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Analysis of Knowledge Level, Consumption Habits, Sugar and Calories Content in Ice Cream on the Nutritional Status of Depok Students

Analisis Tingkat Pengetahuan, Kebiasaan Konsumsi, dan Kandungan Gula serta Kalori pada Es Krim terhadap Status Gizi Mahasiswa Depok

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ABSTRACT

Background: Obesity is a nutritional problem in Indonesia. A factor that influences the incidence of obesity is a high-sugar diet (ex: ice cream products). The consumption rate of ice cream increases every year and is also accompanied by an increasing number of outlets providing ice cream products. Added sugar in ice cream contributes to an increased intake of high-calorie foods that leads to obesity.
Objectives: To analyze level of knowledge, consumption habits, sugar and calorie content of ice cream on the nutritional status of Depok students.
Methods: Observational research with cross-sectional design, analyzed with frequency distribution and chi-square test. Data were obtained using online questionnaire. The research was conducted in the city of Depok, involving 939 samples of Depok students selected with purposive sampling methods.
Results: 667 (71.0%) students have a good level of nutritional knowledge and 578 (61.6%) students unusually eat ice cream. There is no relationship between the level of nutritional knowledge (p-value: 0.609) and ice cream consumption habits (p-value: 0.211) on the nutritional status of students. Vanilla ice cream cup with cookies and cream topping is the most preferred ice cream, containing 13.28 grams of sugar and 154.11 kcal calories.
Conclusions: Depok students have good nutritional knowledge and unusually eat ice cream. The sugar and calorie content of the ice cream are high.

INTRODUCTION

Nutritional status is a condition yielded from the balance between the body's needs and the intake of nutrients for metabolism. If there is a disparity between the existing nutritional status and the desired nutritional state, nutritional problems may arise[1]. Obesity is considered as a significant nutritional issue in almost all countries including Indonesia. According to data from the World Health Organization (WHO), around 13% of adults (>18 years old) worldwide experienced obesity in 2016[2]. The prevalence of obesity continues to rise in Indonesia each year. Based on the main findings of the Basic Health Research (Riskesdas), the prevalence of obesity was 10.15% in 2007, 14.8% in 2013, and 21.8% in 2018[3]. In West Java province in 2018, 23.0% of adults (>18 years old) were obese. Depok city, located in West Java, had the second-highest prevalence of obesity after Bekasi city. The prevalence of obesity in Depok reached 29.16% of adults (>18 years old) in 2018[4].

Obesity is associated with an increase in Body Mass Index (BMI). The increase of BMI is a major risk factor for non-communicable diseases such as diabetes mellitus, heart disease, stroke, musculoskeletal disorders, and various types of cancer[2]. One of the factors influencing obesity is a low level of nutritional knowledge, which affects an individual's attitudes or behaviors in choosing the food they consume[5]. Additionally, high consumption of sugar, salt, and fat also contributes to obesity[6,7].

Several studies have shown a relationship between the consumption of foods containing added sugars and various diseases such as obesity, type 2 Diabetes Mellitus (DM), metabolic syndrome, and other illnesses. A case-control study conducted by Fatmawati (2019) on junior high school students in South Tangerang

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city revealed that high consumption of simple sugars increased the risk of childhood obesity by 5.7 times[8]. In another study, it was mentioned that high sugar intake had a significant association with an increase in fasting blood glucose among office workers (p<0,05)[9]. According to Paglia (2019), multiple studies indicate the risk of developing several diseases, including cavities, cardiovascular diseases, type 2 diabetes, non-alcoholic fatty liver disease (NAFLD), metabolic syndrome, and obesity due to excessive sugar consumption[10].

In the production of food and beverages, sugar serves as a sweetener[11]. . The types of sugar in food are divided into two categories: natural sugars (natural syrups, honey, vegetables, fruits) that enhance nutritional value as they coexist with other nutrients in the food ingredients, and added sugars (syrups, processed sugars, and other caloric sweeteners) that contribute solely to an increase in calorie intake[12,13]. The recommended intake of added sugars is advised to be no more than 10% of the daily energy requirement. According to the Dietary Guidelines for Americans (2020), desserts, sugar-sweetened beverages, and sweet snacks are examples of foods and beverages containing added sugars. Desserts are typically sweet foods containing cream, resulting in high sugar and fat content. An example of a sweet dessert and snack is ice cream[14,15].

Ice cream is preferred by people of all ages and is quite popular in society as a snack[16]. This has led to a high demand for ice cream, accompanied by a wide variety of ice cream options available in shopping centers, restaurants, and even from mobile ice cream vendors[17]. The consumption of ice cream continues to increase each year in Indonesia. From 2013 to 2018, ice cream consumption reached 0.63 liters per person per year, and increased to 0.7 liters per person per year in 2019, and further rose to 0.73 liters per person per year in 2020[18,19]. The growing consumption of ice cream is also accompanied by the rapid growth in the quantity of outlets offering ice cream on their menus. This growth has been particularly fast in recent years. In Indonesia, popular outlets like KFC, Burger King, Mixue, McDonald's, and others that offer ice cream products are increase in the number of branches. The high consumer demand for ice cream products due to the rising consumption of ice cream influence the expansion of these outlet branches.

The consumption of ice cream become a concern as the ice cream industry gain more popularity, especially among teenagers and young adults who continually following the trends. Ice cream has attracted attention due to its high sugar and calorie content, contributing to the development of non-communicable diseases that pose a threat to public health. Additionally, there is a lack of information regarding the nutritional content of ice cream in Indonesia, necessitating the search for research sources from abroad that may not be directly relevant to the local context. These various issues have led the author to be interested in analyzing the level of knowledge, consumption habits, as well as the sugar and calorie content of ice cream in relation to the nutritional status of students in Depok.

METHODS

This study is observational research with a cross-sectional design using purposive sampling technique. The sample size is calculated using the Slovin formula[20] and the minimum required sample size is determined to be 1093 respondents. Inclusion criteria for this research is Depok students aged 17-35 who are willing to fill out the online questionnaire and provide information on their weight and height. Exclusion criteria involve students from outside Depok, those who do not provide weight and height data, and students who filled out the questionnaire more than once. Data collection is conducted using a questionnaire developed by the researcher. The collected data includes information on the level of nutritional knowledge, ice cream consumption habits, and the most consumed ice cream variants by Depok students. There are 5 questions related to nutritional knowledge, and their validity and reliability have been tested, with all questions (P1-P5) being valid (calculated r >table r 0.361) and reliable (Cronbach's Alpha value 0.695 >0.6). The return rate of questionnaires is included in Table 1. A total of 1139 students filled out the questionnaire. Among them, 30 students filled out the questionnaire twice, 14 students were from outside Depok, and 156 Depok students did not provide weight and height data. Therefore, the total data eligible for analysis is from 939 students (82.4%) representing 18 different universities in Depok.

Table 1. Questionnaire Return Rate

Cleaning Data	Total (n = 1139)	
	Number	Percentage (%)
Questionnaires filled out by students in Depok who provided their height and weight information.	939	82.4
Questionnaires filled out by students I Depok but did not include their height and weight.	156	13.7
Questionnaires filled out by students from outside Depok.	14	1.2
Questionnaires filled out more than once.	30	2.7

The data on nutritional knowledge is categorized into good knowledge (score ≥ median = 80) and poor knowledge (score <median = 80)[21]. Information on students' ice cream consumption habits in the last month is collected using a Food Frequency Questionnaire and processed according to Sembiring's classification (2017)[22] with categories of regular consumption (score 15-50 with consumption frequency more than once a day, 4-6 times a week, or 3 times a week) and irregular consumption (score 0-14.5 with consumption frequency 1-2 times a week, less than once a week, and never). Nutritional status data were obtained from calculating students' BMI (Body Mass Index) based on weight and height information. Nutritional status was then classified into

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undernutrition (-3 SD to +1 SD for age <18 years and BMI <18.5–22.9 for age ≥ 18 years) and overnutrition (+1 SD to >+2 SD for age <18 years and BMI 23 - ≥ 30 for age ≥ 18 years)[23]. The most frequently chosen and consumed ice cream variant by students last month, based on questionnaire results, is selected as the ice cream sample. These samples are then taken to the Saraswanti Indo Genetech (SIG) laboratory in Bogor for analysis. Analysis of added sugar content (glucose, sucrose, and fructose) was conducted using the high-performance liquid chromatography (HPLC) method. Protein content analysis is performed using the titrimetric method (semi-micro Kjeldahl), total fat analysis is conducted using the Weibull method, total carbohydrates are calculated using the difference method, ash content analysis is performed using the gravimetric method, water content analysis is done using the dry ashing method, and total calorie analysis is carried out by calculation, which involves summing the calories from fat, protein, and carbohydrates.

The analysis conducted was univariate analysis to understand the frequency distribution and percentage overview of each variable. Additionally, bivariate analysis is performed using crosstab tables and the chi-square test to analyze whether there was a relationship between nutritional knowledge levels and ice cream consumption habits with the nutritional status of Depok students. This research had been approved by the ethics committee of health research at UPN "Veteran" Jakarta with the ethical code number: 272/VI/2023/KEPK.

RESULTS AND DISCUSSION

Data on age range, nutritional status, nutritional knowledge levels, ice cream consumption preferences, and habits among students are presented in Table 2. According to the Kamus Besar Bahasa Indonesia (Indonesian Dictionary), a university student is an individual undergoing education at a tertiary institution. A total of 939 students from 18 different universities in Depok participated in this research. Table 2 indicates that the age range of the students is from 17 to 35 years. Most students, 97.6% or 916 individuals out of the total 939 students, fall into the category of late adolescents (17–25 years). Meanwhile, students aged 26–35, categorized as early adults according to the Indonesian Ministry of Health in 2009 (as cited in Amin and Juniati, 2017), amount to 23 individuals, constituting 2.4% of the total[24]. Students in this age group typically exhibit characteristics of independence, both in term of financial and in terms of the freedom to make their own decisions and a more realistic view of the future[25]. This includes the freedom to choose their own food, as lifestyle is one of the factors influencing student consumption behavior.

In this era of globalization there are lifestyle changes with a tendency of eating out. It has led to an increase in the number of restaurants, eateries, cafes, food courts, located near schools, residential areas, offices, shopping centers, and campus. Lifestyle preferences significantly impact the choice of fast-food brands. One characteristic of the modern environment is the inclination to consume energy-dense foods, thereby promoting unhealthy eating habits[20]. The consumption patterns of students are influenced by changing lifestyles and living arrangements. Students who live far from their parents are more likely to consume unhealthy foods (high in sugar, salt, and fat, and low in fiber). This, in turn, affects body weight, and if continued, can lead to obesity[26].

The results of this study classify the nutritional status of students based on BMI (Body Mass Index) according to the WHO Asia Pacific guidelines as described by Rasyid (2021)[23]. Table 2 presents the characteristics of nutritional status among the 939 students from Depok who participated in this research. Out of these, 277 students (29.5%) were classified as having overnutrition. This figure was higher compared to the obesity prevalence in Depok in 2018, which was 29.16% among adults aged 18 and above[4].

The nutritional knowledge of students is assessed based on five questions related to the nutrition of ice cream. According to the questionnaire data, most students have scores above the overall data median (median = 80), categorizing them as having good nutritional knowledge. Specifically, 667 students, or 71.0% of the total 939 students, are classified into this category. Nutritional knowledge is associated with the occurrence of obesity, as low nutritional knowledge influences a person's attitudes or behaviors in choosing the foods they consume[5].

Based on the questionnaire results, 910 students, or 96.9% of the respondents, indicated that they enjoy consuming ice cream by answering "Yes" to the question "Do you like consuming ice cream?". On the other hand, 29 students, or 3.1%, responded with "No," indicating that they do not enjoy consuming ice cream. Table 2 illustrates the ice cream consumption habits among Depok students. Most students (61.6% or 578 individuals out of the total 939) do not have a regular habit of consuming ice cream.

One of the triggering factors for obesity is a diet high in salt, sugar, and fat. In Indonesia, environmental changes related to food have contributed to the increasing prevalence of obesity by influencing the consumption behavior of the population. This is consistent with the research by Kartolo and Santoso (2022), where the results show a significant relationship between fat, sugar, and sodium intake from fast food and the occurrence of obesity in junior high school adolescents, with p-values of 0.00, 0.00, and 0.0216, respectively[6].

One of the products high in sugar is ice cream. Ice cream has become a trend in society in recent years, especially among adolescents and young adults who continue to follow the trends. In this study, 910 individuals (96.9%) out of a total of 939 Depok students enjoy consuming ice cream. This is because Indonesians, including students, consider ice cream as one of the alternative desserts or snacks[17]. Ice cream is not considered a daily staple; rather, it is consumed as a snack by most people. According to data from BPS, the level of ice cream consumption in Indonesia was only 0.73 L/person/year in 2020[19]. When compared to New Zealand, which had the highest ice cream consumption rate in the world in 2020 (with a consumption rate of 28 L/person/year), ice cream consumption in Indonesia is

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only about 2.6% of the consumption rate in New Zealand[27].

Table 2. Characteristics of Students in Depok

Characteristics	Total (n = 939)			
	Frequency	Percentage (%)	Minimum	Maximum
Age				
17 – 25	916	97.6	17	35
26 – 35	23	2.4		
Nutritional Status				
Undernutrition	662	70.5	13.8	62.8
Overnutrition	277	29.5		
Nutritional Knowledge				
Poor	272	29.0	0	100
Good	667	71.0		
Ice Cream Consumption Preferences				
Yes	910	96.9	-	-
No	29	3.1		
Ice Cream Consumption Habits				
Irregular Consumption	578	61.6	0	50
Regular Consumption	361	38.4		

Bivariate Data Analysis Result

The data on the level of knowledge based on Body Mass Index (BMI) and the results of the chi-square test examining the relationship between the level of knowledge and the nutritional status of Depok students are presented in Table 3. According to the research findings, 272 students (29.0%) have insufficient nutritional knowledge. Out of the total 272 students with inadequate nutritional knowledge, 77 students (8.2%) have overnutrition. The majority of students have good nutritional knowledge, totaling 667 individuals (71.0%). Among these 667 students with good nutritional knowledge, 467 students (49.7%) have normal nutritional status, and 200 students (21.3%) have overnutrition. In the statistical test results, a p-value of 0.609 is obtained (p-value >α).

The statistical analysis of nutritional knowledge with the nutritional status of Depok students shows that there is no significant relationship between nutritional knowledge and nutritional status in students in Depok (p-value = 0.609). This aligns with the research conducted by Wulandari et al. (2021) on 66 students from Ibn Khaldun University in Bogor, which states that there is no relationship between nutritional knowledge and the nutritional status of students (p-value = 0.319)[28]. Similar studies were also carried out by Charina et al. (2022) on 158 students from Nusa Cendana University. The results indicate no significant relationship between knowledge of balanced nutrition and Body Mass Index (BMI) in students (p-value = 0.189)[29]. Sagala (2021) also conducted research on 161 students from Mitra Keluarga Health Sciences College in Bekasi and obtained similar results, showing no relationship between knowledge of balanced nutrition and nutritional status in students (p-value 0.595)[30]. This suggests that having a high level of knowledge does not necessarily correlate with improved nutritional status. Students with good knowledge may not necessarily adopt healthy and nutritious eating habits and engage in regular physical activity to maintain or improve their nutritional status[28]. Therefore, individual awareness is needed to prevent obesity by maintaining a healthy lifestyle and engaging in physical activity.

Table 3. Bivariate Statistical Analysis Results

	Nutritional Status		p-value
	Undernutrition	Overnutrition	
Nutritional Knowledge			
Poor	195 (20.8%)	77 (8.2%)	0.609
Good	467 (49.7%)	200 (21.3%)	
Total	662 (70.5%)	277 (29.5%)	
Ice Cream Consumption Habits			
Irregular Consumption	416 (44.3%)	162 (17.3%)	0.211
Regular Consumption	246 (26.2%)	115 (12.2%)	
Total	662 (70.5%)	277 (29.5%)	

The data on consumption habits based on Body Mass Index (BMI) and the results of the chi-square test examining the relationship between consumption habits and nutritional status of Depok students are presented in Table 3. According to Table 3, the majority of Depok students do not have a regular habit of consuming ice cream, totaling 578 students (61.6%). On the other hand, 361 students (38.4%) have a regular habit of consuming ice cream. Out of the total 361 students with this habit, 115 students (12.2%) have overnutrition. In the statistical test results, a p-value of 0.211 is obtained (p-value >α).

The statistical analysis of consumption habits with the nutritional status of Depok students shows that there is no significant relationship between the habit of

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consuming ice cream and the nutritional status of students in Depok (p-value = 0.211). This is in line with the research conducted by Diani (2018) on 215 students from the Faculty of Medicine, Indonesian Christian University, which states that there was no relationship between eating patterns and obesity with a p-value of 0,591[26]. The results of this study are also consistent with Mahmoud et al. (2022) on 369 children aged 5-10 years in Egypt, which shows a significant positive correlation between BMI and legumes, ice cream, soft drinks, sugar, desserts (cakes/donuts/sweet pies/baklava/basbosa/konafa), fast food, and caffeinated beverages. The study also mentions that overweight/obese participants have the habit of consuming ice cream 1 to 6 times a day[31]. Obesity can be caused by several factors such as excessive energy intake due to improper diet and lack of balance with physical activity, leading to the accumulation of fat in the body[26].

Laboratories Data Analysis Result

Based on the conducted survey, it was found that there were 83 ice cream variants commonly purchased by students in Depok. The variant most frequently chosen by students is the cup-type vanilla ice cream with cookies and cream topping, selected by 192 individuals (21.1%). The research did not delve into the reasons behind the students' choice of ice cream variants. This particular ice cream variant will be used as a sample for analyzing the sugar and calorie content in ice cream. The ice cream samples for analysis were purchased from two different branches of the selected ice cream brand located in the Depok region, West Java.

Data analysis of the nutritional content in ice cream samples was processed by calculating the averages for both single and double portions. The results of the nutritional analysis of the ice cream (per 100 mL) are presented in Table 4. Based on the analysis results, it was observed that every 100 mL or one cup of vanilla ice cream with cookies and cream topping contains 2.67 g of protein, 5.11 g of fat, 24.35 g of carbohydrates, and an energy content of 154.11 kcal. These nutritional values are lower compared to the nutritional content data for ice cream in the Indonesian Food Composition Table, which is 4.0 g of protein, 12.5 g of fat, 20.6 g of carbohydrates, and an energy content of 210 kcal[32].

The studied ice cream has a sucrose content of 13.28 grams, approximately equivalent to one tablespoon of granulated sugar. This sugar content already fulfills ¼ of the recommended daily sugar intake[15]. The intake of added sugar in ice cream is associated with the increased prevalence of obesity, type 2 diabetes, and heart diseases. Sugar activates the brain reward pathway, leading to addiction and excessive consumption, thereby triggering weight gain[13].

The type of sugar in the examined ice cream is sucrose, which falls under the category of added sugar. Inside the body, sucrose is broken down into fructose and glucose molecules, allowing fructose to exhibit reinforcing properties that activate the reward system. Fructose activates the reward-related areas in the mesocorticolimbic dopamine system, leading to increased impulsivity towards food rewards. It initiates overeating behavior. Furthermore, the effects of sugar on modulating the dopamine pathway in the mesolimbic system may not be direct and may involve the release of hormones in the periphery and interactions with dopaminergic pathways. Insulin, ghrelin, leptin, and GLP-1 (glucagon-like peptide 1) interact with dopamine neurons in the midbrain. Leptin and insulin inhibit dopamine neurons, while ghrelin triggers their activation. Insulin is known to increase cravings for fat and sugar, reducing hedonic eating. Additionally, after leptin injection in the ventral tegmental area (VTA), food intake decreases, and the ablation of leptin receptors in this area increases the rewarding aspects of enjoyable foods, including sugar[33].

The ice cream in this study had a total of 154.11 kcal and 5.11 grams of fat. The analyzed total calories from the ice cream already fulfill 12.9% of the daily energy requirement of 2000 kcal. If this ice cream product is consumed excessively, it can lead to weight gain.

One of the main factors that can affect normal glucose levels in the body is the consumption of a high-calorie and high-fat diet. Increased calorie intake can lead to the accumulation of excess adipose tissue, causing an imbalance between what is consumed and what is expended by the organism. Several circuits and organs are required to maintain glucose homeostasis, with the brain and hypothalamus (nutrient sensing nucleus/hormone) playing a central role. The hypothalamus is not only involved in the physiological regulation of glucose homeostasis but its deregulation (or at least the deregulation of some circuits/cores) contributes to the development of obesity and type 2 diabetes mellitus. This phenomenon activates microglial stress and endoplasmic reticulum (ER) stress culminating in the development of central insulin and leptin resistance. Obese individuals and some type 2 diabetes mellitus patients experience hyperleptinemia due to an increase in adipose tissue mass. This state of hyperleptinemia results in a decrease in leptin's ability to suppress appetite or increase the body's energy expenditure, leading to continued weight gain[33].

Table 4. Nutritional Content of Depok Students' Choice of Ice Cream

Ice Cream Nutrients (per serving or 100 mL)	Nutrient Content
Total Energy (kcal)	154.11
Energy from fat (kcal)	45.99
Protein (g)	2.67
Total fat (g)	5.11
Carbohydrate (g)	24.35
Total Sugar (g)	13.28
Glucose (g)	<0
Fructose (g)	<0

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Ice Cream Nutrients (per serving or 100 mL)	Nutrient Content
Sucrose (g)	13.28

The limitations of this study include the online data collection method with a large sample size, which did not involve direct measurements of weight and height. The data on weight and height were solely based on the respondents' recall, introducing the risk of data bias. The study did not delve into the reasons for students' choice of ice cream brands or variants and did not explore physical activity and other dietary consumption habits that could contribute to obesity.

CONCLUSIONS

Most Depok students (71.0%) have good nutritional knowledge. The most preferred ice cream variant among Depok students is the cup variant with vanilla flavor and cookies and cream topping. About 96.9% of Depok students enjoy consuming ice cream. Most Depok students (61.6%) did not regularly consume ice cream. The examined ice cream contains 13.28 grams of sucrose (fulfilling about ¼ of the recommended daily sugar intake) and had a total calorie content of 154.11 kcal (fulfilled 12.9% of the daily energy requirement of 2000 kcal). There is no correlation between nutritional knowledge level and nutritional status in students (p-value = 0.211). There was no connection between ice cream consumption habits and nutritional status in students (p-value = 0.609). There are still some limitations in this study, such as not exploring the reasons for students' choice of ice cream variants, not investigating physical activity, and other dietary consumption habits that might contribute to obesity, making it a potential reference for future research.

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Conflict of Interest and Funding Disclosure

All authors of this article declare no conflicts of interest. This research is the result of joint discussions among all researchers and received funding from UPN Veteran Jakarta with the aim of enriching knowledge, particularly related to the phenomenon of the increasing consumption of ice cream in the present time.

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