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Evaluation of Iranian Household's Diet in terms of Calcium and Iron Density in the Seven Provinces of Iran

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ABSTRACT

Background: Imbalanced diet, as it may cause micronutrient malnutrition has been known as a causal factor for several chronic diseases. Several studies in Iran have shown that some micro-nutrient deficiencies are prevalent and of high concern. Minerals such as calcium and iron can supply physical and mental health as well as survival, and growth development. In this study, Nutrient density analysis was used to display Iranian households' diet quality. **Methods:** In this descriptive-analytical study, the diet quality of seven provinces, namely Eastern Azarbaijan, Isfahan, Tehran, Khorasan, Khouzestan, Sistan Balochestan and Fars was assessed in terms of calcium and iron. To do so, the data were obtained through national household food consumption survey conducted by National Nutrition & Food Technology Research Institute, 2000-02, in Iran. **Results:** Generally, 80% of households' calcium density was less than the standard value and this rate was 40-70% for iron. Index of nutrition quality (INQ) for calcium and iron were respectively almost 1/2 and 1/3 of requirements in all provinces. **Conclusions:** There were significant differences in calcium intake density between the rural and urban households however; there were no differences between the selective provinces and all over the country.

Keywords: *Calcium; Iron; Nutrient density; Diet*

Introduction

Imbalanced diet, as it may cause micronutrient malnutrition has been known as a causal factor for several chronic diseases (Imamura *et al.*, 2015, Rashidi *et al.*, 2005). In most developing countries, nutrition transition is highly associated with excess calorie intake and poor diet quality. In other words, plentiful energy content of diet mostly comes from energy-dense food items such as refined carbohydrates and edible oils, while intakes of

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complex carbohydrates, whole grains and beans, micronutrient dense foods such as fruits and vegetables and animal-source foods are low (Tulchinsky, 2010). Several studies showed that calcium and iron can supply physical and mental health, survival, growth, and development via the cellular metabolism. Accordingly, providing balanced and sufficient nutrient intake could have been set up as a priority in the community based nutrition interventions (Camaschella, 2015, Peterlik and Cross, 2009).

Diet quality index has been developed to achieve some purposes including nutrient adequacy and its relationship with chronic disease, the relation of nutrient intakes with biochemical index and mortality. Variety, adequacy, moderation, and overall balance are major categories of this index and could provide valuable evidences for community based interventions (Kim *et al.*, 2003, Waijers *et al.*, 2007).

Nutrient-based indices are one of the diet quality classifications to introduce nutrient intake adequacy. These indices are exerted in the form of abbreviated scales as a group of nutrients or a single nutrient. They are then expressed as a diversity index, i.e., nutrient adequacy ratio (NAR), mean adequacy ratio (MAR), nutrient density (ND), index of nutritional quality (INQ), and recommended ratio to restricted (RRR) (Hansen and Wyse, 1980). In this study, nutrient density analysis was used to display Iranian households' diet quality.

Several surveys in United States and other contexts demonstrated that different groups of society have unhealthy dietary patterns without considering that their diets are leading to chronic diseases. For the first time, the importance of ND was emphasized in Americans food guide (2005) in response to a recognized need and necessity for a more reliable food guide for improving public health (Scheidt and Daniel, 2004, Skerrett and Willett, 2010). The concept of ND was developed to compare the amount of macro- and micro-nutrients provided by a food or a diet in relation to the energy taken from food or diet. ND (nutrient in 1000 kcal) can be used for nutritional recommendations and food labeling. Calorie intake is the key factor in determining nutrients' intake values (Duyff, 2012). In order to achieve appropriate diet quality, foods should contain the nutrients with high nutritional value or high ND along with the needed amount of calories (Rhee *et al.*, 2014). The results of national household food consumption survey indicated that a large percentage of people in the provinces of Iran have non-standard intake values of calorie and lower amounts of nutrients (NNFTRI, 2005).

Several studies in Iran have indicated that some micro-nutrient deficiencies are prevalent and in high concern (Ghassemi, 1998). Considering the importance and application of ND concept and according to the limited conducted investigation in the field of diet quality of Iranian households, this study was carried out to assess the calcium and iron density in the household diets of seven provinces of Iran. Then, Single value nutrient allowance (SVNA) and index of nutritional quality (INQ) were determined for calcium and iron in each province by urban and rural areas separately and together.

Materials and Methods

Study design, Site and Sample selection: In this descriptive-analytical study, the diet quality of seven provinces, i.e., Eastern Azarbaijan, Isfahan, Tehran, Khorasan, Khouzestan, Sistan Balochestan and Fars was assessed. The required data were obtained through national household food consumption survey conducted by the National Nutrition and Food Technology Research Institute (NNFTRI), 2000-02, in Iran. These provinces were selected because of containing the main part of Iran's population. They were also from various geographical distributions and consequently representative of Iranian food cultures. Further, the quality data were at hand for these provinces during past decade (**Figure 1**).

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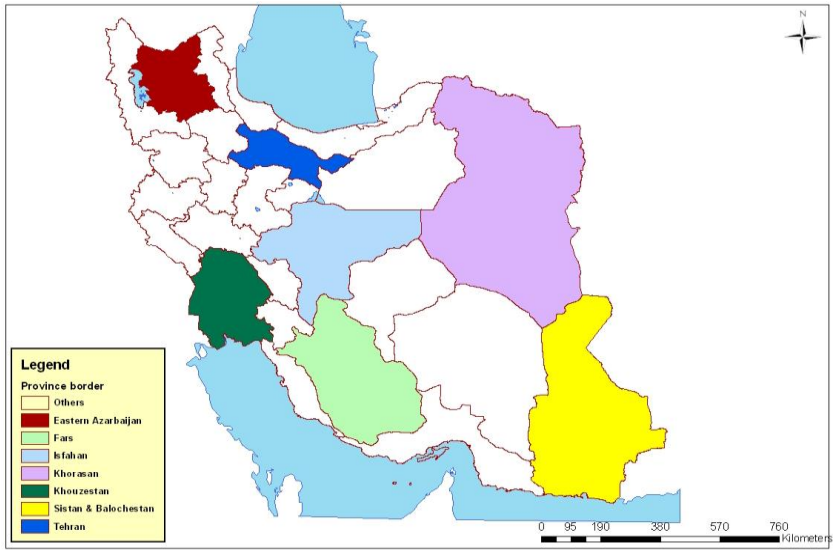

Figure 1. Distribution of the selected provinces of Iran

All of the above mentioned urban and rural households living in the seven provinces were selected as the research sites. The target households were determined using systematic cluster sampling by Statistical Center of Iran. Sample frames for 108 households in each province were developed and used for data collection.

Data collection: Density of calcium and iron was measured and single SVNA tables were designed using allowance figures for developing countries. The mean and standard deviation were calculated in each province disaggregated by urban and rural areas. Data were collected on demographic and socio-economic characteristics, anthropometric measurements including weight and height for all members of households, and food consumption patterns using 3-day recall questionnaire. Weight and height were measured in light clothing without shoes. BMI was also calculated as weight in kilograms divided by the square of height in meters (kg/m^2) and classified into three categories of normal (BMI < 25), overweight (25 < BMI < 30), and obese (BMI > 30).

Data analysis: Data were fed into MS Access software and later analyzed using the SPSS version 16 software. Descriptive data were presented as mean, standard deviation, and confidence interval. Further, Bonferroni analysis was applied to compare means and qualitative variables were represented as frequency tables. The statistical significance level was set at p-value < 0.05.

Calculating methods for ND, SVNA, and INQ: ND was determined as the households' consumed nutrients' values divided by their calorie intake values that was then multiplied in 1000 (Willett, 1998). In the national household food consumption survey, age group requirements (per 1000 Kcal energy intake) were determined due to the revealed characteristic of the households' age and gender composition as well as FAO/WHO recommendation for the developing countries (Hansen and Wyse, 1980). Finally, standard SVNA was presented for calcium and iron by determining upper level in terms of age and gender groups' needs. ND and SVNA were used to calculate INQ that is obtained as ND divided by SVNA.

Ethical considerations: This study was approved by the Ethics Committee of the NNFTRI, Shahid Beheshti University of Medical Sciences.

Results

The findings showed that the highest mean iron densities were found in Sistan Balochestan and Eastern-Azarbaijan provinces. The highest mean calcium density was obtained from Tehran

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provinces. INQ for calcium in all provinces was almost 1/2 for 450 mg of requirements and 1/3 for 650 mg of requirements. Comparison of iron density to the standard values showed that daily iron intake is three quarters of the standard rate in these provinces. According to international institutes' recommendations, SVNA for calcium is 450-650 mg and 9mg for iron (Hansen and Wyse, 1980). The amounts of INQ and AVNA are tabulated in **Table 1**.

According to **Table 2**, the mean of calcium density is less than 70% of the standard value among more than 80% of households. Means of calcium intake density were significantly different between the rural and urban areas except for Sistan Balochestan and Khouzestan provinces.

In 40-70% of households, iron density mean was less than 70% of the recommendations. In the rural and urban areas of Fars, Khouzestan, Tehran, and Sistan Balochestan meaningful differences were observed in means of iron intake density.

Table 1. Mean of calcium and iron intake density (mg/1000 Kcal), SVNA, and INQ for calcium and iron in seven provinces compared with all provinces of the country

Province	Calcium			Iron		
	Density	SVNA	INQ	Density	SVNA	INQ
Eastern Azarbaijan	224.71	650	0.35	6.22	9	0.69
Isfahan	251.24		0.39	6.08		0.68
Tehran	255.68		0.39	5.55		0.62
Fars	217.16		0.33	5.98		0.66
Sistan Balochestan	231.55		0.36	6.41		0.71
Khouzestan	243.97		0.38	6.09		0.68
Khorasan	214.65		0.33	5.34		0.59
Total	239.31		0.37	5.74		0.64
Rural	210.33		0.32	5.68		0.63
Urban	250.10		0.38	5.77		0.64

SVNA: Single value nutrient allowance; INQ: index of nutritional quality

Table 2. Households' distribution by calcium and iron intakes' densities in comparison to the required amounts

Area/ Province	Less than 80%	80-90%	90-110%	More than 110 %
	n (%)	*n (%)*	*n (%)*	*n (%)*
Rural				
Eastern Azarbaijan	105 (92.5)	6 (5.1)	3 (2.9)	1 (0.9)
Fars	140 (96.6)	1 (0.7)	3 (2.1)	1 (0.7)
Khouzestan	95 (92.2)	3 (2.9)	5 (4.9)	0 (0)
Tehran	180 (94.7)	5 (2.6)	1 (0.5)	4 (2.2)
Isfahan	100 (95.2)	1 (1)	3 (2.9)	1 (1)
Khorasan	329 (97.9)	4 (1.2)	2 (0.6)	1 (0.3)
Sistan Balochestan	72 (90)	4 (5)	4 (5)	0 (0)
Urban				
Eastern Azarbaijan	193 (88.9)	11 (5.1)	10 (4.6)	3 (1.4)

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Fars	220 (89)	0 (0)	10 (4.3)	3 (1.3)
Khouzestan	187 (86.2)	10 (4.6)	16 (7.4)	4 (1.8)
Tehran	1151 (81.4)	101 (0.7)	108 (7.6)	54 (3.9)
Isfahan	282 (84.9)	22 (6.6)	21 (6.3)	7 (2.1)
Khorasan	421 (90.9)	11 (2.6)	17 (4.1)	10 (2.4)
Sistan Balochestan	58 (91.1)	2 (3.2)	1 (1.6)	2 (3.2)
Total				
Eastern Azarbaijan	300 (89.8)	17 (5.1)	13 (3.9)	4 (1.2)
Fars	360 (95.2)	1 (0.3)	13 (3.4)	4 (1.1)
Khouzestan	282 (88.2)	13 (4.1)	21 (6.6)	4 (1.2)
Tehran	1331 (83)	106 (6.6)	109 (6.8)	58 (3.7)
Isfahan	382 (87.4)	23 (5.3)	24 (5.5)	8 (1.8)
Khorasan	710 (94.1)	15 (2)	19 (2.5)	11 (1.4)
Sistan Balochestan	130 (90.9)	6 (4.2)	5 (3.5)	2 (1.4)

Discussion

The present study assessed the mean intake densities of calcium and iron in the selected provinces of Iran categorized by the rural and urban areas. As **Table 1** shows, there are significant differences in calcium intake density between the rural and urban households of seven provinces.

Rasaei observed that the most calcium intake density belonged to the urban areas of Isfahan province and rural areas of Isfahan and Eastern Azarbaijan provinces, while a significant difference was observed in the urban and rural areas of Khorasan and Fars provinces. Comparison of these two studies showed reduction in calcium intake density in these provinces except for the rural areas of Sistan Balochestan province (Rasaei, 1998).

Mirmiran et al. reported that calcium intake mean of daily food patterns in women in the age range of 18-80 was more than the current study for the urban households of Tehran province (Mirmiran *et al.*, 2006). The data from the National Survey in the united State of America showed that from 1977 to 1996, the mean of calcium intake density for population in the age range of 2-18 years was two times more than the intake of Iranian households and a part of this high level of intake was related to the National School Meals Program (Lin *et al.*, 2001).

Bowman et al. reported that the calcium intake density mean of the American adults was 369-389 mg/1000Kcal that was higher than the observed amounts of this study (Bowman and Vinyard, 2004).

Calcium intake density in comparison to SVNA and INQ was half of its predetermined value. Although the calculated value of INQ was a little less in the rural than the urban areas, all the selected provinces had insufficient intakes.

In spite of extensive animal husbandry in many areas of Iran, consumption of dairy products, especially milk is low in Iranian culture. According to the national investigations, dairy products' portions to meet the calcium needs are 34 % in Iranian households. Generally, per capita dairy products' consumption in Iran is 50 kilogram/year, while, this amount is equal to 370 kilogram/year in Finland and Sweden and 250 kg/year in America and England (NNFTRI, 2005).

The mean of iron intake density was not different between the studied provinces and all over the country. However, urban and rural households of Fars, Tehran, and Sistan Balochestan provinces were different in iron intake, but this diversity was significant in Sistan Balochestan province.

This little difference for iron intake density was also reported in Rasaei and colleages' study (Rasaei, 1998). In the current research, there were no significant differences in iron intake density between the rural and urban areas of the provinces under investigation. The minimum level of iron intake density was observed in the urban areas of

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Tehran province (10.68 mg) while Khouzestan and Sistan Balochestan provinces had the maximum level of density (12 mg).

Lin reported the increasing trend of iron intake (5.8 to 7.6 mg) over 20 years in the assessed population through the National Survey (Lin *et al.*, 2001). Mirmiran et al. also observed that the iron intake mean in urban areas of Tehran province was twice the value obtained in this study (Mirmiran *et al.*, 2006).

The results of investigations in the field of disease incidence confirm the findings of the present manuscript. Low hemoglobin level in one-third of Iranian women shows the insufficient intake and bioavailability of iron in Iranian diet. In the urban communities of Iran, more than 50% of the required iron is met through cereals, while only 7.8% of it is provided by meat consumption. Because of high level of bread consumption in the rural communities of Iran, 60% of the required iron is obtained from cereals' consumption while meat consumption takes the reduced proportion of 5.5% (NNFTRI, 2005).

Considering the calculated INQ for iron, intake of this nutrient was not in acceptable range among the investigated provinces. INQ for iron intake was less in rural areas except for Sistan Balochestan province in which it was 67% for urban and 74% for rural areas.

Conclusions

In general, findings of this study showed that calcium and iron densities are far from the adequate value in a large number of Iranian households. Nowadays, the rate of physical activity is low, thus, the calorie needs is less than the past and nutrients should be met from fewer volume of foods. Therefore, informed selection of consumed foods is necessary to meet the nutrients' needs.

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Authors' contributions

This article is resulted from a MSc. thesis in Nutritional Sciences belonging to Valaei S. She was the main researcher to take master's degree who involved in all of the steps i.e., designing, performing the study, analyzing, and writing the manuscript. Dr. Rashidi A was the supervisor of this research, he was involved in designing of the work, analyzing the data, and writing of manuscript. Haghighian Roudsari A helped in analyzing data, writing the manuscript, and finalizing approval of the version to be published. Ms. Houshyarrad A has contributed in designing the work, analyzing, interpreting the data, and writing the manuscript. He performed the statistical analysis, interpreted the data and wrote the manuscript. Abadi A has performed the statistical analysis, interpreted the data, and contributed in writing the manuscript. Abdollahi M was involved in designing research, analyzing and interpreting the data, as well as writing the manuscript. Milani Bonab A helped in writing the manuscript and performed the final revision of the paper.

Conflicts of interest

The authors of this article do not have any conflict of interest to declare.

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