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Body Mass Index and Dietary Intake of Saudi Adult Males in the Riyadh Region-Saudi Arabia

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Abstract: The aim of this study was to investigate intake of macronutrients and its relation to Body Mass Index (BMI) as well as intake of selected micronutrients in urban and rural healthy adults in Riyadh region-Saudi Arabia. 170 health adults were recruited, 85 of which were urbans and 85 were rurals. Three consecutive days food records were collected and dietary intakes were analyzed by the food processor and other food composition tables. Results showed high intake of macronutrients and prevalence of overweight and obesity in both groups with no significant differences. Subjects of both groups also had high intake of saturated fat. Results also showed inadequate intake of vitamin D, calcium and folate. Few of the participants of both groups had inadequate intake of vitamin C. Intakes of vitamin B_1, vitamin B_3, iron, vitamin B_{12}, vitamin B_6 and vitamin B_2 was adequate. No significant differences between the two groups were observed except for vitamin D, calcium and vitamin B_2 that their mean intakes were significantly higher in urban group compared to rural group. Mean intake of vitamin B_3 was higher in rural group compared to urban group. These findings suggested that overweight and obesity among adult Saudis are due to high intake of macronutrients combined with inadequate intake of some micronutrients, which are results of non-balanced diet and inappropriate consumption patterns. The study also suggests that there is a need of increasing the nutritional education and awareness among adult Saudi males.

Key words: Dietary intake, nutrients intake, food records, BMI, Saudi males, rural, urban, Riyadh

Introduction

The country of Saudi Arabia is among the richest and highest per caption income countries of the world. This high income combined with food affluence and lack of nutritional awareness has led to a state of over-nutrition of macronutrients and malnutrition of micronutrients among the population. The over-nutrition of macronutrients is one of the leading causes of the prevalence of overweight and obesity among adult population (Madani *et al*., 2000; Al-Shoshan, 1992; Al-Nuaim *et al*., 1997; El-Hazmi and Warsy, 1997). These studies as well as other several studies determined overweight and obesity by anthropometric methods without measuring macronutrients intake. On the other hand, deficiency of some micronutrients among certain groups of Saudi population was reported. Anemia, mostly iron deficiency, was found among school students in Jeddah (Abalkhail and Shawky, 2002) and among schoolgirls in Riyadh (Al-Othaimeen *et al*., 1999) as well as among adult and elderly subjects in Riyadh (Alhamdan, 2004). Riboflavin deficiency was reported by El-Hazmi and Warsy (1989) who found minor deficiency of the vitamin in three different regions of the country including Al-Hafouf, Jazan and Riyadh. Several studies reported deficiency of vitamin D among adult and elderly subjects in Riyadh (Sedrani *et al*., 1983) among adult (Fonseca *et al*., 1984) among adolescent subjects (Abdullah *et al*., 2002) and among adolescent schoolgirls in Western region of Saudi Arabia (Siddiqui and Kamfar, 2007). The previous studies in addition to other several studies that examined micronutrients status assessed the deficiency biochemically without measuring the dietary intake. The aim of this study is to measure Body Mass Index (BMI) as well as dietary intake of macronutrients and selected micronutrients of adult Saudi males in the Riyadh region. Since dietary intake is expected to differ between urbans and rurals, the study measured dietary intake in both and compared the intake for each nutrient between them.

Materials and Methods

One hundred seventy healthy Saudi adult males were recruited from the Riyadh region of Saudi Arabia. Eighty-five of these individuals were urban subjects living in Riyadh City; and eighty five were rural subjects, living in towns and villages near the city. The recruitment was done by personal contact as well as by advertisement. All volunteers received a questionnaire asked for age, exercise habits, health status and use of dietary supplements. Non healthy and users of dietary supplement were excluded. Subjects received written instruction about keeping three days' food records. The instructions were discussed with each subject individually. Moreover, a one-day trial of keeping food record was performed after discussion of the instructions with subjects to ensure that all subjects

Table 1: Mean (±SD) of age, height, weight and BMI for urban and rural subjects

	Urban (n = 85)	Rural (n = 85)
Age (yr)	32.8±6.8[a]	31.5±5.7[a]
Height (cm)	171.2±4.7[a]	171.6±5.6[a]
Weight (kg)	78.6±14.8[a]	83.0±15.8[a]
BMI (kg/m^2)	26.8±4.8[a]	28.2±5.4[a]

Different letters in a given raw denote a significant difference, $p \leq 0.05$

Table 2: Percentage of urban and rural subjects in the BMI categories

BMI categories	% Urban subjects	% Rural subjects
Normal	43.5	23.5
Overweight	31.8	40.0
Obesity	24.7	36.5

Table 3: Mean (±SD) intake of macronutrients of urban and rural subjects

Nutrient[a]	Urban (n = 85)	Rural (n = 85)
Calories (k.cal)	2460±429.9[a]	2522±400[a]
Carbohydrates (g)	334±81.8[a]	232±61.0[a]
Total fat (g)	84.1±21.6[a]	86.9±23.0[a]
Saturated fat (g)	26.9±11.7[a]	27.9±10.3[a]
Unsaturated (g)	45.9±13.6[a]	49.1±12.5[a]
Protein (g)	99.7±21.6[a]	105.1±26.1[a]

a: Means are the average intake of three consecutive days.
Different letters in a given raw denote a significant difference, $p \leq 0.05$

properly followed the instructions. For each subject, energy requirement (based on his physical activity level, weight, height and age) and energy intake (based on his food record intake) were determined. Subject (s) for whom their difference between energy requirement and energy intake exceeded 15% were excluded since this difference indicates incomplete food records or poor validity of the food records. One-day prior to food records collection weight was measured by a digital SECA balance with a precision of 0.1 kg. Height was measured by physician scale (Health meter, USA) with a precision of 0.01 m. BMI was calculated as weight (kg)/height (m^2). Food records of three consecutive days, two week days and one weekend day were analyzed by the Food Processor Software, version 7.8 (2001) (ESHA research, Salem, OR, USA). For foods that are not in the software, other tables of food composition were used (Pellett and Shadarevian, 1970; Paul and Southgate, 1978). The study protocol was explained to the subjects and informed consent was obtained. Nutrients intake was reported as average of the three consecutive days. The intakes of subjects were compared with Dietary Reference Intake (DRI, 1997; 1998; 2000a,b; 2005). The statistical analysis included means, standard deviations, percentage of subjects with intakes below Estimated Average Requirement (EAR) value and t-test comparison between urban and rural subjects were performed by SSPS version 10. Significance of difference was set at p-value of ≤ 0.05.

Results

Characteristics of urban and rural subjects are shown in Table 1. No significant differences were observed between groups for any of these characteristics. Results of BMI for both groups as an indicator of weight status showed prevalence of overweight and obesity among participants. According to the classification of the National Heart, Lung and Blood institute (1998) 31.8% and 24.7% of urban subjects were overweight and obese, respectively. Among rural subjects 40.0% and 36.5% were overweight and obese, respectively; the data is presented in Table 2. The most frequently consumed foods that were reported by >90% of each urban and rural participants were mutton, white rice, wheat bread and dates. Other foods that were reported by >70% of the participants were chicken, camel meat, tomatoes, cucumber, potatoes, broad beans and watermelon. The predominant drink consumed with meals was cultured buttermilk; between meals, sweet black tea was the favorite drink. Soda and coffee were consumed to a lesser extent. Arabic coffee-lightly roasted coffee beans with cardamom in a ratio of 2:1-was consumed more frequently, compared to American style coffee. Means±SD intake of macronutrients for urban and rural groups is shown in Table 3. With exception of carbohydrates, mean intake of macronutrients for rural group was higher compared to urban group, but differences were not significant for any of the macronutrients. The Acceptable Macronutrient Distribution Ranges (AMDRs) for adult individuals that have been established in the DRI (2005) for carbohydrates, protein and fat were 45-65%, 10-35% and 20-35% of energy, respectively. The mean intake of both groups, were within these ranges. None of the participants of the two groups had an intake of any micronutrient out of the AMDRs. Means±SD intake of selected micronutrients is presented in Table 4. Mean intakes of vitamin D, calcium and vitamin B_2 were significantly higher in urban group compared to rural group. On the other hand, mean intake of vitamin B_3 was significantly higher in rural group. Since inadequacy of micronutrient is expected when intake is below the EAR recommendation (Lee and Nieman, 2003), the percentage of participants of both groups whom their intake is below EAR recommendation is shown in Table 5. Our findings showed inadequate intake of vitamin C, calcium, vitamin D and folate and adequate intake of the rest of the micronutrients in both groups.

Discussion

The BMI data revealed a high prevalence of overweight and obesity in both urban and rural subjects. This is in agreement with several previous studies conducted on Saudi subjects (Al-Nuaim *et al.*, 1997; Al-Nuaim *et al.*, 1996; El-Hazmi and Warsy, 1997; Mdani and Khashoggi,1994). Major factors, which may contribute to

Table 4: Mean (±SD) intake of selected micronutrients of urban and rural subjects

Nutrient[a]	Urban (n = 85)	Rural (n = 85)
Vitamin C (mg)	152.1±106.2[a]	141.5±89.3[a]
Vitamin B_1 (mg)	1.5±0.4[a]	1.6±0.5[a]
Vitamin D (IU)	54.2±35.0[a]	43.3±23.7[b]
Calcium (mg)	969.7±385.8[a]	795.4±265.8[b]
Iron (mg)	11.8±2.7[a]	12.5±3.7[a]
Vitamin B_3 (mg)	31.4±9.4[a]	35.6±10.4[b]
Vitamin B_{12} (µg)	5.9±7.6[a]	4.5±3.6[a]
Folate (µg)	210.7±74.5[a]	205.4±64.8[a]
Vitamin B_6 (mg)	2.7±0.5[a]	2.3±0.8[a]
Vitamin B_2 (mg)	2.3±0.6[a]	2.0±0.5[b]

a: Means are the average intake of three consecutive days.
Different letters in a given raw denote a significant difference, $p \leq 0.05$

Table 5: DRI and percentage of urban and rural subjects with intakes below EAR values

Nutrient	DRI	Urban%	Rural%
Vitamin C	90 mg	14.5%	17.0%
Vitamin B_1	1.2 mg	0.0%	0.0%
Vitamin D	200 IU	90.6%	100%
Calcium	1000 mg	27.1%	35.3%
Iron	8 mg	0.0%	0.0%
Vitamin B_3	16 mg	0.0%	0.0%
Vitamin B_{12}	2.4 µg	0.05	0.0%
Folate	400 µg	60.0%	56.7%
Vitamin B_6	1.3 mg	0.0%	0.0%
Vitamin B_2	1.3 mg	0.0%	0.0%

this prevalence, are high incomes and affluence among Saudis, which lead to a sedentary lifestyle in addition to the lack of nutritional awareness. However, the several studies that have evaluated overweight and obesity among Saudis used either BMI or weight for height measures. These two anthropometric measures do not indicate the amount of body fat or the location of body fat that are strongly related to health hazards associated with overweight and obesity. Since obesity is one of the major health problems in Saudi Arabia, measures of body fat such as skin fold measurements and measure of fat location such as waist to hip ratio need to be evaluated among Saudi adults, especially for overweight and obese subjects. Data of food records showed that caloric intake was consistent with the energy requirements of the subjects. The records also showed that variations in caloric intake between subjects were relatively low. This suggests that these subjects were relatively accurate in the completion of their food records. Since this is the first study that has measured dietary intake for adult Saudi males by three-day food records, comparison with other studies is not possible. However, dietary intake by other methods than three-day food records was reported in very limited studies. The mean calorie intake for both urban and rural groups, reported in this study was 11% lower than the per capita estimation reported by Musaiger (2002). The main reason for the difference is that per capita estimation counts wasted food in the consumption data, which could overestimate intake. The mean intake of total fat in present study was lower than that reported by Al-Nozha *et al.* (1996) by 35% and 32.6% for urban and rural groups, respectively. Al-Nozha *et al.* (1996) reported that the mean intake of total fat, both genders, was 145g, which represented 42% of calorie intake. This high intake of fat raised the calorie intake to 3082 k.cal, which is above the calorie intake reported in the present study. This could be due to overestimation of the invisible fat in the diet (such as oil that is used in food preparation). High intake of saturated fat presented in our study (32% and 33.2% of total fat for urban and rural groups, respectively) is in agreement with high intake of saturated fat of healthy young Saudi males reported by Alissa *et al.* (2006) and adult Saudis in Jeddah City reported by Alissa *et al.* (2005). Although the intakes of macronutrients of all subjects were within the AMDR (DRI, 2005) they were considered high due to the high calorie intake. This high intake of calories explains the prevalence of overweight and obesity among participants of this study as illustrated by BMI. The high intake of fat, especially saturated fat explain the prevalence of hypercholesterolaemia among adult Saudis reported by Al-Shammari *et al.* (1994) Al-Nuaim *et al.* (1995) and Madani *et al.* (2000). Inadequate intakes of vitamin D and calcium of some urban and rural subjects are consistent with other studies that reported biochemical deficiency of vitamin D and calcium (Sedrani, 1984a; Sedrani, 1984b; Abdullah *et al.*, 2002; Al-Faraj and Mutairi, 2003).

The mean intake of micronutrients (Table 4) and percentage of subjects with intake below EAR (Table 5) showed minor inadequate intake of vitamin C,which is in consistence with the findings of Al-Numair, 2006 who found minor deficiency in serum ascorbic acid in smokers and non-smokers Saudi subjects. Table 4 and 5 also showed major inadequate intake of folate and adequate intake of vitamin B_1, vitamin B_3, vitamin B_{12} and vitamin B_6. Comparison of this data with others is impossible since status of the previous nutrients of healthy adult Saudis is not available, neither by dietary intake nor by biochemical methods. However, the previous adequacy is expected since these nutrients are widely distributed in foods with exception of vitamin C that its main source is limited to fruits. Low intake of fruits explains the small percentages of urban and rural subjects with vitamin C intakes below EAR recommendation (Table 5). Although anemia was reported in several previous studies in Saudi population, non-of which was among adult males. Our findings of iron intake showed that anemia-iron deficiency-is not likely among adult males in Riyadh region since intake of all participants exceeded the recommendation of DRI. The only conflict we found in this study is the adequate intake of vitamin B_2 which is not consistent with the results of El-Hazmi and Warsy (1987 and 1989), which

reported riboflavin deficiency among adult Saudis. The later two studies suggested that riboflavin deficiency could be due to one or more of three factors: insufficient dietary intake, lactose intolerance and climatic conditions. Results of this study, indicates that insufficient dietary intake is not one of the contributing factors for riboflavin deficiency among adult Saudi males.

Comparison between the urban and rural groups for the mean intake of macronutrients and the selected micronutrients raised an interesting point. The urban group, compared to rural group had lower mean intake of macronutrients and a higher mean intake of the selected micronutrients. The exceptions to this were the means of intakes of carbohydrate, vitamin B_1, vitamin B_3 and iron, which were higher in urban group compared to rural group. This suggests that the rural group, compared to urban group consumed more meat and starchy foods and less fruits and vegetables. However, these differences in the mean intake between the two groups were not statistically significant except for vitamin D, calcium, vitamin B_3 and vitamin B_2. This study was conducted in the month of September, 2006, which is the summer season in Riyadh region and the harvest season for several foods such as watermelon, dates, tomatoes and cantaloupe. Intake of these foods may be higher during summer season compared to other seasons. Thus, a seasonal variation in intake may be expected.

Overweight and obesity due to high intake of macronutrients combined with inadequate intake of some micronutrients are results of non-balanced diet and inappropriate consumption patterns. These problems can be averted by increasing the nutritional education among population as well as by fortification of some popular Saudi foods with folate, calcium and vitamin D. This study also encourages use of unsaturated fat in the expense of saturated fat.

Conclusion: Results of this study showed high intake of macronutrients and high prevalence of overweight and obesity among urban and rural subjects as measured by dietary intake and BMI. The mean intakes of vitamin D, calcium and folate were lower than the DRI (1997; 1998) recommendations in the two groups. No significant differences between urban and rural groups were observed in the nutrient intake, except for vitamin D, calcium, vitamin B_3 and vitamin B_2. The mean intakes of the other selected micronutrients were adequate when compared to DRI (1998; 2000a, b) recommendations. Results of this study indicate the need of raising nutritional awareness among adult males in Riyadh region-Saudi Arabia.

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