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Role of alternate healthy eating index (AHEI) in communicating the quality of diet

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Introduction: The food habits of global population has been evolving in such a way that makes unhealthy foods cheaper and widely available and healthy foods costly and less available. Being surrounded by such foods and living in an environment with lesser requirement for physical activity is the primary reason for the pandemic explosion in overweight and obesity. This study is an attempt to analyze the quality of diet with an aim to study the significance of Alternate Healthy Eating Index (AHEI) in predicting the quality of dietary intake. **Methodology:** The study was conducted in 66 respondents (44 females and 22 males) aged 18-65 years with BMI between 23 kg/m^2 to 50 kg/m^2. The respondent's data were collected using a pretested standard questionnaire. The nutrient consumption was calculated from the 24 hour recall and the AHEI scores were derived from recall and food use frequency data. The data were analysed using SAS software. **Results:** The intake of Energy, protein, fat and carbohydrates were more than their requirement while intake of fibre was not meeting the requirement. The AHEI scores obtained ranged from 36 to 76 with a mean value of 55.6 ± 9.54. A positive linear association for AHEI with BMI (0.0362) and energy intake (0.13) was established through Pearson's correlation while the association was negative with BMR (-0.14). Paired t test comparing AHEI against the difference between intake and requirement of macronutrients revealed that when the diet quality was good (as indicated by AHEI>51), the difference in intake exhibited a significant linear relationship with p values <0.001 while no relation was established when the diet quality was poor. **Conclusion:** AHEI encompasses all nutrients and food groups relevant to metabolic health and it can be used as a good tool to assess the quality of dietary habits of overweight and obese subjects.

Key Words : Alternate healthy eating index, Quality of diet, Overweight, Obesity, Quality of diet

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INTRODUCTION

The global burden of disease study report in 2017 (GBD, 2017) has pointed that suboptimal diet is an important preventable risk factor for non-communicable diseases (NCDs). Obesity and overweight are increasing worldwide and can be considered as the major causative factor for the development of non communicable diseases. The food habit of global population has been evolving in such a way that makes unhealthy foods cheaper and widely available and healthy foods costly and less available. Competition between manufacturers has led the food industry to aim at delivering rich, tasty foods

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with long shelf life at cheaper costs. Being surrounded by such foods and living in an environment with lesser requirement for physical activity is the primary reason for pandemic explosion in overweight and obesity. In this circumstance, it is imperative to have sound knowledge for making informed choices when deciding what to eat. Woodruff *et al.* (2010) analysed the quality of diet of teenagers using Healthy eating index- C and reported that Increased family dinner meals were positively associated with daily diet quality and negatively associated with breakfast and lunch skipping.

Wolongevicz *et al.* (2010) evaluated the diet quality and obesity in American women as part of the Framingham nutrition studies and suggested that overall diet quality need to be considered a key component in planning and implementing programmes for obesity risk reduction and treatment recommendations.

A systematic review by Rosemary *et al.* (2019) has shown that dietary patterns in India are highly diverse, including traditional vegetarian patterns, those that incorporate high-fat, high-sugar foods and also meat. The Healthy Eating Index-2005 (HEI-2005) measures adherence to 2005 dietary guidelines for Americans, whereas the Alternate Healthy Eating Index (AHEI) is based upon foods and nutrients predictive of chronic disease risk and was associated inversely with chronic disease risk (Marjorie *et al.*, 2006). Latest updation of AHEI in 2010 with inclusion of more dietary factors, had stronger association with chronic disease risk (Chiuve, *et al.,* 2012). This study is an attempt to analyze the quality of diet through AHEI of overweight and obese respondents who were enrolled in a nutrition intervention programme.

Aim :

To study the significance of Alternate Healthy Eating Index (AHEI) in predicting the quality of dietary intake of a selected overweight and obese population.

Objectives :

– To elicit data on dietary pattern of the respondents through 24 hour recall and food use frequency.

– To analyze the utility of AHEI scores as a tool to predict quality of diet.

METHODOLOGY

The study was carried out in two hospitals of Thiruvananthapuram city during the years 2018-2019 in a sample population selected from a nutrition intervention survey. The original survey population had a size of 500 respondents and for this experiment, a smaller sample size of 66 respondents were selected based on the study inclusion criteria indicated below.

– Age between 20-50 years

– BMI between 23 kg/m^2 to 50 kg/m^2

– Respondents willing to participate in the experiment.

The respondent's data were collected using a pretested standard questionnaire and elicited data on their demographic details, physiological parameters such as Basal Metabolic Rate (BMR) and Body Mass Index (BMI), and a detailed diet history through 24 hour dietary recall, and food use frequency. The nutrient consumption was calculated from the 24 hour recall and the AHEI scores were derived from recall and food use frequency data. The data obtained were summarized and statistical analysis was carried out using SAS software.

OBSERVATIONS AND ASSESSMENT

The results obtained are presented below. Fig. 1 depicts the basic picture of the respondents through demographic pattern.

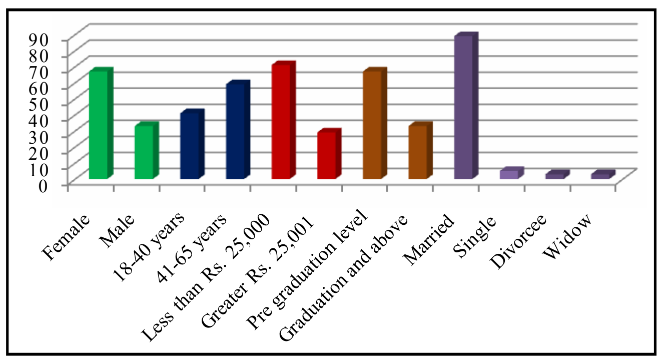

Fig. 1 : Demographic distribution of the respondents

It was observed that larger segment of the respondents were elderly married females educated up to pre graduation level. The age of 59 per cent of the respondents ranged from 41-65 years and 71 per cent of them had monthly income less than or equal to Rs. 25,000. The education level was below graduation in 67 per cent of the respondents and 89 per cent of them were married.

The diet patterns of the respondents were analyzed in detail. Out of the 66 respondents, two were vegetarians while the rest were non vegetarians. Lunch was the heaviest meal eaten by 44 per cent of the respondents, and the sweet taste was preferred over other tastes by 39 per cent. The requirement of energy and macronutrients were calculated based on Adjusted Ideal Body Weight (AIBW) (Indian Dietetic Association, 2011) to derive reducing calories and corresponding other nutrients.

The dietary intake of the respondents was analyzed against the estimated requirement to see whether their intake was exceeding what is required. Data on macronutrients including total energy, fat, protein, carbohydrates and fibre intake were subjected to paired t test in comparison with requirement, calculated based on the reducing diet. The results obtained are presented in Table 1.

The estimates were analyzed with 5 per cent significance level with P value < .05 being significant. The mean values of the difference suggested that the intake of energy, protein, fat and carbohydrates were more than their requirement while intake of fibre was not meeting the requirement. The intake of fat was found to be obviously higher than the requirement and hence was the major source of energy intake. The difference in the case of protein and carbohydrates were not as significant as that of other nutrients.

A systematic review by Reynolds *et al.* (2019) analysed the relationship between dietary fibre and non communicable diseases and revealed that relatively high intakes of dietary fibre and whole grains had striking dose-response relationships to several non-communicable diseases. Agrawal *et al.* (2020) highlighted that their study population had lower amount of protein, higher amount of fats and carbohydrates intake were as micronutrients intake was very low as compared to RDA.

Alternate Healthy Eating Index (AHEI) was calculated to assess the quality of the diet being taken by the respondents. AHEI score originally was derived from the data of Nurses health survey and the scores could range from 0 to 110. The parameters considered included inclusion of whole grains in the diet, nuts and legumes, vegetables, fruits, Eicosa Pentanoic Acid, Docosa Hexanoic Acid, percentage energy from Poly Unsaturated Fatty Acids, salt intake, red meat consumption, sugar sweetened beverages and alcohol intake. The original scoring guide was slightly modified to suit the study population in two aspects. First was the data on trans fats and second was the scoring of alcohol intake. The column on trans fat were completely omitted as calculating trans fat was not possible for foods other than packet foods. Thus the total score was reassigned to 100 rather than the original 110. Alcohol consumption in moderation was given positive scores in the original tool and was considered negative in the present one. The global burden of diseases study group (2016) has suggested that alcohol use is a leading risk factor for global disease burden which causes substantial health loss and the level of alcohol consumption that minimised harm across health outcomes was zero (95% UI 0·0–0·8) standard drinks per week. Final AHEI tool used for the present study is given in Table 2.

The tool analyzed by Chiuve *et al.* (2012) was used as base in the present study. Food groups were scored based on portion sizes suggested while the intake of long chain fats, PUFA and sodium were calculated from the dietary recall data. A study conducted at Bikaner by Jakhar *et al.* (2017) found out significant positive correlation between table salt intake in food and blood

Table 1 : Comparison of the dietary intake versus requirement of macronutrients

Variables	Statistical parameters	Value			P value
		Requirement	Intake	Difference	
Energy (n=66)	Mean±SD	1276.52±209.02	1573.29±382.66	-296.77±373.94	<.0001
	Range	960-2070	810-2699	-1219-454	
Protein (n=66)	Mean±SD	50.80±7.65	56.72±14.81	-5.89±15.56	0.0029
	Range	38-69	19-89	-37.71-27.99	
Fat (n=66)	Mean±SD	21.24±3.59	50.93±15.94	-29.66±15.52	<.0001
	Range	16-35	20-80	-57.9-1.3	
Carbohydrates (n=66)	Mean±SD	220.42±36.89	246.35±64.04	-25.94±64.65	0.0018
	Range	166-371	49-454	-199.17-192	
Fibre (n=66)	Mean±SD	35±0	27.56±9.41	7.41±9.41	<.0001
	Range	35	12-54	-18.63-23	

pressure. Vinay *et al.* (2017) studied the oxidative stress in COPD patients and concluded that decrease in intake of fruits and vegetables contribute to the worsening of oxidative strength. Vispute *et al.* (2017) analysed the habitual consumption of fruits and vegetables by children and adolescents from Western India and showed that majority of them had inadequate intake of fruits and vegetables and also that fruit and vegetable intake had a positive correlation with hemoglobin concentration. An Iranian study by Azadbakht *et al.* (2005) has reported that dietary diversity score is favourably associated with metabolic syndrome.

AHEI scores of all the respondents were calculated using the above tool. Higher scores indicated better eating habits. The AHEI scores obtained for the study respondents ranged from 36 to 76 with a mean value of 55.6 ± 9.54. The quality of the diet can influence physiological factors like Body Mass Index (BMI), Basal Metabolic Rate (BMR) and also the habitual energy intake of the respondents and AHEI was compared to the above said parameters. Regression analysis was carried out to test whether the AHEI scores were influenced by these variables and the result obtained is presented in Table 3.

At 5 per cent confidence level, none of the parameters tested had statistically significant influence on AHEI. Correlation analysis was carried out to measure the strength of association between AHEI and the variables. Though not statistically significant, there was positive linear association for AHEI with BMI (r value 0.0362), and energy intake (r value 0.13), while the association was negative with BMR (r value -0.14). To analyze in depth, AHEI was categorized into two as good quality diet when AHEI was more than or equal to 51 and poor quality diet when AHEI was less than 50.

Difference between nutrient intakes and requirement were subjected to paired t test against two categories of AHEI to verify whether quality of diet was influencing these parameters. The results obtained are presented in Table 4.

The Table 4 clearly indicates that when the AHEI scores were above 51, the difference in the intake and requirement of energy, protein, fat, carbohydrate and fibre had a linear relationship. In the case of energy and protein, the difference in the category with AHEI score above 51 was significant while in the case of fat, the relation was strong for both the categories of AHEI. But in the case of carbohydrates and fibre the relation of good quality diet versus intake was not statistically significant. Interestingly, lower quality diet had a higher intake of fibre which was also statistically significant. This could be due to the fact that high fibre consumption was not an indicator of good quality diet in terms of whole grains, healthy fats and proteins.

A study by Bashir *et al.* (2020) analysed the quality of diet in diabetic subjects and suggested that deficiently found nutrients must be supplemented as a part of therapy to enhance the treatment benefits. A study by Miller *et al.* (2016) assessed the fruit and vegetable consumption pattern in 18 countries and concluded that the fruit and vegetable consumption was low worldwide and particularly low in Low income countries which was associated with low affordability. Jariseta *et al.* (2012) compared the role of household consumption and expenditure survey against 24 recall method in calculating

Table 2 : Alternate healthy eating index tool for adults used for the study

Components	Serving sizes	Criteria for minimum score (0)	Criteria for maximum score (10)
Vegetables, servings/d	100 g	0	≥ 5
Fruit, servings/d	100 g	0	≥4
Whole grains, g/d	30 g	0	75g for women and 90 g for men
Sugar sweetened beverages and fruit juices, servings/d	200 ml	≥1	0
Nuts and legumes, servings/d	30 g	0	≥1
Red/processed meat, servings/d	50 g	≥1.5	0
Long-chain (n-3) fats (EPA+DHA), mg/dl		0	250
PUFA, % of energy		≤2	≥10
Sodium ,mg/dl		Highest decile	Lowest decile
Alcohol , drinks/day			
Women		≥2.5	0
Men		≥3.5	0
Total		0	100

Table 3 : Association of physiological factors with AHEI

Parameter	Estimate	P value
Intercept	51.65646871	<.0001
BMI	0.41442085	0.1932
BMR	-0.01154080	0.0661
Energy intake	0.00577943	0.0871

nutrient density and obtained promising results.

Carson *et al.* (2014) highlighted that the effect of dietary interventions on quality of life should be considered while planning because negative effects on QOL might be a barrier for successful and sustainable dietary changes. At the same time, a review by Veenhoven (2019) revealed that healthy eating tends to make one's life more satisfying and adds to happiness. According to him, more than three portions of fruits and vegetables per day goes with the most happiness. A review by Patnode *et al.* (2017) suggested that small to moderate improvements in dietary and physical activity behaviours could translate to long term reduction in CVD-related events.

Summary:

The study enumerated here was an attempt to analyse the quality of diet of selected respondents through Alternate Healthy eating index. Larger segment of the respondents were elderly married females educated up to pre graduation level.

The dietary intake of the respondents was analyzed against the estimated requirement of macronutrients through paired t test and the differences were found to be statistically significant. The quality of the diet was assessed through Alternate Healthy Eating Index (AHEI) scores. Higher scores indicated better eating habits. The AHEI scores obtained for the study respondents ranged from 36 to 76 with a mean value of 55.6 ± 9.54. Regression and correlation analysis were done between AHEI and physiological parameters. Though not statistically significant, there was positive linear association for AHEI with BMI (0.0362), and energy intake (0.13), while the association was negative with BMR (-0.14).

To analyze in depth, AHEI was categorized into two as good quality diet when AHEI was more than or equal to 51 and poor quality diet when AHEI was less than 50. Nutrient intake against requirement were subjected to paired t test against two categories of AHEI. When the AHEI scores were above 51, the difference in the intake

Table 4: Comparison of AHEI and habitual nutrient intake

Parameter	AHEI category	Statistical parameters	Value			P value
			Requirement	Intake	Difference	
Energy (n=66)	AHEI ≥51	Mean±SD	1274.05±223.77	1634.71±374.8	-360.67±364.1	<.0001
	(n=42)	Range	980-2070	810-2699	-1219-454	
	AHEI<51	Mean±SD	1280.83±184.86	1465.79±380.1	-184.96±371.96	<0.023
	(n=24)	Range	960-1720	813-2123	-954-367	
Protein (n=66)	AHEI ≥51	Mean±SD	50.62±7.9	60.30±14.18	-9.71±14.32	<.0001
	(n=42)	Range	39-69	21-89	-37.7-26.89	
	AHEI<51	Mean±SD	51.12±7.34	50.46±14.02	0.79±15.67	0.8376
	(n=24)	Range	38-69	19-74	-34-28	
Fat (n=66)	AHEI ≥51	Mean±SD	21.21±3.86	54.06±15.96	-32.81±15.36	<.0001
	(n=42)	Range	16-35	24-80	-57- -.82	
	AHEI<51	Mean±SD	21.29±3.17	45.46±14.67	-24.14±14.52	<.0001
	(n=24)	Range	16-29	20-70	-53-1.3	
Carbohydrates	AHEI ≥51	Mean±SD	220.12±39.81	251.29±68.29	-31.15±69.37	0.0059
(n=66)	(n=42)	Range	169-371	49-454	-199-192	
	AHEI<51	Mean±SD	220.96±31.95	237.7±56.16	-16.82±55.67	0.1546
	(n=24)	Range	166-297	127-354	-136-76	
Fibre (n=66)	AHEI ≥51	Mean±SD	35	29.55±9.28	5.38±9.27	0.0005
	(n=42)	Range	35	13-54	-18-21.5	
	AHEI<51	Mean±SD	35	24.08±8.76	10.96±8.8	<.0001
	(n=24)	Range	35	12-47	-11.9-23	

and requirement of energy, protein, fat, carbohydrate and fibre had a linear relationship. Lower quality diet had a higher intake of fibre which was also statistically significant.

Conclusion:

It can be concluded that the diet analysis carried out through traditional methods and using AHEI obtained similar results. As AHEI encompasses all nutrients and food groups relevant to metabolic health, it can be used as a good tool to assess the quality of diet of overweight and obese subjects. Future studies in the field of nutrition can employ similar tools to report diet quality as the interpretation will convey the results better than conventional methods.

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