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A comparison of food pattern, macro- and some micronutrients density of the diet across different socio-economic zones of Tehran

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Abstract

Background: The consumption of low quality foods is common in low socioeconomic areas; and according to epidemiological studies, the density of nutrients often proves the quality of diet. This study aimed to compare the density of macronutrients and micronutrients in various parts of Tehran.

Methods: This was a cross-sectional study performed from September to December 2007 in all the 22 districts of the municipality of Tehran including 1,807 households. Experienced interviewers completed a 24-hour recall questionnaire. To estimate the nutrient densities, nutrient intake (grams or milligrams) was calculated per 1,000 kcal energy intake. To calculate the density of energy intake, energy intake (kcal) was divided by 100 g of foodstuff. The 22 districts of Tehran were divided into five zones of north, center, east, west and south. ANOVA and Tukey tests were used.

Results: The highest density of protein and fat intake was observed in the north of Tehran, while carbohydrate density was highest in the west, east and south zones, and energy density was highest in the south zone ($p<0.05$). Calcium and vitamin C had the highest density in the north of Tehran, and vitamin A and riboflavin had the highest density in the north and center of Tehran, and the lowest level in the south of Tehran ($p<0.05$).

Conclusion: Despite the high density of energy in the south of Tehran, a deficiency of micronutrient intake was obvious, reflecting the importance of the impact of socioeconomic factors.

Keywords: Energy Density, Macronutrients Density, Micronutrients Density, Socioeconomic Status.

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Introduction

Some studies have examined the factors influencing food choices and the relationship between food and nutrient intakes and illnesses. Explaining the quantitative and qualitative patterns of people's food intake and its determinants contribute to designing and implementing proper interventions to improve the nutritional status. Economic and sociocultural factors along with other factors from the fields of sociology, psychology, geography and climate affect people's food patterns (1-2). Low quality foods are common in low socioeconomic areas. For example, low consumption of fruits and vegetables causes insufficient intake of micronutrients particularly vitamin C and beta-carotene, which is more common in are-

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as with less income and lower sociocultural levels (1-4). Even though the reason for the low quality food intake is not clear in areas with low socioeconomic status, nutrition knowledge and economic factors certainly play a prominent role (5-6).

Consumption assessment is used in different researches to identify the food pattern, and various methods of summarizing and presenting data have been utilized with respect to the objectives of the studies. The macronutrient composition for supplying energy intake is one method of presenting data, and it is a good indicator to assess the qualitative pattern according to international recommendations. In addition to this method, the density of calorie and nutrients intake can also be used. In epidemiological studies, the density of nutrients often represents the composition of a diet. Nutrient intake in grams or milligrams per 1,000 kcal of energy intake indicates the density of a nutrient (7-8). The density of calorie and nutrients intake is actually a reflection of the resultant of economic and sociocultural factors. It is expected that households with proper nutrition culture and knowledge choose those foods that are high in nutrient density and putting this choice into practice depends on the household's financial ability to buy such foods. Finally, the interaction of social factors on the one hand and economic factors on the other determines the consumers' final food pattern (9).

The concept of nutrient density was the base of the design of USDA My Pyramid and the American Dietary Guidelines in 2005, which emphasized that people should consider nutrient density to choose foodstuffs. Moreover, people's food pattern depends on variables such as income, cost of food and awareness and knowledge about the nutritional value of each food group. Determining the density of macronutrients and micronutrients based on calorie is a modern tool for setting nutritional policy and the dietary recommendations (10-13).

This study aimed to determine the food pattern (macronutrient composition in energy supply, energy, and nutrient density) of people living in Tehran. The distribution of people's living place across these different areas is the outcome of economic and socio-cultural factors. Therefore, the relationship between economic, sociocultural factors and food pattern can be examined.

Methods

Data

This was a cross-sectional study performed from September to December 2007 in all the 22 districts of the municipality of Tehran including 1,807 households. The multistage cluster sampling method was used for data collection. The number of samples in each district of the municipality was determined by estimating the energy intake with reasonable accuracy. After the random selection of blocks in the city from a list of National Statistics Center, trained interviewers counted and listed all the bells in selected blocks, and chose households using systematic sampling method. They went door to door to explain the aims and method of the research, and asked the homemakers to answer the questions. After inquiring about the general characteristics of the household members, the interviewers completed a 24-hour recall questionnaire. This questionnaire and the interview method were already approved in the national studies of consumption survey.

After conducting the interviews, the questionnaires were immediately examined by trained experienced experts and returned to the interviewers for correction in case of any defect or error. In addition, these experts converted the recorded household units into gram while encoding the eaten food items. After quality control, an experienced operator entered the data into the Access Ms environment. The executives ensured the accuracy and correctness of the entered data by controlling 3% of the entered questionnaires. The household intake data were converted into g/person/day based on the number of individuals older than two years of age in each household. The energy and other nutrients intake levels

were calculated for each person per day using the food composition table in the national consumption survey.

To calculate nutrient density, the amount of each dietary nutrient (grams or milligrams) was calculated per 1,000 kcal energy intake. To determine the density of energy intake, it (kcal) was divided by 100 g of foodstuff. To determine the share of carbohydrate, lipid and protein intake, calorie intake from each was divided by the total daily calorie intake.

Considering the extent of the city and previous experiences, Tehran was divided into five socioeconomic districts. Different socio-economic levels grouping was carried out based on the surveyed households' geographical area of residence, and experience and knowledge of the executives about the socioeconomic situation of each region. Thus, five socioeconomic levels were defined as follows:

The north region: Districts 1, 2 and 3 of the municipality (relatively affluent)

The center region: Districts 6 and 7 of the municipality (average)

The south region: Districts 9, 10, 11, 12, 14, 15, 16, 17, 18, 19, 20 and 21 of the municipality (non-affluent)

The west region: Districts 5 and 22 of the municipality (economically average)

The east region: Districts 4, 8 and 13 of the municipality (relatively average)

The Ethics Committee of Iran University of Medical Sciences approved the research protocol.

Statistical Analysis

The mean and standard deviation were used to describe the data. ANOVA and Tukey test were utilized to check the significant differences among the five areas of the city. P-values less than 0.05 were considered as statistically significant. All analyses were performed using SPSS 18.

Results

Table 1 shows how Tehran was divided into different zones, and displays the distribution and number of the households. The highest density of energy was observed in the south (160 kcal per 100 g of food intake), and the lowest in the north (133 kcal per 100 g of food intake) ($p<0.001$) (Table 2). The density of protein intake had the highest level in the north and center of Tehran, 34 and 33 g per 1,000 kcal intake, respectively; and the south had the lowest level with 31 g per 1,000 kcal intake ($p<0.001$) (Table 2). The highest density of lipid intake was reported in the north and center of Tehran (31 g per 1,000 kcal intake), and the lowest in the west (28 g per 1,000 kcal intake), and this difference was not significant (Table 2). The density of carbohydrate intake had the highest level in the west and south and east of Tehran, 157, 156 and 155 g per 1,000 kcal intake, respectively, and the lowest was in the north and center with 149 g per 1,000 kcal intake ($p<0.002$); there was a significant difference (Table 2).

Table 1. Distribution and the number of 1807 households studied in Tehran

Zone	Municipality district	number
East	4	75
	8	78
	13	79
	Total	232
Center	6	71
	7	68
	Total	138
North	1	71
	2	88
	3	79
	Total	238
South	9	73
	10	82
	11	76
	12	78
	14	84
	15	151
	16	75
	17	92
	18	91
	19	76
	20	78
	21	83
	Total	1039
West	5	79
	22	81
	Total	160

Table 2. Comparison of energy density and macro nutrient intake among 1807 households in Tehran*

	North	Central	East	West	South	Total	p$
Energy# Kcal/100gr food intake	134.6[a] (131.9-137.3)	136.2[b, c] (133.0-139.4)	145.8[b] (143.1-148.4)	148.1[b] (144.3-151.8)	160.5[b, d] (156.9-164.0)	152.3 (151.2-153.3)	<0.001
Protein gr/100gr food intake	33.3[a] (32.7-33.8)	32.2[a] (31.6-32.8)	31.6 (31.2-32.0)	31.7 (31.1-32.3)	30.4[b] (30.2-30.6)	31.2 (31.0-31.3)	<0.001
Fat gr/100gr food intake	30.8 (30.0-31.5)	30.9 (30.0-31.7)	29.0 (28.4-29.6)	28.4 (27.6-29.2)	29.6 (29.26-29.94)	29.6 (29.36-29.8)	<0.086
Carbohydrate gr/100gr food intake	148.9[a] (147.3-150.5)	149.8 (147.8-151.8)	154.7 (153.3-156.1)	156.0[b] (154.0-156.4)	154.5[b] (153.7-155.2)	153.5 (152.95-154.0)	<0.002

*Mean (CI 95%), $ ANOVA
Different superscript letters indicate significant differences between zones (Tukey test)

Table 3. Comparison of the micronutrient density of 1807 households in Tehran

	North	Central	East	West	South	Total	p$
Calcium mg/1000Kcal intake#	407.3[a] (395.8-418.4)	402.6[a] (386.6-418.6)	374.7[a] (363.7-385.7)	376.6[a] (364.3-388.8)	327.9[b] (323.0-332.8)	354.4 (350.5-354.4)	<0.001
Riboflavin mg/1000 kcal intake	0.7[a] (0.68-0.71)	0.7[a] (0.67-0.72)	0.6 (0.58-0.61)	0.6[b] (0.58-0.67)	0.5[b] (0.49-0.50)	0.6 (0.595-0.605)	<0.001
Vitamin C mg/1000 kcal intake	67.2[a] (64.2-70.2)	62.3 (58.95-65.63)	57.4[b] (55.0-59.7)	56.9[b] (53.5-60.3)	47.3[b] (46.3-48.3)	53.2 (52.3-54.1)	<0.001
Vitamin A mg/1000 kcal intake	552.2[a] (518.4-585.9)	564.2[a] (506.2-622.1)	505.1[b] (466.1-544.1)	496.4[b] (452.2-540.6)	387.0[b] (372.2-401.8)	447.1 (434.6-459.5)	<0.001

*Mean (CI 95%), $ ANOVA
different superscript letters indicate significant differences between zones (Tukey test)

Table 4- Contribution of macro nutrients to energy supply in different zones of Tehran (%)

	North	Central	East	West	South	Total	p$
Carbohydrate#	59[a] (58.4-59.6)	60 (59.2-60.9)	62 (61.5-62.5)	62 (61.6-62.4)	61[b] (60.7-61.3)	61 (60.8-61.2)	<0.002
Protein	13[a] (12.8-13.2)	13[a] (12.8-13.2)	13 (12.8-13.2)	13 (12.8-13.2)	12[b] (11.9-12.1)	12 (11.9-12.1)	<0.001
Fat	28 (27.4-28.6)	28 (27.2-28.8)	26 (25.5-26.5)	25 (24.3-25.6)	26 (25.7-26.3)	27 (26.8-27.2)	<0.090

*Mean (CI 95%), $ ANOVA
different superscript letters indicate significant differences between zones (Tukey test)

The findings revealed that in affluent zones of Tehran (north and center), protein density was the highest along with high lipid density, indicating high animal protein intake. This implies a positive correlation between economic status and protein density, particularly as a high carbohydrate density (bread and starchy foods) was seen in less affluent zones (south). Thus, in Tehran districts, with increasing socio-economic status, intake of protein and lipid increased and intake of carbohydrates decreased.

Calcium had the highest density in the north of Tehran with 421 mg per 1,000 kcal intake and the lowest density in the south with 330 mg per 1,000 kcal intake. The highest density of riboflavin was seen in the north and center of Tehran with 0.68 mg per 1,000 kcal intake, and the lowest density in the south with 0.53 mg per 1,000 kcal intake. Vitamin C had the highest density in the north of Tehran with 68 mg per 1,000 kcal intake, and the lowest density in the south with 48 mg per 1,000 kcal intake. Vitamin A had the highest density in the north and center of Tehran with 595 micrograms (RE) per 1,000 kcal intake, and the lowest density in the south with 384 micrograms per 1,000 kcal intake (Table 3).

The share of carbohydrate in energy supply was seen more in the south, west and east compared to the north and center of the city (p<0.001). The share of protein in the north and center (13%) was more than other areas. The share of lipid in the north and center (28%) was more than the rest of the areas (Table 4).

Discussion

This study aimed to compare the density of macronutrients and micronutrients intake in various zones of Tehran and revealed that the density of energy intake had the highest level in the south of Tehran. Given

that the share and density of carbohydrate was highest in the south and West of Tehran, it seems that carbohydrate sources play a major role in the food pattern of the people of the south and west of Tehran. Protein and lipid intake had the highest density in the north of Tehran, and lipid intake had the highest density in the center of Tehran. A comprehensive study on household food consumption patterns and nutritional status of IR Iran during 2001-2003 revealed that the energy from bread as a main source of carbohydrate was higher in the lower socioeconomic classes and the energy from oil was lower in these regions. In this study, the higher socioeconomic classes had smaller share of rice, oil and sugar (14). In this study, calcium and vitamin C had the highest density in the north of Tehran, and vitamin A and riboflavin had the highest density in the north and center of Tehran. These results are consistent with other studies and suggest that the higher the nutrient density is in a diet, the lower the energy density is in that diet (8,15-17).

This study revealed that as the energy density of foods increases, the nutritional value decreases. Fruits and vegetables have the highest amount of nutrients yet they have low energy content. The western dietary pattern is rich in energy, but it is nutritionally poor. Energy density is inversely related to the nutrient density, and the more density the key nutrients, the lower the density of energy (7,18,19). When assessing the adequacy of nutrients, it should be kept in mind that some nutrients in some foods have higher density such as vitamin C in fruits and vegetables and calcium in milk. However, some nutrients have lower density, but exist in more food items (20-22).

Another study in 2005 showed that a diet high in energy content has fewer fruits and vegetables and is associated with a higher BMI compared to a low energy dense diet. In this study, a positive relationship was found between energy, lipid and lower nutrient density, and the nutrient density was inversely related to energy density (19).

Several reports have indicated that energy density is independent of the composition of macronutrients intake (23-24).

Cross-sectional studies show that energy density is associated with lipid and energy intake (18,21). Study of Abtahi et al. on comparing overweight and obesity in adolescent girls between north and east of Tehran revealed that higher intake of energy from fat could lead to higher prevalence of overweight in southern districts than the northern (25). Another study showed that women residing in districts with lower socioeconomic status had unhealthier (higher fat and sugar) diet compared to higher SES districts (26). A review of different articles found no specific standard for determining nutritious foods. However, studies conducted on nutrient density allow the consumers to choose nutritious foods in the range of their calorie intake (12-15,27).

Studies have shown that the foods with lower energy density have more satiating effect. On the other hand, a low fat diet with high fiber content has low energy density and is more effective in weight loss (27-28). A study on 20-60 year old people living in district 17 of Tehran showed that despite the adequacy of energy intake, micronutrient intake was not sufficient. The findings of this study confirmed that we obtain more energy, but less micronutrient, and established that more energy intake is associated with less micronutrient intake (29).

The prevalence of overweight and obesity is increasing among Iranian children and teenagers in areas with average income (30,31). Iran is one of the countries that has experienced hasty nutritional transition, and it is a country in which the prevalence of metabolic syndrome is strongly growing among its adults and young people. The number of teenagers affected by overweight and obesity has doubled in the past two decades in Iran, and environmental and nutritional factors have a large impact on this epidemic (32-33). Moreover, the consumption of energy-dense foods with low nutrient density has been publicized, particularly among the young and teenage Ira-

nians (30-33). A study conducted in the north of Iran (Gilan) revealed that obesity was seen more in rural areas than in the urban areas, whereas another study in central areas of Iran showed a higher prevalence of overweight and obesity in urban areas (34). These studies suggest that people's life and nutrition pattern vary in different areas, and economic and cultural factors significantly affect the nutritional status, micronutrients intake and energy in each region (30-34).

Conclusion

Despite the high density of energy in the south of Tehran, deficiency of micronutrient intake was obvious, and this reflects the importance of the impact of socioeconomic factors. That is, the lower purchasing power of inhabitants of the unprivileged zones results in consumption of foods with high-energy content, which do not meet their micronutrient needs.

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