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Original article

Comparison of energy and micronutrient intake and their adequacy between different socio economic zones of Metropolitan Tehran

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Summary. *Background:* Micronutrient deficiency is a major health problem in many countries. The purpose of this study is to assess and compare the adequacy of energy and micronutrient intake within five different zones of Tehran. *Methods:* This is a cross-sectional study that was conducted from September to December 2007 in all 22 districts of the municipality of Tehran. A 24-hour Recall questionnaire was completed by experienced interviewers. The micronutrient requirements of household members were calculated and determined using the FAO / WHO table. *Results:* The average energy intake in the South of Tehran is 2491 (2469-2513) Kcal/person/day. In the West it is 2525 (2467-2583) Kcal/person/day, these values being higher than the three remaining zones ($P < 0.001$). The highest calcium intake of 960 (921.59-997.6) mg/person/day was found in the Center zone, with the lowest value of 799 (776.0-823.2) mg/person/day found in the South, ($P < 0.001$). The highest intake of riboflavin is in the Center, at 1.6 (1.28-1.31) mg/person/day, and the lowest intake is in South, at 1.3 (1.28-1.31) mg/person/day. The highest intake of vitamin C was shared between the North and Center at150 (141.0-159.0) mg/person/day with the lowest consumption seen in South, 119 (116.0-121.1) mg/person/day. The highest consumption of vitamin A was in Center at 1420 (1296.5-1543.0) mg/person/day and the lowest consumption was in South at 937 (906.0-969.0)mg/person/day.*Conclusion:* Despite the high energy intake of the South and the West zones, micronutrient deficiency is quite prevalent, representing the major impact of social and cultural factors independent of economic factors.

Key words: micronutrients, food security, nutrition adequacy, cultural factors

Introduction

Nutritional knowledge and education and a healthy eating pattern have important roles in health promotion and disease prevention (1, 2). Food security is a concept that includes household access to adequate quantities of varied foods to meet the needs of all members of the household. Today, more than hundreds of millions of families around the world suffer from food insecurity, which appears in two forms: explicit hunger and hidden cell hunger (3-6). Studies on nutritional transition in Iran indicate that malnutrition and low energy and nutrient intake coincide with diseases caused by excess nutrients and energy consumption, causing a variety of metabolic disorders, such as obesity, cardiovascular disease, diabetes and cancer (7-9).

Today micronutrient deficiency on the macro level of society is one of the major nutritional health problems

in many countries of the world, resulting from undesirable socio-economic consequences and slowing down economic development. It is noteworthy that food insecurity is more common in rural and low-income districts with poor socio-economic conditions (10-11).

In Iran, studies on household expenditure have shown that 20% of the community does not have the economic capacity to fill their belly and almost 50% are in trouble with regards to cell satiation. In other words, one fifth of the population suffers from energy deficiency and half of the people are suffering from micronutrient deficiency (12-14). McLaren believes that if at least 20% of the population of a country receive less than 75% of a nutrient recommended daily allowance (RDA), its deficiency should regarded as a major health problem in that population (15). In a study conducted by the National Nutrition and Food Technology Research Institute in 1995, a severe shortage of vitamin B2, vitamin A, and Calcium is addressed as a public health problem. In this study 30%, 46% and 70% of people were found to receive less than 80% of their RDA for calcium, vitamin A and riboflavin, respectively (16). Another study in northern Iran demonstrated that nutrient intake was less than 75% of the RDA amount, affecting the health of the population. One of the important issues of nutrition policy at the macro level is to identify families at risk of nutrient deficiencies and investigate their intake of food and nutrients, which is of great importance in the design of appropriate policies and intervention programs (19-18). In the past decade, social justice in health and the distribution and allocation of resources in cities (particularly metropolitan areas) have been considered by experts and researchers (20-22). The World Health Organization (WHO) has suggested the urban health equity program and recommended its implementation in large cities to mayors and health officials. Tehran Municipality implemented the first phase of this project in 2007. The results of this study helped better understand factors and risks of lack of equity in health and its outcomes, as well as the complications that may ultimately lead to the inclusion of these issues in decision-making and resource allocation. This study aims to determine the differences in energy and nutrient intake across different zones of Tehran, which may be a reflection of health inequality.

Materials and methods

This study is a cross-sectional study which was conducted from September to December 2007 in all 22 districts of the municipality of Tehran. The sampling method was multistage cluster sampling. The number of samples in each district of the municipality was determined so as to estimate the energy intake with reasonable accuracy. After a random selection of blocks in the city from a list provided by the National Statistics Center, trained interviewers counted and listed all the addresses in selected blocks, and selected households using the systematic sampling method. Visiting the houses and explaining the aims and methods of the research, the interviewers asked the women to cooperate and answer the questions. After questions on the general characteristics of the household members, the 24-hour recall questionnaire was completed. The questionnaire and the interview method were already approved as part of the national studies of consumption survey. After conducting the interviews, the questionnaires were immediately examined by trained and experienced experts, and were returned to the interviewers for correction if there was any defect or error. Also these experts, while encoding the eaten food items, converted the recorded household portion sizes into grams. The data, after quality control, were entered into an MS Access environment by an experienced computer operator. Then the investigators ensured the accuracy and correctness of the entered data by checking 3% of the entered questionnaires. The household intake data, based on the number of household members older than two years were converted into g/person/day. This is a standard analytical procedure when presenting data on household food consumption. Although households may have different compositions with regards to age, gender and body size, this technique allows for the comparability of household data adjusted for number of members. Using the food composition table used in the national consumption survey, the energy and other nutrients intake levels were calculated per person per day. More details are presented elsewhere (23).

To assess adequate intake of nutrients and energy, the nutrient requirements for household members were calculated and determined using the FAO/

WHO table for micronutrients. In the national consumption survey the energy required for the 35,000 individual participants in the study was estimated. The average energy needed for each age-gender group in this research was copied from the same age-gender group in the national survey. For computing the energy and nutrient adequacy, the daily amount of energy and macronutrient intake per person was divided by the average requirement and was presented as a percentage. An average percentage was then calculated for each household.

Considering the extent of the city and previous experiences, Tehran was divided into 5 socioeconomic zones. The grouping of different socio-economic levels was carried out based on the surveyed households' geographical area of residence, and the experience and knowledge of the researchers about the socio-economic situation of each region. The 5 socio-economic regions were defined as follows:

The North zone: Including districts 1, 2 and 3 of the municipality (relatively affluent)

The Center zone: Including districts 6 and 7 of the municipality (average)

The South zone: Including districts 9, 10, 11, 12, 14, 15, 16, 17, 18, 19, 20 and 21 of the municipality (non-affluent)

The West zone: Including districts 5 and 22 of the municipality (economically average)

The East zone: Including districts 4, 8 and 13 of the municipality (relatively average)

The research protocol was approved by the ethics committee of Iran University of Medical Sciences. To perform the analysis the data was transferred to SPSS 18. The effect of sampling was included in the calculations to allow for the adjustment of standard deviations. Means and standard deviations were used to describe the data. ANOVA and post hoc Tukey tests were used to examine significant differences between the 5 zones of the city. A p-value less than 0.05 was considered statistically significant.

Findings

Table 1 shows the distribution of households in different districts of the municipality and their classification into 5 zones: North, Central, East, West and South.

Table 1. Zones of Tehran and the number of households in each of them

Zones	Districts	Number
East	04	99
	08	101
	13	94
Total		294
Center	06	96
	07	92
Total		188
North	01	93
	02	99
	03	98
Total		290
South	09	90
	10	95
	11	97
	12	97
	14	96
	15	169
	16	88
	17	103
	18	106
	19	93
	20	95
	21	97
Total		1226
West	05	93
	22	95
Total		188

Energy intake in South of Tehran of 2491 (Kcal/person/day) and in the West of 2525 (Kcal/person/day) is higher than the 3 other zones, and this difference is statistically significant ($p<0.001$). The Tukey test revealed significant differences between the North (2219 Kcal/person/day) and the West and South only. In total, the energy intake of the North, Centre and East zones is below total average (Table 2).

The highest calcium intake is in the Center (960 mg daily) and the lowest is in South (799 mg daily). This difference is significant for the 5 districts ($p<0.001$). The Tukey test showed significant differences in the South compared to the other 4 districts (Table 2). The difference in intake of vitamin B2 is significant between all the zones ($p<0.001$). The maximum intake was seen in

Table 2. Comparison of micronutrient intake between 5 zones of Tehran*

	North	Center	East	West	South	Total	P Value (ANOVA)
Energy# Kcal/person/day	2218a (2176-2261)	2365 (2311-2420)	2380 (2338-2423)	2525b (2467-2583)	2491b (2469-2513)	2432 (2416-2449)	P<0.001
Calcium mg/person/day	912.2a (884.4-940.6)	959.6a (921.59-997.6)	881.2a (849.0-913.4)	32.41a (892.0-957.0)	799.4b (776.0-823.2)	849.9 (840.5-859.2)	P<0.001
Riboflavin mg/person/day	1.5a (1.4 -1.54)	1.6a (1.5-1.7)	1.4a (1.36-1.43)	1.4a (1.35-1.45)	1.3b (1.28-1.31)	1.4 (1.38-1.41)	P<0.001
Vitamin C mg/person/day	149.2a (143.0-156.0)	149.7a (141.0-159.0)	133.9 (129.0-139.0)	141.2a (132.62-149.78)	118.6b (116.0-121.1)	129.4 (127.2-131.5)	P<0.001
Vitamin A mg/person/day	1251.6a (1186.0-1317.2)	1419.8a (1296.5-1543.0)	1172.6a (1246.6-1099.6)	1190.3 (1087.4-1293.1)	937.2b (906.0-969.0)	1073.8 (1048.0-1100.0)	P<0.001

**Mean (CI 95%), Significant level P<0.05 # different superscript letters indicate significant differences between zones (Tukey test)*

the Center (1.6mg) and the lowest in the South (1.3 mg). The Tukey test also showed significant differences between the South and the other zones (Table 2 and Figure 1). The highest intake of vitamin C was observed in the North and Center (150 mg) and the lowest was observed in the South (119 mg) (p<0.001). The Tukey test showed that there is a significant difference between South in comparison with North or West and Center. The highest amount of vitamin A intake was reported in Center (1420 mg), and the lowest was in South (937mg). The difference between the 5 zones was significant (p<0.001). And the Tukey test showed that the differences between the South and the North, Center and East zones were significant (Table 2).

An investigation of nutritional adequacy revealed that the energy and micronutrient intake has significant differences between zones of Tehran (Table 3). There is a difference in energy adequacy between the North and the East, West and South zones. The lowest calcium adequacy was observed in the North (79%) and the highest adequacy was seen in the Center and West (92%). The highest riboflavin adequacy was seen in the Center (137%) and the lowest one was seen in the South (115%), the differences between the South and the North and Center and East zones were significant (Table 3 and Figure 1).

Table 3. Comparison of energy and micronutrient adequacy in different zones of Tehran (%)*

	North	Central	East	West	South	Total	P Value
Energy#	92a (90.3-94.0)	100 (98.0-102.3)	100b (98.2-101.8)	104 (102.0-106.3)	105b (104.1-106.0)	102 (101.3-102.7)	P<0.001
Calcium	86 (83.3-88.6)	92a (88.1-96.0)	85 (82.4-87.6)	92a (88.6-95.4)	79b (77.8-80..2)	83 (82.1-83.9)	P<0.001
Riboflavin	128a (124.4-131.6)	137a (132.1-142.0)	125a (121.6-128.3)	126 (121.7-130.3)	115b (113.5-116.5)	121 (119.8-122.22)	P<0.001
Vitamin C	341a (326.5-355.5)	341a (320.4-361.4)	308 (296.3-319.7)	324a (304.6-343.4)	275b (269.0-281.0)	298 293.1-302.9)	P<0.001
Vitamin A	232a (219.8-244.2)	261a (238.0-284.0)	215 (201.8-228.1)	220 (201.0-239.0)	174b (168.0-180.0)	199 (194.0-203.9)	P<0.001

**Mean (CI 95%); Significant level P<0.001 # different superscript letters indicate significant differences between zones (Tukey test)*

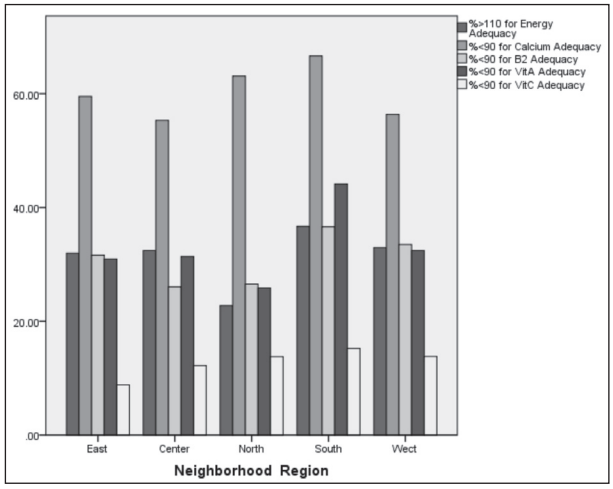

Figure 1. High Energy adequacy and low micronutrient adequacy across 5 zones of Tehran

Discussion

Overall, the data suggest that the South and West of Tehran have the highest intake and adequacy of energy indicating abdominal fullness in these two zones, while in the South evaluation of micronutrient intake suggests that cell satiety is a major problem, contributing to nutritional insecurity. In the downtown area including the municipalities of districts 6 and 7 there is an almost favorable status with regards to energy and the micronutrients, even though these zones might not be better off than the North and West in terms of economic situation. According to the studies, food patterns that include high energy content foods are usually rich in fat, but are accompanied by a lower intake of fruit and vegetables and therefore include fewer nutrients (24-25). Studies have shown that the highest rates of food insecurity and obesity in Tehran society can be found in the poorer regions because their food choices are limited and consumption of energy-dense foods is more common in this group. As a result, despite abdominal satiety, this group of people suffers from micronutrient deficiencies (26). Studies on obese children show that food insecurity in the household is associated with obesity in children (27, 28). Another study on food security in Californian women showed a prevalence of 13.9% for insecurity without hunger, and 4.3% for insecurity with hunger; women who suffer from food insecurity have a 31% higher chance of being obese than women who have food security (26). This study is in line with our study and shows that a high intake of energy is not necessarily accompanied by more consumption of nutrients, and so despite the abdominal satiety cell hunger is present in many people. The higher energy intake in this population may be associated with overweight and obesity and yet, a shortage of micronutrients remains (27, 31-29). One study in Golestan province showed that vitamin A and C intake was low in both urban and rural regions, which might be related to the high incidence of esophageal cancer in this province. This low intake is more frequent in districts with lower socioeconomic status (32). Studies suggest that different life style and nutrition patterns exist in different districts. Cultural and economic factors heavily influence nutritional status, and micronutrient and energy intake in all areas (32). Another study in Isfahan showed that the intake of folate, iron, calcium and fiber is lower than the recommended daily allowance. These shortages have their roots in bad eating habits, such as the use of sweetened drinks, processed foods, hydrogenated vegetable oils and fats for frying. This study emphasizes that due to a rapid transition in nutrition and changing the pattern of traditional food, there remains a degree of inadequate micronutrient intake despite the increased consumption of energy, while there is a simultaneous increase in diseases related to a high energy intake (34). The Glucose and Lipid Study in Tehran in 2013 showed that eating high-energy snacks is a risk factor for metabolic syndrome and its related components. In a comprehensive study on household food consumption patterns and the nutritional status of Iran during 2001-2003, 23% of households consumed under 90% of recommended energy requirements, 12% consumed below 80%, and 5% had consumptions of less than 70% of the required energy (35). In 2005, Kant showed that there is a direct relationship between energy intake and low density of nutrients (36). In Figure 1 the energy and micronutrient adequacy are shown together; demonstrating that the South has the highest proportion of households with energy intake higher than 110% and has the worst status in terms of adequacy of key micronutrients. The energy intake is also relatively high in the West, where micronutrient deficiency exceeds that of the other zones, especially

the North and Center; this reflects consumption of energy rich foods by people in South and overeating in the West of Tehran due to their economic situations.

The high energy intake in the South and West is an interesting point in this study (Table 2). In the South, despite high energy intake, there are quite specific micronutrient deficiencies. In the West micronutrient adequacy is at borderline values. Despite the better economic situation in the West of Tehran (municipality districts 5 and 22) in comparison with the South of Tehran, the micronutrient intake pattern is almost the same, which represents the major impact of social and cultural factors independent of economic factors.

In Tehran significant differences in energy and micronutrient intake can be seen across the various zones. Based on the mean intake and mean adequacy, it seems that the main problem for the people of Tehran is cell hunger, which in the South of Tehran is probably due to the low economic status; however when present in other zones it is most likely due to nutritional knowledge and education. Still, in the case of some nutrients such as calcium, deficiency is clearly seen in all zones.

Strengths and limitations

This study has included a large number across Metropolitan Tehran and the interviews were carried out by experienced interviewers making the collected data representative and accurate. Sampling more than one day of intake would also capture the within variation.

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