Original Article

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Nutritional Status and Dietary Pattern of Iranian's Residing in Mysore

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Abstract

An adequate healthy diet must satisfy human needs for energy and all essential nutrients. Adequate nutrition is the right proportion of food and nutrients needed for growth and maintenance. Food and nutrient intakes are influenced by the living environment and availability of food. Hence dietary habits can change when people travel to different country. Improved nutritional status plays an important role in the well being of individuals and is critical for socio- economic development. The aim of this study was to find out the nutritional status and dietary pattern of Iranian's residing in Mysore city, India. The methodology involved the measurement of somatic status, collecting data on food frequency and dietary intake using standardized techniques. Results indicated that 37% of males and 16% of females were obese grade II. Nearly 46% of males and 32% of females had waist hip ratio of >0.9, which is considered a risk factor for cardiovascular diseases and diabetes. Food frequency indicated that the diets were cereal based and subjects were consuming less of various fruits and vegetables. The diets were sufficient in energy and protein content. Fat intake was much higher than recommended. Calcium was also inadequate. Thiamin and riboflavin were adequate; however, niacin was lesser than needed. The antioxidant nutrients such as vitamin C and β- carotene were also inadequate. The contribution of calorie from carbohydrate sources was found to be the highest followed by fat and protein. The study brought to light some important inferences such as how a shift in dietary pattern or a migration affects the quality of diet and nutritional status.

Keywords: Body mass index; Dietary recall; Nutrient adequacy; Obesity.

Introduction

The dietary habits of Iranian adults seems to be greatly influenced by the nutrition transition, which is taking place in the country as a result of rapid changes in demography, social development as well as urbanization and industrialization. This has resulted in considerable dietary changes, which includes increased consumption of inexpensive dietary energy sources like, bread, sugar, fats and oils and reduced intake of meat, fruits and vegetables, as these are comparatively costlier. A healthy diet plays a vital role in delaying and or preventing a large number of chronic degenerative diseases.[1]

The trend towards assessing dietary nutrient quality is increasing day by day.[2] In developing countries total energy intake is the most important indicator of food security.[3] Studies report that adult Iranian men have inadequate intake of some nutrients and assessing the dietary diversity is thought to be a useful indicator of nutrient adequacy among adults.[4-8] The different ways of defining food, its consumption, and dietary observances are all thought to be governed by cultural conditions and various social contexts. For an individual, eating food is not just considered as a simple biological action. Food and its obligations are mainly governed by factors such as population, social tradition, religious beliefs, social position, gender role and aesthetics.[9-11] Each society follows different

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food styles and dietary pattern, which depends on environmental, cultural and social traditions.[12]

Migration is also one of the factor which tends to influence the individuals nutritional status. A healthy migrant effect is one which facilitates the individual to cope with the pressures associated with moving from one country to another.[13] The healthy migrant effect appears to wane with increasing length of stay in the country. Over time the lifestyle and nutritional patterns of immigrants converge towards that of the host population. Many migrant groups show a significant adoption to obesogenic behaviours (e.g. consumption of more energy dense and nutrition poor foods, as well as less physical activity), experience weight gain following migration and record higher body weights than their host country counterparts.[14-15]

The estimates of World Health Organization show that, by the year 2020, non communicable diseases will become the leading cause for approximately three quarters of all deaths in the developing world.[16] Reduced physical activities, coupled with nutrition transition are considered to be partly responsible for rising prevalence of such risk factors among the communities all over the world.[17] In recent years, this epidemiological transition has made Iranian young people prone to chronic disease in later life.[18-19] Hence, it is very pertinent to assess their dietary and nutrient intakes in relation to their somatic status. The present study was planned and conducted to evaluate the nutritional status and dietary pattern of Iranian adults residing in Mysore using a small representative sample.

Methodology

In this cross sectional study, a total of 324 individual (191-males and 124-Females) were selected randomly. The study was conducted in Mysore and approved by the Human Ethical Committee of the University of Mysore. The baseline information collected included age, gender, weight, height, education and food pattern *via* a face-to-face interview with the participants of the study. The details about the method followed for assessing the nutritional status are given below.

Anthropometric measurements

Body weight was measured using an electronic weighing balance and recorded to the nearest of 0.5 kg. The subjects were measured bare foot and wearing light clothing. Height was measured using a mounted tape and recorded to the nearest 0.5 cm. Body mass index (BMI) was then calculated as weight in kg divided by the square of height in meters. The subjects were then classified into different grades of BMI based on the WHO guidelines.[20] Body circumferences were measured to the nearest millimeter using a flexible tape. Waist circumference was taken at the end of normal expiration with the measuring tape positioned at the mid way between the lower rib and the iliac crest. Hip circumference was measured at the level of maximal protrusion of the gluteal muscles. WHR was calculated as waist circumference (cm) divided by hip circumference (cm). The cutoff points were deviced based on the study reported by Azadbakht.[21] The normal cutoff points used in this study were 0.7-0.9 and 0.7-0.8 for male and female subjects. The subjects were then categorized as normal, gluteal femoral obese and abdominal obesity based on the cutoff ranges of 0.7-0.8, 0.8-0.9 and >0.9. The mid-upper arm circumference measurement was taken on the left hand. The mid-point between the tip of the acromion of scapula and the tip of the olecranon process of the ulna, with the arm flexed at the elbow at right angle. The reading was taken to the nearest millimeter. The recorded measurements were compared with the standards for computing the percent standard of MUAC.[22]

Dietary assessment

Dietary assessment was done using food frequency and dietary intake survey by 24 hr

recall. Twenty four hour dietary recall interview was used to estimate the nutrient intake. During the interview the respondents were asked to report and recall the amount of food they had consumed in a day. Portion sizes of consumed foods were converted to grams using household measures and the nutrient content of the foods were computed using food composition tables for Indian foods.[23] The percent adequacy of nutrient intake was determined using the United States recommended dietary allowances.[24]

For evaluating the frequency of consumption of various foods, a food frequency questionnaire was used. The food frequency questionnaire consisted of a list of foods, and participants were asked to report their frequency and amount of intake of each food item. The data obtained was computed as mean number of times a food was consumed in a day by subjects.

Statistical analysis

Data were analyzed and reported as mean ± SD for all measurements using a software on computer. Levels of significance between genders were measured using t-test and chi-square test.

Results

Information on the general profile of the study population is presented in Table 1. The age wise distribution of subjects showed that majority (42% and 34%) of male and female subjects were between the age group of 25-30 years. A considerably higher percentage (79% and 85%) of subjects from both male and female were pursuing undergraduate courses, 47% of males and 58% of females were reported to be in postgraduate courses, and 39% of males and 19% of females were pursuing doctoral degrees. Around 42% of males and 40% females were unmarried and the rest were married.

The mean anthropometric measurements of subjects given in Table 1 show that among males the mean height was almost similar in all the age groups ranging from 173.6±8.2 to 178.5±6.6 cm. A slightly higher mean body weights were recorded in the age group of 20-

Table 1: General information and mean anthropometric measurements of subjects

Parameter	Category	Age (Years)							
		Males (N=199)				Females (N=125)			
		20-25	26-30	31-35	36-40	20-25	26-30	31-35	36-40
Number of subjects		37 (18)	68 (34)	53 (27)	41 (21)	35 (28)	53 (42)	20 (16)	17 (14)
Educational level	Under-graduates	22 (11)	3 (2)	1 (1)	-	22 (18)	5 (4)	1 (1)	-
	Post-graduates	15 (8)	51 (25)	10 (5)	18 (19)	13 (10)	44 (35)	10 (8)	5 (4)
	Doctoral degree	-	14 (7)	42 (20)	23 (12)	-	3 (2)	9 (7)	12 (10)
Marital status	Married	4 (2)	15 (8)	28 (14)	35 (18)	6 (5)	21 (17)	15 (12)	8 (6)
	Un married	33 (16)	53 (26)	25 (13)	6 (3)	29 (23)	32 (26)	5 (4)	9 (7)
Somatic status	Mean Height (cm)	177.7 ±5.4	178.5 ±6.6	176.7 ±5.5	173.6 ±8.2	163.4 ±6.3	164.6 ±6.2	162.6 ±4.4	160.3 ±6.2
	Mean weight (kg)	82.8 ±17.1	76.2 ±11.8	78.6 ±12.2	78.6 ±13.3	57.4 ±9	60.7 ±10.5	57.4 ±8.8	67.3 ±7.4
	MUAC (cm)	30.8 ±4.2	29.8 ± 3.2	30.7 ± 3.2	30.8 ± 4.0	25.2 ± 4.2	26.9 ± 4.1	25.9 ± 2.1	29.4 ± 3.3
	WHR (cm)	0.85 ±0.08	0.86 ±0.06	0.88 ± 0.55	0.90 ±0.05	0.79 ±0.05	0.80 ±0.06	0.79 ±0.05	0.83 ±0.05

Table 2: Subjects classified according to nutritional status (percent of subjects)

Indicators	Age (Years)							
	Males (N=199)				Females (N=125)			
	20-25	26-30	31-35	36-40	20-25	26-30	31-35	36-40
BMI grading								
17-18.5	-	-	-	-	4	4	-	-
18.5-20	1	2	3	-	7	8	7	-
20-25	10	19	6	11	15	26	6	7
25-30	4	11	14	8	2	6	2	6
30-35	4	3	2	2	-	-	-	-
X^2	**0.008****							
Waist-hip ratio								
0.7-0.8	4	6	3	2	18	18	8	3
0.8-0.9	11	17	16	9	10	25	8	10
>0.9	4	10	8	10	-	-	-	-
p-value	**0.0001*****							
MUAC (percent of standard)								
70-80	-	-	-	-	6	6	-	-
80-90	3	4	2	3	11	8	8	-
>90	15	30	24	18	10	29	8	14
p-value	**0.0001*****							

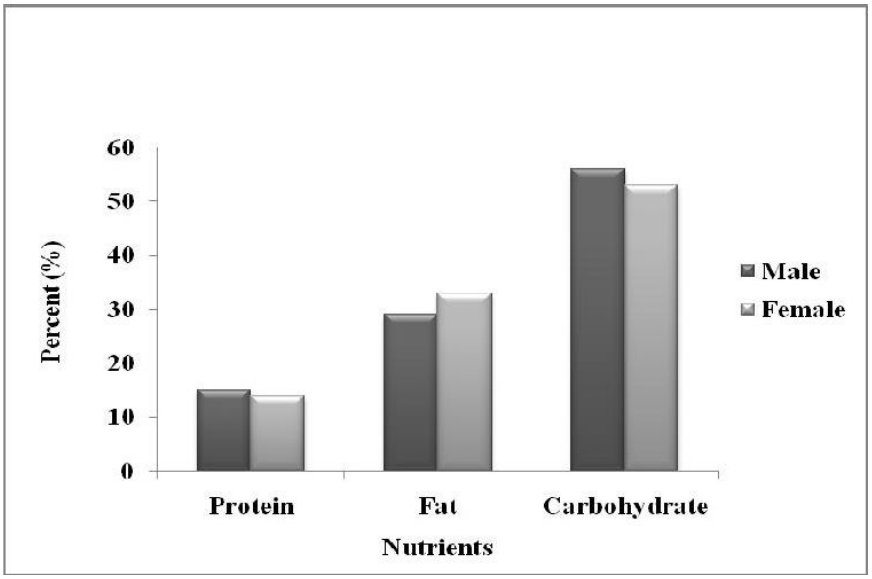
Table 3: Food frequency categorized as mean number of subjects using daily

Food group	Frequency of use		Food group	Frequency of use		Food group	Frequency of use	
	Male	Female		Male	Female		Male	Female
Cereals			**Vegetables**			**Fruits**		
Rice	165	98	Onion	185	111	Banana	102	63
Wheat	145	97	Tomato	139	89	Orange	69	48
Maize	13	8.9	Potato	102	89	Mango	41	36
Barley	12	7	Cucumber	97	89	Grapes	42	23
Oat	4.2	2.9	Eggplant	92	69	Apple	33	21
Pulses			Carrot	51	43	Pineapple	27	21
Bean	26	18	Mint leaves	44	32	Pomegranate	17	13
Peas	22	15	Cabbage	39	24	papaya	15	12
Wax bean	21	14	Lettuce	30	21	Pear	8	7
Lentil	20	14	Mushroom	22	17	Peach	6.7	5.5
Chick pea	19	11	Turnip	1	1.4	Strawberry	0.4	1.7
Broad beans	6	4	**Snacks and ready to eat food**			**Beverages**		
Animal Foods			Sweets	71	65	Tea/ coffee	172	108
Beef	130	101	Honey	68	45	Soft drink	112	64
Chicken	84	44	French fries	44	44	Energy drink	19	8
Goat meat	64	31	Biscuit	40	38	**Dry fruits & nuts**		
Fish	29	13	Cake	40	31	Date	47	43
Shrimp	8	5	Jam	31	27	Coconut	45	43
Egg	75	31	Macaroni	28	21	Walnut	42	26
Milk & milk products			Noodles	24	18	Peanut	23	24
Yogurt	127	84	Soup	22	16	Pistachio	23	20
Milk	116	72	Peanut butter	15	14	Almond	21	17
Cheese	96	72	Corn flakes	10	12	Hazelnut	12	5
Butter	47	31	Nuggets	12	7	Fig	6	7
Ice cream	27	19	Pizza	9	6	-	-	-
-	-	-	Jelly	6	6	-	-	-

Table 4: Mean nutrient intake of subjects per day and nutrient adequacy

Nutrients	Age in years								P-Value
	Male				Female				
	20-25	26-30	31-35	36-40	20-25	26-30	31-35	36-40	
Protein (g)	74 ± 15.8 (133.2)	74 ±16.7 (133.3)	79 ± 20.6 (141.2)	82 ± 16.1 (146.6)	61 ±17.1 (133.6)	64 ± 19.1 (140.1)	71 ±16.1 (155.3)	62 ±20.0 (136.0)	0.0001***
Fat (g)	67 ±22.7 (94.5)	61 ± 22.2 (86.9)	68 ±24.5 (98.1)	64 ±19.9 (93.7)	69 ± 23.0 (122.6)	64 ±25.3 (112.3)	72 ± 20.5 (129.2)	58 ± 24.4 (105.1)	0.625NS
Dietary fibre (g)	20.5 ± 10.1 (54.0)	18.1 ±7.2 (47.8)	17.9 ±8.55 (64.1)	23.2 ± 15.9 (92.9)	16.5 ± 4.9 (66.2)	16.9 ± 8.3 (67.9)	15.3 ±6.2 (61.3)	19.6 ±10.2 (78.7)	0.018**
Energy (kcal)	3063 ± 481 (101.7)	3890 ± 496 (93.8)	3133 ± 516 (107.4)	3029 ±373 (106.2)	2492 ±312 (105.4)	2265 ±423 (95.8)	2439 ± 238 (105.7)	2480 ± 275 (110.1)	0.0001***
Calcium (mg)	428± 185.7 (42.9)	448± 190.2 (44.9)	443± 185.3 (44.4)	478 ± 194.6 (47.9)	401± 180.6 (50.9)	473± 184.8 (58.7)	473± 190.9 (55.0)	408 ± 179.0 (50.8)	0.001**
Iron (mg)	10.3 ± 2.1 (127.7)	9.8 ±2.2 (121.3)	9.1 ± 2.4 (111.9)	10.5 ± 1.7 (130.8)	15.5 ±6.3 (86.4)	14.6 ± 4.7 (81.5)	14.3 ± 2.5 (79.8)	13.1 ± 4.2 (73.1)	0.0001***
Thiamin (mg)	1.34 ±0.1 (111.1)	1.30 ± 0.17 (108.3)	1.23 ± 0.12 (102.3)	1.24 ±0.10 (103.2)	1.22 ±0.18 (110.3)	1.24 ±0.15 (112.2)	1.19 ±0.15 (108.4)	1.15 ±0.12 (104.6)	0.0001***
Riboflavin (mg)	1.32 ±0.13 (101.4)	1.36 ± 0.11 (103.7)	1.35 ± 0.13 (103.6)	1.26 ±0.14 (96.6)	1.08 ± 0.06 (98.2)	1.16 ± 0.13 (105.0)	1.27 ± 0.15 (115.2)	1.25 ± 0.26 (112.9)	0.0001***
Niacin (mg)	16.3 ± 3.3 (102.0)	16.4 ± 2.59 (102.4)	14.2 ± 2.1 (88.2)	14.7 ± 1.5 (91.7)	11.3 ± 2.8 (81.1)	10.1 ± 1.99 (71.9)	12.0 ± 1.45 (86.3)	12.9 ±1.66 (92.3)	0.0001***
Vitamin C (mg)	100 ±19.5 (111.9)	103 ± 24.7 (114.2)	94 ±27.3 (103.9)	114 ±27.1 (126.6)	87 ± 12.0 (115.3)	104 ± 23.2 (138.9)	105 ± 27.5 (139.1)	89 ±29.2 (118.7)	0.077NS
B-Carotene (µg)	886 ±304 (98.4)	786 ±333 (87.1)	810 ±298 (82.4)	726 ±276 (92.3)	817 ±349 (78.6)	785 ±424 (85.2)	686 ±363 (68.9)	955 ± 553 (75.1)	0.958NS

Fig 1: Percent calorie contribution from different macronutrients



25 years (82.8±17.1 kg). Among females the mean height was in the range of 160.3±6.2 to 164.6±6.2 cm. A higher mean body weights were noticed for subjects in the age group of 35-40 years (67.3±7.4 kg). With increasing age a steady increase in the mean body weight gained was also observed among the study group.

The somatic status of subjects is shown in Table 2. Distribution into different grades of nutritional status based on body mass index (BMI) indicated that 8% of females were suffering from chronic energy deficiency. Six percent of males and 22% of females had normal body mass index. Forty six percent of males and 54% of females were shown to have obesity grade I, whereas 37% of males and 16% of females belonged to grade II obesity. Waist - hip ratio (WHR) indicated that a relatively equal percentage of subjects belonging to male and female category had normal WHR ranges. A considerably high percent of males (32%) had WHR >0.9. The classification of MUAC as standard percent showed that 87% of males and 61% of females belonged to >90% of standard category. Only 12% of females between the age group of 20-30 years had a lower MUAC in the category of percent standard of 70-80%.

The food frequency data of subjects computed as average intake per day is given in table 3. Food frequency revealed that the major cereal consumed was rice followed by wheat. Maize was consumed to a lesser extent and other cereals were rarely used. Among legumes, use of beans, peas, and lentil was very common; others were used very rarely which indicates a poor dietary diversity. Among vegetables, tomato, potato, onion and egg plant were used by almost all the subjects. Others were hardly used by the study population. Fruit consumption was found to be moderate in both the groups. Beef, chicken and goat meat were commonly consumed by both the groups. Among the beverages tea, coffee and soft drink consumption was found to be very high among males. Dry fruits and nuts intake was shown to be in moderation. Milk and curd were commonly consumed products. Processed foods like biscuit, cake, and macaroni fell in the average use category.

Dietary intake of subjects was determined using 24hr recall method of survey. Table 4 presents the mean nutrient intake of all subjects. The mean protein intake was found to be sufficient. The highest protein intake was observed in the age group of 35-40 years among male subjects (82 ± 16.1g/day). Among females it was 71±16.1g/day in the age group of 30-35 years. Fat intake was found to be much higher and highest intake was seen in the age group of 30-35 years for both male and female subjects (68 and 72 g/day). Fiber intake was found to be satisfactory for both the groups. The mean energy intake for males ranged between 3029±373 Kcal to 3890±496 Kcal. Among females it was 2265±423 Kcal to 2492±312 Kcal. Calcium intake was found to be much below the recommended level for both male and female subjects which was in the range of 428±185.7 to 478±194.6 and 401±180.6 to 473±190.9 mg/day. Iron intake was found to be low among male subjects whereas for females it was satisfactory. The intake of thiamin, riboflavin and niacin were found to be adequate. The intake of vitamin C was found to be much higher than recommended allowances. â-carotene intake was lower which ranged from 726±276 to 886±304 for males and 686±363 to 955±553 µg/100g for females. Statistically significant differences were noted for the intake of protein, fiber, energy, calcium, iron, thiamin, riboflavin and niacin among the genders.

The analysis of percent adequacy of nutrients showed that the both protein and energy consumption was above the recommended level which ranged between 133.2 to 146.6% of protein for males and 133.6 to 155.3% for females, energy intake was found to be in the range of 93.8 to 107.4% for males and among females, it was 95.8 to 110.1%. Fat intake was more in all the subjects. Among all the nutrients, calcium consumption was found to be the least for all the age groups for both male and female subjects (42.9 to 47.9% and 50.8 to 58.7%). Iron consumption was satisfactory for both the groups which

accounted for 130.8% among males. Thiamin and riboflavin were consumed in adequate quantity by both the groups. Vitamin C consumption was higher than the recommended. Retinol adequacy was found to be marginal. The lowest (68.9%) adequacy level was observed in the age group of 30-35 years of females

It was worthwhile to examine the contribution of macronutrients protein, fat and carbohydrate to the energy intake of subjects to understand the composition of their diets. The mean percent contribution of protein, fat and carbohydrate to the total energy intake of subjects is presented in Fig 1. It is evident from the figure that among the three nutrients the highest energy was contributed by carbohydrate followed by fat and protein for both the groups. The calories contributed by protein, fat and carbohydrate were 16%, 29% and 56% for males and 14%, 33% and 53% for females respectively. It can be seen that fat calories were very high in the study subjects and they need to reduce the intake of fat in their diets.

Discussion

The prevalence of obesity is on the rise in developing countries like Iran, which might be possibly due to the involvement of various environmental factors such as socio- economic status, physical activity level and dietary pattern. Of all these educational level may also play a role in obesity through shaping the knowledge of individuals about diet, physical activity and their consequences on health status.[25] The negative association of obesity may therefore be related to a low level of knowledge among individuals about the intake of balanced meals in day-to-day living.[26] Body mass index (BMI) is a method used to measure a person's percent body fat. Accumulation of excess fat in the waist area increases the risk of having high blood pressure, cholesterol, diabetes, cardiovascular diseases and stroke.[27] In our study as we can see from the results, it is evident that with increasing age there is a gradual increase in mean body weight especially among women. This is an indication that the risk of obesity increases with aging if there is no consequent reduction in the energy intake as most of them prefer to be sedentary. Our results are consistent with the findings of Seidell[28] who reported that women show generally higher obesity prevalence than men especially after 50 years of age.

Waist-hip-ratio (WHR) is used to measure the distribution of person's body fat. WHR is a very good indicator of abdominal obesity which percentage can be considered as an independent predictor of cardiovascular diseases, morbidity and subsequent mortality. [29] Since a considerably higher percentage of subjects, both male and female were suffering from grade I and II obesity, it can be inferred that they are at the higher risk for developing degenerative diseases. Chi-square test was performed to check the degree of association of BMI for various age groups. Statistically significant association was noted between the groups. Similarly for WHR and MUAC, t-test showed statistically significant difference ($p< 0.0001$).

Several studies have reported that a shift from a monotonous diet to a more diverse diet has been shown to increase energy and micronutrient intakes especially in developing countries.[30-33] Intake of a diverse range of foods has been a recommendation for achieving adequate nutrient intake.[34] The results of the study indicated that the diets were adequate in energy and protein content. The energy density of the diet could also be associated with healthy or unhealthy characteristics of the diets. Energy dense diets have been reported to contain higher amounts of fat, refined grains and added sugars, but lower amounts of fruits and vegetables, whole grains and dietary fiber which are associated with unhealthy food choices.[35] However, fat was found to be much higher. The high fat intake could be attributed to the higher intake of meat and meat products, various processed foods and dairy products.

Dietary calcium intake especially from dairy products has been shown to have a protective effect on overweight and obesity.[36-39] Since all the study groups showed a lower intake of calcium it can be inferred this could be one of the reasons for the prevalence of higher mean body weights and BMI. Vitamin A intake was below the recommended level. Most of the vitamin A intake comes through carotenoids consumed through vegetables and fruits. Since the study population showed a lower consumption of green leafy vegetables and other vegetables, their carotene intakes were also found to be low. Adequate consumption of fruits and vegetables has a prominent role in weight management probably because their consumption decreases energy density, promotes satiety and decreases energy intake. [40] The Vitamin C intake would possibly be contributed by the consumption of fruit juices. Thiamin and riboflavin are shown to be adequately consumed by all the age groups as cereals are the richest sources of these nutrients and since the diets were predominantly cereal based, the intakes were sufficient.

It was interesting to analyze the percent contribution of calories form various macronutrients. For both male and female subjects, the calories contributed by carbohydrate was almost similar and fat calories were very high indicating a high fat intake. A higher intake of protein, fat and carbohydrate would have contributed to the higher energy intake among both group of subjects.

Conclusion

The extent of dietary change after migrating to another country would depend upon the place of origin, time of migration as well as extent of exposure to host country. In the present study it was observed that the subjects were more dependent on the processed food rather than home prepared foods. This might be due to the lack of time and adequate resources to prepare and serve themselves. Adopting diverse foods in the diet is important to obtain the beneficial effect of protective nutrients. An awareness programme about the judicious selection of foods is necessary for such category of individuals for maintaing health and well being, nutrient adequacy and quality of the diets.

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References

1. Nitzke S, Graves JF. American Dietetic Association. Position of the American Dietetic Association: total diet approach to communicating food and nutrition information. *J Am Diet Assoc.* 2007; 107: 1224–32.
2. Coulston AM. The search continues for a tool to evaluate dietary quality. *Am J Clin Nutr.* 2001; 74: 417.
3. Torheim LE, Quattara F, Diarra MM, Thiam FD, Barikmo I, Hatloy A and Oshaug A. Validation of food variety as an indicator of diet quality assessment with a food frequency questionnaire for werstern mali. *Eur J Clin Nut.* 2003; 57: 1283-91.
4. Ogle BM, Huang PH and Tuyet HJ. Significance of wild vegetables in micronutrients intakes of women in Vietnam; an analysis of food variety. *Asia Pacific J Clin Nut.* 2001; 10: 21-30.
5. Bernstein AM, Tucker LK, Ryan DM, O'neill FE, Clements MK, Nelson EM, Evans JW, Fiatrone AM. Higher dietary variety is associated with better nutritional status in frail elderly people. *J Am Diet Assoc.* 2002; 102: 1096-1104.
6. Torheim LE, Quattara F, Diarra MM, Thiam FD, Barikmo I, Hatloy A and Oshaug A. Nutrient adequacy and dietary diversity in rural mali;association and determinants. Eur *J Clin Nut.* 2004; 58: 594-604
7. Foote JA, Murphy SP, Wilkens LR, Basiotis P and Carlson A. Dietary variety increases the probability of nutrient adequacy among adults. *J Nutr.* 2004; 134: 1779-85.

8. Mirmiran P, Azadbakht L & Azizi F. Dietary diversity within food groups: an indicator of specific nutrient adequacy in Tehranian women. *J Am Coll Nutr.* 2006; 25: 354–61.
9. Bailey G and Peoples J. Humanity: Introduction to Cultural Anthropology. 6th Edition. Belmont: Wadsworth Press; 2000.
10. Ember C, Melvin E. Cultural Anthropology. 10th Edition. New Jersey: Prentice-Hall; 2002.
11. Scupin R, David MC. Anthropology: A Global Perspective. New Jersey: Prentice-Hall Press; 2004.
12. Watson M, Caldwell ML. The Cultural Politics of Food and Eating. New York: Bantam Books; 2005.
13. Arnold M, Razum O, and Coebergh JW. Cancer risk diversity in non-western migrants to Europe: an overview of the literature. *Eur J Cancer.* 2010; 46: 2647-59.
14. Daryani A. Risk factors for coronary heart disease among immigrant women from Iran and Turkey, compared to women of Swedish ethnicity. *Ethnicity & Disease.* 2005; 15(2): 213-20.
15. Gadd M. Do immigrants have an increased prevalence of unhealthy behaviours and risk factors for coronary heart disease? *Eur J Cardio Preven & Rehab.* 2005; 12(6): 535.
16. World Health Organization (WHO). Obesity: preventing and managing the global Epidemic, 1st ed. Report of a WHO Consultation on Obesity, Geneva, 3–5 June 1997.WHO/NUT/NCD/98.1. Geneva: WHO; 1997.
17. Goran MI and Gower BA. Relationship between visceral fat and disease risk in children and adolescents. *Am J Clin Nutr.* 1999; 70: 149s-56s.
18. Kelishadi R, Alikhani S, Delavari A. Obesity and associated lifestyle behaviours in Iran: Findings from the First National Non-communicable Disease Risk Factor Surveillance Survey. *Public Health Nutr.* 2008; 11: 246-51.
19. Azizi E, Rahmani M, Emami H and Madjid M. Tehran Lipid & Glucose Study: rationale and design. *C.V.D Prevention.* 2000; 3: 242-47.
20. Physical status: The use and interpretation of anthropometry. Report of a WHO expert committee World health Organization. *Tech Rep Ser.* 1995; 854: 1-452.
21. Azadbakht L, Mirmiran P, Shiva N and Azizi F. General obesity and central adiposity in a representative sample of Tehranian adults; prevalence and determinants. *Int J Vit and Nut Res.* 2005; 75(4): 297-304.
22. Rao HK, Raghavan V and Rao M. Anthropometry in the assessment of nutritional status. Human nutrition. 3rd edition. Oxford and IBH publishing company; 2003.
23. Gopalan C, Rama Sastri BV, Balasubramanian SC, Narasinga Rao BS, Deosthale YG and Pant KC. Nutritive value of Indian Foods. Hyderabad: National Institute of Nutrition, Indian Council of Medical Research; 1996.
24. Mahan K, Stump E. eds. Krause's Food, Nutrition and Diet therapy, 12th edition, Philadelphia, PA: WB saunders; 2008, 347.
25. Ball K, Mishra G and Crawford D. Which aspects of socio economic status are related to obesity among men and women? *Inter J Obesity and Rel Met Dis.* 2002; 26: 559-65.
26. Astrup A, Grunwald GK, Melonson EL, Soris WH, Hill JO. The role of low fat diets in body weight control; a metanalysis of ad libitum dietary intervention studies. *Inter J Obesity and Rel Met Dis.* 2000; 24: 1545-52.
27. Landen M. dyslipidemia and high waist-to-hip ratio in women with self reported social anxiety. *Psychoneuroendocrinology.* 2004; 29: 1037-46.
28. Lin S. Impact of dysglycemia, body mass index, and waist hip ratio on the prevalence of systemic hypertension in a lean Chinese population. *Am J Cardiology.* 2006; 97: 839-42.
29. Seidell JC. Epidemiology, Definition and classification of obesity in kopelman PG, Stock MJ, eds. Clinical obesity. Cambridge: Blackwell; 1998, 1-17.
30. Janghorbani M, Amini M, Willett W, Gouya M, Delavari A, Aikhani S. First nationwide survey of prevalence of overweight, underweight, and abdominal obesity in Iranian adults. *Obesity.* 2007; 15: 2797-808.
31. Hoddinott J & Yohannes Y. Dietary diversity as a food security indicator. Discussion Paper no. 136.Washington, DC: International Food Policy Research Institute, Food Consumption and Nutrition Division; 2002.
32. Mirmiran P, Esmailzadeh A and Azizi F. Detection of cardiovascular risk factors by anthropometric measures in tehranian adults;

receiver operating characteristic (ROC) curve analysis. *Eur J Clin Nut.* 2004; 58: 1110-8.

33. Steyn N, Nel J, Nantel G, Kennedy G & Labradarios D. Food variety and dietary diversity scores: are they good indicators of dietary adequacy? *Public Health Nutr.* 2006; 9: 644–50.
34. Kennedy GL, Pedro MR, Seghieri C, Nantel G & Brouwer I. Dietary diversity score is a useful indicator of micronutrient intake in non-breast-feeding Filipino children. *J Nutr.* 2007; 137: 472–77.
35. Ledikwe JH, Blanck HM, Khan LK, Serdula MK, Seymour JD, Tohill BC and Rolls BJ. Low energy density diets are associated with high diet quality in adults in the United States. *J Am Diet Assoc.* 2006; 106: 1172-180.
36. Davies KM, Heaney RP, Recker RR, Lappe JM, Bergerlux J and Rafferty K. Calcium intake and body weight. *J Clin Endo and Met.* 2000; 85: 4635-8
37. Zemel MB, Shi H, Greer B, Dirienzo D, Zemel PC. Regulation of adiposity by dietary calcium. *FASEB Journal.* 2000; 14: 1132-8.
38. Carruth BR and Skinners JD. The role of dietary calcium and other nutrients in moderating body fat in preschool children. *Inter J Obesity and Rel Met Dis.* 2001; 25: 559-66.
39. Skinners JD, Bounds W, Carruth BR, Ziegler P. Longitudinal calcium intake is negatively related to childrens body fat indexes. *J Am Diet Assoc.* 2003; 103: 1626-31.
40. Howarth NC, Saltzman E, Roberts SB. Dietary fiber and weight regulation. *Nutr Reviews.* 2002; 59: 129-39.