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The association between nutrient intake and physical activity with nutritional status of undergraduate medical students

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ABSTRACT

Background: Malnutrition, especially overnutrition, is a primary adult nutrition problem. Food intake and physical activity have been the primary factors that affect nutritional status. In college students, food consumption and physical activity tend not to be compatible with the recommendation.
Objective: To know the association between nutrient intake and physical activity with the nutritional status of undergraduate students in the Faculty of Medicine of the Universitas Islam Negeri (UIN) Syarif Hidayatullah Jakarta.
Methods: This study was an analytical cross-sectional at the Faculty of Medicine, UIN Syarif Hidayatullah Jakarta, from August to September 2019. The sample of this study was undergraduate medical students at the Faculty of Medicine UIN Syarif Hidayatullah Jakarta, with as many as 113 students meeting qualified criteria. The sample was chosen with a stratified sampling method. Data was taken using IPAQ (International Physical Activity Questionnaire) for physical activity, food records, and height and body weight measurements. Data was analysed using comparative analysis
Results: Our analysis demonstrated an association between nutritional status and adequacy of calorie intake (p = 0.001), as well as macronutrient intake (p = 0.001). There was no association between nutritional status and physical activity (p = 0.737).
Conclusion: There was an association between nutrient intake and the nutritional status of undergraduate medical students in the Faculty of Medicine UIN Syarif Hidayatullah Jakarta. On the contrary, there was no association between physical activity and the nutritional status of undergraduate medical students in the Faculty of Medicine UIN Syarif Hidayatullah Jakarta.

Latar Belakang: *Malnutrisi terutama gizi lebih menjadi masalah gizi utama pada orang dewasa. Pola asupan dan aktivitas fisik menjadi faktor utama yang mempengaruhi status gizi. Pola asupan dan tingkat aktivitas fisik pada mahasiswa cenderung tidak sesuai rekomendasi.*
Tujuan: *Mengetahui kaitan antara konsumsi nutrien dan aktivitas fisik dengan status gizi mahasiswa Fakultas Kedokteran UIN Syarif Hidayatullah.*
Metode: *Penelitian ini merupakan penelitian potong lintang analitik yang dilakukan di Fakultas Kedokteran UIN Syarif Hidayatullah Jakarta pada bulan Agustus hingga September 2019. Sampel penelitian merupakan mahasiswa Program Pendidikan Sarjana di Fakultas Kedokteran UIN Jakarta dengan sampel sejumlah 113 orang yang memenuhi kriteria dengan metode stratified sampling. Data diambil menggunakan IPAQ, pengisian food record, dan pengukuran terhadap berat badan serta tinggi badan. Data kemudian dianalisis menggunakan uji komparasi.*
Hasil: *Hasil analisis menunjukkan hubungan yang bermakna antara status gizi dengan kecukupan asupan kalori (p = 0.001) dan dengan keseimbangan makronutrien (p = 0.001). Tidak ditemukan hubungan yang bermakna antara status gizi dengan aktivitas fisik (p = 0.737).*

Kesimpulan: *Terdapat hubungan antara konsumsi nutrien dengan status gizi, namun tidak terdapat hubungan antara aktivitas fisik dengan status gizi pada mahasiswa Program Pendidikan Sarjana Fakultas Kedokteran UIN Syarif Hidayatullah Jakarta.*

INTRODUCTION

Malnutrition, especially overnutrition, is a substantial problem worldwide.[1,2] The reason is that being overweight or obese could cause metabolism disturbance through pathophysiological processes. People who are overweight and obese also have a higher risk of having non-communicable diseases, such as hypertension, ischemic stroke, coronary heart disease, hypercholesterolemia, and diabetes mellitus.[3] According to the World Health Organisation (WHO), about 39% of adolescents are overweight and obese.[4] In Indonesia, around 18% of adults aged 19-24 are classified as overweight to obese. This number continues to increase as age increases.[5] A previous study in Iran demonstrated that about 12% of undergraduate students are overnourished.[6] Another study in Indonesia, specifically in Jakarta, demonstrated that more than 30% of undergraduate medical students were categorised as overnutrition either being overweight or obese.[7]

Nevertheless, undernutrition is also a problem that could not be overlooked, as macronutrients and micronutrients are needed by every organ in the human body. A low intake of nutrients, which leads to a low nutritional status, could cause disturbances in organ function, either in the gastrointestinal, cardiorespiratory, muscular, or even immune systems, and it could have a psychosocial effect.[8] Worldwide, 462 million adults were estimated to be underweight.1 In Indonesia, 9.3% of adults were classified as undernutrition. Even more, in the 19-24 years age group, the prevalence was higher as around 17% were classified as undernutrition.[5]

Nutritional status is a state where the body successfully fulfils nutritional needs. The success of meeting these nutritional needs could be described as a balance between the amount of nutrient intake and the number of nutrients required for the body to fulfil various biological functions.[9] Nutritional status could be either good or bad, which is affected by the balance between nutrition intake and energy expenditure. Good nutritional status could be obtained when nutrition intake and energy expenditure are balanced.[10]

Nutritional status could be assessed by taking history, anthropometric measurements, and other physical examinations.[10-12] For mass examination, anthropometric measurement interpreted to body mass index (BMI) is the easiest and the most effective way to determine nutrition status.[13] Anthropometric is a measurement of individuals' physics classified as a standard applied to see growth and development. The most common anthropometric measurement is height and body weight.[11,14] Height represents linear growth of the body and long-term nutrient intake.[11,15] Conversely, weight represents short-term nutrient intake and gives a rough image of body fat proportion.

Nutrition status could be affected by either direct or indirect factors.[16] Direct factors include nutrient intake, physical activity, infection and inflammation, age, and metabolism disturbance.[11,17,18] Meanwhile, indirect factors include education, sleep duration, and income.[6,10,19–21] Nutrient intake and physical activity are the two factors that affect nutritional status the most.[22,23]

Other than total energy intake, nutrient intake could affect nutritional status through other aspects. Dietary habits or eating patterns such as eating breakfast, skipping meals habits, frequency of eating fast foods, sweets, and others were associated with nutritional status.[6] Macronutrient consumption either in terms of composition or compared to dietary recommendation also could affect nutritional status.[24,25]

Nutrient intake, especially macronutrients, is an energy source for the body. The amount of nutrient intake the human needs depends on how much energy is expended. The main source of calorie needs consists of 60% carbohydrates, 25% fat, and 15% protein.[26] Total energy expenditure count based on basal metabolic rate, thermogenesis, and physical activity. The basal metabolic rate represents the energy needed in 24 hours while resting physically and mentally. The Mifflin-St Jeor equation is a tool to count a healthy or unhealthy person's basal metabolic rate (BMR). BMR value could then estimate energy expended by multiplying this number with the physical activity coefficient.[11]

Physical activity plays a direct role in determining an individual's nutritional status. It could be quantified either directly, by measuring the kilocalories expended during activity, or

indirectly, by estimating the amount of oxygen consumed during activity using metabolic equivalents (METs). The MET scores could be obtained through both subjective and objective means. Subjectively, physical activity is most commonly measured in METs using various Physical Activity Questionnaires. Objectively, physical activity could be gauged using methods such as pulse rate monitoring, pedometers, and accelerometers.[27,28]

As future doctors, medical students are expected to exemplify a healthy lifestyle, thereby serving as positive role models within the community. However, numerous studies have highlighted a concerning trend among undergraduate students: a tendency towards suboptimal nutrient consumption, particularly concerning macronutrients.[6,29,30] Concurrently, additional study has revealed a widespread low level of physical activity among this group.[6] Such findings underscore the urgent need to address the nutritional issues prevalent among medical students. In light of the abovementioned circumstances, our study seeks to figure out the association between dietary intake, physical activity, and overall nutritional status.

METHODS

Study design

This study used an observational analytic approach employing a cross-sectional method conducted between August and November 2019. The participants were undergraduate students from the Medical Faculty of UIN Syarif Hidayatullah Jakarta. To ensure appropriate respondents, specific inclusion and exclusion criteria were applied. Inclusion criteria encompassed undergraduate students aged 18 years or older who consented to participate. Exclusion criteria comprised individuals with illnesses such as diabetes mellitus or thyroid disease, as well as those following a diet program, as these conditions could impact their nutritional status. A total of 113 students, selected through stratified random sampling from the 2016, 2017, and 2018 classes, agreed to participate after providing informed consent.

Nutrient intake assessment

Each participant documented their meals using the food record method, receiving guidance on detailed recording of all food and beverages consumed, including cooking methods and portion sizes. They were provided with a ruler to aid in accurately depicting the size of the food and drink items, enhancing the validity of their records. Over a week, subjects recorded their food and drink intake for three days, specifically two weekdays and one weekend day. Collected forms were retained daily to ensure data validation. The dietary intake data was processed using the Nutrisurvey application to calculate calorie intake and assess macronutrient balance.

Nutrient intake in this study involved evaluating both energy sufficiency and macronutrient composition. Energy sufficiency was determined by comparing total energy intake with individual energy expenditure, accounting for gender, physical activity, age, and nutritional status. These measurements were categorised into three groups: low energy (energy intake <90% of expenditure), normal (energy intake 90-110% of expenditure), and high energy (energy intake >110% of expenditure). Additionally, the study evaluated macronutrient consumption by analysing its composition. Macronutrient balance was considered achieved if the total energy intake consisted of carbohydrates between 45-65%, protein between 10-35%, and fat between 20-35%. Deviations from these ranges were classified as imbalances.

Physical activity assessment

The long-form IPAQ was employed to assess the physical activity levels of the participants. After a week of recording their food intake, subjects completed the questionnaire online. To ensure clarity and aid in responding accurately, the study facilitator was present to assist participants in understanding the questions. The collected data were analysed to determine each subject's daily Physical Activity Level (PAL). Subsequently, these PAL values were classified into three categories of physical activity levels: sedentary, low active, and active.

Nutritional status assessment

Height and weight measurements were obtained following a week of dietary intake recording. The data were collected using the SECA® 703 medical scale, which provided measurements to one decimal place. Subjects were instructed

to stand upright in lightweight clothing for accuracy. Each measurement was taken twice to ensure precision. Any discrepancies between the measurements exceeding 0.4 units were deemed invalid, necessitating the re-collection of data. The collected height and weight data were then utilised to calculate the BMI using the WHO classification specifically designed for the Asia-Pacific region.

Statistical analysis

The Kruskal-Wallis test was employed in bivariate analysis to investigate the relationship between two variables: nutrient intake (specifically energy sufficiency and macronutrient composition) and their association with both nutritional status and physical activity levels. Statistical analysis was conducted using SPSS version 22.

Ethics

This study has been approved by the Ethical Committee of Syarif Hidayatullah State Islamic University with ethical reference number: B-011/F12/KEPK/TL.00/9/2019.

RESULTS

A number of 111 undergraduate medical students were analysed, as two students dropped out. Seventy-nine respondents were female (71.2%) and others were male (28.8%). Subjects' characteristics based on their gender were demonstrated in Table 1. According to nutritional status, 29.7% of subjects were overnutrition (overweight, obese I, and obese II). The male had higher nutritional status with a median of 22.94 (15.10 – 34.30); also, there was a higher percentage of male students being overweight or obese. Likewise, male students' average energy intake was higher (1,492 kcal) than females (1,198.2 kcal). However, based on energy sufficiency, female students tend to fulfil their energy expenditure more than male students, as more have normal (50.6%) or high intake (12.7%). However, most respondents were generally categorised as normal for energy sufficiency.

The macronutrient compositions in both males and females exhibited similarities, with carbohydrates being the most consumed macronutrient. A majority of subjects maintained a balanced macronutrient composition (61.3%), characterised by 45-65% carbohydrates, 10-35% protein, and 20-35% fat. However, 38.7% of subjects, particularly more males (43.8%), displayed an imbalanced macronutrient composition.

Regarding physical status, female students demonstrated higher levels of physical activity (1.35) compared to males (1.26). Despite this, only 2.5% of female students were classified as active, whereas 21.9% of male students were deemed active. Unfortunately, the majority of subjects exhibited a sedentary level of physical activity.

Table 2 demonstrates the association between nutritional status and each physical activity, macronutrient balance, and energy sufficiency. BMI as representative of nutritional status has demonstrated a significant association with macronutrient balance ($p = 0.003$) and energy sufficiency ($p = 0.032$). Subjects with balanced macronutrient consumption mostly had underweight to normal nutritional status. Compared to this, more subjects with imbalanced macronutrient consumption had overweight to obese status. Based on energy sufficiency, those with low to normal energy sufficiency tended to be underweight to normal status, while those with high energy sufficiency tended to have overweight to obese status. Despite this, BMI has demonstrated no statistical association with physical activity ($p = 0.150$).

DISCUSSION

Most subjects in this study were in normal nutritional status, similar to the report in a previous study at Andalas University.[31] However, 29.7% of subjects were overweight to obese, which is 10% more than the percentage of overweight to obese nationally.[5] This could suggest that being overweight to obese status is a health problem that needs more concern, especially in early adulthood. High BMI score, as in overweight and obese in early adulthood to middle age, has demonstrated a greater likelihood of developing myocardial infarction, stroke, and especially diabetes mellitus type 2.[32] Higher BMI scores in males rather than females have also been demonstrated in another study.[23] Theoretically, females have higher body fat. Thus, females should have a higher BMI. Nevertheless, BMI only shows weight-to-height proportion and not body composition.[11]

Nutrient intake is a critical factor influencing nutritional status, significantly impacting BMI

Table 1. Subject's characteristics

Characteristics	Female	Male	Total
BMI*	20.65	22.94	20.96
	(15.43 – 34.13)	(15.10 – 34.30)	(15.10 – 34.3)
Energy intake (kcal)*	1,198.2	1,492	1,231,46
	(828-2226)	(921-2215)	(828-2226)
Macronutrient composition			
Carbohydrate (%)*	51 (30-74)	50 (35-67)	51 (30-74)
Protein (%)*	15 (3-24)	15 (8-23)	15 (3-24)
Fat (%)*	34 (18-51)	34 (22-50)	34 (18-51)
Physical activity level*	1.35 (1.17-1.93)	1.26 (1.11-2.71)	1.29 (1.11-2.71)
Nutritional Status			
Underweight	13 (16.5)	5 (15.6)	18 (16.2)
Normal	49 (62.0)	11 (34.4)	60 (54.1)
Overweight	8 (10.1)	7 (21.9)	15 (13.5)
Obese 1	5 (6.3)	7 (21.9)	12 (10.8)
Obese 2	4 (5.1)	2 (6.3)	6 (5.4)
Energy sufficiency			
Low	30 (38.0)	17 (53.1)	47 (42.4)
Normal	39 (49.4)	11 (34.4)	50 (45.0)
High	10 (12.7)	4 (12.5)	14 (12.6)
Macronutrient composition			
Balance	52 (65.8)	16 (50.0)	68 (61.3)
Imbalance	27 (34.2)	16 (50.0)	43 (38.7)
Physical activity status			
Sedentary	67 (84.8)	22 (68.8)	89 (79.2)
Low active	10 (12.7)	3 (9.3)	13 (11.7)
Active	2 (2.5)	7 (21.9)	9 (8.1)

*Median with minimum and maximum value as data distribution was abnormal

Table 2. Characteristics based on nutritional status analysis

Characteristics	Underweight (n=18)	Normal (n=60)	Overweight (n=15)	Obese 1 (n=12)	Obese 2 (n=6)	p-value*
Physical activity						
Sedentary	17 (94.4)	44 (73.3)	11 (73.3)	11 (91.7)	6 (100.0)	0.150
Low active	0 (0.0)	10 (16.7)	2 (13.3)	1 (8.3)	0 (0.0)	
Active	1 (5.6)	6 (10.0)	2 (13.3)	0 (0.0)	0 (0.0)	
Macronutrient balance						
Imbalance	12 (66.7)	16 (26.7)	7 (46.7)	3 (25.0)	5 (83.3)	0.003
Balance	6 (33.3)	44 (73.3)	8 (53.3)	9 (75.0)	1 (16.7)	
Energy sufficiency						
Low	12 (66.7)	19 (31.7)	8 (53.3)	4 (33.3)	4 (66.7)	0.032
Normal	5 (27.8)	36 (60.0)	6 (40.0)	2 (16.7)	1 (16.7)	
High	1 (5.6)	5 (8.3)	1 (6.7)	6 (50.0)	1 (16.7)	

Data on nutritional status based on physical activity, macronutrient balance and energy sufficiency presented by frequency and percentage n(%); *Comparative analysis using Kruskal-Wallis test, significant at 5% significance level ($p < 0.05$)

through its effect on energy balance.[22] Consuming excessive calories beyond the body's requirements, leading to high energy sufficiency, can disrupt this balance, pushing it towards a positive direction. In a positive energy balance scenario, where energy intake surpasses energy expenditure, the surplus calories are transformed into glycogen or stored as fat, thereby contributing to increased body weight.[33,34] The current study corroborates these findings, revealing that individuals with high energy sufficiency tended to have an overweight to obese nutritional status. Previous research has also highlighted a correlation between nutritional status and calorie consumption (r = 0.23).[6,35] A study conducted in Iran further supported this link, illustrating that individuals with different nutritional statuses exhibited varying calorie intake patterns. Specifically, those classified as overweight demonstrated higher calorie consumption compared to individuals with a normal weight. Meanwhile, individuals with a normal weight consumed more calories than those who were classified as underweight.[6]

As for macronutrient balance, most of the students had balanced macronutrient consumption. Either male or female subjects mostly were consuming balanced macronutrients. However, we could not neglect that 38.7% of subjects consumed imbalanced macronutrients associated with nutritional status.

A study in Turkey has demonstrated a significant association between unbalanced macronutrient consumption, especially high in protein and fat, with BMI. Their study demonstrated that underweight to normal subjects consumed 35% of fat, while overweight to obese subjects consumed up to 40% of fat.[29] As this study has demonstrated, most of the subjects consuming unbalanced macronutrients were overweight to obese status. In contrast, subjects consuming balanced macronutrients had low to normal status. High carbohydrate consumption could lead to high glycogen and fat deposits, thus increasing body weight. This also happens in high-fat consumption, which leads to high-fat deposits; thus, body weight will increase.[34] Further analysis has demonstrated that in the imbalanced macronutrients group, the average fat proportion was more than the recommendation (40.0%), with low carbohydrate (42.00%) and normal protein consumption (16.00%). They were more likely to have higher BMI status because of a high-fat diet.

Physical activity status itself also affects nutritional status. This study has demonstrated that most of the subjects who were undergraduate students were classified as having sedentary activities. A previous study on ASEAN undergraduate students also demonstrated that 56.3% of Indonesian students had sedentary activities.[36] Undergraduate students, in general, lean towards a sedentary lifestyle. Distance to school, busy class schedules that require sitting in most classes, and using a private vehicle for commuting have become reasons for students to have sedentary habits. Some were not interested in sports, were injured, or did not have the discipline to work out regularly.[37,38]

Sedentary activities or even low physical activity could lead to being overweight or obese. Physical activity status affects BMI through energy balance because it increases energy output.[28] Previous studies have demonstrated different physical activity status, represented by the duration of exercise, that is significantly related to BMI.[6] However, this study did not show a significant association between physical activity status and BMI. This study did not show that because other factors affect body weight, primarily energy intake. In low physical activity status, if followed with low energy intake, BMI will appear normal, and vice versa. The result of this study was similar to those done in Poland, where male subjects had high physical activity but were still in normal weight because of the balance of energy intake.[23]

This study concentrated solely on nutrient intake and physical activity as factors influencing nutritional status, disregarding the various other elements that can impact nutritional status. The assessment relied solely on modified food records collected over a short period. Consequently, it is conceivable that certain dietary elements consumed over the long term were not captured in this study. Moreover, using BMI as the sole indicator of nutritional status has limitations, as it only measures weight-to-height proportions, neglecting to reveal comprehensive body composition. Therefore, this assessment could not provide insights beyond weight-to-height ratios in evaluating nutritional status.

CONCLUSION

The majority of undergraduate students at UIN

Syarif Hidayatullah Jakarta were predominantly classified as having a normal weight. The study revealed a noteworthy association between nutrient intake, specifically energy sufficiency and macronutrient balance, and their impact on nutritional status. However, no significant association was found between physical activity levels and nutritional status. Consequently, our recommendation to students within the medical faculty is to ensure adequate calorie intake with a balanced macronutrient composition. Additionally, encouraging them to enhance their physical activity levels, striving to achieve at least a status of low activity. Moving forward, future studies should delve deeper into exploring the various factors that affect nutritional status. This could involve a comprehensive examination of these factors in a larger population to ascertain which among them exerts the most significant influence on nutritional status. Furthermore, adopting a combined approach utilising methods such as the Food Frequency Questionnaire (FFQ) alongside food records could provide a more comprehensive assessment of nutrient intake.

CONFLICT OF INTEREST

The authors reported no potential conflict of interest and did not receive any grant funding or financial support for the work presented in the manuscript.

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AUTHOR CONTRIBUTION

IAS and WA presented the idea and developed the theory. WA verified the analytical methods and tools used in the study. IAS analysed the result. WA and SK supervised the process. All authors discussed the results and contributed to the final manuscript.

LIST OF ABBREVIATION

BMI: Basal Metabolic Rate; BMI: Body Mass Index; FFQ: Food Frequencies Questionnaire; IPAQ: International Physical Activity Questionnaire; METs: Metabolic Equivalents; PAL: Physical Activity Level

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