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Original Article

Socioeconomic Statuses of Calorie Intake and Healthy Eating Index in Staff of Shahroud University of Medical Sciences

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ABSTRACT

Background and Objectives: Providing sufficient calories and quality nutrition based on recommended quantities is essential for maintaining health and preventing diseases. The aim of this study was to assess the extent of socioeconomic inequality in calorie intake and healthy eating index in staff of Shahroud University of Medical Sciences.

Materials and Methods: Data for this cross-sectional study were extracted from the cohort information of the staff at Shahroud University of Medical Sciences. A total of 1,151 individuals were included in the study after excluding missing data. The healthy eating index was used to assess nutritional quality,, and the concentration index and curve were used to assess inequality.

Results: The concentration index for healthy nutrition quality and calorie intake based on socioeconomic tertiles was not significant. No significant relationships were seen between healthy nutrition quality and calorie intake with the variables such as age, years of education, chronic disease and marital status ($p > 0.05$). However, significant relationships were seen between healthy nutrition quality and calorie intake with variables such as body mass index and gender ($p < 0.05$).

Conclusions: Since salaries of all employees at Shahroud University of Medical Sciences were paid based on the national regulations, no significant differences were reported between the wealthy and poor groups for socioeconomic status regarding calorie intake and quality of healthy nutrition. Calorie intake of the employees at Shahroud University of Medical Sciences was higher than the necessary values and the quality of their healthy nutrition needed improvement.

Keywords: SES, Calorie intake, HEI, Concentration index

Highlights

- This study explores socioeconomic inequalities in calorie intake and the quality of healthy eating among staff at Shahroud University of Medical Sciences.
- Findings indicate no significant socioeconomic disparities in calorie intake or healthy eating quality.
- Gender and body mass index (BMI) were significantly related to both calorie intake and diet quality.
- Staff calorie intake exceeded recommended levels, while their diet quality fell below the ideal standards.

Introduction

Access to sufficient food forms the foundation for future generations of a country (1). According to the Food and Agriculture Organization (FAO), the world population will reach 8.8 billion by 2050 and FAO is planning to feed nearly 10 billion people (2). Food is a significant issue, connected to human biological needs and economic, social and cultural factors (3). Therefore, food sociologists believe that nutrition should be assessed from multiple angles, including its relationship with economic, social and cultural aspects (4). The relationship between energy intake and socioeconomic status is always challenging (5). Daily calorie consumption is a fundamental measure of poverty,

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as calorie intake heavily depends on financial status, allowing calorie consumption to be used in assessment of the poverty line (6). Over time, dietary patterns have shifted, often towards consuming ready-made foods (7). This shift results in excessive calorie intake and decreased healthy nutrition quality, increasing the risk of chronic diseases such as cardiovascular diseases (CVD), obesity, fatty liver, hypertension and diabetes (8–10). Individuals with low SES (socioeconomic status) typically have low incomes and education levels, contributing to their poor nutrition quality (11).

A 2018 study involving 150,000 people in a multinational cohort in USA showed that high-quality nutrition was directly linked to decreased risks of mortality and chronic diseases, including CVDs, diabetes, hypertension, cancers and stroke (12). Food procurement and use are directly linked to individuals' socioeconomic statuses. The United Nations (UN) declares access to food as a fundamental human right and states in Article 25 that everyone has the right to a standard of living adequate for health and well-being, including (13). Iran 20-y vision document outlines characteristics such as welfare, food security and equal opportunities by 1404. Studies indicate that socioeconomic factors account for nearly 50% of health determinants, referred to as the root causes (14). Several studies have shown significant relationships between the family income and nutrition status, highlighting effects of socioeconomic status on food consumption patterns (15). Studies indicate sharp increases in calorie intake in higher deciles and decreases in lower deciles (16). This study aimed to assess the role of socioeconomic status in calorie intake and assess the quality of calorie intake based on the main food pyramid groups in the staff of Shahroud University of Medical Sciences. Since human resources are in country's most valuable resources and success and development of organizations are tied to employee satisfaction, ongoing training and assessment alone do not enhance efficiency and performance. Decreasing socioeconomic status can improve performance and motivation in employees. This study results are expected to help policymakers and decision-makers in effective planning and prioritization.

Materials and Methods

This study was a cross-sectional study. Data were extracted from the cohort study on the staff at Shahroud University of Medical Sciences. Information from 1,178 staff members were extracted after signing informed consents and data from 1,175 individuals were analyzed after excluding missing data. Inclusion criteria for the cohort included all health and medical staff working at the university at the time, willingness to participate and completion of the informed consent forms. Exclusion criteria included long-term leave during the study and failure to complete the consent forms. Descriptive data (e.g., birth year, gender, marital status and years of education) and socioeconomic data (e.g., household appliances, travels and entertainments) and clinical data [e.g., body mass index (BMI), diabetes, hypertension, CVDs] were analyzed. Socioeconomic status was assessed through a questionnaire and statistical analysis using principal component method, categorizing participants into three groups (tertiles) from lowest (first tertile) to highest (third tertile). The PCA decreased number of variables in a dataset, converting them into smaller dimensions. Assets unequally distributed in households included a greater weight in PCA, while variables with lower standard deviations included less weight (17). Socioeconomic status was assessed through household assets (e.g., vehicles, personal computers, mobile phones and household items such as dishwashers, washing machines and televisions), housing characteristics (e.g., type of residence, number of rooms), travel and entertainment variables (e.g., number of domestic and international trips and cinema visits) and job category (technical and service jobs against administrative and medical jobs) (18). Nutritional assessment for calorie intake was carried out using FFQ, which assessed foods consumed in the past 24 h. This questionnaire assessed food consumption (e.g., bread and cereals, fruits, vegetables, dairy and oils) based on common sizes (piece, spoon, plate and cup) (19). The 113-question FFQ, validated previously, was used to assess food intake in staffs. It included a list of common Iranian foods and reported data based on the reported consumption. Staffs were asked to complete the questionnaire based on their food intake in the past 24 h (19). Total calorie intake was reported based on the questionnaire data. Daily energy expenditure (TEE) was calculated for comparison with calorie intake using the following formula: Basal metabolic rate (BMR) plus 10% for food thermogenesis multiplied by physical activity factor (20, 21).

Total energy expenditure = (BMR + food thermogenesis) × physical activity factor

The BMR was calculated using Mifflin formula for men and women:

Men, kcal/d = (weight in kg × 10) + (height in cm × 6.25) - (age in y × 5) + 5

Women, kcal/d = (weight in kg × 10) + (height in cm × 6.25) - (age in y × 5) - 161

Physical activity was calculated based on metabolic equivalents (METs), a unit measuring physical activity linked to a person's metabolism during various physical activities (22). The physical activity questionnaire included 22 questions on sleep, leisure, sports activity and work in the past week. Since disabled individuals were excluded, no participants were recorded with zero physical activity.

Physical activity levels were categorized into light, moderate and intense with corresponding factors of 1.5, 1.7 and 2.2 (18). After calculating received calories and required calories for the individuals, quantity of energy consumption greater than 10% of the required energy was categorized as receiving more calories than needed and less than 10% of the required energy was categorized as receiving fewer calories than needed. After calculation, individuals were divided into groups of receiving less than needed, normal, and more than needed energy. It could be assessed how many individuals consumed calories more than needed, how many individuals consumed calories less than needed and how many individuals consumed normal calories. To assess socioeconomic inequality with calorie intake, concentration index (CI) and concentration curve in economic tertiles were reviewed. The HEI-2020 (healthy eating index) was an index used to assess the alignment of food consumption with key recommendations and dietary patterns. This index assessed the quality of nutrition and was independent of quantity. The 2020 version was the latest edition. The HEI was first published by the United States Department of Agriculture (USDA) in 1995. The HEI is updated every five years. This index is applicable for age groups of 12–23 m and 2 y and older (23). To assess dietary quality of the employees at Shahroud University of Medical Sciences, HEI designed in 2020 was used. This index consisted of ten components and included an overall score range of 0–100. The HEI-2020 reviewed 13 food groups. In the 13 components, nine components assessed sufficient consumption and four components assessed balanced consumption. Each component was calculated on a scale of zero to five or zero to ten using mean proportion method. Standard values for sufficient consumption included total fruit, whole fruit, total vegetables, dark green vegetables and legumes, whole grains, dairy, total protein foods, plant proteins and seafood, and fatty acids. Values for the balanced consumption included refined grains, sodium, added sugars and saturated fats. In this study, due to the lack of access to data on added sugars, this component was removed and HEI scores were calculated out of 90. Data on total fruit, whole fruit, total vegetables, dark green vegetables and legumes, whole grains, dairy, total protein foods, plant proteins and seafood, refined grains and sodium were in grams. To use the HEI index, these were converted to cups and ounces. Each ounce was equivalent to 28.35 g and each cup was equivalent to 236.59 g. Fatty acids were calculated using the ratio of monounsaturated and polyunsaturated fatty acids (MUFAs and PUFAs) to saturated fatty acids (SFAs). Saturated fats were considered as a percentage of total energy intake (23). For each component of the HEI, number and percentage of individuals in the poor group (< 5), in need of improvement (5–8) and desirable (> 8) were calculated. Based on previous studies and the opinion of nutrition experts, nutritional quality based on HEI was divided into three groups in this study. Poor nutritional quality with a score of less than 45 (considering the lack of added sugar component), in need of improvement with a score of 45–72 and desirable with a score of more than 72 were identified. To assess socioeconomic inequality with healthy dietary quality, CI and concentration curve in socioeconomic tertiles were reviewed (24). The CI is widely used as a tool for measuring socioeconomic inequality in health studies and other fields. This index, first introduced by Wagstaff and colleagues in 1989, helps analyze the extent of inequality in the distribution of health-linked variables. The CI quantitatively measures inequality and is easy to calculate. A key characteristic of this index includes that it can be decomposed into the various factors contributing to inequality, allowing the estimation of each factor individual contribution. This analysis was carried out using regression models. Numerical range of the CI was from -1 to +1, with a value of zero indicating equal distribution of the variable in question across various socioeconomic groups. On the concentration curve, this would align with the 45° line, which represented perfect equality in distribution of the health variable across socioeconomic groups (24, 25). Pearson correlation coefficient was used to assess the relationship between calorie intake and healthy dietary quality with age, years of education and BMI. Independent t-test was used to assess the relationship between calorie intake and healthy dietary quality with chronic disease and gender. One-way ANOVA was used to assess the relationship between calorie intake and healthy dietary quality with marital status (26). Design and implementation of the SHAHWAR cohort study were approved by the Ethics Committee of Shahroud University of Medical Sciences (IR.SHMU.REC.1397.033). For data collection, purpose of the study was explained to all participants and they were assured that data were confidential and used for research purposes. Written consents were signed by the participants.

Results

Data of 1,151 individuals were analyzed. General characteristics of the staff at Shahroud University of Medical Sciences are reported in Table 1. Based on the table, the largest population was detected in women, middle-aged individuals (30–60 y), married individuals, those with a bachelor degree, those without underlying health conditions and those in the overweight BMI category. The smallest population was in men, elderly individuals (over 60 y), widowed individuals, those without formal education, those with underlying health conditions and those in the underweight BMI category.

Table 1. General characteristics of the staff of Shahroud University of Medical Sciences

Variable	Subgroup	Percentage
Gender	Male	40.4%
	Female	59.6%
Age	<30	9.4%
	30-60	90.2%
	>60	0.4%
Marital Status	Single	8.3%
	Married	86.7%
	Widowed	1.7%
	Divorced	3.3%
Education Level	Illiterate	0.2%
	Primary	4%
	Middle School	4.4%
	High School Diploma	16.6%
	Associate Degree	8.6%
	Bachelor's Degree	48.2%
	Master's Degree- Professional Doctorate	14.3%
	PhD	3.3%
	Postdoctoral - Specialist	0.4%
Chronic Disease	Yes	14.5%
	No	85.5%
BMI	Underweight	2.5%
	Normal	40.9%
	Overweight	41%
	Obesity Class1	11.8%
	Obesity Class2	2.5%
	Obesity Class3	1.3%
Socioeconomic Status	Poor	33.3%
	Moderate	33.3%
	Good	33.3%
Physical Activity	Poor	7%
	Moderate	37.4%
	Good	55.6%

In general, the BMI range classified various types of weight, including underweight, less than 18.5; normal range, 18.5–24.9; overweight, 25–29.9; obesity Class 1, 30–34.9; obesity Class 2, 35–39.9, and obesity Class 3, more than 40. First, quantity of calorie intake was calculated based on food consumption, with an average intake of 2026 kcal/d. The highest calorie intake in women was 6933 kcal/d and the lowest was 592 kcal/d, with an average intake of 1839 kcal/d for women. The highest calorie intake in men was 4869 kcal/d and the lowest was 893 kcal/day, with an average intake of 2244 kcal/day for men. Next, the required energy for each individual was calculated based on basal metabolic rate (BMR), the thermic effect of food, and each person's physical activity. For calculating the BMR, the Mifflin formula was used. Based on this formula, a specific number was calculated for each individual according to their weight, height, and age. The highest required calorie intake for women was 2120 kcal/day, and the lowest was 438 kcal/day, with an average required intake of 1024 kcal/day for women. The highest required calorie intake for men was 3337 kcal/day, and the lowest was 909 kcal/d, with an average required intake of 1648 kcal/d for men. Based on these values, individuals were categorized into three groups of those consuming more than required, those with normal consumption and those consuming less than required. Results of calorie intake are reported in Charts 1, 2 and 3.

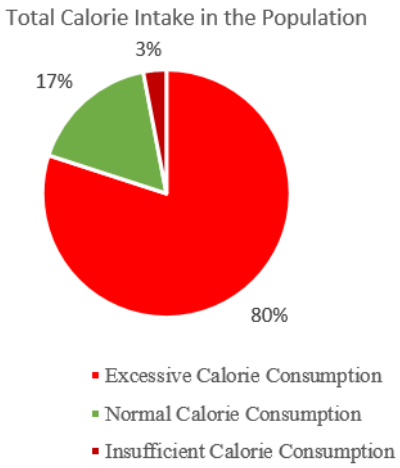

Chart 1. Calorie intake by the staff of Shahroud University of Medical Sciences

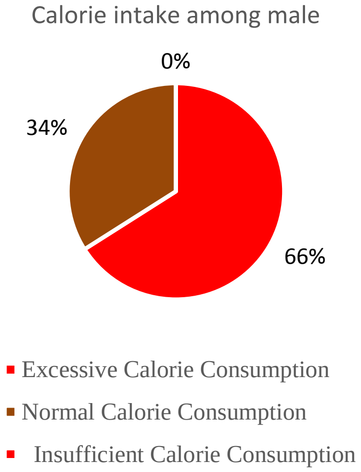

Chart 2. Calorie intake by the male staff of Shahroud University of Medical Sciences

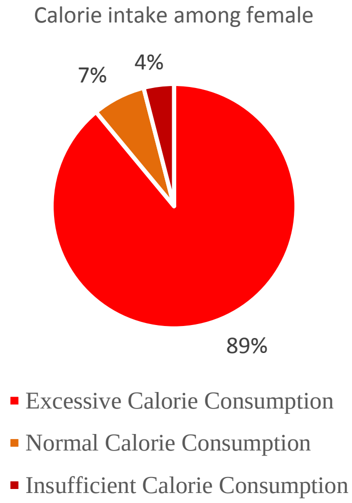

Chart 3. Calorie intake by the female staff of Shahroud University of Medical Sciences

The highest score was linked to whole grains and saturated fats, while the lowest score was linked to fatty acids and refined grains. The total score of the HEI components was calculated and since no reliable data were available for added sugars, this component was excluded and the score for this index was calculated out of 90.

After calculating HEI score, individuals were classified into one of the following nutrition quality groups of poor nutrition quality with a score of less than 45 (due to the absence of the added sugars component), needing improvement with a score of 45–72 and optimal nutrition quality with a score greater than 72. Results of healthy nutrition quality are reported in Charts 4, 5 and 6.

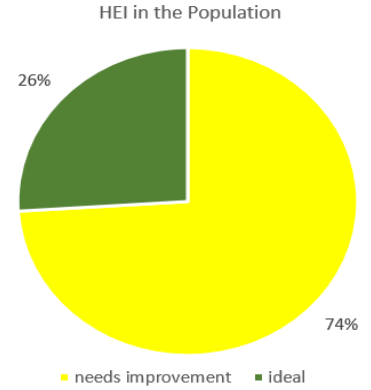

Chart 4. Healthy eating index in staff of Shahroud University of Medical Sciences

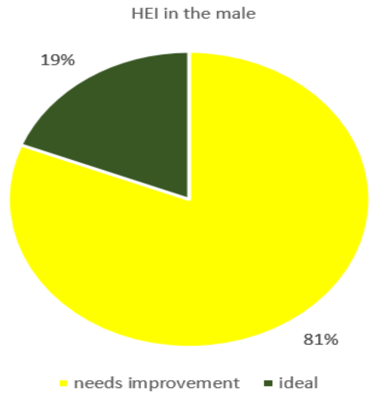

Chart 5. Healthy eating index in the male staff of Shahroud University of Medical Sciences

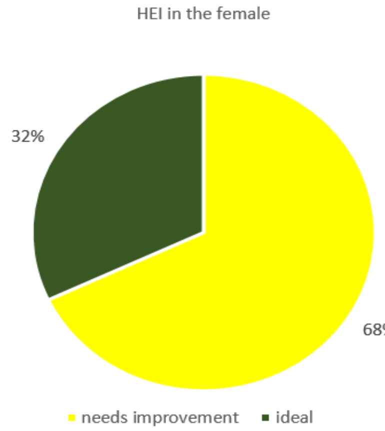

Chart 6. Healthy eating index in the female staff of Shahroud University of Medical Sciences

Table 2. Scores of the healthy eating quality index and its components in staff of Shahroud University of Medical Sciences

HEI Component Scores	Satisfactory(8<)		Needs Improvement(5-8)		Weak(5>)	
	Percentage	Number	Percentage	Number	Percentage	Number
Total Fruits	92.5%	1086	5.2%	62	2.3%	27
Whole Fruits	92.5%	1086	5.2%	62	2.3%	27
Total Vegetablesd	97.8%	1149	1.8%	21	0.4%	5
Greens and Beans	97.1%	1141	1.8%	21	1.1%	13
Whole Grains	100%	1175	0%	0	0%	0
Dairye	37.6%	441	31.4%	369	31%	365
Total Protein Foods	95.8%	1125	3.3%	39	0.9%	11
Seafood and Plant Proteins	94.5%	1111	3.5%	41	2%	23
Fatty Acids	3.5%	41	7%	82	89.5%	1052
Refined Grains	7.8%	92	6.4%	75	85.8%	1008
Sodium	98.3%	1155	0.2%	2	1.5%	18
Fatty Acids	100%	1175	0%	0	0%	0

In this study, CI was used to assess the level of socioeconomic inequality. The CI for healthy eating quality and calorie intake was not significant, meaning no differences in calorie intake and HEI scores in various socioeconomic groups.

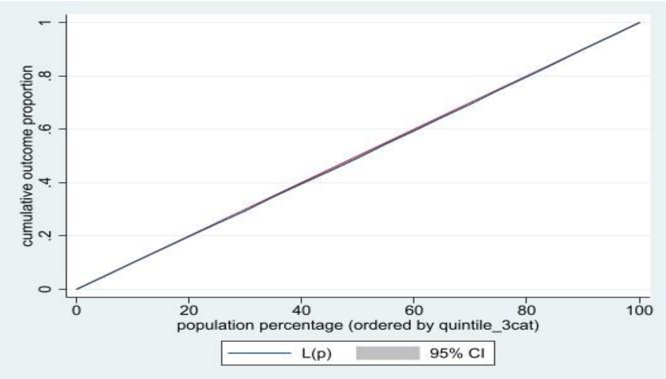

Chart 7. Concentration index of healthy eating index by socioeconomic groups of staff in Shahroud University of Medical Sciences

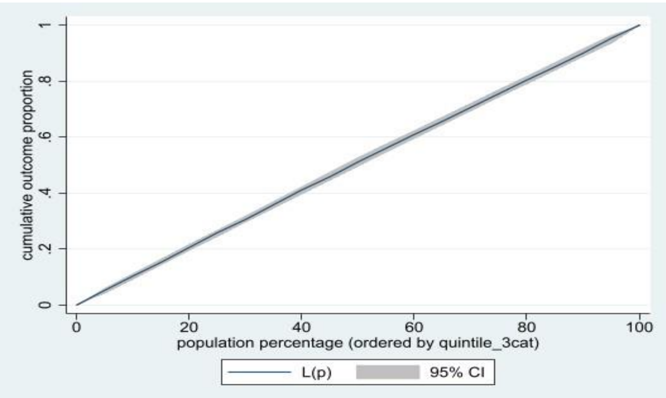

Chart 8. Concentration index of caloric intake by socioeconomic groups of staff in Shahroud University of Medical Sciences

Discussion

The HEI is widely used to assess the quality of an individual's diet by assessing adherence to dietary guidelines. In this study, participants followed diets with moderate adherence, as indicated by their HEI scores. However, calorie intake in participants exceeded the recommended levels, which might be reflective of an acceptable socioeconomic status (SES) that enabled consistent food preparation and consumption. In contrast, the overall quality of the diet did not meet HEI standards, as excessive consumption of refined grains and fatty acids was recorded. This highlighted that while food was available and consumed, it was not always of optimal nutritional quality. Importantly, the study did not find a significant relationship between the SES and calorie intake, nor between the SES and HEI. These findings were in contrast to other studies that suggested a stronger relationship between the SES and diet quality. For example, a study carried out in Tehran (2001–2002) assessed the nutritional adequacy of households based on food expenditure indices and detected significant relationships between higher household expenditure and increased consumption of meat, dairy, fruits, calcium and vitamins A and B2. In contrast, the current study did not find such relationships, which might be due to differences in study populations or geographic and cultural factors (27). A study by Masaru and colleagues (2018) investigated the effect of economic factors on macronutrient intake in Japan and detected no significant relationships between the household income and protein intake in men and women. Furthermore, an inverse relationship was reported between carbohydrate intake and income (5). These findings were similar to those of the current study, suggesting that income or expenditure might not always be a determining factor in calorie or macronutrient consumption. Further supporting results of the current study, a large cohort of 918,861 postmenopausal women in the UK detected no associations between daily energy intake, macronutrients and socioeconomic statuses (28). This lack of associations was similarly reflected in the participants of this study, where 74% were classified as "needs improvement" and 26% as "adequate" for their dietary quality as measured by HEI.

Other studies have shown links between economic, social and ethnic inequalities and poor nutritional status. For example, a study by Lisa and colleagues (2017), which assessed a cohort of 7,511 pregnant women in the US, detected that the average HEI scores across all age groups were less than the recommended levels (29). Similarly, it was observed that quality of the diets did not align with healthy eating guidelines in the present study despite having access to foods. Additionally, adolescent-focused studies, such as one carried out by Mirmiran and colleagues (2008), detected that 74% of adolescents needed to improve their diets, similar to the findings of the current study (30). The two studies highlighted the widespread issue of suboptimal diet quality despite food availability, increasing concerns about dietary habits in various age groups. In this study, all employees scored full marks for whole grain consumption, reflecting a positive habit. However, other findings such as excessive simple carbohydrate intake in the elderly people (Salehi et al., 2010) underscored the need of further balanced dietary patterns, particularly macronutrient consumption (31). Studies have shown a significant relationship between age, HEI and calorie intake. However, no such correlation was observed in this study or in the 2017 study by Akhlaghi et al., which assessed the relationship between health and eating habits in Shiraz residents aged 20–50 (32). Similarly, significant associations were detected between gender and HEI or calorie intake, similar to other studies such as Aghanuri et al. 2010 study of elderly residents in Markazi Province, Iran (33).

Regarding marital status, previous studies have reported mixed findings. For example, Aghanuri and colleagues detected no significant relationships between marital status and HEI, similar to findings of this study (33). However, other studies have indicated that marital status may affect diet quality (34, 35). The current study detected no significant associations between marital status and HEI or calorie intake, suggesting that dietary habits might not strongly be linked to marital status in this population. A study by Jazayeri and colleagues, assessing food and micronutrient intake in Tehran population, detected that excessive consumptions of fat and cholesterol occurred despite deficiencies in micronutrients, as risk factors for obesity and overweight (36). The current study findings were similar as well, as over 55% of the employees were either overweight or obese. These reflected broader global concerns about increasing obesity rates and their associated risks, including hypertension, insulin-resistant diabetes and CVDs (8, 9, 37, 38). A study by Kord Varkaneh and colleagues detected a significant relationship between the modified HEI and abdominal obesity (26), while other studies have reported inverse associations between HEI, BMI and waist circumference (39, 40). In this study, a relationship between BMI, calorie intake and HEI was observed, further linking diet quality with obesity status. While Aghanuri et al. detected a significant relationship between education level and HEI (33); this study did not find such a relationship. It is possible that employees at Shahroud University of Medical Sciences were further aware of nutritional guidelines due to their academic environment, which might minimize effects of education on dietary habits. Similarly, no significant relationships were observed between calorie intake, diet quality and presence of chronic diseases (33). In conclusion, while calorie intake in the participants exceeded the recommended levels, quality of their diets did not meet HEI standards. No significant association was seen between the SES and diet quality or calorie intake, though a relationship between BMI, calorie intake and HEI was reported. These findings highlighted the need of continued efforts to improve dietary quality and address obesity-linked health concerns, particularly in academic settings where knowledge of nutrition is further accessible. This study included strengths due to its cross-sectional nature such as use of a food frequency questionnaire allowing calculation of calorie intake as well as HEI with independence of calorie intake. Additionally, this study used a comprehensive questionnaire to assess socioeconomic status, which assessed assets and social status. However, the study might include limitations such as since the results belonged to employees of Shahroud University of Medical Sciences, caution is needed when generalizing data to the entire population. Moreover, participants might report their food consumption quantities inaccurately.

Conclusion

Expansion of nutritional research in recent decades worldwide has led to increased attention to the importance of appropriate nutrition in maintaining health and preventing diseases. It is clear that people’s nutrition is closely linked to their physical and mental health. The present study was carried out on the staff of Shahroud University of Medical Sciences. Since their salaries were assessed based on the national regulations and most of the staff were either familiar with nutritional sciences or affected by the university environment and also were aware of healthy eating, no significant differences were reported between the first and the third groups for socioeconomic statuses regarding calorie intake and the quality of healthy nutrition. Calorie intake of the staff exceeded their needs and the quality of their healthy nutrition needed improvement.

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Author Contributions: M. Mirrzaie and R. Chaman participated in designing study and supervision of data analysis. Data collection and analysis was carried out by F. Zarei and F. Baskabadi. All authors read and approved the manuscript

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