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Original article

Efficacy of a nutrition education intervention designed to improve overall diet quality of female adults

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Summary. *Objective:* Determine the effectiveness of a nutrition education (NE) intervention in improving nutritional knowledge and diet quality. *Design:* Quasi experimental with a control group. *Setting/Participants/Intervention:* Fifty six female undergraduate students aged 18-24 years. The experimental group (n=28) received 44 sessions of NE lectures while the control group (n=28) received no intervention. *Main Outcome Measures:* Questionnaire with nutrition knowledge questions, semi-quantitative FFQ distributed at pre-test, posttest (3M) and posttest 2 (6M). USDA food composition tables were utilized to calculate a Diet Quality Index-International (DQI-I) score. *Analyses:* Analysis through SPPS with significance at p <.05. *Results:* Mean knowledge scores in only the experimental group increased significantly between the 3 stages (p=.000) from 9.03 vs. 11.85 vs. 12.85. In the control group, calcium and vitamin C intake decreased and in the experimental group, there was a significant increase in fiber (21.40 vs. 23.56 vs. 27.30g) and calcium intake (674.96 vs. 690.60 vs. 852.85 mg). DQI-I score of only the experimental group increased (53.25 to 56.36 to 65.93) and post hoc test revealed 6 months of NE were required to significantly increase diet quality (p=.000) specifically variety (p=.008) and adequacy (p=.001) subcomponents. *Conclusions:* Nutrition courses play a valuable role in improving diet quality.

Key words: diet quality, nutrition education

Introduction

A low quality diet is a risk factor for several chronic diseases. Leading causes of deaths worldwide include heart diseases, cancer, stroke, and diabetes mellitus, all of which are associated with dietary intake. Indices that measure diet quality through a scoring approach such as the Diet Quality Index-International show that more varied and nutritious diets are associated with many benefits including higher income and education levels, increased energy intake, nutrient adequacy, and higher concentrations of serum nutrients. A high quality diet is also associated with reduced all-cause and cardiovascular disease mortality, and in some cases, reduced incidence of and mortality from certain cancers (1).

Data collected during the transition period from adolescence to adulthood suggests that along with unfavorable shifts in physical activity, decline in overall diet quality may occur during this transition period. The Bogalusa Heart Study showed that diet quality declines as individuals pass through the transition into adulthood as they adopt unfavorable diet consisting of low amounts of fruits and milk products and more salty snacks and sweetened beverages (2). University students have a low intake of several vitamins and minerals including thiamin, riboflavin, calcium and iron (3). Fast food consumption is associated with weight gain and it is seen that use of fast food restaurants is highest among people in young adulthood (4). Data from Add Health also shows that breakfast consumption decreases in the 5 year transition period between adolescence and adulthood (5).

Unhealthy eating behaviors and lack of physical activity decrease quality of life and increase the likelihood of osteoporosis, obesity, and diabetes in the future (6). Many strategies have been proposed to reverse such unhealthy eating habits and one of these is to increase nutrition knowledge since it is seen that nutrition knowledge about nutrients, food labels, food guide pyramid, energy expenditure, and metabolism is generally low in university students (7). University students are important to target for nutrition education because it is a time when they start to become more responsible for their own food choices and health behaviors as opposed to their parents (8).

Methods

A total of 56 undergraduate female students volunteered for the study. They were recruited from Kinnaird College for Women, Lahore. The inclusion criteria were that subjects were in between the ages 18-24, had not taken any nutrition course previously, and would be available for data collection at all three stages. Written informed consent was obtained from all participants. A quasi-experimental design consisting of pretest-posttest experimental with a control group was employed. Nutrition education lectures were given to the experimental group (n=28) and no intervention (n=28) was given to the control group. The study utilized the measurement of nutrition knowledge and diet quality at pre-test (Baseline), post-test (3 Months), and post-test 2 (6 Months).

Instruments

A 3 section questionnaire was used to collect data. The first section of the questionnaire was of demographics and included 13 questions addressing the participant's name, age, height, weight, major, semester, parental marital status, mother's educational level, mother's occupation, father's educational level, monthly household income, living arrangements and regular physical activity. The second section consisted of 20 multiple choice questions focused on macronutrients, micronutrients, food sources and diet planning principles intended to measure the nutrition knowledge of the participants. It was developed after thorough literature review and with the help of experts in the field of nutrition education. A pilot test was conducted on 12 undergraduate students who were not included in the final study to estimate reliability for the instrument. Cronbach's alpha coefficient, α was found to be $\alpha = .720$. The third section was a semi quantitative food frequency questionnaire (SFFQ). A SFFQ lists the portion size of the foods so that specific nutrient and energy intake could be estimated (9). The SFFQ was developed after an initial 90 item food list was created following interviews of 40 students for their 24-hour diet recalls (DR). This SFFQ was then pilot tested on 222 other undergraduate students and the top 60 food items selected were included in the final SFFQ. These items were divided into 7 groups and students marked whether each item was consumed on a daily/weekly basis and if on a daily basis then the number of servings (1-6) per day.

Procedure

Pre-testing was carried out in Sept 2015 when questionnaires were administered to the students in both groups during their scheduled class timings. Post-testing was carried out in Dec 2015 and post-test 2 were taken both groups in April 2016 after the implementation of 6 months of nutrition education in the experimental group. The nutrition education intervention in the experimental group consisted of 44 lessons. Two lessons each lasting 90 minutes were delivered every week. The main broader topics included were nutrition definition and concept, function and types of food, carbohydrates, proteins, fats, vitamins, minerals, water, and diet quality.

Data analysis

The food items selected in the SFFQ were used to calculate the average daily intake of nutrients and total energy of students according to the food composition tables developed by the United States Department of Agriculture (USDA) National Nutrient Database for Standard Reference. A diet quality score was then

computed using Diet Quality Index-International (DQI-I) (10). The DQI-I index examines four dietary components including variety, adequacy, moderation, and balance & allows us to measure diet quality through the scores (0-100), with 100 representing very good diet quality. For the nutrition knowledge questions, each correct answer was scored as 1 mark and each incorrect answer was scored a 0 and therefore the highest possible score was a 20. The higher the score, the more nutrition knowledge the student had. Tests utilize on SPSS included $\chi 2$ test, independent samples t-test, Cochran's Q test, repeated measures ANOVA, and post hoc tests using the Bonferroni correction with significant at $p<.05$.

Results

Characteristics of Participants at Pre-Test

A chi-square test found no significant differences between the demographic characteristics of both groups ($p > .05$) (Table1). Independent samples *t*-tests also found no significant differences between mean age, weight, height, BMI, basal energy expenditure, total calorie requirements, nutrition knowledge score, total caloric intake, and DQI-I score of both groups prior to intervention ($p > .05$) (Table 2).

Percent of Correct Answers in Nutrition Knowledge Section

In the experimental group, a Cochran's Q test determined that there was a significant difference in the proportion of students, who answered 9 questions correctly over time from pretest to post-test 2, $p < .05$) (Table 3).

Nutrition Knowledge Scores

Repeated measures ANOVA with a Greenhouse-Geisser correction determined that mean nutrition knowledge scores of the control group didn't differ significantly between the three time points ($p = .149$) whereas in the experimental group, the mean nutrition knowledge scores (9.03±2.70 vs 11.85±3.74 vs 12.85±4.07 differed significantly between the three time points ($p < 0.000$) (Table 4). Post hoc tests using the Bonferroni correction revealed that nutrition education in the experimental group elicited in significant increases in nutrition knowledge after 3M ($p=.018$) as well as 6M ($p<0.05$) (Table 5).

Usual Dietary Intake

Repeated measures ANOVA with a Greenhouse-Geisser correction determined that the calcium intake (824.75±432.66 vs. 670.35±369.87 vs. 683.39±367.20 mg respectively) and vitamin C intake (130.68±114.86

Table 1. Pre-test Demographic Characteristics (n=56)

Group	**Experimental**		**Control**			
Characteristics	*n*	(%)	*n*	(%)	χ^2	*p*-value
Year of Undergraduate Study						
1st Year	7	(25.0)	15	(53.6)	7.742	.052
2nd Year	2	(7.1)	2	(7.1)		
3rd Year	2	(7.1)	4	(14.3)		
4th Year	17	(60.7)	7	(25)		
Parents Marital Status						
Married	26	(92.9)	28	(100.0)	2.074	.150
Single/Widowed	2	(7.1)	0	(0)		
Mother's Education Level						
≤ 10th grade	2	(7.1)	5	(17.9)	1.987	.577
> 10th grade to ≤ 12th grade	8	(28.6)	5	(17.9)		
> 12th grade to ≤ Bachelors	11	(39.3)	11	(39.3)		
> Bachelors	7	(25.0)	7	(25)		
Mother Employed						
Yes	4	(14.3)	1	(3.6)	1.976	.16
No	24	(85.7)	27	(96.4)		
Father's Education Level						
≤ 10th grade	1	(3.6)	2	(7.1)	.862	.835
> 10th grade to ≤ 12th grade	3	(10.7)	4	(14.3)		
> 12th grade to ≤ Bachelors	9	(32.1)	10	(35.7)		
> Bachelors	15	(53.6)	12	(42.9)		
Monthly Household Income (USD)						
≤ $250	2	(7.1)	0	(0)	2.296	.317
> $250 to $500	7	(25.0)	6	(21.4)		
> $500	19	(67.9)	22	(78.6)		
Living Arrangement						
Alone	1	(3.6)	0	(0)	1.018	.313
With Family	27	(96.4)	28	(100)		
Regularly Exercise						
Yes	4	(14.3)	6	(21.4)	.487	.485
No	24	(85.7)	22	(78.6)		

Table 2. Pre-Test Measurements (n=56)

Group	**Experimental**		**Control**			
Characteristics	Mean	SD	Mean	SD	*t*	*p*
Age (years)	20.46	1.81	19.75	1.60	1.56	.124
Weight (kg)	56.60	9.13	53.42	6.98	1.46	.150
Height (m)	1.61	0.05	1.61	0.04	-.331	.742
BMI (kg/m^2)	21.89	3.68	20.47	2.37	1.70	.094
BEE (kcals/day)	1397.45	85.89	1372.40	70.61	1.19	.238
Total Calorie Requirements (kcals/day)	1676.9	103.06	1646.89	84.73	1.19	.238
Nutrition Knowledge Score	9.03	2.70	8.92	2.66	.149	.882
Total Caloric Intake (kcals/day)	1950.96	899.45	1950.21	811.11	.003	.997
Diet Quality (DQI-I) Score	53.25	10.92	58.35	12.67	-1.615	.112

Table 3. Percent of Correct Answers in Nutrition Knowledge Section (n=56)

	Control Group				**Experimental Group**			
Nutrition Knowledge Items	Pretest (%)	Posttest (%)	Postest2 (%)	*p*	Pretest (%)	Posttest (%)	Postest2 (%)	*p*
Macronutrients								
Composition of Foods	71.4	82.1	82.1	0.05*	75.0	60.7	75.0	.169
Energy Yielding Nutrients	71.4	82.1	78.6	.174	75.0	89.3	89.3	.135
Carbohydrate Intake	60.7	64.3	67.9	.115	67.9	60.7	71.4	.529
Functions of Fat	46.4	64.3	60.7	.012*	50.0	64.3	64.3	.202
Essential Fatty Acids	17.9	39.3	39.3	.062	21.4	39.3	39.3	.007*
Micronutrients								
Classification of Vitamins	50.0	53.6	50.0	.174	50.0	71.4	75.0	.028*
Vitamin C Function	85.7	60.7	71.4	.005*	85.7	92.9	100.0	.091
Vitamin D Precursor	10.7	7.1	7.1	.368	7.1	7.1	7.1	1.00
Vitamin K Source	25.0	28.6	32.1	.223	21.4	46.4	46.4	.001*
Calcium Absorption	32.1	25.0	28.6	.368	35.7	57.1	57.1	.027*
Food Sources								
Carbohydrate Source	17.9	17.9	14.3	.368	10.7	25.0	35.7	.016*
Low Protein Source	67.9	67.9	71.4	.368	67.9	71.4	75.0	.741
Potassium Source	60.7	60.7	64.3	.368	60.7	64.3	75.0	.307
Absorbable Iron Source	25.0	21.4	21.4	.368	25.0	50.0	60.7	.001*
Vitamin A Sources	28.6	32.1	32.1	.368	28.6	53.6	57.1	.017*
Diet Planning Principles								
Base of Healthy Diet	78.6	64.3	67.9	.156	21.4	89.3	89.3	.165
Food Guide Pyramid	14.3	14.3	10.7	.097	78.6	21.4	32.1	.121
Exchange List	71.4	82.1	78.6	.030*	14.3	57.1	75.0	.174
Adequacy Definition	3.6	0	3.6	.174	25.0	25.0	71.4	.002*
Fiber Digestibility	53.6	53.6	57.1	.717	3.6	82.1	92.9	.000*

* $p < 0.05$

Table 4. ANOVA between Mean Nutrition Knowledge Scores in the Control & Experimental Group (n=56)

	Control Group		Experimental Group	
	Mean	SD	Mean	SD
Pretest (Baseline)	8.92	2.66	9.03	2.70
Post-test (3 Months)	9.21	2.46	11.28	4.07
Post-test 2 (6 Months)	9.39	2.40	12.85	3.74
F	2.060		15.814	
p	.149		.000*	

* $p < 0.05$

Table 5. Bonferroni Comparison for Nutritional Knowledge Score over Months of Nutrition Education in Experimental Group (n=28)

				95% CI	
Comparisons	**Mean Score Difference**	**Std. Error**	***p***	**Lower Bound**	**Upper Bound**
Month 3 vs. Baseline	2.250*	.754	.018	.327	4.173
Month 6 vs. Month 3	1.571*	.492	.011	.316	2.827
Month 6 vs. Baseline	3.821*	.768	.000	1.861	5.782

* $p < 0.05$

vs. 99.94±103.41 vs. 87.88±81.20 mg respectively) of the control group decreased significantly between the pre-test, post-test and post-test 2 with $p < .05$. Repeated measures ANOVA with a Greenhouse-Geisser correction determined that the fiber intake (21.40±13.04 vs. 23.56±14.39 vs. 27.30±10.20 g, respectively) and the calcium intake (674.96±479.51 vs. 690.60±496.95 vs. 852.85± 435.02 mg respectively) of the experimental group also increased significantly between the pre-test, post-test and post-test 2 with $p < .05$ (Table 6).

DQI-I Component Scores

Repeated measures ANOVA with a Greenhouse-Geisser correction determined that the overall food group variety score of the control group decreased significantly between the pre-test, post-test and post-test 2 (13.07±2.47 vs. 12.00±2.44 vs. 12.11±2.51 respectively) as $p < .05$ (Table 7). Whereas in the experimental group, the DQI-I score, overall food group variety score, fruit group score, grain group score, fiber score, vitamin C score, and empty calorie food score increased significantly between the pre-test, post-test and post-test 2 as $p < .05$ (Table 8). Post hoc tests using the Bonferroni correction revealed that nutrition education elicited a slight increase in diet quality score from pre-test to post-test (53.25±10.92 vs. 56.36±13.08, respectively), which was not significant (p =.231). The post-test 2 diet quality score had increased to 65.93±12.74, which was significantly higher to pre-test (p =.000) and post-test diet quality score (p =.011) score. Therefore, we can conclude that a long-term nutrition education program (6 months) elicits a significant increase in diet quality (Table 9).

Discussion

The DQI-I score was measured at baseline so its change throughout intervention could be monitored and it was found that the experimental group had a score of 53.25±10.92 and in the control group had a score of 58.35±12.67 which although higher wasn't significantly different. This was about the same as of a study of young people in Spain which found its population to have a mean score of 56.31 (11) and is indicative of a poor diet as they are below a score of 60 (10). It is generally seen that there are some aspects on nutrition knowledge which are lacking in the population and these include identifying foods containing starch or categorizing high fiber and low fiber foods (12). In this study, the question regarding carbohydrate source was answered correctly by 53.6% of people and the question regarding fiber was correctly answered by a maximum of 17.9% of the people in the pretest. Also, although more and more people are able to related dietary fat knowledge with the incidence of heart disease, they still have trouble differentiation between the fat content of butter and vegetables oils (13). Only a maximum of only 21.4% students could correctly identify the essential fatty acids in this study (Table 3). Most studies use questionnaires although measurement of nutrition knowledge is a difficult task (14). In this study the questionnaire asked the students in both groups twenty questions on their macronutrients, micronutrient, food sources, and diet planning principals. In the control group, over the course of pre-test, post-test, and post-test 2 only 3 questions had a percentage of correct answers go

Table 6. Usual Dietary Intake (n=56)

		Pre-test (Baseline)		Post-test (3 Months)		Post-test 2 (6 Months)		
		Mean	SD	Mean	SD	Mean	SD	*p*
Control Group	Calories (kcal)	1950.21	811.11	1797.93	723.80	1868.71	658.02	.298
	Protein (g)	62.63	27.69	57.04	24.05	58.46	24.62	.364
	Fat (g)	73.66	37.16	67.71	28.84	72.58	27.99	.450
	Carbohydrate (g)	262.86	108.48	245.73	107.46	252.45	100.55	.330
	Fiber (g)	23.78	10.87	24.97	13.14	25.25	11.76	.565
	Calcium (mg)	824.75	432.66	670.35	369.87	683.39	367.20	.032*
	Iron (mg)	11.71	5.57	11.35	5.51	11.67	5.37	.757
	Sodium (mg)	3696.10	1628.22	3477.75	1836.62	4013.57	2084.96	.308
	Vitamin C (mg)	130.68	114.86	99.94	103.41	87.88	81.20	.050*
	Saturated Fat (g)	20.89	11.6	19.41	12.29	19.81	12.33	.582
	MUFAS(g)	28.34	14.64	26.78	10.66	29.52	10.62	.453
	PUFAS (g)	17.60	10.39	15.08	6.75	16.97	6.50	.229
	Cholesterol (mg)	208.71	180.93	219.50	128.27	220.18	139.24	.807
Experimental Group	Calories (kcal)	1950.96	899.45	1988.11	1052.6	1986.00	777.88	.952
	Protein (g)	67.59	33.55	67.47	35.86	74.55	32.81	.343
	Fat (g)	76.66	42.33	76.91	48.97	72.35	37.93	.802
	Carbohydrate (g)	242.77	126.27	254.33	136.90	262.74	99.93	.542
	Fiber (g)	21.40	13.04	23.56	14.39	27.30	10.20	.042*
	Calcium (mg)	674.96	479.51	690.60	496.95	852.85	435.02	.033*
	Iron (mg)	12.56	6.69	13.46	6.97	14.22	5.78	.297
	Sodium (mg)	3247.46	2000.89	3086.42	2128.95	2807.75	1507.95	.612
	Vitamin C (mg)	113.95	127.29	133.98	126.191	158.99	109.99	.087
	Saturated Fat (g)	23.71	16.06	23.97	16.71	23.27	14.17	.961
	MUFAS(g)	28.78	16.54	28.41	17.10	25.66	13.50	.499
	PUFAS (g)	17.32	10.03	17.66	12.88	16.17	10.17	.745
	Cholesterol (mg)	274.14	148.65	258.18	174.17	271.43	155.311	.825

up. These questions were related to composition of foods, functions of fat and the exchange list. Whereas in the experimental group, there was an increase in correct answers of more questions over a period of time. As a result of the nutrition intervention, the percentage of correct answers about essential fatty acids, vitamins in general, vitamin K, calcium absorption, carbohydrate sources, iron sources, adequacy, and fiber in the diet increased (Table 3). The usual dietary intake of students in both groups was also assessed. Calcium and vitamin C intake of the control group decreased significantly. On the other hand in the experimental group, fiber and calcium intake group increased significantly between the pre-test, post-test and post-test 2 (Table 6). However, in both of the groups, calcium intake was lower than the recommended RDA of 1000 mg/day and iron intake was also lower than the recommended RDA of 18 mg/day. The intake of calories was above the requirements and protein intake was also more than the recommended 0.8g/kg body weight. Similar results were seen in a study on Croatian students aged 22 years. Their average energy intake was 130.1% of the dietary reference intake and the protein intake was more than double the dietary reference intake in 64.3% students. Iron intake in females, and calcium intake as well as folate, vitamin C and A were also below the recommendations (15). In another study in Iran on female students it was seen that iron intake was 76% of the RDA, calcium intake was 90% of the RDA and fiber intake was 56%

Table 7. Control Group DQI-I Scores (n=28)

		Pre-test (Baseline)		Post-test (3 Months)		Post-test 2 (6 Months)		
Component	**Range**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	***p***
DQI-I, total	**0-100**	58.14	12.95	58.68	13.13	57.61	12.97	.812
Variety	**0-20**	16.71	3.90	15.43	3.79	15.65	3.83	.073
Overall food group variety	0-15	13.07	2.47	12.00	2.44	12.11	2.51	.021*
Within-group variety for protein sources	0-5	3.64	1.78	3.43	1.81	3.54	1.77	.613
Adequacy	**0-40**	27.01	6.84	27.00	7.38	27.46	6.95	.841
Vegetable group	0-5	3.43	1.81	3.14	1.84	3.39	1.79	.512
Fruit group	0-5	3.79	1.87	3.57	2.11	3.64	2.05	.741
Grain group	0-5	3.14	1.20	3.36	1.51	3.43	1.64	.361
Fiber	0-5	3.86	1.26	3.86	1.48	4.00	1.38	.714
Protein	0-5	4.57	0.83	4.79	0.63	4.57	0.83	.279
Iron	0-5	2.07	1.15	2.21	1.37	2.43	1.31	.328
Calcium	0-5	2.86	1.71	2.71	1.41	2.64	1.33	.618
Vitamin C	0-5	3.29	1.94	3.36	1.72	3.36	1.63	.949
Moderation	**0-30**	12.85	6.57	14.26	5.57	12.85	5.40	.286
Total fat	0-6	0.86	1.60	0.86	1.38	0.75	1.32	.907
Saturated fat	0-6	3.32	2.05	3.75	2.10	3.21	2.29	.250
Cholesterol	0-6	5.25	1.93	5.04	2.00	5.14	1.97	.771
Sodium	0-6	1.71	2.37	2.36	2.36	1.61	2.23	.201
Empty calorie foods	0-6	1.71	2.63	2.25	2.90	2.14	2.92	.394
Overall Balance	**0-10**	1.58	2.13	2.00	2.77	1.64	2.66	.566
Macronutrient ratio	0-6	.79	1.91	1.43	2.48	1.14	2.33	.330
Fatty acid ratio	0-4	.79	1.13	0.57	1.06	0.50	1.03	.267

* $p < 0.05$

of the RDA (16). Similarly, a study conducted in Peshawar on female university students aged 22-26 found that the mean intake of fiber intake was 5.6±1.91 g, calcium intake was 623±217 mg, and iron intake was 13.8±2.8, all of which were below recommended intake (17). The changes in diet quality of both groups using DQI-I was also observed. In the control group it was seen that overall food group variety score of the control group decreased significantly between the pre-test, post-test and post-test 2 (Table 7). In the experimental group it was seen that the DQI-I score, overall food group variety score, fruit group score, grain group score, fiber score, vitamin C score, and empty calorie food score of the experimental group increased significantly between the pre-test, post-test and post-test 2 as $p < .05$ (Table 8). A study done on 1040 adult participants in England found that those in the highest quintile for nutrition knowledge were 25 times more likely to meet fruit, vegetable and fat intake as compared to those in the lowest quintile (18). In the experimental group it was also found that a long-term nutrition education program (6 months) elicits a significant increase in diet quality score but not after only 3 months of nutrition education. A study on obese Iranian women, however, found an increase in diet quality through HEI scores after three months of nutrition education with an increase in the components of fruits, vegetables, legumes, grains and milk from 60.58±6.31 to 83.34±5.12 (19). An objective of the research was to see which if any DQI-I components would improve during the course of the study. It was found that in the experimental group that variety (p=.008) and adequacy scores (p=.001) were increased significantly whereas moderation (p=.063) and balance scores (p=.364) while increased did not do so significantly. In the control group there were very minis-

Table 8. Experimental Group DQI-I Scores (n=28)

		Pre-test (Baseline)		Post-test (3 Months)		Post-test 2 (6 Months)		
Component	**Range**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	***p***
DQI-I, total	**0-100**	53.25	10.92	56.36	13.08	65.93	12.74	.000*
Variety	**0-20**	13.92	4.52	13.97	4.79	16.32	5.05	.008*
Overall food group variety	0-15	10.71	3.30	10.93	3.38	12.64	3.49	.006*
Within-group variety for protein sources	0-5	3.21	1.64	3.04	1.79	3.68	1.70	.116
Adequacy	**0-40**	25.25	9.08	26.71	9.39	31.53	7.25	.001*
Vegetable group	0-5	3.04	2.20	3.11	2.18	3.82	1.88	.122
Fruit group	0-5	2.57	2.36	3.00	2.35	4.21	1.79	.001*
Grain group	0-5	3.18	1.72	3.21	1.64	3.89	1.37	.045*
Fiber	0-5	3.43	1.66	3.50	1.68	4.43	1.06	.003*
Protein	0-5	4.71	.897	4.57	.997	4.86	.525	.148
Iron	0-5	2.57	1.37	3.07	1.48	2.93	1.38	.188
Calcium	0-5	2.71	1.60	2.64	1.63	3.21	1.57	.076
Vitamin C	0-5	3.04	1.97	3.61	1.79	4.18	1.46	.008*
Moderation	**0-30**	12.97	6.58	14.03	6.43	16.29	6.90	.063
Total fat	0-6	1.07	1.67	0.96	2.00	1.39	2.07	.539
Saturated fat	0-6	3.64	2.21	3.75	1.93	3.86	2.28	.868
Cholesterol	0-6	4.18	2.21	4.29	2.22	4.29	2.37	.966
Sodium	0-6	2.79	2.82	3.21	2.82	3.00	2.82	.763
Empty calorie foods	0-6	1.29	2.37	1.82	2.74	3.75	2.90	.000*
Overall Balance	**0-10**	1.21	1.83	1.85	2.54	1.79	2.68	.364
Macronutrient ratio	0-6	0.57	1.61	0.71	1.65	0.79	1.91	.774
Fatty acid ratio	0-4	0.64	1.22	1.14	1.48	1.00	1.58	.227

* $p < 0.05$

Table 9. Bonferroni Comparison for DQI-I score over Months of Nutrition Education in Experimental Group (n=28)

				95% CI	
Comparisons	**Mean Score Difference**	**Std. Error**	***p***	**Lower Bound**	**Upper Bound**
Month 3 vs. Baseline	3.107	1.69	.231	-1.208	7.422
Month 6 vs. Month 3	9.571*	1.69	.000	5.24	13.90
Month 6 vs. Baseline	12.67*	2.26	.000	6.90	18.44

* $p < 0.05$

cule increases in the adequacy and balance components although these were not significant. In both the groups, highest scores were seen in the variety component and the lowest scores were seen in the balance component. A study done on a Mediterranean population in between the ages of 16-65 years also found the poorest scores to be in the balance component of DQI-I (20).

Conclusion

Nutrition knowledge significantly increased in the experimental group after three months; however, diet quality improved only after six months of nutrition education as expected since behavior change is a slow process.

Implications for research and practice

Although macro and micro nutrient intakes in the experimental group were significantly improved, more nutrition education and the initiation of a college breakfast and lunch program is required to make sure that all RDAs are met and diet quality scores are further increased.

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