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Association of BMI with Nutrient intake among adult couples: A comparative study

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Abstract
Adult's food intake behaviours is particularly important in the context of food insecurity. Since there has been population studies indicating increased risk of overweight and obesity among those who are food insecured. The disparity between the food supply and the intake of foods and nutrients has been getting larger ever since 1970's. BMI, a widely used measure of nutritional status is the ratio of weight to height measurements. As far as food security is concerned, the adequacy of the supply of nutrients, in particular energy and protein are available to the population.
Objective: i) To study the anthropometric measurements and the association between BMI and nutrient intake of the adults.
Methodology: Demographic data, nutrient intake (diary technique) and anthropometric measurements (height, weight, MUAC, waist and hip circumferences) were obtained using standard procedures. 350 couples aged 35-60 yrs formed the study population.
Results: All were educated, regardless of occupation with varied kind of jobs. Both men and women had normal BMI however WHR was higher indicating central obesity (1.00±0.97 and 0.99±0.137); for males and females respectively. Mean nutrient (Energy) intakes of male and females partners are: 2042 ±369 ±.92 and 1875± 511.090kcals; Compared to RDA, intake of all nutrients except fat and calcium were markedly low and there was a extremely significant difference. Energy bears a positive association of micronutrients. Although the association between nutrient intake and BMI did not exhibit statistical difference.
Conclusion: Nutrient intakes of men and women were essentially similar and their BMI tend to be overweight.

Keywords: BMI, food security, energy, nutrients, adults

1. Introduction
Nutrient security is defined "adequate nutritional status in terms of protein, energy, vitamins, and minerals", which can be reflected from the nutrient intake of individual. Good nutrition is the fundamental requirement for positive health, functional efficiency, and productivity. The ability of an individual to fully reach his/her personal and economical potential depends to a large degree on his/her level of nutrient intake [1].
Saletti's study revealed that protein energy malnutrition is common among both the sexes and the prevalence was 14.3% in men and 26.3% in women. The study also suggests that the elderly, who are cognitively impaired, need a modified type of feeding [2]. A high prevalence of malnutrition (15-60%) in older people has been reported worldwide because of lack of nutrition security [3]. Various factors like physical activity, health and psychological status of the older people can influence the nutritional status. Meydani *et al*., felt that the nutritional status, particularly in developing world is poor and preventive measures should be planned ahead in order to prevent certain disease conditions [4-7]. Elderly people in low socio-economic groups are at higher risk of poor dietary intake [8, 9]. Hence, dietary practices and food choices are related to wellness and energy intake with a known amount of essential micro nutrients of an individual.
Food security can be achieved only when the right kind and the right amount of food is consumed so that all the required nutrients are provided. Also meals provide a sense of security and meaning to an adult's day [10]. Inclusion of variety of foods is an important aspect in diets. Diet surveys carried out by National Nutrition Monitoring Bureau in different states of India shows that the mean intakes of cereals and millets are more than recommended allowances (RDA), while pulses are low in both males and females, mean intake of protein and energy were slightly lesser than recommended values in both sexes. Chronic energy deficiency was reported to be relatively more among males (53.5%) than in females (49.4%) [11, 12]. The intakes of iron, vitamins A and riboflavin were also below the recommended values as the intakes of other vegetables were better than green leafy vegetables. Calcium intakes were drastically lower leading to age onset osteoporosis. However, like the adults, majority of children and adolescents weigh substantially less and hence their nutrient requirement is lower. In view of these, it is likely that the dietary requirement of Indians is likely to be substantially lower than the current ICMR recommendations [12].
Lower intakes of vegetables that are rich in micronutrients increase the susceptibility to infections. Anaemia and B complex deficiencies may also be more common among them. The nutrition guidelines given by NNMB has suggested that consumption of low-fat, protein-rich foods such as lean meats, fish, pulses and low-fat milk is important for Nutrition Security. They also recommend for establishing healthy eating habits and regular exercise. Weight management is a key factor in achieving health and wellness.
Dietary guidelines mainly focus on limiting the consumption

of fat, saturated fat, cholesterol, sugar and salt. In the Indian context, these guidelines are combined with a diet that is rich in whole cereals, vegetables, and fruits. This reflects reduced energy intake and also features nutrient dense foods, and emphasizes the importance of fluid [13]. The food pyramid developed by USDA has been adopted to Indian condition with suitable modification. There is narrowing of base of the pyramid. Hence the present study focuses on the following objectives

- To study the anthropometric measurements and compare between the male and females participants
- To study the gender differences in their nutrient intake
- To understand the association between BMI and nutrient intake of the adult couples

2. Materials and Methods

A total of 350 adult couples who extended full cooperation to provide the information completely were included for the study The study was approved by Institutional Human Ethical Committee (IHEC), University of Mysore, Mysore, India. A consent letter was obtained form the participants. Cluster sampling was adopted for the purpose

Anthropometric measurements like height, weight, mid upper arm circumference (MUAC), waist circumference (WC) and hip circumference (HC) were obtained using standard technique. The methods of measurement was as described by Jelliffee [14]. Body weight was measured using electronic body weighing machine waist recorded nearest to 0.1 Kg. Height was measured using a height scale, measurement was made nearest to 0.1 cms.

Dietary intake data

Diet diary was used to elicit food intake data from the selected couples. A 7 days diet diary was obtained from 350 selected adult (husband and wife) couples and was explained about the importance of assessing dietary intake. They were trained to record food intake data of individual man and woman through demonstrating use of standard cups, tumblers and spoons for serving food and drinks. Nutrient intake from dietary data was computed using a ready recknor for cooked foods standardized for the purpose and selected nutrients like Energy, proteins, fats, calcium, iron, β carotene and retinol were calculated [15]. Individual intake of the male and female couples was also collected through diary technique. Total consumption of each nutrient was compared to the 'mean nutrient requirements' was computed using RDA of ICMR, and calculated mean. This has been presented as RDA-derived in tables. Individual intake of nutrients by male and female couples was computed and used for the study.

Statistical Analysis

Descriptive analysis was used to analyze the data; Chi-square analysis was employed for comparisons between variables. Mean, Standard Error and co efficient of variation was calculated.

3. Results and discussion

Anthropometric parameters are the useful indicators of health in any population; they are frequently used in assessing nutritional status. Table 1 presents mean and SD values of linear height, weight, MUAC, waist and hip circumference of adult male and female participants. The mean age of the study population was 40-60 and 35-50 years respectively for males and females. Mean height of men was 166.0cms with a SD of 8.63 (range being 157.4 -175.0), women were 157.0±8.5 cms. It is evident that actual weight was more than the Ideal body weight in both males and females. Using BMI cutoff for SE Asians regions; the BMI was found to be overweight range both for males and female subjects. The MUAC was found to be 30.39±4.64 for males and 28.9±5.107cms for females respectively. WHR exhibited a typical occurrence of central obesity in both male and female participants.

Table 1: Mean Anthropometric Measurements of Selected Participants

Parameters n=350	Males	Female
	Mean ± SD	Mean ± SD
Age (Yrs)	50.0±10.0	42.0±10.0
Ht (cms)	166.0±8.30	157.0±8.50
Actual Wt (kg)	66.3±8.492	58.7±8.939
Ideal Wt (kg)	61.0±6.250	54.8±6.880
MUAC (cm)	30.39±4.645	28.9±5.107
WC (cms)	88.3±7.431	86.58±9.725
HIP (cms)	88.0±7.512	86.8±10.05
BMI	24.06±3.305	23.8±3.561
WHR	1.00±0.097	0.99±0.137

Energy intake in general for both males and females was less compared to their RDA's. Nevertheless, females were found to meet 85% of the requirement while male members consumed only 64% of the RDA's. Therefore, statistically extremely significant differences were found. Protein intake of males was found to be 83% RDA while female consumed enough proteins thereby their mean intake was essentially similar to their respective RDA's. Fat intake in general was high wherein intake among females was markedly higher as compared to males. It can be perused from table that female consumed two times more fat than their RDA's while men consumed 1.3 times higher. Calcium, iron and retinol intakes were satisfactory. Gender differences in intake of all nutrients did existed to certain extent. Majority of nutrients consumed by females were higher than those of men according to the percentage sufficiency calculated. Some of the nutrients, with particular reference to proteins in our case were consumed less by the adult males and females. Also distinct differences were noted in intake of males and females where in intakes for females were high for most nutrients. It is encouraging however to point that females from the study population were better in their nutrient consumption as compared to men.

Findings also indicated that, females had a higher proportion of nutrient intake than males. Mean intake of protein and energy was slightly lower than recommended values in both sexes [11-12]. Population developing countries like India, which is rapidly urbanising, demonstrate an increase in energy intake, dramatic increases in fat intake along with increased levels of sedentarianism and less gender disparity. While Surveys from western countries reported gender differences in energy intake and micronutrient [1].

Table 3: Mean Daily Nutrient Intake: Comparison between Male and Female Couples

	Males				Females			
Nurtrients	**RDA Mean±SD**	**Actual intake Mean±SD**	**% Adequacy**	**P value**	**RDA Mean ±SD**	**Actual intake Mean±SD**	**% Adequacy**	**P value**
Energy (kcal)	3168.0±526.47	2042.0±369.92	64	NS	2200.0±422.702	1875.0±511.090	85	***
Protein (g)	60±0	50.3±8.170	83		50±0	51.2±24.569	102	*
Fat (g)	25±0	32.4±5.997	130		25±0	53.1±16.07	212	NS
Ca (mg)	400±0	865.0±267.499	219		400±0	651.4±163.052	163	
Iron (mg)	28±0	27.6±7.182	100	*	30±0	35.0±14.970	116	**
Retinol(µg)	600±0	488.8±126.783	81	NS	600±0	498.5±107.329	83	NS
β Carotene (µg)	2400±0	1245.88±471.110	52	NS	2400±0	1643.70±1184.048	68	NS
								t value-1.99-2.0

*P<0.05, **P<0.01, ***P <0.0001 & NS-Non Significant

Variance and CV have been used in studies to express the intergroup variation in characteristics that are naturally occurring in populations. It helps to arrive at a better understanding in the nature of dispersion occurring in the intakes. Hence we attempted to present the data obtained with respect to nutrient intake of male and female couples. A perusal of table 3 presents the details of the nutrient intake and their dispersion among male and female participants. The variance was large for energy, calcium and β carotene. The CV for males for the macro nutrients like protein, fat and energy varied from 16-19% indicating a larger inter group homogeneity in intakes. CV for micronutrient was relatively high. High variability was seen for calcium and β carotene. Female consumption pattern appeared to vary enormously as against male members, both macro and micro nutrients exhibited high CV suggesting large intergroup variations. CV for energy and fat was 27-36%, variations for protein were very large being 47%. Hence this suggests female in general have a different consumption pattern in both quality and quantity. Among the micro nutrient β carotene intake varied enormously with a 72% variation followed by iron (42%). Other studies have also reported variations in food intake among males and females [16].

Table 3: Mean Daily Nutrient Intake: Comparison between Male and Female Couples-Variance and Coefficient of Variation

Nutrients	**Males**				**Females**			
	Mean	**Variance**	**CV**	**SEM**	**Mean**	**Variance**	**CV**	**SEM**
Energy (K cals)	2042.0	77460.0	19.0	44.24	1875.0	261213.4	27.0	61.13
Protein (g)	50.3	66.7	16.0	0.97	51.5	603.7	47.0	2.93
Fat (g)	32.4	36.0	18.0	0.71	57.0	438.8	36.0.	2.50
Ca (mg)	916.1	115665.0	37.0	40.64	651.4	26586.1	25.0	19.48
Iron (mg)	27.6	51.50	26.0	0.85	35.0	224.2	42.0	1.78
Retinol(µg)	488.8	16074.04	25.0	15.15	498.5	11519.69	21.0	12.82
β carotene (µg)	1245.88	221944.8	37.0	56.30	1643.70	1401971.0	72.0	141.52

CV- Coefficient of Variation **SEM**- Standard Error

There is a general consensus that a diet providing calories sufficient to meet RDA is considered to also provide other nutrients in quantities to meet the requirements. Therefore it was proposed to perform correlation test between energy intake and macro/micro nutrients, in adult male and female couples. Table 4 provides the details. We found significant association between energy intake and protein intake; a linear relationship can be seen.. It is also obvious from the table that when energy intake increases there was a linear increase in protein intake indicating that energy content of the diet has a positive association to protein content of the diet [17]. Our results have supported this fact, that energy bears a positive association to micronutrients It can be seen from the table that calcium and iron intake of both males and females increased linearly with an increase in energy intake, and the association was highly significant. With respect to β carotene, no such association could be established.

A perusal of Table 4 also suggests that, protein and calcium intakes had significant correlation with energy intake; iron and β carotene intake did not show such correlation consistently. Hence it is evident that energy intake of adult subjects is an important indicator for the adequacy of protein and calcium intakes. Studies supports the fact that the potential requirement is met in terms of quantity and quality of foods [18]. Gender differences in mean daily energy and protein intakes were related to gender differences in body size. Apparent gender differences in the crude intakes disappeared when they were expressed by nutrient density since micronutrient intakes were significantly correlated with energy intake.

Table 4: Correlation Coefficient between Energy Intake with other Macro and Micro Nutrients of Males and Female Couples

Energy		**Males**		**Females**	
		'r'	**P value**	**'r'**	**P value**
In total diet n=70	Proteins	0.385	0.003	0.454	0.000
	Calcium	0.660	<0.0001	0.373	0.004
	Iron	0.259	0.052	0.386	0.003
	β carotene	0.043	0.748	0.317	0.014

Out of academic interest correlation coefficient was performed between BMI and nutrient intake to identify whether any

nutrient intake influenced BMI significantly and vice versa. The data is presented in table 5. It can be perused from the table that the energy and BMI was less linear in males than that seen with females. The other striking feature seen in the fig 5a and 5b was with fat intake and BMI, it was different for males and females. Males exhibited a negative curve while females the curve was linear and had a bearing with BMI. Although the association between nutrient intake and BMI did not exhibit statistical significance.

Table 5: Correlation between BMI and Nutrient Intake of Male and Female Couples

	Males		Females	
	Observed value	**P value**	**Observed value**	**P value**
Energy (K cals)	-0.025	0.852	-0.086	0.523
Protein (g)	0.031	0.800	-0.097	0.430
Fat (g)	-0.095	0.443	0.098	0.443
Ca (mg)	-0.100	0.441	0.103	0.402
Iron (mg)	-0.072	0.562	0.004	0.976
β carotene (μg)	0.081	0.505	-0.141	0.251

4. Summary and conclusion

The gender effect studied indicated less difference in all the assessed parameter. Nutrient intake between male and females were negligible. Health profile was essentially similar among men and women. Nutrient intakes of men and women were essentially similar; both the genders consumed less energy while other nutrients such as protein, calcium, fat and iron intakes were higher than their respective requirements. A critical view of the intakes suggests that women consumed all nutrients in little higher quantities than those of their male counterparts. Among the micronutrients, β carotene and retinol intakes were very low among both men and women. My study has tried to provide evidence that in the contemporary society gender differences have minimised to great extent. Nutrient intakes of men and women were essentially similar.

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