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Research Article

Adequacy of Intake of Nutrients among Shift Workers in a Public Hospital of Rio de Janeiro, Brazil

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Abstract The analysis of nutrient intakes of shift workers has shown a diet low in fiber and high in animal protein, saturated fatty acids, and high energy foods. This study aimed to analyze the adequacy of nutrient intakes according to the work shifts among nursing professionals of a public hospital in Rio de Janeiro. We interviewed 307 workers and collected data on socioeconomic conditions, work, physical activity, nutritional status and food consumption according to two 24-hour dietary recall (24 hour). Adequacy of nutrients was based on the Dietary Reference Intake. To compare the means of nutrient adequacy we used the Student's t-test, and the Qui-Square was used to compare the proportions ($p < 0.05$). The average energy and macronutrients intake was adequate in relation to the recommendations, except for proteins, which presented above intake. As for other dietary components, adequate intake was only found for iron among men and vitamin C among women. The workers presented dietary inadequacy of micronutrients regardless of the work shift. Thus, incentives for healthy eating are needed by these professionals, in order to increase access to food sources of micronutrients.

Keywords *Micronutrients; Macronutrients; Nurse Team; Food Intake*

1. Introduction

In shift work, teams of workers take turns so as to allow the availability of the service or production for a longer interval than daily workdays (Fischer et al., 2013). This type of work organization includes activities performed outside the so-called usual hours (from 8 or 9 a.m. to 5 p.m. or 6 p.m. on weekdays), including those performed at night and at weekends. Among the modalities of shift work are alternating shifts (working at different times according to predetermined scale) and fixed shifts, i.e. always at the same time (Fischer et al., 2013). One of the sectors that most employ shift workers are hospitals, given the need to provide uninterrupted care throughout the 24 hours (Dall'Ora et al., 2016).

In Brazil, hospital nursing teams generally work on fixed 12-hour day-shift or night-time shifts - followed by 36 or 60 hours off (Silva et al., 2011).

Shift work, especially night work, implies the need to stay active at night and rest during the day, which leads to consequences for sleep quality and duration (Boivin and Boudreau, 2014). Sleep deprivation, in turn, affects the consumption of snacks, increasing the preference for densely energetic foods (Chaput, 2014). Sleep deprivation coupled with circadian maladjustment due to night work leads to cardiovascular (Esquirol et al., 2011) and metabolic disorders such as diabetes mellitus (Hansen et al., 2016) and metabolic syndrome (Kawabe et al., 2014). In addition, several studies point to changes in lifestyle among night workers, with higher prevalence of those who are not physically active, smokers and obese (Puttonen et al., 2010).

Although literature as a whole point to the deleterious effects of shift work to health, especially night work, few studies consider the adequacy of the diet of nursing professionals, suggesting that they present changes in eating habits. Some authors hypothesize that these workers have a high-carbohydrate diet, fats and caffeine; lower intake of dietary fibers and in some cases an increase in alcohol consumption (Assis et al., 2003; Lowden et al., 2010). However, a recent study did not detect differences between day and shift workers (different schemes) regarding diet quality, although presented higher energy consumption, which would partially explain the higher prevalence of overweight and obesity in this group (Hulsegge et al., 2016).

Inadequate eating habits can produce short-term effects, which are related to energy supply, or long-term effects related to deficiency of intake of essential nutrients, i.e. vitamins, minerals, amino acids and essential fatty acids that are necessary for the functioning of the organism.

The contingent of shift workers has expanded in several countries (Sangheon et al., 2009; Costa, 2010), which demands attention from companies, institutions and the academic community regarding the specificities of this population in relation to health, including aspects related to the quality of food. Thus, this study aimed to analyze the adequacy of nutrient intake in the day and night shifts, according to sex and age of nursing professionals in a public hospital in Rio de Janeiro.

2. Materials and Methods

Population and Sample

The study was carried out with the nursing team (nurses, nursing technicians and aids) of a public hospital in Rio de Janeiro. The population of 1,369 professionals was considered, using a conservative prevalence of 50%, with 95% confidence and 5% of error. The sample calculation estimated the accomplishment of 330. Participated 307 workers, considering 14 (4.2%) losses due to refusals; nine (2.7%) exclusions due to energy intake of less than 500 kilocalories.

Data Collection

The collection was performed in the work environment, in a room assigned by the nursing head. Two 24-hour dietary recall (24 hour) were applied by previously trained interviewers from the nutrition area, to workers who had agreed to participate in the study and had signed the informed consent form. The first recall was applied considering the day the worker was in the work environment and the second, on the day after the day off, on non-consecutive days.

Participants reported all food and beverages consumed in the 24 hours preceding the interview and photographic album of food portions was also used to enhance the accuracy and the record of food items consumed. The participants informed the time, place, amount consumed in household measures, the way of preparation, and in the case of industrialized products brands were also

informed. When it was not possible to fulfill the 24 hour, this was done by telephone, totalizing 10 people in the sample (4%). The workers also participated in an interview to fill out a questionnaire with thematic blocks related to socioeconomic, occupational, health status and lifestyle data.

Description of Variables

The socioeconomic and lifestyle characteristics considered in this study were: age, sex, schooling and physical activity. According to FNB / IOM / DRI recommendations (2005), age was stratified into intervals: 19 years to 30 years; 31 years to 50 years; 51 years to 70 years. Schooling was categorized in complete elementary education, complete secondary education and complete graduation. The level of physical activity (LPA) was based on the International Physical Activity Questionnaire (IPAQ) (Craig et al., 2003).

The definition of working hours was based on the question "Do you work regularly (at least once a week / 4 times a month) on night shifts in nursing care somewhere?" Workers who answered "Yes" were classified as working night; the others were categorized working day shifts. It should be noted that this classification considers all workplaces, not necessarily the working hours in the study hospital. So, day workers work exclusively during the day at the study hospital or elsewhere. On the other hand, the group of night workers can include professionals who work during the day, besides taking night shifts.

Body mass and height were measured to determine the Body Mass Index (BMI). The classification followed the criteria recommended by the WHO (1998) for adults and Lipschitz et al. (1994) for adults aged 60 years or older.

To analyze 24 hour household measurements were converted to gram (g) and milliliter (ml) based on the Table for Evaluation of Food Consumption in Household Measurements (Tabela para Avaliação de Consumo Alimentar em Medidas Caseiras, (2002) - TACAMC). Food preparations and processed products not included in the TACAMC were searched on recipes websites. The ingredients of the culinary preparations were separated for analysis of the nutritional composition.

The nutritional composition of the diets was analyzed using the Brazilian Table of Food Composition (Tabela Brasileira de Composição de Alimentos, (2011) - TACO). In order to make food intake reliable, soybean oil (4 ml) and salt (1 g) were added to 100 grams of the following preparations: rice, beans, pasta, red meat, fish, eggs and chicken (Food and Nutrition Board, 2000). This increase is justified by the lack of addition of oil and salt in the preparations analyzed in the TACO (2011). In addition, nutritional information of industrialized foods labels, which were not included in the table, was added.

To investigate energy adequacy, the Estimated Energy Requirements (EER) was determined through the equation that, besides taking into account sex, height, age and physical activity level, also considers individuals with adequate weight, overweight or obesity (FNB/IOM/DRI, 2005).

The adequacy of macronutrients and micronutrients, were evaluated according to the recommendations of Dietary References Intakes (FNB/IOM/DRI, 2005) were used. Macronutrients were used for the Accelerated Macronutrient Distribution Range (AMDR), and for calcium, iron and vitamin C were used the Estimated Average Requirement (EAR) (FNB/IOM/DRI, 2011; 2002; 2000). Adequate Intake (AI) was used for dietary fiber and sodium (FNB/IOM/DRI, 2005; 2004). The assessment of micronutrient adequacy was estimated by means of a statistical approach called ‘apparent adequacy’, which allows to estimate the degree of confidence that the intake of a given nutrient reaches the nutritional needs of an individual. This approach compares the difference between the reported intake and EAR values. For nutrients that have not established the EAR, AI reference values were used (Marchioni et al., 2004).

The Z-score calculation of the nutrient apparent adequacy is based on EAR and AI values (FNB/IOM/DRI, 2004). In order to determine the apparent adequacy of nutrients it is necessary to take into account the variation of the nutrient need, the variability of intrapersonal consumption, the intake estimation and the estimated average need for EAR values. The estimation of intrapersonal consumption variability allows us to explain the variation in daily food consumption, which is given by the nutrient's coefficient of variation (CV), which in the present study was 10% (FNB/IOM/DRI, 2000a). Values of American intrapersonal variability was used (Marchioni et al., 2004; FNB/IOM/DRI, 2000a), since in Brazil population-based data on this variability are not available.

The result estimates the adequacy of the diet, that is, the degree of confidence with which the individual's intake reaches the nutritional needs, considering adequate the results that obtain Z-score greater than zero. In cases where the AI recommendation was used, the individual's usual intake was quantitatively classified as above or below recommendations (FNB/IOM/DRI, 2000a).

Statistical Analysis

In the simple descriptive analyzes, the t-test compared the means, considering the level of significance of 5%. For the proportions, the Chi-Square Test ($\chi 2$) and Fisher's Exact Test (p = 5%) were used. Data were analyzed in the statistical software RStudio, version 3.2.1.

Ethical Aspects

The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Research Ethics Committees of Fiocruz (635/11) and of the hospital where the study was conducted (000.472).

3. Results

Higher rates of daytime workers were observed among married women with a nurse position. Among the night workers, the highest were observed among single men with family income above US $ 2,288.73 and obese (Table 1).

Table 1: *Socioeconomic, labor and health characteristics of nursing professionals, according to work shifts*

Variables	Day Shift	Night Shift	
	165 (53.7%)	**142 (46.3%)**	**p - value**
Sex			
Male	16 (39.0)	25 (61.0)	0.06
Female	149 (56.0)	117 (44.0)	
Age group			
19-30 years	28 (60.6)	27 (39.4)	0.20
31-50 years	71 (50.9)	72 (49.1)	
51-70 years	66 (60.6)	43 (39.4)	
Schooling			
Elementary School	08 (66.7)	04 (33.3)	0.61*
Complete High School	59 (54.6)	49 (45.4)	
Complete Graduation	98 (52.4)	89 (47.6)	
Marital Status			
Married	107 (56.6)	82 (43.2)	0.08
Separate / Divorced	28 (59.6)	19 (40.4)	
Single	30 (42.3)	41 (57.7)	
Income			

U$ 286.05 to 858.15	18 (66.7)	09 (33.9)	0.21*
U$858.47 to 2,288.41	101 (53.7)	87 (46.3)	
Above U$2,288.73	42 (47.7)	46 (52.3)	
Position			
Nurse	60 (59.4)	41 (40.6)	0.27
Technician	25 (46.3)	29 (53.7)	
Auxiliary	80 (52.6)	72 (47.4)	
BMI			
Eutrophic	63 (57.8)	46 (42.2)	0.23*
Overweight	59 (55.1)	48 (44.9)	
Obesity	41 (46.1)	48 (53.9)	

Inadequate food intake was identified in the various age groups and in both shifts for calcium, sodium and dietary fiber for male and female. As for iron, adequate consumption was found in all age groups and work shifts among men. Vitamin C was adequate only among men aged 31 to 50 years and 51 to 70 years in the night shift. Among women, iron intake was adequate in all age groups of the night shifts and only 51 to 70 years in the day shift; and for vitamin C, only the age range of 31 to 50 years was inadequate (Table 2).

Table 2: *Average consumption of micronutrients and dietary fiber of nursing professionals in relation to reference values (FNB / IOM / DRI), by sex, age group and work shifts*

Male								
Age group (years)								
Nutrients and Dietary Fibers	**19 to 30**		**31 to 50**		**Reference**	**51 to 70**		**Reference**
	Day Shift†	**Night Shift**	**Day Shift**	**Night Shift**	**Values[1,2]**	**Day Shift**	**Night Shift**	**Values[1,2]**
	Average (SD)		**Average (SD)**			**Average (SD)**		
Calcium[1] (mg)	-	589.7(286.0)	503.2 (169.6)	389.4 (252.5)	800.0	549.3 (388.6)	460.7 (200.0).	800.0
Iron[1] (mg)	-	7.9 (2.7)	10.0 (3.2)	7.8 (2.8)	6.0	7.4 (3.2)	6.8 (2.2)	6.0
Vitamin C[1] (mg)	-	23.8 (14.6)	68.9 (81.8)	218.2 (551.7)	75.0	40.2 (28.3)	78.7 (50.5)	75.0
Sodium[2] (mg)	-	2961.0 (596.6)	3,246.5 (1,042.6)	3,076.4(1320,2)	1500.0	3,081.0 (804.2)	2,893.7 (749.0)	1300.0
Fibers[2] (g)	-	17.8 (8.4)	28.5 (17.3)	25.8 (9.7)	38.0	25.6 (10.1)	23.9 (9.3)	30.0
FEMALE								
Calcium[1] (mg)	531.7 (273.8)	560.9 (324.2)	532.8 (314.4)	477.9 (375.3)	800.0	529.7 (358.4)	615.7 (528.6)	1,000.0
Iron[1] (mg)	7.4 (3.1)	8.1 (2.7)	6.8 (2.6)	8.2 (9.8)	8.1	6.8 (2.7)	6.5 (2.8)	5.0
Vitamin C[1] (mg)	64.5 (112.6)	142.6 (281.2)	62.2 (82.5)	48.2 (56.0)	60.0	79.8 (68.4)	71.6 (82.8)	60.0
Sodium[2] (mg)	2,911.1 (1574.4)	2,569.7 (804.6)	2,582.8 (1073.6)	2,574.9 (1188.)	1,500.0	2,013.5 (788.4)	2253.7 (1077.2)	1,300.0
Fibers[2] (g)	19.1 (8.9)	20.9 (11.0)	17.2 (6.91)	17.8 (8.6)	25.0	17.8 (7.8)	16.9(7.70)	23.0

EAR - Estimated Average Requirement; AI - Adequate Intake; SD - Standard Deviation; † No participant in day shift.

The average of the EER of the day shift nursing professionals was 2,163 kcal and the energy intake 1,692 kcal. In the night shift the EER was 2,248 kcal and the energy intake 1,674 kcal. In both shifts

the EER value was not reached, and we observed significant differences (p <0.001) between day and night shifts.

Table 3 shows the distribution of the macronutrient percentage of the diets ingested by nursing professionals, indicating that the percentage distribution of macronutrients is adequate. However, protein intake per gram / kg weight was higher than the recommendation (FNB/IOM/DRI, 2005).

Table 3: *Average consumption of micronutrients and dietary fiber of nursing professionals in relation to reference values (FNB / IOM / DRI), by sex, age group and work shifts*

Macronutrients	Below n (%)	Adequate n (%)	Above n (%)	Average intake (SD)	Recommendation FNB/IOM/DRI (2005)
Day Shift (n=165)					
CHO	53 (32.1)	108 (65.4)	04 (2.5)	49.4% of TEI (8.4)	45% – 65% of TEI
PTN	21 (12.7)*	---	144 (87.3)	1.15 g/ kg/weight (0.44)	0.66 g/ kg/weight
LIP	07 (4.2)	105 (63.6)	53 (32.2)	31.3% of TEI (7.0)	20% - 35% of TEI
Night Shift (n=142)					
CHO	44 (31,0)	93 (65.5)	05 (3.5)	49,5% of TEI (9.1)	45% – 65% of TEI
PTN	21 (14.8)	--	121 (85.2)	1.06g/kg/weight (0.40)	0.66 g/ kg/weight
LIP	08(5,6)	87 (61.3)	47(33.1)	31.6% of TEI (7.2)	20% - 35% of TEI

PTN - Proteins; CHO - Carbohydrates; LIP - Lipids; TEI - Total Energy Intake; * Significant difference between shifts.

Table 4: *Analysis of the apparent adequacy of micronutrients of nursing professionals according to sex, age group and work shifts*

MALE						
Age Group (years)						
	19 to 30		**31 to 50**		**51 to 70**	
Shifts						
Nutrients	**Day †**	**Night**	**Day**	**Night**	**Day**	**Night**
Calcium (mg)	**-**	- 0.58	- 0.95	- 1.06	- 1.13	- 1.23
Iron (mg)	**-**	0.31**	0.55**	0.34**	0.23**	0.22**
Vitamin C (mg)	**-**	- 0.14	0.44**	0.09**	- 0.08	- 0.02
Sodium (mg)	**-**	0.00	0.00	0.00	0.00	0.00
FEMALE						
Calcium (mg)	- 1.09	- 0.98	- 1.11	- 1.30	- 2.14	- 2.08
Iron (mg)	- 0.05	- 0.07	- 0.02	- 0.20	0.58**	0.28**
Vitamin C (mg)	0.10**	0.25**	0.00	- 0.04	0.11**	0.60**
Sodium (mg)	0.00	0.00	0.00	0.00	0.00	0.00

**Z Score greater than zero indicates adequacy; - without values †for age group 19-30 years in day shift no male individual was observed.

The apparent adequacy of micronutrients is shown in Table 4. For iron in all age groups and shifts we found adequate intake, and for vitamin C only in the age groups 31-50 years in both shifts for males. The apparent adequacy of sodium was inadequate for men in all age groups and shifts, indicating a higher than recommended intake. As for women, most of the apparent nutrient adequacy results were inadequate, except for iron between the ages of 51-70 years, and vitamin C for the age group between 19-30 and 51-70 years in both shifts.

4. Discussion

For the micronutrient calcium among men and women, in all age group, both the average consumption and the apparent adequacy had the inadequate values in relation to the recommendation. In the literature, in general, results are similar to those found in the present study, i.e., inadequate calcium intake for men and women, even considering ethnic issues, place of residence (urban or rural and food supplementation (Arab et al., 2003; Kolahdooz et al., 2013; Martini et al., 2013). Exception was observed by Viñas et al. (2011), who evaluated data from the European Nutrition and Health Report II (ENHRII) with 12,156 individuals and found suitability for almost all observed nutritional studies, both in men as in women. Calcium is an important nutrient for the maintenance of bone health and its deficiency leads to the onset of osteoporosis, arterial hypertension and consequently poor quality of life.

Both the mean iron intake and the values found by the apparent adequacy method demonstrated that men and women reached the recommendation in all age groups and shifts, except women in the age group of 19-30 years and 31-50 years in the day shift. When comparing the results of mean iron intake with FNB / IOM / DRI (2002), the results are similar to those of apparent adequacy. Manios et al. (2014) in study on 1,468 Greek individuals, observed average iron intake above the recommendation. The findings of Lennernas et al. (1995) on 96 industrial workers on day off and working days in Sweden had values higher than the recommendation. Iron is one of the essential nutrients and its deficiency causes iron deficiency anemia, which is the most prevalent nutritional deficiency in the world.

Comparing the apparent adequacy of vitamin C and FNB / IOM / DRI recommendations (2000), nutrient adequacy was observed for men only for the age group 31-50 years night shift and, for women, adequacy was present in the age groups of 19-30 and 51-70 years in both shifts. In the survey of Arab et al. (2003), in which all 3,548 American women participants presented intake of vitamin C according to the EAR. Manios et al. (2014) found adequate vitamin C for men and women in Greece. Similar result was found by Knutson et al. (1990) with 25 male shift workers from a paper factory. Findings from Kolahdooz et al. (2013) with an African rural population of 136 individuals presented values lower than the recommendation for both sexes. In the study by Nguyen et al. (2014) with 4,983 women in reproductive age in Vietnam, vitamin C was below the recommended levels in all age groups. In the last Brazilian Population Budget Survey - POF 2008-2009 (IBGE, 2010), it was found that the best sources of vitamin C, fruits and vegetables, were consumed less than 10% of the recommendation, a minimum of 400g / day, and this may be a justification for the values of inadequacy found for this vitamin, which is so important to improve the bioavailability of iron.

The mean amount of sodium ingested presented values above the recommendation for men and women in both shifts. Serra-Majém et al. (2007), in a population survey carried out in two different periods in Spain, with samples of 1,211 and 954 individuals aged 10 to 75 years, showed intake above the recommended level. The authors observed that men consumed 3.4 mg less sodium and women increased their consumption by 82.7mg between the periods 1992-1993 and 2002-2003. In the population study with 2,659 individuals, represented by Chinese, Japanese and Americans, Zhang et al. (2015) confirmed values above the recommended level. Chinese men achieved sodium intake from 4,711mg to 7,344mg; the Japanese, from 4,449mg to 4,961mg; and Americans from 3,955mg to 4,346mg. Chinese women consumed between 5,112mg to 6,121mg; Japanese women, 3,701mg to 4,252mg; and American women between 2,791mg and 3,116mg. So it can be affirmed the urgency to implement measures to reduce 30% in the average consumption of salt / sodium of the world population according to the World Health Organization guidelines for the Global Plan of Action for the Prevention and Control of Noncommunicable Diseases (2013), recommending intake less than 2,000 mg sodium / day.

The mean intake of dietary fiber presented values below the recommendation for all age groups, genders and shifts among nursing professionals. In a study conducted in a factory, Knutson et al. (1990) observed inadequate fiber intake in alternating shifts and daytime workers, with consumption of 15.1g / day and 16.6g / day, respectively. However, survey involving South Africans found consumption above the recommendation for men, but women over 19 years of age presented inadequate intake in relation to the recommendation (Kolahdooz et al., 2013). Dietary fibers are among the major dietary component in preventing chronic noncommunicable diseases, having a beneficial power for diverticular disease of the colon, reducing the risk of cancer and controlling diabetes.

The energy consumption of nursing professionals in the two shifts was not adequate for the EER. Studies indicating higher (Kolahdooz et al., 2013) and lower (Nguyen et al., 2014) energy intakes for men, and above (Nguyen et al., 2014) and lower (Araújo et al., 2013) for women are in the literature. In a food survey conducted by Reeves et al. (2004) with 36 nurses from nursing homes and hospitals, the men of the night shift had energy intake of 2,300kcal and those of the day shift 2,211kcal, and were not statistically different. Women presented inversion of the energy intake between the shifts, being smaller in the night shift and greater for the diurnal one, 1,577kcal and 1,669kcal, respectively.

These differences in energy intake among individuals from different countries may be influenced by factors such as: nutritional transition, increased consumption of processed foods, especially ultra-processed foods, by the inadequacy of use equations by populations other than those of origin to estimate the energy value or the food consumption assessment tool used. Most of the time, prediction equations overestimate the basal metabolic rate, causing errors in the estimation of the energy requirement of populations.

The main limitation of this study resides in underreporting of energy intake. That is a well-known and well-documented problem of self-reported dietary assessment methods such as the 24-hour dietary recall. The other limitation of this study is due to the limitation of the Brazilian dietary database. The important strength of this study is in methods and procedures used during the data collection and processing. Precise and comprehensive instructions were given to interviewers for the completion of a single 24-hour dietary recall.

5. Conclusion

Nutritional inadequacies are independent of the work shift among the nursing professionals studied. Incentives for healthy food are needed, so that these professionals will be able to increase access to food sources of micronutrients such as whole grains, fruits and vegetables, milks and dairy products and fish.

Author Contribution

Odaleia Barbosa de Aguiar, Eliane de Abreu Soares, Camila Fidelis Nobre performed the analysis and interpretation of the data and writing of the manuscript. Odaleia Barbosa de Aguiar, Eliane de Abreu Soares, Camila Fidelis Nobre, Lúcia Rotenberg, Rosane Härter Griep and Maria de Jesus M. da Fonseca contributed to the review of the manuscript.

Conflict of Interest

There was no conflict of interest to report.

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Research Article

Diet Quality of Clients of a Soup Kitchen

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Abstract This study discerned the impact of a meal donation on the total diet quality of clients of a soup kitchen. A total of 110 adults were selected randomly from a soup kitchen in Central Texas. Participants completed a demographic questionnaire, food frequency questionnaire and a list of meal donations. Diet quality and food servings of the original diet, meal donation and total dietary intake were estimated via both the HEI-2010 and 2015 U.S. Dietary Guidelines. The soup kitchen provided a daily meal, which included fruit, cheese, egg, and bagel, but did not contain any vegetables or meat. Mean diet quality for their original diet was modest (HEI-2010 = 55.25). The extra meal donated by the soup kitchen increased the diet quality of the total diet by 10%, and added fat-soluble vitamins and essential minerals. Health professionals should support these soup kitchens, by volunteering and providing advice to the directors about the importance of offering a variety of healthy foods.
Keywords *Clients; Low-income; Meal donations; Nutritional status*

1. Introduction

In the United States (U.S.), approximately 47 million individuals are classified as low-income (DeNavas-Walt and Proctor, 2015). Of this population, 7.4% lives below 100% of the poverty rate (<$12,000 per capita), and 0.2% are homeless (Federal Register - the U.S. Department of Health and Human Services, 2018). Consequently, the lack of financial resources may limit the availability and consumption of healthy foods, leading to diminished diet quality (Nackers and Appelhans, 2013).

A number of government food assistance programs have been created to provide food benefits to those in need, including Special Supplemental Nutrition Program for Women, Infants and Children (WIC), Head Start (for low-income children) and Meals on Wheels (for elderly) (U.S. Department of Health and Human Services, 2015). But private non-government programs also have been developed to provide free food, such as community and religious organizations, food pantries and soup kitchens (Office of the Chief Economist USDA, 2014; Campbell et al., 1987). A soup kitchen is a facility that is present in neighborhoods to distribute free meals to those in need. To date, the exact number of soup kitchens in the U.S. is unclear (Office of the Chief Economist USDA, 2014). Yet several nutritional assessment studies have been conducted in soup kitchen populations because of their vital role in supporting the low income.

Smith et al. (2010) examined nutritional status of 254 women who resided in shelters and “food deserts” in Minnesota. The meals contained daily serving of fruits (<2), dairy foods (<2) and meat (<2.5) that were lower than that of the U.S. Dietary Guidelines ($P < 0.05$) (Smith et al., 2010). In

Nevada, diets of 191 users of emergency programs including food pantries and soup kitchens were evaluated by 24-hour dietary recall (Institute of Medicine (US) Panel on Micronutrients, 2001; Institute of Medicine, 1998; Lenhart and Read, 1989). Mean daily energy intakes of the clients were below Dietary Recommended Intakes (DRI), as they averaged < 1200 kcal. Also levels lower than the DRIs were documented for thiamin (72%), riboflavin (67%), niacin (59%), vitamins A (70%) and C (73%), iron (Fe) (59%), and calcium (Ca) (76%) (Institute of Medicine (US) Panel on Micronutrients, 2001; Institute of Medicine, 1998; Lenhart and Read, 1989). In Canada, Tse and Tarasuk assessed the nutritional content of the meals offered at 18 soup kitchens (Tse and Tarasuk, 2008). These meals provided mean servings of 2.6 of grains, 4.1 of fruits and vegetables, 0.4 of dairy foods, and 1.7 of meat (Tse and Tarasuk, 2008). All of these quantities were less than the recommended Dietary Guidelines for Americans (6, 5, 2 and 2.5 portions, respectively) (U.S. Department of Health and Human Services, 2015). Nonetheless, these donations are believed to improve the diet of the clients of these charitable agencies. Although the previous studies evaluated the nutritional status of the clients or the dietary breakdown of the meals offered, none yet have compared the diets of clients with and without the donated meals. The objective of the present research is to focus on the impact of a meal of soup kitchens on the diet quality of a low-income population before and after the donation (food received). It is hypothesized that the soup kitchen meal will improve the diet quality of the clients.

2. Materials and Methods

2.1. Design

A soup kitchen in Central Texas which served about 1800 individuals each month was the venue for this research. A total of 110 clients (≥ 18 years) of the soup kitchen agreed to participate in this cross-sectional study. Data was collected at the soup kitchen by visiting this facility three times in September 2015. The same meal was offered every day at the soup kitchen. Study participants were interview-administering a demographic questionnaire, food frequency questionnaire (FFQ), and a list to document the meal donation (Klohe-Lehman et al., 2007; George et al., 2004). Instruments were provided in English and Spanish and completed by paper and pencil. The validated FFQ measured the monthly energy and dietary intake of the total diet of clients. A meal donation list documented the frequency of receiving the meals, and their type and amount; these quantities were validated by the researcher who took photographs via a smart phone.

2.2. Study Participants

A total of 110 clients of the soup kitchen who received free meals were enrolled. The number was based on power analysis, in which a one-tailed t-test with a medium effect size of 0.3 requires a sample size of 110 subjects to yield 95% power. The protocol of the study was explained to the participants, and consent was obtained. Study participants were compensated by $10 upon successful completion of the questionnaires. All adult clients aged 18 years and above were included, with the exclusion of children, pregnant and lactating women. This study was approved by the Institutional Review Board at the University of Texas at Austin.

2.3. Tools of Assessment

Demographic questionnaire is a validated 25-item tool that was developed by the author and collected information about: age, sex, ethnicity, weight and height, educational level, marital status, occupation, housing and socioeconomic status of the clients (Klohe-Lehman et al., 2007).

Food frequency questionnaire (FFQ) is a 195-item scale developed and validated by the author in a tri-ethnic low-income population recruited from Central Texas in 2004 (Cronbach's α = 0.69) (George

et al., 2004). This FFQ measured the frequency and amount of dietary intake over a period of one month; thus, this food intake included the meal consumed at the soup kitchen. Then the total daily intake was calculated by dividing the monthly food intake by 30. The portion size was estimated as small, medium, large or extra-large. A 9-point likert scale of frequency of food consumption ranged between never or <1 per month to 2+ times per day. The researcher and trained nutrition undergraduate students administered the FFQ and used photographs of portion sizes of foods/meals, measuring cups and spoons to assist in estimation of portion size.

The meal donation list (list of foods received) collected descriptive, qualitative and quantitative information about the frequency of receiving the meal, its type (fresh, cooked and/or packaged), amount (quantity or portion size in grams, ounces, liters), and quality (taste and presentation: unsatisfactory, satisfactory, and outstanding). The researcher weighed each food item offered and estimated its price based on grocery market cost. The clients received the same meal during the month of data collection, which was consumed at same facility of the soup kitchen. Each client provided information about the meal eaten on the day of recruitment; thus, one meal was analyzed per client. Content validity of this list was evaluated by comparing the data collected from the participants with the photographs of the free meal that were captured via a smart phone at two sessions. These photographs were taken prior to and after eating the meal, to estimate the plate waste (mean = 12.93 g) and actual amount consumed.

Dietary intake of the total diet (collected via the FFQ, which included the consumed soup kitchen meal), soup kitchen meal (obtained from list of meal donation) and original diet (total diet - the consumed soup kitchen meal) was estimated for all participants via Food Works 8 Professional software (Epi Info., 2015). This software is based on the United States Department of Agriculture (USDA) database (Nutrition.gov - National Agricultural Library USDA, 2014). The nutrient values of foods were compared with the corresponding DRIs for energy, macro- and micro-nutrients (Institute of Medicine (IOM) of the National Academies of Science, 2001; Institute of Medicine (US) Panel on Micronutrients, 2001; Institute of Medicine, 1998). In the case of missing nutrient data for any food during dietary analysis, the nutrient intake was extrapolated from values of closely related foods; this method was used for <1% of food items.

Choose MyPlate was developed by the USDA and used to estimate portion size equivalents for each food group based on daily recommended intakes of foods that were derived from the 2015-2020 Dietary Guidelines for Americans (U.S. Department of Health and Human Services, 2015). Food groups utilized included fruits, vegetables, beans, grains (refined and whole), dairy and protein foods (plant proteins, poultry, meat, and seafood), solid fats and added sugars (U.S. Department of Health and Human Services, 2015; Neter et al., 2014). Choose MyPlate was the source used to calculate the number of servings consumed each day for the original and total diets for each client.

The Healthy Eating Index-2010 (HEI-2010) was calculated to measure the quality of the original diet (total diet - meal donation), meal donation, and total dietary intake (obtained from the FFQ) (Guenther et al., 2013). The HEI-2010 describes adherence of food groups consumed with the Dietary Guidelines for Americans, in terms of adequacy and moderation. The scale ranges from 0-100 points, in which higher scores reflect greater compliance with the guidelines. This index consists of 12 items; nine groups measure adequacy (total fruit, whole fruit, total vegetables, greens and beans, whole grains, dairy and total protein foods, seafood and plant proteins, and fatty acids), and the other three evaluate moderation (refined grains, sodium, and empty calories) (Cronbach's alpha = 0.68) (Guenther et al., 2014).

2.4. Analysis of Statistics

Statistical analyses were conducted using the Graduate Pack SPSS 19.0 for Windows 2010 (Epi Info., 2010). Descriptive statistics were performed and presented as mean ± standard error of the mean (SEM) and frequency distributions. Analysis of variance and paired sample t-tests were used to estimate mean differences for diet quality and food servings when comparing the original diet with the overall diet. Bonferroni post-hoc-test was used to control for covariates. All two-tailed P <0.05 were considered significant.

3. Results

General characteristics of the population sample are presented in Table 1. The soup kitchen clients were adults with an average age of 46 years, and a mean body mass index of 26 kg/m^2. Less than half of the participants were overweight or obese (46%). The mean annual income of the clients was $3,878 (Table 1). Only 16% were employed, 66% did not have any income and 93% lived below the poverty level ($11,880 per household) (data not shown). None of the participants reported receiving any housing resources. Moreover, Figure 1 shows that only 9% of the clients received a monthly supplemental social income (SSI), averaging $433.90/month. These SSI benefits were only 6.4% of the mean total annual income, $3,878. None reported having any children or others living in their households; only 23% were married.

Table 1: *Characteristics of clients of a soup kitchen (n = 110)*

Characteristic	Mean ± SEM	Range
Age, yrs	45.45 ± 1.14	21 - 78
Body mass index, kg/m^2	25.98 ± 0.55	16.61 - 51.88
Yearly income, $	3,878 ± 800	0 - 30,000
Annual Supplemental Security Income per household*, $ [a]	433.92 ± 181.2	0 - 10,800
Education, yrs	13.54 ± 0.33	6 - 22
Household Size	1.00 ± 0.00	1 - 1

[a]The supplemental security income is provided by the social security administration.

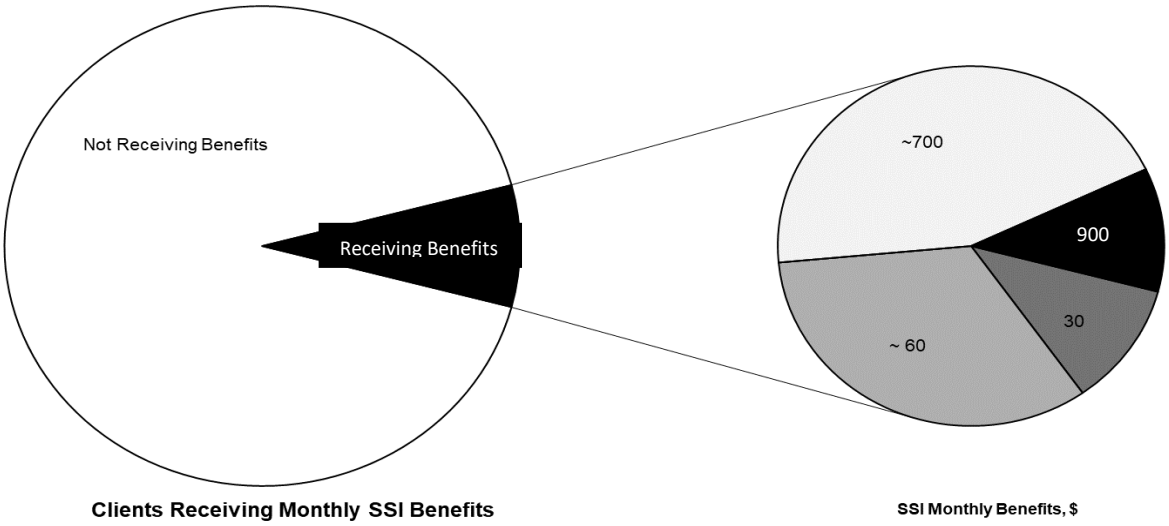

Figure 1: *Clients of soup kitchen receiving Supplemental Security Income (SSI) (n = 110)*

More than two thirds of the recipients were men (70%); and total participants were Non-Hispanic Whites (51%), Hispanics (15%) and Blacks (28%) (Table 1). In our sample, 95% reported that they were homeless: living in cars, trailers, shelters (53%) or on the streets (43%). Only 50% had finished high school and 45% drank alcohol daily, primarily beer (78%). Moreover, the majority of them were smokers (73%), and physically active (82%), but suffered from a health problem (78%) such as heart disease, type-2 diabetes, arthritis and depression (data not shown).

Clients of the soup kitchen received a modest daily meal, weighing ≈ 400 g per client as seen in Table 2. The monetary value of the free meal was estimated to be slightly over $4. The meal was required to be consumed at the same location. It included a piece of fruit, bakery products, egg, cheese, and coffee. Of these, the bagel provided the highest quantities of energy, carbohydrates and protein; cheddar cheese contained the greatest amount of fat. More than one third of food recipients reported that the meal did not satisfy their hunger; however, most of them considered the meal to be very good (88%) (data not shown).

Table 2: *Sample of a meal from a soup kitchen*

Food	Amount	Energy (Kcal)	Carbohydrate (g)	Protein (g)	Fat (g)
Apple/Orange	1	80	19	1	0
Flour tortilla	1	58	12	1	1
White/Whole wheat bagel	1	260	52	11	1.5
Egg (hard-cooked)	1 large	77.5	0.6	6.3	5.3
Cream cheese	28.3 g	49.6	0.6	0.87	4.9
Cheddar cheese	28.3 g	111.4	1	7.1	9.1
Coffee	1 cup	2.4	0	0.3	0
Total (g)	360	638.9	85.2	27.6	21.8
Estimated cost ($)	4.3	_	_	_	_

Table 3 describes the mean servings of food groups in the original diet, meal donation and total diet, and the HEI-2010 scores of original and total diets of clients of a soup kitchen. Total food consumption (total diet) of participants almost met the 2015 U.S. Dietary Guidelines (U.S. Department of Health and Human Services, 2015) for grains, refined grains, fruits, and protein foods. However, the total diet was lacking in whole grains, vegetables and dairy foods. The soup kitchen meal provided the total diet with more than half of the portions of refined and whole grains, fruits, dairy products and meat (i.e., eggs) and 13% of empty calories [added sugars, saturated fatty acids and alcohol (grams/1000 kcal)] ($P < 0.05$).

Regarding the total diet, participants scored above the cut-off point of the HEI-2010 for total proteins (score = 5), and refined grains (score = 10), and high for empty calories (score = 20) in which higher scores reflect better diet quality. This is believed to be due to low to moderate intakes of protein foods, refined grains and foods that are high in fat and/or sugar. In contrast, the clients had low scores for whole grains, dairy foods, fatty acids and sodium (Na) (score = 10); total and whole fruits, total vegetables, greens and beans, and seafood and plant proteins (score = 5). This poor diet quality of the total diet (with the exception of lack of empty calories) might be due to the inadequate consumption of energy (1919 kcal/day). Total diet quality was modest, with the mean HEI-2010 score of the original diet being 55. This HEI-2010 score improved to 61 with the meal donation. Thus, the meal improved the diet quality of the original diet by ~ 10% ($P < 0.05$) (Table 3).

The meal provided 616 kcal which consisted of 51% of carbohydrates, followed by fat (33.9%) and protein (17%). Moreover, carbohydrates, fat, protein and dietary fiber of the meal provided 25%, 32%, 44% and 41% of their DRIs, respectively (Institute of Medicine (IOM) of the National Academies of Science, 2001). The contribution of carbohydrates, protein, fat and dietary fiber from the additional

meal to the total diet was 38% for carbohydrates, 44% for protein, 45% for fat and 64% for dietary fiber (P <0.05) (data not shown).

Table 3: *Mean servings of food groups in original diet, meal donation and total diet, and Healthy Eating Index-2010 (HEI-2010) scores of diets of clients of a soup kitchen (n = 110)* *[¶]

Food Group	Original diet		+	Meal donation	=	Total diet	
	Serving/d	HEI-score		Serving/d		Serving/d	HEI-score
	Mean ± SEM						
Adequacy							
Total fruits [a]	0.78 ± 0.17 [h]	2.44 ± 0.05 [j]		1.66 ± 0.02		2.44 ± 0.19 [g]	4.78 ± 0.05 [i]
Whole	0.52 ± 0.13 [h]	3.25 ± 0.13 [j]		1.11 ± 0.01		1.63 ± 0.13 [g]	5.0 ± 0.00 [i]
Total vegetables [a]	1.83 ± 0.15 [g]	3.32 ± 0.14 [i]		0.00 ± 0.00		1.83 ± 0.15 [g]	3.32 ± 0.14 [i]
Greens and beans [a]	0.59 ± 0.07 [g]	4.54 ±0.11 [i]		0.00 ± 0.00		0.59 ± 0.07 [g]	4.54 ± 0.11 [i]
Whole grains	0.07 ± 0.02 [h]	0.23 ± 0.09 [j]		0.50 ± 0.00		0.57 ± 0.02 [g]	2.14 ± 0.09 [i]
Dairy [a]	0.73 ± 0.08 [h]	0.36 ± 0.19 [j]		0.48 ± 0.02		1.21 ± 0.10 [g]	4.54 ± 0.24 [i]
Total protein foods	5.57 ± 0.31 [h]	5.57± 0.14 [j]		1.09 ± 0.03		6.66 ± 0.39 [g]	4.65 ± 0.08 [i]
Sea food and plant Proteins	0.79 ± 0.05 [g]	2.47 ± 0.17 [j]		0.00 ± 0.00		0.79 ± 0.05 [g]	2.47 ± 0.17 [j]
Fatty acids (g) [b]	_	1.03 ± 0.16 [i]		_		_	1.03 ± 0.16 [i]
Moderation							
Refined grains	2.71 ± 0.26 [h]	7.53± 0.29 [i]		2.79 ± 0.02		5.50 ± 0.28 [g]	5.05 ± 0.29 [i]
Sodium	_	5.69 ± 0.29 [i]		_		_	5.44 ± 0.29 [i]
Empty calories (g) [c]	31.95 ± 2.01 [h]	18.82 ± 0.46 [j]		13.43 ± 0.10		45.73 ± 2.11 [g]	16.48 ± 0.38 [i]
Total [d]	_	55.25 ± 0.69 [j]		_		_	60.58 ± 0.68 [i]
Total grains	2.79 ± 0.27 [h]	_		3.29 ± 0.02		6.08 ± 0.29 [g]	_
Meat	2.17 ± 0.14 [h]	_		1.09 ± 0.03 [k]		3.26 ± 0.17 [g]	_
Poultry	1.78 ± 0.13 [g]	_		0.00 ± 0.00		1.78 ± 0.13 [g]	_
Sea Food	0.43 ± 0.05 [g]	_		0.00 ± 0.00		0.43 ± 0.05 [g]	_
Discretionary foods	1.89 ± 0.10 [g]	_		0.00 ± 0.00		1.89 ± 0.10 [g]	_
Fat in foods							
High [e]	7.87 ± 0.43 [g]	_		0.00 ± 0.00		7.87 ± 0.43 [g]	_
Low [f]	0.20 ± 0.04 [g]	_		0.00 ± 0.00		0.20 ± 0.04 [g]	_

[*] Maximum HEI component-score for: total and whole fruits, total vegetables, greens and beans, total protein foods, seafood and plant proteins is 5; whole and refined grains, dairy and sodium is 10; and empty calories is 20.

[¶] Total diet is calculated from the food frequency questionnaire. Original diet is estimated by subtracting the total diet from the meal donation.

[a] Cup.

[b] Fatty acids = (Poly-unsaturated fatty acids + Mono-unsaturated fatty acids)/Saturated fatty acids

[c] Empty calories = [added sugars (grams) + saturated fatty acids (grams) + alcohol (grams)] per 1000 kcal

[d] Range of total HEI-2010 score is 0 - 100; a higher score reflects greater diet quality.

[e] Burrito; chicken nuggets; full fat mayonnaise.

[f] low-fat ice-cream, yogurt or mayonnaise.

[gh] Different superscripts indicate significant differences for servings between overall and total diets at P ≤ 0.05.

[ij] Different superscripts indicate significant differences for HEI-scores between overall and total diets at P ≤ 0.05.

[k] The meat group of the meal is the cooked egg.

Figure 2 shows the percentage of contribution of micronutrients of the meal to the total diet and DRI of soup kitchen clients. The soup kitchen meal increased the total dietary intake by more than 40% for vitamins A and D, and riboflavin, as well as trace minerals, copper (Cu), phosphorus (P) and magnesium (Mg). The vitamin C contribution from the meal was the lowest of all nutrients added, only 14.4%.

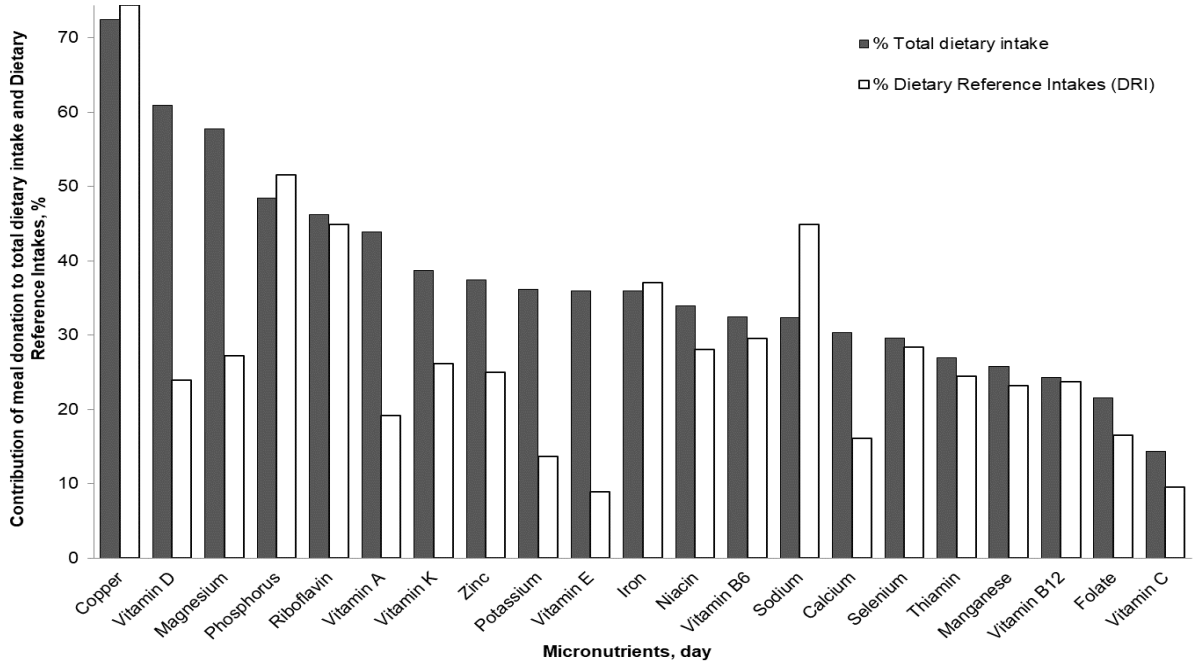

Figure 2: *Percentage of contribution of micronutrients of the meal donation to the total diet and Dietary Reference Intakes (DRI)* of clients of a soup kitchen (n = 110)*

*(Institute of Medicine (IOM) of the National Academies of Science, Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc, 2001) (Institute of Medicine (IOM) of the National Academies of Science, Institute of Medicine (IOM) of the National Academies of Science, 2001).

Compared with the DRIs, the meal provided < 30% of the reference intakes of the vitamins, with the exception of riboflavin (Institute of Medicine (US) Panel on Micronutrients, 2001; Institute of Medicine, 1998).

Minerals that were not provided at this 30% level were calcium (Ca), Mg, potassium (K), zinc (Zn), manganese (Mn) and selenium (Se) intakes (Institute of Medicine (US) Panel on Micronutrients, 2001). The only nutrients of the meal that contributed > 50% to the respective DRIs were P and Cu (Institute of Medicine (US) Panel on Micronutrients, 2001; Institute of Medicine (IOM) of the National Academies of Science, 2001) (Figure 2).

4. Discussion

This study observed that clients of the soup kitchen were almost all homeless and quite poverty-stricken. Only 9% of the sample reported receiving a social supplemental income. Most of the participants did not receive a SSI presumably because of age (<65 years), residence in shelters, and/or not having a taxable income due to lack of employment. It should be noted that the majority of clients reported lack of knowledge about the presence of public food assistance programs such as the Supplemental Nutrition Assistance Program (SNAP). Others indicated encountering challenges such as being convicted of a crime, and/or not being a citizen (the eligibility criteria to enroll in government assistance programs) (Food and Nutrition Services, 2016).

The meal offered by the soup kitchen was not, nor did it include, soup. Rather the meal provided a variety of other food groups, with exception of a lack of vegetables. Nonetheless, the meal enhanced the total nutrient intake of their original diet and was considered to be very good. Similar findings have been reported by others, in which the free meal consisted of bakery products, fresh fruits, eggs,

cheese, coffee and/or tea (Lyles et al., 2013; Keller-Olaman et al., 2005). Two studies also reported inclusion of vegetables in the soup kitchen meal (Tse and Tarasuk, 2008; Sisson and Lown, 2011). Moreover, clients of food emergency programs including shelters, food pantries and soup kitchens stated food preferences were not considered (Campbell et al., 2011). Clients reported desiring more fruits, vegetables, and diabetic and cultural foods (Azurdia et al., 2011; Verpy et al., 2003). Nonetheless, the various types of foods offered at soup kitchens modestly improved the diet quality of its clients ($P < 0.05$).

Although the meal of the soup kitchen was not substantial in size, it added more than half of the portions of refined and whole grains, fruits, dairy foods and meat (i.e. egg) to the total diet of the participants. The total food intake of the soup kitchen clients met the 2015 U.S. Dietary Guidelines for grains, refined grains, fruits and protein foods; however, the total diet was still lacking in whole grains, vegetables and dairy foods (U.S. Department of Health and Human Services, 2015). The low levels of these foods in their original diet could be due to the high prices of vegetables and dairy food. Low-income populations may lack the financial resources to purchase these types of foods, as previously reported by Morrissey et al. (Morrissey et al., 2014).

In Minnesota, Smith et al. (2010) observed that 254 homeless women consumed quantities that were less than the recommended for grains (5.4 vs. 6 servings), fruits (0.7 vs. 2 servings), vegetables (2.1 vs. 2.5 servings), milk (1.2 vs. 2 servings) and meat (2 vs. 2.5 servings), respectively. All of these portions are less than the quantities found in our sample, with the exception of vegetables and dairy foods. Similarly, Martins et al. indicated that 197 homeless using shelters in Rhode Island did not meet the dietary guidelines for fruits, dairy and meat/beans (≤ 2.2 servings/day); these values are less than the amounts consumed by our sample (Martins et al., 2015).

The overall diet quality of our participants was modest (mean HEI-2010 = 61), despite the consumption of the donated meal. The moderate score was due primarily to low amounts of whole grains, vegetables, seafood and plant proteins, as well as elevated intakes of fatty acids, empty calories and Na (U.S. Department of Health and Human Services, 2015).

Nguyen et al. (2015) recently explored diet quality in a population of 8,333 low-income men and women (mean age 45.5 years) that included SNAP recipients (27.3%). The diet quality of their diets was even lower than that found in the present study (HEI 2010 score = 45.4 vs. 55, respectively) (Nguyen et al., 2015). Yet other studies conducted in the low-income in Texas by the author and in Canada reported findings that are similar to our outcomes (Shah et al., 2010; Huet et al., 2012). For instance, Shah et al. (2010) found that diet quality was modest (mean HEI-2005 = 51.4) in 125, multi-ethnic, low-income post-partum women receiving WIC and SNAP benefits (Shah, 2010). Huet et al. (2012) also observed that diet quality of 1901 low-income Inuit families was similar (HEI 2010 ≈ 54) to that of our sample ($\bar{x}$ HEI-2010 = 55). Thus, the nutritional quality of diets of the individuals who receive food donations was modest.

The meal donation of the soup kitchen added to the total diet more than 50% of the DRIs of P and Cu, yet <30% of vitamins C and B_{12}, folate and Mn (Institute of Medicine (US) Panel on Micronutrients, 2001; Institute of Medicine, 1998). In 2013, Lyles et al. (2013) examined 22 meals of soup kitchens in San Francisco. Quantities of dietary fiber, Ca, K and vitamins A and E were lower than the DRIs by 77% - 93% (Institute of Medicine (US) Panel on Micronutrients, 2001; Institute of Medicine, 1998; Lyles, 2013). These levels are similar to our results, except that our meal provided larger amounts of dietary fiber (7.1 vs. 13.3 g, respectively), presumably due to the incorporation of a whole-wheat bagel and large piece of fruit.

A nutritional analysis of three soup kitchens in Michigan (Sisson and Lown, 2011) also determined that the offered meal provided lower amounts than the recommended intakes of energy,

carbohydrates, protein, fat, vitamins A and C, B-vitamins, Mg, iron (Fe), P, Zn, Ca, and Na (Institute of Medicine (US) Panel on Micronutrients, 2001; Institute of Medicine, 1998; Institute of Medicine (IOM) of the National Academies of Science, 2001; Sisson and Lown, 2011). But a single meal would not be expected to provide all the nutrients needed for one day.

In North Carolina, Eppich and Fernandez (2004) documented that the meal served by a church supplemented the clients with about 1,149 - 1,244 kcal, 139 - 157 g carbohydrate, 36 - 54 g protein, 41 - 50 g fat, 98 - 142 µg folate, 46 - 54 mg, vitamin C, 569 - 1,244 µg vitamin A, 1 µg vitamin D, 300 - 411 mg Ca, 7 - 8 mg Fe, 2, and 2,113 - 3,939 mg Na. Nonetheless, these quantities were less than the reference intakes, except for Fe and vitamin A (Institute of Medicine (US) Panel on Micronutrients, 2001; Institute of Medicine, 1998; Institute of Medicine (IOM) of the National Academies of Science, 2001; Sisson and Lown, 2011). In comparison to our results, quantities of energy (1,149 - 1,244 kcal/day; 999 kcal/day), macro- and micronutrients of the meals reported by Sisson et al. (2011) and Eppich and Fernandez (2004) were greater than what we found (616 kcal/day). Therefore, it is believed that clients of soup kitchens need to receive meals of better diet quality, such as the inclusion of vegetables and meat/poultry in the donation.

In a study conducted in Manhattan of 69 men and women who attended the Flint Hills Breadbasket, total food intake was less than our findings and of the recommendations for dietary fiber (16 g) and folate (239 µg); but not for vitamin D (3.5 µg), Ca (831 mg) and Mg (285 mg) (Institute of Medicine (US) Panel on Micronutrients, 2001; Institute of Medicine, 1998; Bell et al., 1998). Similarly, Tse and Tarasuk (2008) observed that the offered meal provided 1,136 kcal, 48 g protein, 10 g dietary fiber, 411 µg vitamin A, 99 mg vitamin C, 266 µg folate, 1 mg thiamin, 1 mg riboflavin, 22 mg niacin, 1 mg vitamin B_6, 3 µg vitamin B_{12}, 158 mg, 8 mg Fe, 667 mg P, 7 mg Zn and 360 mg Ca. Compared with our meal, the nutrients in the meals observed by Tse and Tarasuk (2008) contained larger quantities of all nutrients except of fiber, which was greater in our research (10 vs. 13 g, respectively).

The variations in results could be due to the diverse characteristics of the participants and meals, as well as methods of diet assessment. For example, most studies used 24-hour dietary recalls to estimate dietary intake, in contrast to our use of a FFQ that incorporated foods consumed over a month.

Limitations of this research may include: limited resources and participation of soup kitchens that did not allow for a larger sample size, measurement error from the instrument (FFQ), under- or over-estimation of the amount of the meal that the client received, recall bias, and the use of self-reported weights and heights (Kirkpatrick et al., 2012; Subar, 2004). However, the utilization of a validated FFQ, visual aids to estimate and report the portion size consumed, and a smart phone to document the quantity of the offered and consumed meal, were strengths of this research.

5. Conclusion

According to our knowledge, this is the first study that measured diet quality of clients of a soup kitchen by the HEI. Although the meal itself was modest in size, the diet quality of the total diet was increased by 10% with the addition of a soup kitchen meal. Total daily dietary consumption of the participants met the recommendations for most food groups, with the exception of whole grains, vegetables and dairy foods. The addition of a citrus fruit and green leafy vegetables would greatly increase the intake of nutrients lacking (such as Mn, folate and vitamin C). Yet, it is recognized that the addition of these types of food may be the constrained by limited budgets and storage facilities. Health professionals should be cognizant of these soup kitchens for their impact on improving nutritional status of the low-income and homeless in their communities. It would be helpful to provide advice to the directors of soup kitchens about the importance of offering a variety of healthy foods.

Conflict of Interest

The authors report no conflict of interest.

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Author Agreement

The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported. The reporting of this work is compliant with The Code of Ethics of the World Medical Association (Declaration of Helsinki). The lead author affirms that no important aspects of the study have been omitted and that any discrepancies from the study as planned have been explained.

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