Examining the Relationship between Healthy Eating Index and Nutritional Status among Medical Students: Insights from a Cross-Sectional Analysis

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Abstract. Maintaining optimal health through nutrition and healthy eating is crucial for a fulfilling life. Healthy Eating Index (HEI) serves as a measure of dietary adequacy based on recommended food intake guidelines. However, limited research has investigated the relationship between HEI and nutritional status specifically among medical students in Indonesia. This study investigated the relationship between the Healthy Eating Index (HEI) and the nutritional status of medical students at Halu Oleo University in Indonesia. A cross-sectional study was conducted, and data were collected from 80 medical students. Food intake data were collected using a 2x24-hour food recall method and IGS3 and analyzed using Nutrisurvey 2007. Nutritional status was determined based on the Asian Pacific Body Mass Index (BMI) standard. The Chi-Square test and Fisher Test were employed to assess the relationship between HEI and nutritional status. The results revealed that although a majority of students had normal nutritional status, their HEI scores indicated poor dietary quality. These findings suggest that some students rely on high levels of physical activity to compensate for their suboptimal dietary choices. This study established a significant relationship between HEI scores and the nutritional status of medical students (p=0.02), serving as a foundation for future research and interventions aimed at improving dietary habits. Future studies should examine specific dietary components and consider the effect of socio-economic factors on food choices within this population.

Keywords: Healthy Eating Index, Nutritional Status, Medical Students.

1   Introduction

Maintaining optimal health is crucial for achieving a long and satisfying life. Nutrition and healthy eating serve as vital components in maintaining overall health. Excessive food consumption and obesity may cause degenerative illnesses, while inadequate nutrition is associated with increased susceptibility to infections [1]. A balanced diet offers the body the essential nutrients, vitamins, and minerals required

for optimal functioning and also provides the necessary energy, nutrients for growth, for repair, promoting strength, health, and prevention of diet-related illnesses like certain cancers [2, 3]. Currently, Indonesia faces a complex issue referred to as the "triple burden of malnutrition," which encompasses several types of malnutrition, including obesity, stunting, wasting, and a deficiency in essential micronutrients such as anemia. According to 2018 data from the Ministry of Health of the Republic of Indonesia, 9.3% of the population is underweight, 13.6% is overweight, and 21.8% is obese [4]. The prevalence of body mass index (BMI) was assessed in the province of Southeast Sulawesi in 2018 among individuals who were 18 years of age and older. Out of the population, 15.63% were categorized as underweight, with 8.23% of men and 7.40% of women falling into that category. Furthermore, 26.28% of individuals were classified as overweight, with 11.89% of men and 14.39% of women falling into this group [4].

Medical students face unique challenges when it comes to maintaining a healthy diet and lifestyle. They have demanding schedules, high levels of stress, limited access to healthy food options, lack of knowledge about nutrition, lack of time for physical activity, and irregular sleep patterns. Addressing these challenges and promoting healthy habits among medical students can have a positive impact on their health and well-being, as well as their future medical practice [5, 6]. The Healthy Eating Index (HEI) measures diet quality and assesses how well a set of foods aligns with key recommendations and guidelines for a healthy balanced diet. The HEI is an objective metric that assesses diet quality based on several dietary components, including carbohydrates, vegetables, fruits, animal proteins, plant proteins, total fats, sodium intake, added sugar, iron intake, and dietary diversity [7-9]. Various countries, including the United States, Australia, and Thailand, have developed instruments to evaluate food quality according to their respective national dietary recommendations. The HEI evaluates the degree to which U.S. diets correspond to the Dietary Guidelines for Americans (DGA). The Healthy Eating Index (HEI) is used to assess dietary quality. However, it has not been tailored to certain ethnic or cultural groups, including Indonesia, which comprises over 700 ethnic groups. Nevertheless, the tool can be presumed to be relevant in populations where diets can be categorized according to its existing components [10]. The Healthy Eating Index (HEI) is a valuable research tool that can address various questions related to diet quality and nutrient intake [11].

In Indonesia, the Ministry of Health has issued dietary guidelines, a comparable tool called the Balanced Nutrition Index (IGS) is employed, but implementation remains poor, resulting in high prevalence of overweight and obesity, particularly in adult women [10]. The HEI has been used in many previous studies as an indicator of diet quality in Indonesia. The HEI score can be used to assess the overall diet quality as well as the quality of several dietary components in Indonesia. The HEI score can be used to monitor diet quality of the Indonesian population and to examine alignment of dietary patterns with the dietary guidelines [11]. The Indonesian Dietary Guidelines, also known as "Pedoman Gizi Seimbang" (balanced nutrition guideline), were introduced in 1995 by the Ministry of Health. The guidelines aim to promote balanced nutrition and healthy eating habits among the Indonesian population. The guidelines emphasize the importance of consuming a variety of foods, maintaining hygienic

conditions, consuming staple foods, vegetables, and fruits every day, consuming protein sources, limiting the consumption of salt, sugar, and fat, drinking enough water, maintaining a healthy body weight, being physically active, and avoiding smoking and alcohol consumption [12, 13].

Nutritional status among medical students can be evaluated through the use of anthropometric methods, which provide safe, non-invasive, and simple quantitative measurements of body size and composition. Medical students may utilize these measurements to assess their nutritional status and pinpoint areas for improvement in their diet and lifestyle [14-16]. However, it is important for medical students to consider other supplementary factors that may impact their overall nutritional status, such as demanding schedules and academic workloads, potentially influencing the nutritional quality of their food [17]. Unfortunately, no study has specifically evaluated the relationship between HEI or IGS and nutritional status, particularly among medical students at Halu Oleo University. Examining the relationship between HEI and the nutritional status of medical students is crucial for enhancing their health and future medical practice. Improving the nutritional status of medical students can positively affect their overall health and well-being, resulting in improved academic performance and clinical outcomes [5, 18-20]. The IGS program evaluates how well an individual's dietary habits align with recommended dietary allowances, as evidenced by previous studies [8]. As of now, inadequate research exists to establish a conclusive cause-and-effect relationship between the IGS program and the nutritional status or difficulties experienced by the Indonesian populace. Danty et al. [8] reported that examined adolescents between the ages of 13 and 18. It was found that female adolescents aged 16 to 18 had higher HEI scores compared to their male counterparts with regard to carbohydrate consumption [8]. There are limited studies that have examined the relationship between the HEI and nutritional status for adolescents in Indonesia. While some studies have assessed the nutritional status of adolescents in Indonesia using other methods. Several studies have evaluated the diet quality index in Indonesia and its association with blood glucose profiles and the total Bifidobacterium count, including Hayuningtyas et al. [11]. Further research is needed to examine the relationship between the HEI and nutritional status for adolescents in Indonesia. This study aims to address the existing information gap by examining the relationship between Healthy Eating Index (HEI) scores and the nutritional health of medical students enrolled in the 2022 intake at Halu Oleo University.

2   Methods

This study utilized an observational analytical cross-sectional design to gather data during April and May of 2023 at Halu Oleo University's Faculty of Medicine. Purposive sampling was employed to select participants meeting the inclusion criteria of being medical faculty students from the 2022, aged between 17 and 20, and providing voluntary consent. Participants who were on a weight loss program or following a particular diet, as well as those with chronic illnesses such as hypertension, heart

disease, or diabetes mellitus, were excluded from the study. The final sample for analysis consisted of 80 participants.

Interviews were conducted to determine the participant's age and sex, whereas height and weight measurements were recorded through anthropometric assessments. Height was measured using a Microtoise Stadiometer 200 cm with 0.1 cm precision, and weight was measured using a GEA SMIC ZT120 scale. Each anthropometric measurement was taken twice, and the mean values were utilized to calculate Body Mass Index (BMI).

Nutritional status was assessed based on BMI in kg/m^2 applying the WHO Asia-Pacific guidelines. Participants were classified as having normal nutritional status if their BMI ranged from 18.5 to 24.9 kg/m^2. Those with a BMI lower than 18.5 kg/m^2 or higher than 24.9 kg/m^2 were categorized as abnormal. For the Physical activities, we used IPAQ Short Questions.

Food intake information was gathered through a 2-day food recall procedure and was subjected to analysis using Nutrisurvey 2007. The Healthy Eating Index (HEI) score was computed using ten components from the 2x24-hour food recalls: carbohydrates, vegetables, fruits, animal source proteins, vegetable source proteins, total fats, total salt, total sugar, iron intake, and dietary diversity. The study applied the Balanced Nutrition Index (IGS) with three levels (0, 5, and 10). The inclusion of these food groups and nutrients is associated with degenerative diseases. The guidelines issued by the Ministry of Health of the Republic of Indonesia were used as a reference to determine the number of servings of carbohydrate foods, animal foods, and nuts [13].

The carbohydrate scores were calculated using 2x24-hour food recall data, and Nutrisurvey was used to convert carbohydrate intake data into servings. One serving of carbohydrates, equivalent to 100 g of rice, contained 175 kcal, 4 g of protein, and 40 g of carbohydrates. One serving of fruits and vegetables weighing 100 grams contained 50 kilocalories, 10 grams of carbohydrates, and 3 grams of protein. Animal protein in a serving of 40 grams provided 50 kilocalories, 7 grams of protein, and 2 grams of fat. Vegetable protein in a serving of 50 grams of tempe provided 90 kilocalories, 6 grams of protein, 3 grams of fat, and 8 grams of carbohydrates. Predefined criteria were used to calculate the scores for dietary diversity, fat, iron, salt, and sugar.

The Healthy Eating Index (HEI) assessment derived from data collected from two periods of 24-hour food recall and then organized into three score levels (IGS3). If the total score is ≥ 50, it is considered adequate, and if the total score is < 50, it is deemed inadequate. Each component then classified into minimum (0-5) and maximum (10) values. For the analysis of the relationship between the two variables, used the Chi-square test if it meets the requirements and the Fisher test if it does not meet the requirements [7-9]. The present study has received ethical clearance from the Health Research Ethics Commission at Halu Oleo University's Faculty of Medicine, with reference number 012/UN29.17.1.3/ETIK/2023.

3   Results

Table 1 presents the participants' characteristics. A Number of 80 subjects were analyzed, with a mean age of 18.23 ± 0.68 years, and the majority (57.5%) were 18 years old. Males constituted a higher percentage (72.5%) than females (27.5%). Most individuals had a normal nutritional status, resulting in an average BMI of 22.04 ± 4.43 kg/m².

Table 1. Characteristics of respondents (n=80).

Variables	n (%)	Mean ± SD	Median	Min	Max
Age, y.o		18.23 ± 0.68	18	17	20
17	9 (11.25)				
18	46 (57.5)				
19	23 (28.75)				
20	2 (2.5)				
Gender					
Male	22 (27.5)				
Female	58 (72.5)				
Anthropometric					
Weight, Kg		56.48 ± 12.69	53	40	95
Height, Cm		159.89 ± 7.96	159	145	179
BMI, Kg/m2		22.04 ± 4.43	20.52	16.02	39.73
Nutritional Status					
Normal	47 (58.7)				
Abnormal	33 (41.3)				
Underweight	15 (18.8)				
Overweight	12 (15)				
Obesity	6 (7.5)				
HEI Score		38.37 ± 10.36	40	20	60
Adequate	16 (20)				
Inadequate	64 (80)				
Physical Activities METmin/Week		2194.05 ± 1504.17	2047	192	8355
Low (<600)	11 (13.7)				
Moderate (600-1500)	20 (25)				
High (>1500)	49 (61.3)				

Source: Primary Data, 2023

Table 2. Healthy eating index distribution (n=80).

Components	Mean	SD	Minimum HEI		Maximum HEI	
			n	%	n	%
Carbohydrates	7	3.43	39	48.75	41	51.25
Vegetables	1.81	3.39	71	88.75	9	11.25

Fruits	1.31	2.60	77	96.25	3	3.75
Animal Based Protein	9.25	2.11	10	12.5	70	87.5
Plant Based Protein	1.75	2.98	75	93.75	5	6.25
Fats	2.93	3.70	68	85	12	15
Salts	3.81	2.54	77	96.25	3	3.75
Sugar	2.87	3.79	67	83.75	13	16.25
Fe	4.43	1.77	79	98.75	1	1.25
Diversity	4.06	2.76	74	92.5	6	7.5

Source: Primary Data, 2023

Table 3. Relationship between HEI and nutritional status.

Variable	HEI scores	Nutritional status				Total		p
		Abnormal		Normal				
		n	%	n	%	n	%	
Total HEI	Inadequate (<50)	31	38,75	33	41,25	64	80	0.02[f]
	Adequate (>49)	2	2,5	14	17,5	16	20	
Carbohydrates	Min (0-5)	18	22,5	21	26,25	39	48,75	0.521[cs]
	Max (10)	15	18,75	26	32,5	41	51,25	
Vegetables	Min (0-5)	32	40	39	48,75	71	88,75	0.51[f]
	Max (10)	1	1,25	8	10	9	11,25	
Fruits	Min (0-5)	32	40	45	56,25	77	96,25	0.632[f]
	Max (10)	1	1,25	2	2,5	3	3,75	
Animal Based Protein	Min (0-5)	2	2,5	8	10	10	12,5	0.131[f]
	Max (10)	31	38,75	39	48,75	70	87,5	
Plant Based Protein	Min (0-5)	33	41,25	42	52,5	75	93,75	0.64[f]
	Max (10)	0	0	5	6,25	5	6,25	
Fats	Min (0-5)	27	33,75	41	51,25	68	85	0.359[f]
	Max (10)	6	7,5	6	7,5	12	15	
Salts	Min (0-5)	31	38,75	46	57,5	77	96,25	0.368[f]
	Max (10)	2	2,5	1	1,25	3	3,75	

Sugar	Min (0-5)	26	32,5	41	51,25	67	83,75	0.484 cs
	Max (10)	7	8,75	6	7,5	13	16,25	
Fe	Min (0-5)	33	41,25	46	57,5	79	98,75	0.587 f
	Max (10)	0	0	1	1,25	1	1,25	
Diversity	Min (0-5)	30	37,5	44	55	74	92,5	0.482 f
	Max (10)	3	3,75	3	3,75	6	7,5	

The Healthy Eating Index (HEI) score averaged 38.37 ± 10.36. There were 91.25% of the study participants had a poor diet according to their Healthy Eating Index (HEI) score. The study determined that the mean amount of physical activity among subjects was 2194.05 ± 1504.17 Metmin/week, with 61.3% reporting high levels of activity.

Table 2 displays the distribution of scores for the Healthy Eating Index (HEI). Eight components, specifically vegetables, fruits, plant-based protein, fats, sodium, added sugar, iron-containing foods, and overall dietary diversity, scored a minimum of 0-5. Only two components, carbohydrates and animal-based protein, earned a maximum score of 10 on the HEI, with 7 ± 3.43 for carbohydrates and 9.25 ± 2.11 for animal-based protein.

The chi-square analysis of carbohydrate and sugar intake found no significant relationship between dietary intake and nutritional status ($p>0.05$). Similarly, the Fisher test revealed no significant relationship between various dietary components (e.g., vegetables, fruits, protein, fat, salt, iron, and dietary diversity) and nutritional status ($p>0.05$). Additionally, it is noteworthy that according to Table 3, there was a significant association between the participants' nutritional status and their total HEI score ($p=0.02$) after the application of the Fisher Test.

4   Discussion

HEI serves as a tool to assess the degree to which an individual's dietary habits align with the recommended food portions outlined in the Balanced Nutrition Guidelines. When a subject's HEI score approaches the maximum value, it signifies that the quality of their dietary choices is commendable and adheres to the stipulations set forth in the Balanced Nutrition Guidelines. The research findings indicated that a majority of the respondents (58.7%) exhibited normal nutritional statuses, while a significant majority (80%) obtained insufficient HEI scores. This phenomenon may be attributed to respondents who, despite not strictly adhering to nutritional guidelines in their food choices, compensate through increased physical activity. As a result, the quality of their dietary intake has a lesser impact on their overall nutritional status. This interpretation is substantiated by data illustrating that 61.3% of respondents engage in high levels of physical activity, averaging 2194.05 ± 1504.17 METmin/ Week, well surpassing the recommended threshold of >1500 METmin/Week. These findings align with a

systematic review conducted by Taylor in 2022, which revealed a significant association between heightened physical activity, reduced burnout, and enhanced quality of life among medical students [21].

It's worth noting that medical students tend to maintain active lifestyles, with some studies suggesting that their levels of physical activity surpass those of the general population. Despite their suboptimal dietary practices, multiple studies have consistently reported that the nutritional status of medical students remains within the normal range [5, 21-23]. The mean HEI value for the respondents was 38.37 ± 10.36. This score falls just short of half the maximum score, specifically 50. This implies that the dietary quality of medical students at Halu Oleo University falls into the lower category and deviates from the standards outlined in the Balanced Nutrition Guidelines. These results align with previous research conducted by Danty et al. [8] and Rahmawati et al. [24], where the average HEI values were less than half of the maximum score, measuring at 22.5 and 14.2, respectively. However, it is important to note that a separate study reported a notably higher average HEI score of 63.37 ± 9.0 among university students [25]. However, it's important to note that the HEI is influenced by factors that extend beyond food intake. Variables such as income and education are positively associated with the quality of an individual's dietary choices. Consequently, individuals with higher incomes or educational levels tend to have better access to nutritional information, which in turn enhances the quality of their dietary choices.

In contrast, 31 respondents (38.75%) displayed abnormal nutritional statuses and inadequate HEI scores, while only 14 respondents (17.5%) exhibited normal nutritional statuses and adequate HEI scores. Nutritional status is closely intertwined with daily dietary patterns. The foods we consume daily must not only meet recommended daily allowances (RDA) but also encompass balanced nutrition, encompassing both macronutrients and micronutrients. Furthermore, adherence to established nutritional guidelines, such as reducing salt and sugar intake while prioritizing dietary diversity, is also crucial. The study findings also revealed that 33 respondents (41.25%) had normal nutritional statuses but inadequate HEI scores, while 2 individuals (2.5%) had abnormal nutritional statuses but satisfactory HEI scores. It's important to acknowledge that an individual's nutritional status can be influenced by numerous factors, including dietary choices, income, as well as physical and mental health conditions. Consequently, the HEI score serves as a valuable tool to assess dietary quality in accordance with established Dietary Guidelines and serves as a comprehensive indicator of overall diet quality. Evaluating an individual's nutritional status is a complex process that takes into consideration the various elements impacting an individual's dietary habits. Moreover, it's essential to consider the data collection method, which relies on 24-hour dietary recalls that are contingent on participants' memory. This approach can lead to potential overestimations or underestimations of actual food intake. However, researchers strive to address this issue by underscoring the significance of accurate and truthful reporting, both for scientific inquiry and personal motivation.

Upon closer examination of the components within the HEI, it becomes apparent that most respondents received maximum HEI scores for carbohydrate and animal-based protein consumption. Conversely, the majority of respondents received minimal scores for several other components, including vegetables, fruits, plant-based protein,

fats, salt, sugar, iron intake, and dietary diversity. Additionally, in alignment with findings from Yulianti's [26] research, a significant proportion of respondents exhibited reduced consumption of vegetables and fruits. Research conducted by Rachmi et al. [27] indicates that adolescents consume appropriate servings of protein, fruits, and vegetables in their diets but consume excessive amounts of sodium and Western-style fast food. The World Health Organization (WHO) recommends the consumption of 400 grams of vegetables and fruit per day for a healthy lifestyle. This includes 250 grams of vegetables (equal to 2 portions or 2 glasses of vegetables after cooking and draining) and 150 grams of fruit (equal to 3 medium-sized Ambon bananas) [13]. A significant association between the total HEI value and the nutritional status of medical students at Halu Oleo University (p=0.02). However, HEI and nutritional status were found to be unrelated in the adolescent group according to research conducted by Danty et al. [8] and Yulianti [26] (p>0.05). This demonstrates the absence of a correlation between the HEI score and the nutritional status of adolescent girls.

It's important to note that the HEI is influenced by various factors beyond food intake. Variyam found a strong positive correlation between income, education, and the quality of a person's food consumption. This indicates that individuals with higher income or education tend to have better access to nutritional information, allowing them to make improved food choices. Gender, age, race, ethnicity, and employment status are factors that may impact an individual's food consumption quality [8, 26]. However, this study contradicts research conducted by Tande in the United States, which found that following the Healthy Eating Index (HEI) recommendations can reduce the risk of obesity [8]. HEI is a valuable tool utilized to assess how closely an individual's diet aligns with recommended nutritional guidelines. The Healthy Eating Index (HEI) objectively gauges the quality of an individual's diet. The HEI score reflects the extent to which a person's nutritional intake aligns with federal dietary guidelines. While a high HEI score indicates that a person's basic nutritional needs have been met, it doesn't always signify long-term compliance with proper nutritional guidelines. The HEI score takes into consideration several dietary components, including fruit and vegetable consumption, plant and animal protein intake, fat consumption, salt, and added sugars. Good nutritional status is associated with a high HEI score when a healthy and well-rounded diet is maintained. A higher HEI score signifies closer adherence to healthy nutritional guidelines, while a lower score implies noncompliance.

5   Conclusion

This study has revealed a significant relationship between the total HEI score and the nutritional status of adolescents. These findings provide a foundational basis for future research on the benefits and impact of HEI on nutritional status. It is recommended to further investigate the specific dietary aspects that influence HEI and nutritional status to inform effective interventions. Attention must be paid not only to the quantity but also to the quality of food intake.

5.1   Suggestion

The study aims to enhance existing research by employing a different research approach and acquiring more precise data relevant to the inquiry. This will enable a more comprehensive assessment of the relationship between HEI and nutritional well-being.

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