5	0.057ª
*Household work	400±165	175±160	0.0001°
Recreation	425±230	765±155	0.0001°
Sleep	490±15	585±65	0.0001°
**Physical exercise	100±20	65±35	0.0001°
Office work	400±325	50±145	0.0001°
Total	1885±60	1710±90	
n	250	250	

* Includes all household work - cooking, cleaning, child care, ironing, sweeping, washing cloths and 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 13: Mean Stress Scores Vis A Vis WHR Class of Women in the Disease Group.

Maan soora + SD	Normal	Disease
Mean Score 1 SD	25.5±7.3	30.7±5.2
WHR class		
0.71-0.8	24.5±8.5	30.7±5.3
0.81-0.9	25.7±7.2	30.7±5.2
>0.9	25.1±7.0	30.6±5.5

Energy Protein Fat Energy Variables MUAC BMI WHR TSF Body fat% LBMI intake Intake Intake expenditure -0.308** -0.461** -0.214** -0.267** -0.352** 0.472** -0.185* 0.662** 0.591** -0.450** Age (0.0001) (0.0001) (0.0001) (0.0001) (0.0001) (0.0001)(0.003) (0.0001) (0.0001) (0.0001)0.854** 0.826** 0.851** 0.850** 0.440* 0.838** 0.858** 0.635** 0.645** 0.811** Education (0.0001) (0.0001) (0.0001)(0.0001)(0.007)(0.0001) (0.0001)(0.0001)(0.0001)(0.0001)-0 141* 0 158' 0 204 -0 057 0.065 -0.052 -0 115 0 140* 0 1 1 1 -0 154* Income (0.415) (0.026) (0.069)(0.026) (0.079)(0.012) (0.001) (0.372)(0.304)(0.015) Size of the -0.020 0.006 0.007 -0.005 0.014 0.187* 0.092 0.097 0.133* -0.182* (0.752)(0.921) (0.918)(0.940)(0.820)(0.003)(0.148) (0.125) (0.035)(0.004) family -0.080 -0.043 -0.052 -0.105 -0.046 -0.031 -0.048 -0.063 -0.017 0.044 Age at menarche (0.208) (0.498) (0.413) (0.098) (0.472) (0.621) (0.452) (0.318) (0.784) (0.488) 0.030 0 075 0.018 0.019 -0.045 Age at -0.038 0.011 -0 193 0.027 -0.007 marriage (0.551) (0.865) (0.002)(0.676) (0.235) (0.773)(0.762)(0.915)(0.633)(0.474) -0.353** 0.312** Age at -0.277** -0.082 -0.222** -0.284** -0.188* 0.514** 0.445** -0.283** (0.0001) (0.0001)(0.195)(0.0001)(0.0001)(0.0001)(0.003)(0.0001) (0.0001)(0.0001)menopause Physical 0.201* 0.331** 0.025 0.215* 0.088 -0.197* 0.121 -0.384** -0.232** 0.181* activity (0.001)(0.0001)(0.696)(0.001)(0.166) (0.002)(0.056)(0.0001) (0.0001)(0.004) 0.277** -0 007 0 271** 0.317** -0.152* -0 342** -0.177 0.020 -0 201* -0 297** Stress (0.016)(0.0001)(0.005) (0.759) (0.001)(0.0001)(0.916) (0.0001) (0.0001)(0.0001)

Table 14: Correlation Co-Efficient between Independent and Dependent Variables on the Determinants of Nutrition in Women-Normal group.

Figures in Parenthesis indicate t-values of corresponding co-efficients.

*Significant at 5% level of significance

**Significance at 1% level of significance.

later depending on the emergence of one or the cluster of risk factors breaking the homeostatic balance in the expression of these diseases arthritis, CVD, DM or combination of these with or without obesity.

The rapid growth of socio economic status in developing countries suggests that the break out of NCDs as epidemic imminent particularly affecting women from the pre menopausal stage itself. The data from the present study suggest that a human oriented development towards improving the fetal growth, reducing over weight in later life and controlling the diet and environmental factors that stimulate body compositional changes is important for the prevention of NCD.

In conclusion, on a practical level, improving the nutrition and

Table 15: Correlation Co-Efficient between Independent and Dependent Variables on the Determinants of Nutrition and Risk for disease in Women – Disease group.

Variables	Energy intake	Protein Intake	Fat Intake	Energy expenditure	MUAC	BMI	WHR	TSF	Body fat%	LBMI
Age	-0.378**	-0.363**	-0.230**	-0.555**	0.037	0.154*	0.108	0.131*	0.202*	-0.164*
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.561)	(0.015)	(0.087)	(0.038)	(0.001)	(0.009)
Education	0.782*	0.765	0.789*	0.786	0.509*	0.841	0.852	0.537	0.873	0.874
	(0.023)	(0.028)	(0.026)	(0.161)	(0.012)	(0.665)	(0.552)	(0.233)	(0.278)	(0.172)
Income	0.0001	0.027	-0.032	-0.28	0.122	0.005	0.071	0.009	0.012	0.001
	(0.997)	(0.666)	(0.609)	(0.664)	(0.054)	(0.940)	(0.265)	(0.892)	(0.851)	(0.992)
Size of the family	-0.013	0.045	-0.003	0.004	-0.044	-0.048	-0.027	-0.008	-0.019	0.048
	(0.837)	(0.482)	(0.958)	(0.944)	(0.490)	(0.452)	(0.665)	(0.898)	(0.761)	(0.452)
Age at menarche	-0.055	-0.015	0.006	-0.072	-0.050	0.040	0.012	0.086	0.054	-0.052
	(0.403)	(0.819)	(0.928)	(0.270)	(0.442)	(0.541)	(0.853)	(0.190)	(0.412)	(0.425)
Age at marriage	0.086	0.138*	0.060	0.209*	0.056	-0.019	-0.060	0.038	-0.031	-0.021
	(0.192)	(0.036)	(0.364)	(0.001)	(0.397)	(0.772)	(0.357)	(0.568)	(0.637)	(0.754)
Age at menopause	-0.172*	0.004	-0.068	-0.200*	0.034	-0.019	-0.112	-0.030	-0.035	-0.031
	(0.026)	(0.961)	(0.380)	(0.009)	(0.659)	(0.808)	(0.147)	(0.703)	(0.648)	(0.693)
Physical activity	0.325**	0.248**	0.228**	0.795**	-0.018	-0.155*	0.016	-0.042	-0.170*	0.122
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.772)	(0.014)	(0.806)	(0.512)	(0.007)	(0.053)
Stress	0.074	-0.006	0.138*	-0.232**	0.0001	0.191*	0.042	0.109	0.199*	-0.188*
	(0.241)	(0.929)	(0.029)	(0.0001)	(0.988)	(0.002)	(0.506)	(0.086)	(0.002)	(0.003)

Figures in Parenthesis indicate t-values of corresponding co-efficients.

*Significant at 5% level of significance **Significance at 1% level of significance.

Table 16: Regression Concepts for determinants of nutrition and risk for women - Normal Group.

Variables	Energy intake	Energy expenditure	Protein Intake	Fat intake	MUAC	BMI	WHR	TSF	Body fat%	LBMI
100	-3.260**	-3.348**	-0.341*	-0.173**	-0.081**	0.094**	-0.002*	0.187**	0.193**	-1.656**
Age	(0.0001)	(0.0001)	(0.001)	(0.0001)	(0.0001)	(0.0001)	(0.003)	(0.0001)	(0.0001)	(0.0001)
Incomo	0.0001	0.0001*	-0.00006296	0.0000311*	0.0000087	0.000010*	0.00000068*	-0.0000055	0.0000073	0.0001*
income	(0.415)	(0.026)	(0.069)	(0.026)	(0.079)	(0.012)	(0.001)	(0.372)	(0.304)	(0.015)
Size of the	-1.370	0.293	0.067	-0.020	0.021	0.238*	0.006	0.177	0.280*	-4.303*
family	(0.752)	(0.921)	(0.918)	(0.940)	(0.820)	(0.003)	(0.148)	(0.125)	(0.035)	(0.004)
Age at	-4.289	-1.580	-0.419	-0.343	-0.053	-0.032	-0.002	-0.091	-0.029	0.821
menarche	(0.208)	(0.498)	(0.413)	(0.098)	(0.472)	(0.621)	(0.452)	(0.318)	(0.784)	(0.488)
Age at	-0.588	0.115	-0.450*	0.025	0.025	0.005	0.0001	-0.003	0.015	-0.245
marriage	(0.551)	(0.865)	(0.002)	(0.676)	(0.235)	(0.773)	(0.762)	(0.915)	(0.633)	(0.474)
Age at	-1.284**	-1.123**	-0.057	-0.063**	-0.029**	0.027**	0.0001*	0.064**	0.064**	-0.456**
menopause	(0.0001)	(0.0001)	(0.195)	(0.0001)	(0.0001)	(0.0001)	(0.003)	(0.0001)	(0.0001)	(0.0001)
Physical	0.953*	1.073**	0.018	0.062*	0.009	-0.017**	0.001	-0.049**	-0.034**	0.297*
activity	(0.001)	(0.0001)	(0.696)	(0.001)	(0.166)	(0.002)	(0.056)	(0.0001)	(0.0001)	(0.004)
Stroop	-1.738*	-2.680**	-0.303*	0.014	-0.050*	0.059**	-0.00007	0.083**	0.112**	-1.181**
Suess	(0.016)	(0.0001)	(0.005)	(0.759)	(0.001)	(0.0001)	(0.916)	(0.0001)	(0.0001)	(0.0001)

Figures in Parenthesis indicate t-values of corresponding co-efficients.

*Significant at 5% level of significance

**Significance at 1% level of significance.

Table 17: Regression Concepts for determinants of nutrition and risk for disease in women - Disease Group.

Variables	Energy intake	Protein intake	Fat intake	Energy expenditure	MUAC	BMI	WHR	TSF	Body fat%	LBMI
٨٥٥	-5.372**	-0.372**	-0.154**	-4.909**	0.011	0.090*	0.001	0.006*	0.175*	-1.381*
Age	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.561)	(0.015)	(0.087)	(0.038)	(0.001)	(0.009)
Incomo	0.000004266	-0.000034	-0.000026	0.0001	0.00004308	0.000003409	0.0000004277	0.0000004909	0.00001275	0.00000648
income	(0.997)	(0.666)	(0.609)	(0.664)	(0.054)	(0.940)	(0.265)	(0.892)	(0.851)	(0.992)
Size of the	-1.185	0.292	-0.014	0.252	-0.080	-0.177	0.0001	-0.002	-0.107	2.564
family	(0.837)	(0.482)	(0.958)	(0.944)	(0.490)	(0.452)	(0.665)	(0.898)	(0.761)	(0.452)
Age at	-6.210	-0.126	0.032	-5.089	-0.118	0.192	0.0001	0.032	0.385	-3.616
menarche	(0.403)	(0.819)	(0.928)	(0.270)	(0.442)	(0.541)	(0.853)	(0.190)	(0.412)	(0.425)
Age at	3.280	0.394	0.109	4.980*	0.043	-0.030	0.0001	0.005	-0.074	-0.476
marriage	(0.192)	(0.036)	(0.364)	(0.001)	(0.397)	(0.772)	(0.357)	(0.568)	(0.637)	(0.754)
Age at	-4.795*	0.007	-0.097	-3.607*	0.021	-0.022	-0.001	-0.003	-0.063	-0.499
menopause	(0.026)	(0.961)	(0.380)	(0.009)	(0.659)	(0.808)	(0.147)	(0.703)	(0.648)	(0.693)

Physical	1.822**	0.074**	0.044**	2.470**	-0.004	-0.021	0.0001	0.001	-0.031	0.185
activity	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.569)	(0.152)	(0.262)	(0.674)	(0.162)	(0.365)
Stroop	2.004	-0.011	0.175	-3.882**	0.0001	0.209*	0.0001	0.010	0.326*	-2.985*
Stress	(0.241)	(0.929)	(0.029)	(0.0001)	(0.988)	(0.002)	(0.506)	(0.086)	(0.002)	(0.003)

Figures in Parenthesis indicate t-values of corresponding co-efficients.

*Significant at 5% level of significance

**Significance at 1% level of significance.

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