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The Influence of Gender on College Students' Nutrition Knowledge and External Eating Style toward Healthy Food Choices

Pengaruh Jenis Kelamin dalam Pengetahuan Gizi dan Gaya Makan Eksternal terhadap Pilihan Makanan Sehat pada Mahasiswa

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ABSTRACT

Background: In Indonesia, the prevalence of obesity remains on the rise, with 35.4% of the population experiencing it. Consuming unhealthy food is one of the influential causes, typically affected by nutritional knowledge and external eating style.
Objectives: This study aimed to investigate whether gender, nutrition knowledge, and external eating style influence healthy food choice.
Methods: The *Behavioral measurement* research with *quasi experimental design* were adopted, recruiting 123 participants selected purposively. The study was conducted in a psychology laboratory using the *Fake Food Buffet* (FFB) instrument for food choices, the *Nutrition Knowledge Questionnaire* (NKQ) scale for nutritional knowledge and the *Dutch Eating Behavior Questionnaire* (DEBQ) scale for external eating styles. The data collected were then analyzed using *a generalized linear model*.
Results: Approximately 61.8% of the participants have a normal Body Mass Index (BMI). Gender and nutrition knowledge showed a negative relationship with healthy food choices (p-value = 0.043; η2 = 0.035). Females having good nutrition knowledge tend to make less healthy food choices compared to males. Additionally, the interaction between gender, nutrition knowledge, and external eating style shows a positive correlation with healthy food choices (p-value = 0.036; η2 = 0.038). Females are more likely to choose healthy food compared to males.
Conclusions: The results implied that nutrition knowledge and external eating style influence students' healthy food choices. Gender may affect consistency in making healthy food choices among students' eating behavior. Therefore, future research might have further observation on people's eating behavior.

INTRODUCTION

Obesity has become one of the leading causes of non-communicable diseases (NCDs), contributing to increased mortality rates worldwide. Over time, Indonesia has witnessed a steady rise in the prevalence of obesity. The Indonesian Ministry of Health (2023) reports that the country's obesity rate increased from 11.5% in 2013 to 21.8% in 2018, and 23.4% in 2023. This resulted in a combined prevalence of overweight and obesity of 35.4% in 2018, indicating that obesity issues are worsening each year[1].

An imbalance between energy intake and expenditure leads to obesity, which has detrimental effects on health[2]. In both industrialized and developing nations, obesity is a contributing factor to cardiovascular diseases, diabetes, hypertension, and cancers[3,4,5]. Nutritional awareness is one of the factors contributing to obesity. Nutrition knowledge influences the quality of one's diet, which subsequently affects anthropometric measurements[6]. As women mature, they tend to become more knowledgeable about nutrition, thus reducing the risk of obesity. Several measures must be taken to prevent obesity, including encouraging healthy food policies, preventing unhealthy eating behaviors, implementing fiscal policies such as taxes (specifically on sugary beverages), and providing nutrition education to motivate people to consume healthier foods[7,8].

Nutritional knowledge contributes to healthy food choices. However, being knowledgeable alone is not sufficient to change eating behavior unless an individual also has a positive attitude toward healthy food[9]. Both knowledge and attitude are important for effective behavior change[10]. An individual's food intake and nutritional status are influenced by their eating behaviors, which are based on their nutrition knowledge[11]. Nutrition knowledge refers to the comprehension of concepts related to nutrition, health, the relationship between diet and disease, the main sources of nutrients, and dietary recommendations[12]. Nonetheless, adolescents' attitudes, knowledge, and healthy eating habits continue to vary. Although some people may be aware of a food's nutritional value, they may not be aware of its origins, and vice versa.

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University students often experience this issue, as they may recognize the significance of eating habits and nutritional information but still neglect to incorporate healthy eating habits into their daily routines[13].

A person's eating style also plays a role in the selection of healthy food, in addition to nutritional knowledge. Eating style can be evaluated in three dimensions: external, emotional, and controlled eating styles. External eating refers to the response to external food cues, such as smelling, seeing, or tasting food, regardless of internal factors like hunger and fullness. Emotional eating is related to responses to negative emotions, while controlled eating is the intention to consciously limit food intake to prevent weight gain or aid in weight loss[14]. Those with high nutritional knowledge are more likely to choose healthy foods by reducing external eating behaviors[15]. External eating styles can predict increased consumption of unhealthy foods, which raises the risk of obesity[16]. Additionally, external eating is linked to higher total energy intake[17]. Those who are overweight and prone to overeating, whether emotionally or externally, are more likely to respond to food cues and consume snacks[18]. People with a high external eating style tend to consume more unhealthy sweet foods, primarily influenced by their tendency to respond to external food cues[19].

In addition to nutrition knowledge and external eating styles, gender also influences food choices. Females tend to consume healthier foods (e.g., salads, vegetables, fruits, and snacks like sweets, biscuits, nuts, and seeds), while males are more likely to choose unhealthy foods (e.g., hamburgers, pizza, processed meats, and soda, and they also consume more sugary drinks, salty snacks, and foods high in protein, fat, and sugar)[20,21,22]. However, data from the Indonesian Ministry of Health (2018) indicates that obesity rates are higher in females[23]. Although females typically consume more grains and vegetables, they also have a higher intake of sweet foods compared to males. Such eating styles may result in unhealthy food choices. Additionally, females often exhibit poorer eating behaviors (e.g., replacing main meals with snacks, skipping meals, eating more during the day, and being more likely to eat uncontrollably)[24,25].

However, related studies highlight a gap between nutritional knowledge and food choices. Although students generally have a good understanding of nutrition and recognize the importance of eating patterns, their food choices are often influenced by concerns about food safety. Some students, despite being aware of the risks associated with addictive substances in foods, fast food, processed foods, and sugary sodas, still report being overweight and prefer consuming fast food, usually mixed with salad and fruit[26]. Moreover, a study on students in England found that knowledge about high salt consumption did not affect salt consumption; in other words, the students continued to consume excessive salt[27]. In response, the present study aims to further observe whether gender, nutrition knowledge, and external eating behaviors influence food choices among students. We propose the hypothesis that there are influences among gender, nutrition knowledge, and external eating behaviors on healthy food choices among students.

METHODS

Design and Procedure

This study adopted behavioral measurement method along with quasi-experimental design. The procedure of this research is as follows: (1) the participants were invited individually to come directly to the research laboratory, (2) they were asked to fill out a consent form, nutrition knowledge scale, external eating style, and their demographics in the terms of age, gender, weight and height, (3) they were presented with a Fake Food Buffet (FFB), (4) they were asked to choose a plate of food they were willing to eat from FFB, and (5) they received a reward and debrief.

Research Participants

Following Gpower 3.1.9.4 with a priori effect size d = 0.5; α = 0.05; power 0.95, the present study recruited 123 students selected purposively[28]. We included the criteria of the participants, such as public university students who are no vegans, no vegetarians, do not have food allergies, and are not on a diet program. We also distributed flyers and questionnaires to students through social media (i.e., WhatsApp, Instagram, and Twitter) during the recruitment process.

Research Instruments

This study used three instruments to collect the data including Fake Food Buffet (FFB), Nutrition Knowledge Questionnaire (NKQ) scale and Dutch Eating Behaviour Questionnaire (DEBQ) scale. FFB, developed by Tamara Bucher, is a buffet of food replicas. It was used to draw the participants' food choice. The FFB used in this study has a validity range of 0.76 to 0.87, with reliability for specific food items such as carrots (0.79), legumes (0.81), pasta (0.89), and chicken (0.77)[29]. We utilized the FFB due to its practicality, efficiency, low cost, and hygiene, featuring 24 food items divided into healthy and unhealthy options. The healthy food options were grilled chicken, meatballs, rice, boiled potatoes, boiled carrots, cauliflower, apples, bananas, mineral water, juice, plain tea, and black coffee, while the unhealthy ones were fried chicken, fried sausages, fried rice, fried potatoes, fried carrots, fried cauliflower, cake, chips, soda, Sprite, sweet tea, and sweetened tea. We also used small trays, large trays, forks, and spoons for participants choosing the food. Food choices were measured by calculating the proportion of low-calorie foods chosen relative to the total number of food items selected by participants.

This study further used the NKQ scale, proposed by Parmenter and Wardle (1999), to measure the participants' nutrition knowledge. This scale has a test-retest reliability of 0.98 and a Cronbach's alpha validity of 0.70 to 0.97. There are four domains in this scale: (1) four items for expert advice, (2) twenty-one items for food sources and groups, (3) ten items for food choices, and (4) ten items for the connection between diet and diseases[30]. The correct answers were scored 1, while the incorrect or unanswered items were scored 0. Subscale

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scores are calculated for each domain, and the total of the four sections is computed to obtain an overall score. The measurement results are continuous, meaning that the higher the score, the better the participants' nutrition knowledge.

The DEBQ scale, developed by Van Strien (1986), was also used to measure the participants' external eating styles. The scale has a *Cronbach alpha* validity of 0.81 and 0.910 of reliability. The DEBQ scale, in this study, measured three domains namely controlled eating, emotional eating, and external eating[14]. There are 10 questions regarding external eating style. Participants should complete the questions by selecting an answer from "never" (1), "rarely" (2), "sometimes" (3), "often" (4), and "very often" (5). Each correct answer was scored as 1. Incorrect and missing values were scored as 0. The measurement results were continuous, with higher scores reflecting higher levels of external eating. All questionnaire items were presented in Bahasa to facilitate the participants' understanding.

Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics software version 24.0. Additionally, the General Linear Model was also used to estimate the relationships among variables. It was due to the data of participants' food choice percentages whose results are continuous with two independent variables and one nominal independent variable[24]. This study received approval from the Health Research Ethics Committee of Universitas Negeri Semarang with permit number 042/KEPK/FK/KLE/2024, dated January 29, 2024.

RESULTS AND DISCUSSIONS

The present study engaged 123 college students, 39% males and 61% females, aged 18 to 23 years old (see Table 1). The BMI participants' measurement on their height and weight showed that 61.8% had a normal BMI score. In addition, 23.6% were categorized underweight, 12.2% were overweight, and 2.4% were obese.

Table 1. The participants' demographic and BMI score information

Characteristics	n	%
Gender		
Male	48	39.0
Female	75	61.0
Age (years)		
18-20	77	62.6
21-23	46	37.4
Body Mass Index		
Underweight (<18.5)	29	23.6
Normal (18.5 - 24.9)	76	61.8
Overweight (25 - 29.9)	15	12.2
Obesity (>30)	3	2.4

n: Frequency; BMI: Body Mass Index; SD=Standard Deviation

The descriptive analysis shown that the mean (M) score for females (M = 62.1, SD = 22.3) was higher than for males (M = 60.6, SD = 24.5). However, the standard deviation (SD) for males was higher than for females. It indicated that the individual's scores varied. In contrast, female individuals' scores tended to be more consistent and closer to their average. The study also found a variety of nutrition knowledge levels among the participants (M = 60.4, SD = 12.5) and relatively similar to external eating styles (M = 33.4, SD = 5.5). Moreover, the analysis implied that there was a significant difference in participants' healthy food preferences (M = 61.5, SD = 23.1) (see Table 2).

Table 2. Descriptive statistical analysis of nutrition knowledge and external eating styles

Variables	n	Mean	SD
Gender	48	60.6	24.5
Male	75	62.1	22.3
Female	123	61.5	23.1
Total	123	60.4	12.5
Nutrition Knowledge	123	33.4	5.5
External Eating Styles	123	61.5	23.1
Healthy Food Choices	48	60.6	24.5

n: Frequency; SD: Standard Deviation

The results also confirmed that nutritional knowledge and external eating style influenced food choices (see Table 3 and Table 4). We found correlations between gender and nutrition knowledge, which negatively correlated with healthy food choices, i.e., F (1,115) = 4.192; p-value = 0.043; η^2 = 0.035; β = -4.639. It implied that females whose nutrition knowledge was high made poorer healthy food choices. Furthermore, the correlation among gender, nutrition knowledge, and external eating style were positively correlated with healthy food choices, i.e., F (1,115) = 4.522; p-value = 0.036; η^2 = 0.038; β = 0.138. In other words, gender, nutrition knowledge, and external eating style positively impacted healthy food choices.

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Additionally, females with high nutrition knowledge scores and high external eating style scores tend to choose healthier foods compared to males. The results maintained that gender did not significantly influence healthy food choices, F (1,115) = 3.282; p-value = 0.073; η^2 = 0.028. Meanwhile, nutrition knowledge and healthy food choices did not show any correlation, F (1,115) = 2.492; p-value = 0.117; η^2 = 0.021. Further, external eating style did not significantly affect healthy food choices, F (1,115) = 0.993; p-value = 0.321; η^2 = 0.009. Both interactions between gender and external eating style, F(1,115) = 3.503; p-value = 0.064; η^2 = 0.030, and nutrition knowledge and external eating style, F(1,115) = 1.969; p-value = 0.163; η^2 = 0.017, did not significantly affect healthy food choices.

Table 3. Partial effect of nutrition knowledge and external eating style on food choices

Variable	F	p-value	η^2
Gender	3.282	0.073	0.028
Nutrition Knowledge	2.492	0.117	0.028
External Eating Style	0.993	0.321	0.009
Gender x Nutrition Knowledge ∞	4.192	0.043*	0.035
Gender x External Eating Style	3.503	0.064	0.030
Nutrition Knowledge x External Eating Style	1.969	0.163	0.030
Gender x Nutrition Knowledge x External Eating Style∞	4.522	0.036*	0.038

F: F-statistic value from the ANOVA test; η^2: Partial eta squared; *ANOVA test, significant if p-value<0.05;
∞: There is an interaction/relationship; x = interaction.

Table 4. Univariate analysis of nutrition knowledge and external eating style by gender

Parameter	β	p-value	η^2
Female	257.730	0.073	0.028
Male	0a	.	.
Nutrition Knowledge	4.108	0.026	0.042
External Eating Style	5.847	0.065	0.029
Female x Nutrition Knowledge ∞	-4.639	0.043*	0.035
Male x Nutrition Knowledge ∞	0a	.	.
Female x External Eating Style	-7.632	0.064	0.030
Male x External Eating Style	0a	.	.
Nutrition Knowledge x External Eating Style	-0.114	0.026	0.042
Female x Nutrition Knowledge x External Eating Style ∞	0.138	0.036*	0.038
Male x Nutrition Knowledge x External Eating Style ∞	0a	.	.

β: Beta; η^2: Partial eta squared; *Univariate analysis, significant if p-value < 0.05; 0a = coefficient/parameter estimate
∞: There is an interaction/relationship; x = interaction

Gender Differences in Nutrition Knowledge and External Eating Behavior

People's eating behaviors are typically influenced by gender, nutrition knowledge, and external eating behaviors. External eating, generally caused by external stimuli, contributed most to weight gain[19]. The present study found that those females with high levels of nutrition knowledge and external eating behavior were more likely to choose healthier food. Moreover, females typically exhibit greater confidence in healthy eating, engage more in weight management, and face more substantial social expectations to maintain healthy eating behavior. Unfortunately, they often express frustration with their nutritional behavior. In contrast, preferred to eat more fatty foods, sweets, and fast food[31,32]. They also showed higher levels of impulsivity, increasing susceptibility to external eating cues[32]. The results of this study are in line with the previous study that maintained environmental triggers mainly influenced males' external eating styles[15].

Nutrition Knowledge from a Gender Perspective

Commonly, external eating styles affect weight gain, mostly happening in females[33]. Such eating styles were linked to impulsiveness, where external cues trigger the consumption of unhealthy foods[19]. Although females understand nutrition well, they tend to consume unhealthy food due to their eating behaviors[34]. Students frequently base their food choices on convenience, taste, time, and cost rather than nutritional value. While they often consume fresh fruits, they also eat a lot of fast food, likely due to the limited food options. It indicated that students' nutrition knowledge does not always align with their eating behavior. Despite being aware that fast food is unhealthy, they consume it most[35]. Other studies suggest that knowledge of nutrition is essential for healthy food choices but cannot change behavior. People are likely to act on such knowledge only if they feel comfortable or enjoy doing so, and even then, it can take years for meaningful changes to occur[36]. Many

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students understand that processed foods are unhealthy but consume them daily. Thus, a high level of nutrition knowledge does not necessarily translate into healthy eating behaviors, as habits play a crucial role[35].

Considering only gender and nutrition knowledge, males who are well-informed about nutrition typically choose healthier foods than females. This suggested that men are likelier to link their attitudes about food choice and knowledge. Similarly, studies on vaccine readiness by gender revealed that older males or those with higher education were more likely to be vaccinated. Conversely, females aged 30 to 49 years old and those with greater educational attainment were less likely to consent to vaccinations[37]. Males, older people, and educated people tended to embrace vaccines more[38]. Before making a decision, women were frequently influenced by social media, stimulating more risks and taking longer decision-making, even when they were more aggressive in their preventive measures[37].

Despite the insightful results, this study did not mean without any limitations. First, the lack of balanced representation between male and female participants leading to an imbalance in analyzing the role of gender in nutritional knowledge and eating styles. In respond, future research could expand the research samples by engaging more participants from diverse demographic and socioeconomic backgrounds. Furthermore, to understand the impact of food choices on health, research on monitoring individuals' eating styles and their effects on health should be carried out. Then, studies on the correlation between gender, nutritional knowledge, and external eating styles need more attention, hence further research needs to be conducted.

Indeed, the present study contributes theoretically by providing a more in-depth understanding about the role of gender influence toward nutrition knowledge and food choices. It enables readers to formulate or to develop new theories on how gender social constructs affect individual food choices, and how nutrition knowledge is adjusted to the gender context. Practically, the findings of this study led to the development of more effective nutrition interventions. It provided more specific and focused educational materials for males and females. It also developed targeted dietary guidelines for each gender starting in elementary schools, as eating habits are more likely to be shaped at a younger age. Overall, the present study does not only provide theoretical insights but also leads to practical applications improving people's health and well-being.

CONCLUSIONS

Nutrition knowledge and external eating styles positively influence healthy food choices. Based on moderation effects, females having good nutrition knowledge and external eating styles are more likely to choose healthy food compared to males. However, when ignoring the external eating styles, females tended to make fewer healthy food choices than males. It implied that eating behaviors gave much impact of females' food choices. In fact, males were more consistent in their food choices. Therefore, future research might further examine the eating behavior factors.

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CONFLICT OF INTEREST AND FUNDING DISCLOSURE

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AUTHOR CONTRIBUTIONS

NMA: writing original draft, investigation, software, data curation, data collection, statistical analysis; AU: conceptualization, methodology, supervision, draft review.

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