Original Article

Dietary Patterns in 1125 Iranian Women: Adequacy of Energy and Micronutrient Intakes and Weight Statuses

Abstract

Background: Women's nutrition status includes significant effects on their children and household health. The purpose of this study was to assess energy and micronutrient intake adequacy in Iranian women. **Methods:** This study was a part of the Urban HEART Study, which has jointly been developed by the World Health Organization (WHO) Centre for Health Development, Kobe, Japan. In total, anthropometric and dietary intake data were collected from 1125 women in southern Tehran municipality districts. A 24-h recall questionnaire was completed by the expert nutritionists and the participants' anthropometric statuses were assessed. Food intakes were calculated in grams per capita per day. Micronutrients and energy requirements were adapted from WHO/Food and Agriculture Organization (FAO) tables and Iran National Food Consumption Survey, respectively. **Results:** Nearly 71.5% of the women were overweight or obese [body mass index (BMI) ≥25 kg/m^2]. Furthermore, 1.2% of the women were underweight (BMI <18.5 kg/m^2), while 27.3% had normal weight (BMI = 18.5--24.9 kg/m^2). The mean bread/cereal and vegetable intakes were significantly higher in obese group, compared to that in normal/under/overweight group (375.6 g/day ± 151.4, P = 0.05; and 331.4 g/day ± 227.5, P = 0.02), respectively]. Women in the lean group significantly consumed higher quantities of cakes/pastries and had the lowest calcium and iron adequacy ratios, compared to other groups (p = 0.001, P = 0.03, and P = 0.05, respectively). **Conclusions:** These findings suggest that Iranian women, especially those who reside in the southern areas of Tehran, need to change their dietary habits to maintain their health. Moreover, being under/normal weight does not necessarily mean following healthy diets.

Keywords: *Body mass index, energy density, energy intake, micronutrient adequacy, obesity*

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Introduction

Healthy women have critical roles in the economic, social, and cultural developments of societies, who special attentions must be paid to their health by policymakers and development planners. Promoting health and improving quality of life are the most important priorities in almost all societies. Therefore, women's health has been the major concern in various parts of the societies. Chronic illnesses and disabilities further occur in women as they play key roles in the household health. Usually, females receive less incomes, compared to those males do; therefore, females highly need to have easier access to community resources to improve their health and well-being.[1-3] Nowadays, nutrient inadequacy in women causes malnutrition and immune deficiency. In contrast, excessive energy intake and overeating, which lead to obesity and overweight, cause higher occurrences of chronic diseases such as heart diseases, cancers and diabetes. These diseases are the major causes of death in women worldwide.[4-6]

Several environmental and socioeconomic factors affect occurrence of metabolic diseases, which include the highest effects on women, children and elderly people. Recent studies on Iranian households have shown that more than a quarter of the studied people are malnourished and economically are unable to satisfy minimum abdominal satiety and more than half of them have cellular hunger. Hence, receiving insufficient energy and nutrients has always been a major health problem in Iranian households, especially women.[7-9] Quality and quantity of the food patterns play important roles in a women's health. The nutritional knowledge of women and mothers with their access to healthy and sufficient foods can affect dietary choices and food patterns

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in households. For example, in lower socioeconomic residential areas, low vegetable and fruit intakes are associated to inadequate intakes of micronutrients such as vitamin C, β-carotene, phytochemicals, and antioxidants.[6] In epidemiological studies, density of consumed nutrients (in grams or milligrams per 1000 calories) is an indicator of diet composition, which reflects socioeconomic statuses of the households.[10]

As the most recent national survey, a study by the National Institute of Nutrition Research and Food technology showed that vitamins B_2 and A and Ca levels were less than 80% of the RDA in dies of nearly half of the Iranian households.[6] In addition to guidelines and dietary recommendations, assessment of micronutrient density by calorie intake is a modern tool for the nutrition policymaking. The current study was a part of the comprehensive Urban Heart Study, commissioned by the World Health Organization (WHO) in 2007, supported by Tehran Municipality. One of the study objectives was to assess micronutrient intake adequacy and women's weight statuses in Tehran to identify and support women who were at the risk of micronutrient deficiency as well as making effective steps to include supportive actions to promote nutritional knowledge and thereby women's health.[6]

Methods

This cross-sectional study was carried out on 1125 households in southern Tehran municipality districts. Multistage cluster sampling was used to collect data. Number of samples in each district was determined by assessing energy intakes with sensible exactness. After random selection of squares within the city from a list of National Measurements Center, trained interviewers selected households using systematic sampling method. The Central Executive Committee for the Design and Conducts of Field Operations consisted of technical director, executive director, financial officer, public relations officer and coordinator of supervisors. A 24-hour recall questionnaire was completed by 12 trained nutritionists. Questionnaire and interview method were approved in the national studies of consumption survey.[11] Anthropometric statuses were assessed as the major aspects of nutritional assessments. Body weight and height of the women older than 18 years were measured using digital scale (Seca 763, Seca, Hamburg, Germany) with sensitivities of 0.1 kg for weight and 0.1 cm for height, based on WHO guidelines. Then, body mass index (BMI, kg/m^2) was calculated. After quality control, data were transferred into Microsoft MS Access and analyzed for quality and reliability after essential examinations.

Food intakes were calculated in grams per capita per day. Micronutrient and energy requirements were adapted from WHO/FAO tables and Iran National Food Consumption Survey, respectively.[6,7] Tehran Urban HEART Project used a standard methodology by WHO. This project was jointly supported by WHO Tehran Office, Health Deputy of the Ministry of Health, Tehran Municipality and National Nutrition and Food Technology Institute. No intervention, blood sampling and drug administration were included in the study. The study was actually an observational study where interviewers asked questions from the family members and recorded answers on forms. All the procedures and forms were reviewed by the authorities from the stated organizations and were totally approved. Furthermore, ethical approval was received. The average requirement for age groups from 2001 Iran National Food Consumption Survey was used to assess energy and protein requirements.[6] Proportion of nutritional adequacy was calculated as the number of nutrients received by the households divided by the nutritional requirements of the households.

Statistical analysis

Mean and standard deviation (SD) were calculated for quantitative and frequency table was reported for qualitative variables. ANOVA test was used to compare the average food intake based on weight categories and *P* values of 0.05 or less were reported as significant. Moreover, SPSS Software v. 21 was used for the statistical analysis. This study was carried out based on the guidelines from the Declaration of Helsinki.

Results

The mean age of participants was 42.4 ± 13.3. Anthropometric data showed that the mean weight and BMI were 69.6 kg ± 12.3 and 27.9 kg/m^2 ± 4.9, respectively. Results revealed that 449 (39.9%) women were overweight (BMI = 25–29.9 kg/m^2), 355 (31.6%) were obese (BMI ≥30 kg/m^2) and 14 (1.2%) were underweight (BMI <18.5 kg/m^2), while 307 (27.3%) had normal weight (BMI = 18.5–24.9 kg/m^2). Regarding 24-h recalls, more than 95% of the women consumed breads and cereals, dairy products, fats and oils, sugars and sweets and sweet beverages in their diets. Significant positive

associations were seen between the BMI and breads/cereals and vegetables consumption. The mean breads/cereals and vegetables intakes were significantly higher in obese group than other groups (375.6 g/day ± 151.4, $P = 0.05$; and 331.4 g/day ± 227.5, $P = 0.02$, respectively) [Table 1]. Eggs intake was higher in obese women than other groups with no significance. Cakes and pastries intake in lean women was almost two times greater than overweight and obese women and three times greater than normal weight women (110.1 g ± 81.2, $P = 0.001$) [Table 1]. Based on Table 2, lean women had the lowest calcium and iron adequacy ratio, compared to that the other groups had (0.6 mg/daily ± 0.2, $P = 0.03$; and 0.3 mg/daily ± 0.05, $P = 0.05$). Energy and protein adequacy ratio was lower in the lean group than other groups with no significance ($p \leq 0.03$).

Discussion

In developing countries, malnutrition is addressed as a risk for every average woman in her life cycle mostly because of frequent childbirths, poor-quality diets, socioeconomic barriers and highly intense agricultural labors. In less developed countries, the most important factor that contributes to malnutrition in women is insufficient and poor dietary intake.[12] In recent years, studies have specifically focused on nutritional intakes in Iranian women, who are the major household members, responsible for preparing food, childbearing and childcare. This study has compared women's nutritional intakes and their energy, protein and sub-nutrient intakes with recommended dietary allowance (RDA) in various weight groups. Results showed that more than 70% of the women were overweight or obese in southern areas of Tehran, where the households included lower economic statuses, compared to other areas of Tehran. However, only 27% of the women had normal BMI.

Obese women (BMI ≥30) had significantly higher intakes of breads and cereals and vegetables, while cakes and pastries intake were significantly higher in lean women (BMI <18.5), compared to other women. Although no significant differences were seen in consuming sugar and cubic sugar in various weight groups, thin women (BMI <18.5) seemed to use these foods more than that the other women did. Results revealed that thin women

Table 1: Relationships between various food groups and women's body mass index (%) of women who consumed specific foods based on 24-h dietary recalls (*n*=1125)

	Lean (BMI <18.5), *n*=14 (1.2%)		Overweight (BMI 25–29.9), *n*=449 (39.9%)		Obese (BMI ≥30), *n*=355 (31.6%)		Normal (BMI 18.5-24.9), *n*=307 (27.3%)		*P*
Food group (g/daily)	***n***	**Mean±SD**	***n***	**Mean±SD**	***n***	**Mean±SD**	***n***	**Mean±SD**	
Breads and cereals *n*=1128 (99.9%)	14	309.7±107.9	449	353.8±136.9	355	375.6±151.4*	306	352.6±139.1	*P*=0.05
Legumes *n*=466 (41.3%)	3	43.1±55.1	189	55.6±50.7	149	55.9±51.5	124	50.9±45.4	*P*=0.7
Vegetables *n*=1109 (98.2%)	14	174.8±83.4	442	298.4±221.2	350	331.4±227.5*	299	315.3±232.2	*P*=0.02
Fruits *n*=897 (79.5%)	9	273.1±160.4	371	350.2±306.1	269	343.2±289.4	246	361.0±284.0	*P*=0.7
Meats *n*=929 (82.3%)	12	88.3±55.9	360	108.2±82.3	294	107.3±83.2	260	98.6±79.9	*P*=0.4
Eggs *n*=390 (34.5%)	4	35.8±30.2	165	49.9±40.8	109	57.5±40.8	111	54.4±29.9	*P*=0.3
Dairies *n*=1078 (95.5%)	13	203.3±218.4	428	274.0±243.2	342	271.5±239.4	292	280.3±237.8	*P*=0.7
Fats and oils *n*=1094 (96.9%)	13	37.7±25.2	434	44.7±39.6	343	45.0±36.0	300	48.0±42.1	*P*=0.6
Sugars and sweets *n*=1081 (95.7%)	13	37.0±32.1	433	34.9±37.0	339	32.7±29.2	292	33.3±29.5	*P*=0.7
Cakes and pastries *n*=312 (27.6%)	8	110.1±81.2	121	48.2±47.8	80	47.8±50.2*	101	38.5±39.8	*P*=0.001
Nuts/seeds/dried fruits *n*=337 (29.8%)	1	14.6±00.0	150	28.1±33.0	82	17.6±22.8	102	24.8±28.5	*P*=0.08
Sweet beverages *n*=1094 (96.9%)	13	87.1±148.1	438	37.3±123.4	343	37.3±102.3	296	43.5±117.9	*P*=0.4

BMI, body mass index; *$P \leq 0.05$ is considered significant

Table 2: Adequacy of energy and nutrient intakes in women based on their body mass index

Adequacy of energy and nutrient intake	Lean (BMI <18.5), *n*=14 (1.2%)		Overweight (BMI 25-29.9), *n*=449 (39.9%)		Obese (BMI ≥30), *n*=355 (31.6%)		Normal (BMI 18.5-24.9), *n*=307 (27.3%)		*P*
	n	**Mean±SD**	***n***	**Mean±SD**	***n***	**Mean±SD**	***n***	**Mean±SD**	
Energy ratio kcal/daily	14	0.9±0.2	449	1.0±0.2	355	1.0±0.3	307	1.0±0.3	*P*=0.1
Protein ratio g/daily	14	1.1±0.2	449	1.3±0.5	355	1.3±0.5	307	1.4±0.5	*P*=0.1
Calcium ratio mg/daily	14	0.6±0.2	449	0.8±0.4	355	0.7±0.4	307	0.8±0.4	*P*=0.03
Iron ratio mg/daily	14	0.3±0.05	449	0.4±0.2	355	0.4±0.2*	307	0.4±0.2	*P*=0.05
B_2 ratio mg/daily	14	0.9±0.4	449	1.1±0.5	355	1.1±0.5	307	1.2±0.5	*P*=0.08
B_6 ratio mg/daily	14	1.1±0.3	449	1.2±0.5	359	1.3±0.5	307	1.3±0.5	*P*=0.7
Vit. A ratio mg/daily	14	0.9±0.8	449	1.8±2.0	359	1.8±2.5	307	1.7±1.9	*P*=0.4
Vit. C ratio mg/daily	14	1.6±0.9	449	2.7±2.0	359	2.6±2.1	307	2.8±2.1	*P*=0.1

BMI, body mass index; *$P \leq 0.05$ is considered significant

followed less healthy diets than that the overweight and obese women did. Abdurahman *et al*.[13] (2020) reported that people with a higher healthy eating index (HEI) had higher BMI, compared to those with a lower HEI. However, whole cereals and vegetables intakes, which allow for higher fiber consumptions, may lead to increased anti-inflammatory indices and obesity-related metabolic risks.

A study by Fayet-Moore on 335 Australian women with low socioeconomic positions (SEP) showed that women with higher BMI had higher tendencies to consume vegetables. Similar to the current study, they concluded that various factors such as environment, culture, society, economy, race and gender affected people food choices.[14] In a 16-year follow-up study, Rautiainen *et al*.[15] detected positive relationships between higher vegetable intakes and gaining weight while total dietary fiber intakes did not change the body within long times in middle-aged and elder women. Overall, the idea that high consumptions of fruits and vegetables led to decreasing risks of obesity and overweight and delaying weight gain was not strongly supported by the current results. Lower energy density and high water and fiber contents make fruits and vegetables good choices for satiety. In addition, weight gain can be controlled through other elements in fruits and vegetables such as micronutrients (potassium and magnesium), calcium and polyphenol bioactive compounds, which are antioxidant and anti-inflammatory agents. These characteristics increase energy consumption and thermogenesis, which may delay weight gain as well.[16]

In the current study, people with higher weights had higher vegetable consumptions and biologically no clear mechanisms are described to explain why they had higher weights while having higher fiber intakes. A possible way to explain these results includes focuses on the immediate effects of dietary habits on body weight and BMI while health behaviors affect body weight as one of its consequences over time. It might possibly be concluded that quantity and quality of the dietary intake include synergetic effects on weight change and metabolic syndrome index. If macronutrient intakes are within a certainly recommended limit quantity-wise, they do not affect weight changes to great extents.[17] Results of a study by Tardivo *et al*.[18] on menopausal women in Southeastern Brazil indicated that the type of food consumption and quality of fat intake were not considered as the risk factors increasing serum cholesterol. However, this study included limitations; for example, the samples were not representative of the general population. Hence, results might not be generalizable. Using 24-h recall is not an accurate way to record people long-term intakes. Furthermore, most of the participants were from less affluent and lower socioeconomic classes with insufficient incomes and mostly unfavorable nutritious diets. Apart from socioeconomic statuses, race is another factor affecting people food choices. African-Americans and adults with lower socioeconomic statuses have more limitations in accessing healthy foods. This is especially true for lower-income African-American men; hence, they have higher tendencies to consume types of foods that are more energy-dense but poor in nutrients, which generally give them lower scores of diet quality, compared to Caucasians and adults from higher socioeconomic statuses. Sociodemographic variables are particularly more effective factors in how diet and health are linked to each other.[19] In Iran, no shortage in food supplies occurs to meet the population nutritional needs; however, the nutrient density of foods is inconsistent with what human body cells need. Hence, people overeat to provide their necessary micronutrients, which addresses Iranian people as nation who do not follow healthy lifestyle and diet.

Most Iranian people are not aware of the value of nutrients and micronutrients and instead are mostly focused on trying to satisfy their hunger. Even though bread is addressed as the people main food, cereal and bread consumption in Iran is 40% lower than that in other countries. In Iranian food diet, dairies, eggs and vegetables/fruits are consumed less than that of the world's optimum (25, 20, and 25%, respectively), which generally deprives 20 and 35% of daily required iron and calcium. Iranian dietary patterns are assessed as imbalanced diverse-lacking nutrients. Iranian household sugar consumption as a habit is drastically high, while it is merely an energy-inducing food component. Similarly, people salt intake (15 g/daily) is generally higher than that of the world average (6 g/day). Lower consumptions of milk and dairy products are seen for all age groups, compared to the world recommended values. Furthermore, type of meat in proportion to total energy intake is lower than that of world and developing countries, while meat consumption per person increases.[20,21]

Results of the current study showed that lean women have significantly higher consumptions of cakes and pastries and higher intakes of sugar, sweets and sweet beverages. These results are similar to those of a study on 4665 middle-aged women in Washington and northern Idaho that showed BMI was negatively linked to sweet food consumption.[22] Another study on 2197 16--64-year-old UK residents demonstrated weak but positive relationships between the BMI and dietary fat consumption. Relationships were more consistent for men but only true for women with absolute terms of intake. Relationships between the sugar consumption and obesity were not as clearly defined as that of dietary fat. Various results were observed between the genders as sugar intake as a percentage of energy was negatively correlated to BMI in men.[23] Negative correlations between sugar intake and BMI have been observed in cross-sectional studies.[24] Sugar may not include significant correlations to weight gain without incorporating fat. If combinations of fat and sugar are excessively used, fat oxidation decreases due to

a metabolic environment that is created as a result of this overconsumption.[23,24]

Another study on Iranian women revealed that higher HEI score in these women was linked to lower probability of metabolic syndrome index and obesity. This cross-sectional study on 1036 Iranian women showed that higher consumptions of sweets and lower intakes of fruits and vegetables were associated to higher fat accumulations in the abdomen and healthier dietary habits led to lower risks of obesity; in contrast to the current study.[25] Similar to the current study, Koksal *et al*.[26] reported that dietary quality, including higher consumption of fruits and vegetables and lower consumptions of cakes and pastries, was higher in overweight people. It is highly important to understand what contributes to nutritional inadequacies in overweight and obese individuals as they may have excessive intakes of their energy but inadequate levels of minerals needed for their bodies. In the current study, intake proportions of energy, protein, vitamins A, C, B_6, and B_2, calcium and iron to the recommended dietary intakes were assessed. Iron and calcium intakes were significantly lower than those of recommendations in all groups and lean women (BMI <18.5) received significantly lower levels of iron and calcium, compared to other women. Intake proportions of iron and calcium (0.6 mg/day ± 0.2 and 0.3 mg/day ± 0.05, respectively) were significantly lower than those really needed, compared to other women.

In a study on 19,952 American adults (≥20 years old), Jiang *et al*.[27] reported associations between the intake of mineral nutrients and BMI. In a cross-sectional study on Chinese people, Zhu *et al*.[28] (2018) reported positive correlations between non-heme and total dietary iron levels and the obesity; similar to the current study. In obese people, supplementing iron may help weight loss as it can maintain plasma thyroid hormone high enough to avoid disturbing metabolic rate and to secure maintenance of the biological mechanisms.[28] Moreover, a study in west India revealed that outbreaks of iron deficiency anemia in individuals with low BMI were higher than those in individuals with normal BMI and overweight individuals because of inadequate dietary pattern, dietary deficiency and unequal distribution of foods in Indian families. However, further comprehensive studies can offer chances to investigate possible causal relationships between the iron intake and obesity.[29] High-quality diets provide necessary quantities of the nutrients to secure human health and overall well-being. In other words, people health statuses and their nutrition intakes are directly affected by their dietary quality. For countries with a dominantly low-income population, having high-quality diets is less feasible with poor access to nutrients such as fruits, vegetables and animal originated foods such as meats, milks, eggs and dairies due to the household low budget. Hence, starchy foods have become essential in their diets due to their easier availability and affordability. As a study by Azadbakht *et al*.[30] showed, almost 74% of adults in Tehran needed interventions, in what they eat to improve their dietary quality. As based on dietary guidelines, only 17% of the individuals had acceptable levels of diet quality.

In conclusion, challenges associated to obesity and its consequences are not much different from those of hunger and undernourishment, especially in developing countries. Therefore, countries may struggle (at levels of household and general public) with a double burden caused by undernourishment due to inadequacy of food intake and over-nourishment due to excessive calorie intake. This double burden considerably needs further attentions and urgent actions in poorer countries. In fact, it has turned into a "triple burden", which comprises of problems such as deficient micronutrient coexisting with hunger and excess calorie intakes that are possibly more than the body needs. Even a small excess in intake of energy on a daily basis ends in weight gain over time. Strengths of the present study included studied households were selected based on the sampling plan of the Iran Statistics Center, sampling framework included households living in Tehran City, and the fairly large sample size could help more accurate estimation of people food consumption. Furthermore, the survey planners and administrators were Nutrition Institute researchers, who were highly experienced in population surveys and consumption analyses. Questionnaires were coded and checked for quality by the experienced experts. Moreover, Iranian food composition tables were used to assess nutrition values of the foods. However, limitations of the present study included use of single 24-h recall method to analyze each individual's consumption. If more days were included in the study, more accurate results could be achieved. Moreover, use of general indices to estimate levels of consumption was challenging. Therefore, necessary modifications were carried out based on the previous consumption analysis plans.

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Conflicts of interest

There are no conflicts of interest.

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