Association between Breakfast Nutritional Contribution and Body Mass Index of IPB University Postgraduate Students

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ABSTRACT

Breakfast is one of the habits that contribute to fulfilling daily energy intake and reducing the risk of obesity. This study aimed to analyze the association between breakfast nutritional contribution and body mass index (BMI) of IPB University nutrition postgraduate students. The research applied a cross sectional study design for all 36 postgraduate nutrition students of IPB University. Data collected include socio-demographic, body weight and height, and food consumption, which gained by applying 1x24 hours food recall method. The intake of energy, protein, carbohydrate, fat, fiber, water, vitamin A, D, E, C, B1, B2, B3, B6, B9, B12, and calcium, iron, as well as zinc calculated using Nutrisurvey 2007 version. This research used correlational method between contribution of breakfast energy and nutrients with BMI. The data were analyzed by using simple linear regression with Spearman test. We identified r-square from 19 types of nutrients for this study and the results showed there was a significant negative association between the breakfast contribution of energy (r= -0.364), protein (r= -0.410), fat (r= -0.331), vitamin B2 (r= -0.357), and vitamin B12 (r= -0.443) with BMI. In conclusion, the higher the contribution of major nutrient for breakfast, the lower the BMI.

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Introduction

Breakfast is one of the important habits in an effort to maintain health and is one of the messages in the Balanced Nutrition Guidelines (Ministry of Health RI, 2019). Breakfast is an activity carried out between waking up in the morning until 9 am to meet daily nutritional requirements of 15-30% (Perdana & Hardinsyah, 2013). Humans need breakfast to meet the availability of energy to start their activities and replace the energy used in repairing and renewing body cells at nightv(Gibney et al., 2018).

College students are a group who often do breakfast habits less regularly. The results of research from Arraniri in 2017 showed that college students who had a regular breakfast habit were only 45%, where more than half of college students had less regular breakfast habits (Arraniri et al., 2017). This is in line with the opinion that adult group is the group that skips breakfast more often than other age groups (Uzhova et al., 2018).

Breakfast is proven to reduce factors that can lead to obesity (Ma et al., 2020). Regular breakfast can improve diet quality and reduce the habit of consuming unhealthy snacks and sugary drinks such as soft drinks. Breakfast is also beneficial in controlling blood sugar in those who eat breakfast compared to those who skip breakfast (Leidy, 2013). This is because breakfast habits can increase insulin sensitivity (Dhurandhar, 2016).

People who do not eat breakfast will replace the energy intake that is not sufficient earlier by eating more food at the time of the next meal in the same day (Leidy & Racki, 2010). High hunger and low

satiety are correlated with increased energy consumption at lunch (Astbury et al., 2011). The habit of skipping breakfast will also have an impact on increasing consumption of energy-dense snacks at night (Gwin & Leidy, 2018).

Body mass index (BMI) is a measure that is often used to assess nutritional status, especially obesity (Maukonen et al., 2018) because it is relatively simple and inexpensive to use (Adab et al., 2018). Many recent studies have used BMI as a measure in determining a person's overweight (Deng et al., 2020; Freedman & Berenson, 2017; Slideick et al., 2018; The GBD 2015 Obesity Collaborators, 2017). According to WHO, BMI for Asian was classified into five groups; underweight (BMI <18.5), normal range (BMI 18.5-22.9), overweight (BMI 23-24.9), obese I (BMI 25-29.9), and obese II (BMI >30) (Girdhar et al., 2016).

Researches related to breakfast nutrition and nutritional status involve various groups such as children, adolescents, and adults (Bonnet et al., 2020; Ma et al., 2020; Sievert et al., 2019; Wicherski et al., 2021). However, research involving postgraduate students is limited. Therefore, the authors are interested to examine the association between breakfast nutritional contribution and body mass index of IPB University postgraduate students.

Method

Study design

This research is a quantitative research with a cross sectional research design and conducted online survey. The selection of respondents was carried out by total sampling. The research was carried out in November 2021 at the address of each respondent.

Population and sampling method

The population in this study were postgraduate students of IPB University. The selection of respondents was based on inclusion criteria, namely active nutrition science postgraduate students who took the Advanced Nutritional Status Assessment course class and were willing to be interviewed. By using the total sampling method, the number of respondents involved were 36 postgraduate students of nutrition science IPB University.

Types and methods of data collection

The data collected is primary data by conducting interviews through zoom meetings with respondents. Socio-demographic data were obtained through interviews. Data on the respondent's food intake was obtained by using the food recall method 1 x 24 hours for each respondent. BMI was measured by asking each respondent's weight and height.

Processing and data analysis

Data processing is carried out in several stages, namely coding, entry, editing/cleaning, and data analysis. Data was processed using Microsoft Excel 2019 and analyzed using SPSS for Windows 23.0 software. Energy intake, protein, carbohydrates, fat, fiber, water, vitamin A, vitamin D, vitamin E, vitamin C, vitamin B1, vitamin B2, vitamin B3, vitamin B6, vitamin B9, vitamin B12, calcium, iron, and zinc were calculated using Nutrisurvey 2007 version. Descriptive statistical tests were conducted to examine socio-demographic characteristics and nutritional status of respondents, mean ± SD intake of breakfast energy and nutrients, and percentage contribution of energy and nutrients in breakfast to daily requirements. Spearman's test was conducted to analyze the association between the contribution of energy, protein, carbohydrate, fat, fiber, water, vitamin A, D, E, C, B1, B2, B3, B6, B9, B12, calcium, iron, zinc and BMI.

Results

Respondents Characteristics

Table 1. Socio-Demographic Characteristics and Nutritional Status of Respondents

Characteristics of respondents	Total (n)	Percentage (%)
Age		
< 30 years old	25	69.4
30 years	11	30.6
Gender		
Man	5	13.9
Woman	31	86.1
Region		
Java	26	72.2
Outside Java	10	27.8
Body Weight (Mean ± SD (Median))	54.6 ± 9.6 (52.0)	
Height (Mean ± SD (Median))	158.5 ± 6.8 (158.3)	
Body Mass Index (Mean ± SD (Median))	21.7 ± 3.3 (20.9)	
Nutritional status		
Thin	3	8.3
Normal	27	75.0
Fat	6	16.7
Physical Activity		
Light	16	44.4
Moderate	18	50.0
Active	2	5.6

Income*		
< average income	22	61.1
> average income	14	38.9

*The average income is 17,800,000 rupiah, the standard deviation is 8,744,000

Table 1 presents socio-demographic characteristics and nutritional status of respondents. Most of respondents are classified as early adults. Most of respondents are female. Most of physical activity is moderate. Age, gender, and physical activity determine nutritional requirements (Almatsier, 2009). The average weight and height of the respondents are close to the general weight and height of Indonesians. Based on the RDA (Recommended Dietary Allowances) 2019 for Indonesian, the average of weight and height for Indonesian women is 55 kg and 159 cm and for men it is 60 kg and 168 cm. Body mass index is a way to monitor the nutritional status of adults and identify underweight and overweight (Supariasa et al., 2012). Most of the respondents' nutritional status was normal. Food consumption is one of the factors that affect nutritional status. Income is one of the factors that affect food consumption (Khomsan et al., 2009).

Contribution of Breakfast Energy and Nutrients

The contribution of breakfast energy and nutrients is presented in Table 2. The median intake of energy, protein, fat, water, iron, and zinc on daily requirements is less than 25%. Breakfast should provide an energy contribution of about 25% of the daily energy intake as an effort to fulfill balanced nutrition. In addition, this will also have an impact on one's thinking ability and daily activities (Khomsan, 2004).

Table 2. Contribution of Breakfast Energy and Nutrients

Energy and Nutrients	Intake Mean±SD (median)	Intake Rate (%) Mean±SD (median)
Energy (kcal)	353.3±179.9(356.6)	22.1±11.8(21.3)
Protein (grams)	12.8±7.1(13,2)	22.5±13.1(21,6)
Fat (grams)	14.4±13.5(11,3)	26.6±23.1(23.0)
Carbohydrates (grams)	43.5±25.4(40,1)	20.5±13.5(19.8)
Fiber (grams)	20.7±105.4(1.6)	16.4±24.3(6,3)
Water (ml)	334.2±154.9(353.4)	21.9±9.1(22,6)
Vitamin A (mcg)	108.7±132.5(50,5)	24.7±29.1(10,3)
Vitamin D (mcg)	0.25±0.73(0,0)	4.4±7.9(0,0)
Vitamin E (mg)	0.5±0.0(0.0)	7.6±8.8(5,2)
Vitamin C (mg)	9.8±16.3(2.0)	16,9±25,9(3,2)
Vitamin B1 (mg)	0.1±0.2(0,1)	20.0±23.0(11,1)
Vitamin B2 (mg)	0.3±0.2(0.3)	32.1±21.3(33,3)
Vitamin B3 (mg)	2.6±2.9(1.4)	22,3±23.1(16,1)
Vitamin B6 (mg)	0.3±0.3(0,2)	23.0±33.3(15,6)
Vitamin B9 (mg)	41.1±43.1(27,5)	12.9±13.7(9.0)
Vitamin B12 (mg)	1.0±2,3(0.4)	41.2±90.4(10,8)
Calcium (mg)	136.3±130,2(100,6)	18.7±17.5(15.2)
Iron (mg)	2.5±2.2(2,1)	23.9±18.4(23,2)
Zinc (mg)	1.6±0.9(1.6)	24.1±14.1(24,2)

Source : Primary Data, 2021

Vitamin B12 contributes to the daily requirement of more than 25%. Vitamin B12 acts as a cofactor and as an intrinsic factor in the stomach. Sources of vitamin B12 from food are liver, shellfish, fish, meat, eggs, milk, and yogurt (Almatsier, 2009). Vitamin B12 deficiency can lead to pernicious anemia and vitamin B12 neuropathy. Intake of vitamin D and calcium is less than 5% of the daily requirement. Calcium and vitamin D play a role in bone formation. Lack of calcium and vitamin D can reduce bone density. Food sources of calcium and vitamin D come from animal foods. According to Almatsier (2009), calcium is abundant in milk and its processed products, green vegetables, nuts, and fish.

The results also show that in total, the contribution of breakfast energy and nutrients still does not meet the recommended energy contribution, namely ≥25%. The study stated that the majority of respondents with a poor breakfast category (<25% of total daily requirements) could be associated with breakfast

habits that were more than 9 am and the type of food consumed in the morning did not meet the energy requirements of breakfast (Fathin, 2018). In addition, it can also be caused by busy activities in the morning such as college or work, then there are also individuals who are not used to having breakfast and feel sick to their stomach when they eat breakfast, lazy, and food that does not suit their tastes (Purnawinadi & Lotulung, 2020).

According to Hardinsyah & Aries (2012), the contribution of breakfast nutrients in Indonesia is 15%-30% of the daily nutritional requirements per individual. The percentage of respondents' breakfast quality is presented in Table 3. Most of respondents still have breakfast quality that is less than 15%, especially for the contribution of fiber, vitamins D, E, and C. Meanwhile, the breakfast quality of most of the respondents who have met the recommended energy contribution including energy, protein, fat, carbohydrates, water, vitamins A, B1, B2, B3, B6, B9, B12, as well as calcium, iron, and zinc. Rice is a source of carbohydrates which is a staple food for the people in Indonesia, so it is one of the foods that are widely consumed at breakfast coupled with protein-rich side dishes that are easy to prepare such as eggs, fried chicken, fried tempeh, and fried tofu (Hardinsyah & Aries, 2012).

Table 3. Percentage Contribution of Breakfast Energy and Nutrients to Daily Requirements

Energy and Nutrients	Contribution category			
	<5%	5-15%	16-25%	>25%
Energy (kcal)	3 (8.3%)	9 (25.0%)	10 (27.8%)	14 (38.9%)
Protein (g)	2 (5.6%)	11 (30.6%)	9 (25.0%)	14 (38.9%)
Fat (g)	5 (13.9%)	9 (25.0%)	7 (19.4%)	15 (41.7%)
Carbohydrates (g)	3 (8.3%)	13 (36.1%)	7 (19.4%)	13 (36.1%)
Fiber (g)	17 (47.2%)	6 (16.7%)	5 (13.9%)	8 (22.2%)
Water (ml)	1 (2.8%)	6 (16.7%)	19 (52.8%)	10 (27.8%)
Vitamin A (mcg)	14 (38.9%)	4 (11.1%)	3 (8.3%)	15 (41.7%)
Vitamin D (mcg)	26 (72.2%)	8 (22.2%)	0 (0.0%)	2 (5.6%)
Vitamin E (mg)	17 (47.2%)	13 (36.1%)	2 (5.6%)	4 (11.1%)
Vitamin C (mg)	20 (55.6%)	7 (19.4%)	1 (2.8%)	8 (22.2%)
Vitamin B1 (mg)	10 (27.8%)	8 (22.2%)	4 (11.1%)	14 (38.9%)
Vitamin B2 (mg)	6 (16.7%)	3 (8.3%)	3 (8.3%)	24 (66.7%)
Vitamin B3 (mg)	11 (30.6%)	8 (22.2%)	5 (13.9%)	12 (33.3%)
Vitamin B6 (mg)	8 (22.2%)	9 (25.0%)	8 (22.2%)	11 (30.6%)
Vitamin B9 (mcg)	9 (25.0%)	18 (50.0%)	2 (5.6%)	7 (19.4%)
Vitamin B12 (mcg)	12 (33.3%)	8 (22.2%)	2 (5.6%)	14 (38.9%)
Calcium (mg)	6 (16.7%)	11 (30.6%)	8 (22.2%)	11 (30.6%)
Iron (mg)	6 (16.7%)	8 (22.2%)	6 (16.7%)	16 (44.4%)
Zinc (mg)	6 (16.7%)	3 (8.3%)	10 (27.8%)	17 (47.2%)

Source : Primary Data, 2021

However, it is still found that respondents who have a low contribution of energy and nutrients in breakfast can be caused by the low source of carbohydrates and the variety of types of food at breakfast, even though sufficient nutrients can only be met from a variety of foods (Perdana & Hardinsyah, 2013). Added Hardinsyah (in Ifdal 2014), consumption of breakfast foods should meet 300-500 kcal and 6-10 g protein. The low contribution of energy and nutrients in the breakfast menu will be met with a variety of food types, namely side dishes, vegetables, and fruits.

Association between Contribution of Breakfast Energy and Nutrients and Body Mass Index

In this study we use BMI as an independent variable. BMI itself is the metric currently in use for defining anthropometric height/weight characteristics in adults and for categorizing them into groups. Besides it can represents an index of an individual's fatness, BMI also is widely used as a risk factor for the development of or the prevalence of several health issues. BMI widely used in determining public health policies. Therefore, it has been useful in population-based studies by virtue of its wide acceptance in defining specific categories of body mass as a health issue (Nuttall, 2015).

Based on the results of the Spearman test in Table 4, it shows there is a moderate association that is negative and significant ($p < 0.05$) between the contribution of energy, protein, and fat of breakfast with BMI with a association value (r) of -0.364, -0.410, and -0.331, respectively. This means, the higher the contribution of energy, protein, and fat of

breakfast, the BMI will decrease. The results of the study are in line with a longitudinal analysis which revealed that the habit of skipping breakfast causes an increase in changes in waist circumference, ratio of height, weight, and BMI measurements and vice versa that breakfast habits can reduce the indicator of the increase in body anthropometry. This is what causes a higher risk of abdominal obesity and being overweight (Gong et al., 2016; Traub et al., 2018). Other studies have also found that people who rarely eat breakfast are more likely to be overweight or obese. Castro **(**in Ifdal 2014) states several studies show that obesity is also influenced by breakfast patterns. People who do not eat breakfast will feel hungrier during the day and at night than those who eat breakfast. They will eat more food during the day and night. Eating a lot of food at night will result in an increase in glucose which is stored as glycogen. Physical activity at night is very low, causing glycogen to be stored as fat. This is what causes obesity.

Table 4. Association between Contribution of Breakfast Energy and Nutrients and Body Mass Index

Contribution of Breakfast Energy and Nutrients	p value	r value
Energy	p= 0.029*	-0.364
Protein	p= 0.013*	-0.410
Fat	p= 0.049*	-0.331
Carbohydrate	p= 0.999	0.000
Fiber	p= 0.987	-0.003
Water	p= 0.378	-0.151
Vitamin A	p= 0.332	-0.167
Vitamin D	p= 0.727	0.060
Vitamin E	p= 0.540	-0.106
Vitamin C	p= 0.475	0.123
Vitamin B1	p= 0.438	0.133
Vitamin B2	p= 0.033*	-0.357
Vitamin B3	p= 0.728	0.060
Vitamin B6	p= 0.143	-0.249
Vitamin B9	p= 0.259	0.193
Vitamin B12	p= 0.007*	-0.443
Calcium	p= 0.229	-0.206
Iron	p= 0.527	0.109
Zinc	p= 0.771	-0.050

*Spearman test is significant at $p<0.05$

Significant negative analysis result was also shown in the contribution of vitamin B2 (r= -0.357) and vitamin B12 (r= -0.443). The negative relationship shown can be associated with consistently eating breakfast with better nutritional intake (Barr et al., 2014; Mielgo-Ayuso et al., 2017); In this regard, previous research observed that people who skipped breakfast were significantly less likely to eat the recommended five servings of fruits and vegetables each day (Utter et al., 2007). This will lead to a decrease in respondents' preference for foods that are high in energy and protein which can lead to weight gain.

Breakfast consumption seems to be associated with a decrease in macronutrient intake (energy and protein) which, if consistent in the long term, can affect a person's BMI. In addition, studies have shown a link between breakfast and higher intakes of vitamins and minerals (Giménez-Legarre et al., 2020). This is related to the choice of breakfast food which tends to be healthier than other meal times.

Some respondents tend to choose vegetables, fruit, and cereals as their breakfast menu because they are more quickly processed and consumed in the morning before morning activities. Another study found that respondents who never had breakfast every day had higher intakes of energy, fat, and carbohydrates and had lower intakes of vitamins A and C, carotene, Ca, P, K, Mg, Zn, Se, and Mn compared to those who eat breakfast every day (Zou et al., 2020).

The average breakfast-related research is still focused on the age of children, especially school-age children. This is a strength in this study because the respondents are in the category of adult age and highly educated (postgraduate) with a limited number

of studies. In addition, the online interview method is a new thing to do due to the pandemic situation so that the research results can be one of the references in the formulation of future similar research.

Based on the results of the study, it was seen that breakfast problems still occur among adults. It is necessary to promote the importance of breakfast which is not only focused on children, but also in adulthood in an effort to limit energy, protein intake, and increase vitamin and mineral intake to achieve better nutritional and health status.

The limitations in this study are the limited number of respondents so that there is no randomization process, the short research time, and the online interview process so that it enlarges one of the errors that often occur in the recall method, namely error in estimation. An example of this error is an incorrect measure of the amount consumed. For example, the description of the size of the spoon used is not explained whether it is a tablespoon or a teaspoon so that it can affect the results of the analysis. The absence of a significant relationship between intake of other nutrients with BMI is in line with the results of the study Fitriana (2011) and Rahmawati (2013) which stated that this could be because the consumption data on food recall could not provide an overview of daily food intake habits (Supariasa et al., 2012). In addition, consumption data obtained through food recall only describe current food consumption (short-term), while the condition of nutritional status in this case a person's BMI is the cumulative consumption of food in a long time (long-term).

According to Riyadi (inIfdal, 2014) a person's nutritional status can be caused by many factors, either directly or indirectly. Food consumption and a person's health condition are direct factors that affect a person's nutritional status. Agricultural, economic, socio-cultural, and environmental factors are some indirect factors that can also affect nutritional status. Overall, it is known that nutrient intake is not the only factor that affects the nutritional status of respondents in this study.

Conclusion

The contribution of energy and breakfast nutrients from most of the respondents have met the recommended energy contribution (≥25%). The results showed that the contribution of nutrients (energy, protein, fat, vitamin B2, and vitamin B12) in breakfast was significantly correlated with BMI and had a negative relationship. This means that the higher the contribution of energy and nutrients in breakfast, the lower the BMI will be. For future research, it would be necessary to add the number of male respondents so the contribution of energy and breakfast nutrients based on gender can be compared. In addition, increasing the number of days for food recall method also needed, so it can represent more of the respondents' dietary habits.

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