The Relationship between Nutritional Knowledge with Food Attitudes on Post COVID-19 Pandemic among High School Adolescents

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Abstract. Knowledge of nutrients is essential for adolescents to maintain optimal body function and prevent various health issues. The nutritional knowledge taught to high school students plays a crucial role in empowering high school students to make informed decisions about their health including food choice attitudes. This study aims to determine the relationship between nutritional knowledge and food choice attitudes on post-COVID-19 pandemic among high school adolescents. The research method used is descriptive-correlational, with nutritional knowledge as the independent variable and food choice attitudes as the dependent variable. 80 sample was conducted using purposive sampling continued by simple random sampling. Nutritional knowledge was measured using a multiple-choice test, and food choice attitudes were assessed using the Food Choice Questionnaire (FCQ). Prerequisite test results indicated that the data were normally distributed and homogeneous. The Pearson Product Moment obtained a result of correlation coefficient is 0.446, indicating a moderate correlation. Nutritional knowledge contributed 19.89% to food choice attitudes. From this study, it can be concluded that there is a positive relationship between nutritional knowledge and food choice attitudes.

Keywords: Food Choice Questionnaire, Nutritional Education, Nutritional Status.

1 Introduction

The Large-Scale Social Restrictions (PSBB) and Restrictions on Community Activities (PPKM) policies are known to be effective in reducing COVID-19 pandemic cases as evidenced by the decline in the effective reproductive rate (Rt) of COVID-19 in Indonesia.[1] However, these policies also have a negative impact, one of which is an increase in stress due to staying at home for a long time. Previous research using the General Health Questionnaire (GHQ-12) self-assessment instrument showed that 59.5% of adolescents aged 15-18 years experienced psychological problems and social dysfunction due to changes in school routines from home.[2] Badan Pusat Statistik (BPS) (2020) revealed that the COVID-19 pandemic has brought major changes and created uncertainty in people's lives. Self-isolation and uncertainty about when the pandemic will end have increased worries and stress. The BPS survey results show

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that 65% of respondents felt very worried about the news of COVID-19 and 57% felt very worried about their personal and family health. This can certainly have a negative impact on the mental health of each individual.[3]

The stress of the COVID-19 pandemic has led to changes in unhealthy eating choices. Boredom due to reduced social activities increases the need for energy intake and triggers cravings for overeating, especially "comfort foods" that are high in sugar.[4] This is done to reduce stress and increase serotonin production, which has a positive impact on mood.[5] Research shows that respondents aged 20-65 years use food as a coping mechanism by overeating and choosing unhealthy foods.[6] Research in Indonesia showed that out of 106 adolescents aged 12 to 21 years, only 18 adolescents showed good eating behaviour, while 88 adolescents showed poor eating behaviour such as eating irregularly, skipping breakfast, not consuming staple foods, eating less fruits, and preferring to eat snacks.[7]

The food we eat daily contains various nutrients needed by the body.[8] Nutrients are chemical bonds that are necessary for the body to perform its functions of producing energy, building and maintaining tissues in the body and regulating life processes.[9] Good nutrition and mental health are two important pillars in achieving a happy and quality life. Consumption of nutritious and balanced meals, getting enough sleep, regular exercise, and managing stress are key to maintaining mental and physical health. Nutritional deficiencies can lead to mental problems such as depression, anxiety and fatigue.[10] In addition, the food we consume also provides "information" and essential ingredients for the body to function properly. Like a language, food contains "codes" that are read by the body to perform various metabolic processes and other vital functions. If the "information" the body receives is incorrect or incomplete, these processes can be disrupted and result in poor health.[11] Adolescents need a balanced diet to maintain health and endurance, support growth and development, improve concentration and learning performance, reduce stress and anxiety, and prevent chronic diseases.[12]

Food choice attitudes is the process of making decisions about what, how and why to choose foods and beverages with consideration of how to prepare, distribute and consume constrained by what is available and accessible within the local food environment.[13] Unhealthy food choices, such as the consumption of high-energy, low-nutrient foods, can lead to disruptions in metabolism and cellular energy balance. This can trigger cellular stress, which can ultimately contribute to the development of metabolic syndrome.[14] Cellular stress is a condition when cells are subjected to stress or disturbances that can affect normal function. Cellular stress can be triggered by various factors such as environmental changes, unbalanced nutrition or certain pathological conditions.[15] Metabolic syndrome is a medical condition characterised by a combination of risk factors such as abdominal obesity, insulin resistance, high blood pressure, high blood sugar levels and unhealthy cholesterol levels. This condition increases a person's risk of developing heart disease, stroke and type 2 diabetes.[16]

Good food choice attitudes are based on knowledge and awareness of the importance of balanced nutrition that is safe for health.[17] Knowledge is information that has been processed and organised to gain understanding, learning and experience that accumulates on certain issues.[18] Knowledge about food nutrients includes an understanding of food, sources of nutrients, food safety, and how to process so that nutrients in food are not lost, as well as the importance of healthy living.[19]

High school students study nutrition and nutrition in the biology subject. Some high school biology materials related to nutrition include cells and tissues, food digestion system, metabolism, immune system, reproductive system, food digestion system, and food biotechnology.[20] The process of attitude formation takes place gradually starting from the learning process. This learning process is caused by a person's personal experience with certain objects such as people, objects or events by connecting these objects with previous experiences.[21] Students are expected to be able to choose nutritious, safe and sustainable food through a comprehensive learning process.[22]
This research needs to be done because it wants to see directly the relationship between the variables of food nutrient knowledge and post-pandemic food choice attitudes in adolescents in high school who have learned the concept of food nutrients in biology learning as a provision for making the right decisions about health, especially in food choice. In addition, research with the same variables has been conducted in Yogyakarta but has never been conducted on students in Bekasi and did not specifically use the *Food Choice Questionaire* (FCQ) instrument.

2 Research Methods

This research is observational research with a cross sectional study design. The research location at SMA Negeri 4 Bekasi, which was selected through purposive sampling technique with the consideration that North Bekasi District is the most populous district so that the results of the study can provide a more representative data.[3] The population in this study were grade XI students majoring in science and health and the number of samples used was 80 students using the simple random sampling method.
Knowledge of food nutrients was measured using an instrument in the form of a multiple choice test with different cognitive levels C1-C6 including indicators related to understanding food, sources of nutrients, food safety, food processing and the health effects caused by consumption of foods containing certain nutrients. Knowledge of food nutrients is classified into 4 criteria, namely not yet complete-remedial entirely if the score is 0-40; not yet complete-remedial partially if the score is 41-65; completed-not remedial if the score is 66-85 and completed-need enrichment if the score is 86-100.[23] Food choice attitudes were measured using 36 Food Choice Questionaire (FCQ) questions that have been adjusted to the needs of the study.[24] The categorisation of attitude scores is classified into 3, namely if the score is 0-55 insufficient, 56-75 sufficient criteria and 76-100 good criteria.[25] Each instrument in this study has been tested for validity and reliability. After the data were collected, the data were processed using SPSS (Statistical Product and Service Solution) version 29 and the prerequisite tests of normality and homogeneity were carried out. Furthermore, testing the hypothesis with a correlation test to determine whether there is a relationship between food nutrient knowledge and food choice attitudes then a simple regression test to test the strength of the relationship and predict the value of the dependent variable.

3 Result and Discussion

3.1 Characteristics of Respondents

The frequency distribution of respondents based on gender, age, Body Mass Index (BMI), amount of pocket money and frequency of exercise is shown in Table 1. The highest percentage in the gender category was female (68.75%); the age category was 17 years old (67.5%); the BMI category was normal (60%); the pocket money category was 15,000-24,000 (52.5%); and the frequency of exercise was 1 time a week (56%).

Table 1. Respondents Characteristics.

Variables		n	%
Gender	Male	25	31,25%
	Women	55	68,75%
Age	15	2	2,5%
	16	24	30%
	17	54	67,5%
Body Mass Index (BMI)	Underweight	21	26,25%
	Normal	48	60%
	Overweight	5	6,25%
	Obesity	6	7,5%
Pocket Money Amount	5.000-14.000	20	25%
	15.000-24.000	42	52,5%
	25.000-34.000	12	15%
	≥ 35.000	6	7,5%
Exercise Frequency	1 time a week	45	56%
	2 times a week	23	29%
	≥ 3 times a week	12	15%

3.2 Nutritional Knowledge Score

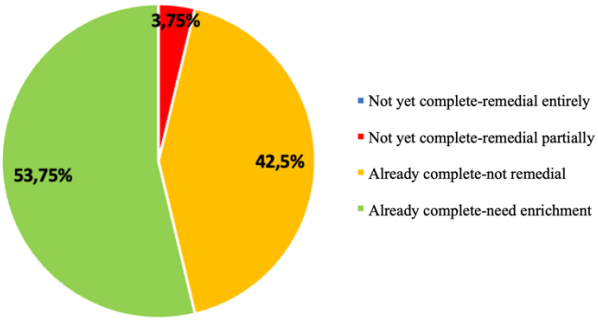

Fig. 1. Distribution Based on Criteria for Food Nutrient Knowledge Score

Figure 1 shows that 43 students (54.75%) have complete knowledge of food nutrients-needing enrichment, 34 students (43%) have complete knowledge-not remedial and

the remaining 3 students (3.8%) have incomplete knowledge of food nutrients-partially remedial. In addition, it can be seen that there are no students who have incomplete knowledge of food nutrients-remedial entirely. The criteria for each cognitive level can be seen in table 2. The average scores that have criteria that are complete-not remedial are cognitive levels C1, C2, C4, and C6. The average scores that have criteria that have been completed-need enrichment are cognitive levels C3 and C5. The highest average score obtained at the C3 cognitive level is 93.9 and the lowest average score obtained at the C1 cognitive level is 69.25.

Table 2. Descriptive Results of Each Dimension of Food Nutrient Knowledge.

Cognitive level	Average	Criteria
C1	69,25	Completed-not remedial
C2	83,63	Completed-not remedial
C3	93,90	Completed-needs enrichment
C4	85,53	Completed-not remedial
C5	91,88	Completed-needs enrichment
C6	77,19	Completed-not remedial

3.3 Food Choice Attitudes Score

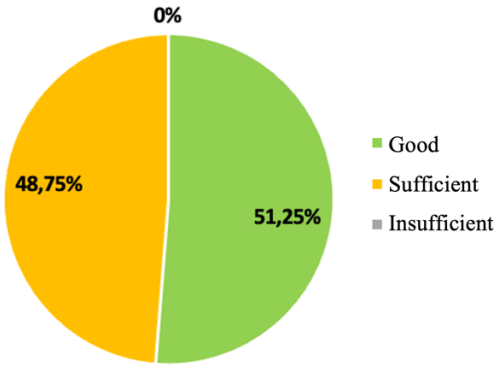

Fig. 2. Distribution based on Food Choice Attitudes score criteria

Figure 2 shows that 41 students (51.25%) have a good food choice attitude and the remaining 39 students (48.75%) have a food choice attitudes with sufficient criteria. In addition, it can be seen that there are no students who have food choice attitudes with insufficient criteria. The values and criteria for each dimension are listed in Table 3. Dimensions with good criteria are health, convenience, sensory appeal, natural ingredients, price, and ethics. Dimensions with sufficient criteria are mood, weight control, and familiarity. The highest average score was obtained for the dimension of food choice based on natural ingredients.

Table 3. Descriptive Results of Each Dimension of Food Choice Attitudes.

No.	Dimensi	Average	Criteria
1.	Health	78,44	Good
2.	Mood	69,63	Sufficient
3.	Convenience	76,85	Good
4.	Sensory Appeal	77,68	Good
5.	Natural Content	80,23	Good
6.	Price	77,93	Good
7.	Weight Control	68,19	Sufficient
8.	Familiarity	73,61	Sufficient
9.	Ethical Concern	78,44	Good

3.4 Correlation and Regression of Nutritional Knowledge with Food Choice Attitudes

Based on the calculation of the Pearson Product Moment correlation test, the significance value is <0.0001 <0.05, which means that there is a relationship between knowledge of food nutrients and food choice attitudes with a correlation coefficient (r_{xy}) of 0.446 which is moderate and positive. Based on the calculation of linear regression test, the regression equation $\hat{Y} = 46.71 + 0.333X$ is obtained and the regression model is significant.

Table 4. Pearson Product Moment Correlation Test Results.

		Food Nutrient Knowledge	Food Choice Attitudes
Food Nutrient Knowledge	Pearson Correlation	1	.446**
	Sig. (2-tailed)		<.001
	N	80	80
Food Selection Attitude	Pearson Correlation	.446**	1
	Sig. (2-tailed)	<.001	
	N	80	80

** Correlation is significant at the $\alpha = 0.01$ level (2-tailed).

Table 5. Linear Regression Test Results.

Model		Non-standardised coefficient		Standardised coefficient	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	46.710	6.427		7.268	<.001
	Food Nutrient Knowledge	.333	.076	.446	4.397	<.001
a. Dependent Variable: Food Choice Attitude						

3.5 Analysis of Nutritional Knowledge Score

The majority of students, namely 77 students (96.25%), have the criteria of complete-not remedial and complete-needing enrichment. The criterion of complete-not

remedial means that students have met the minimum requirements set and do not need repetition or additional interventions to understand food nutrients. The criterion of complete-need enrichment is defined as the minimum requirements have been met, but there is room for further development. Students at SMAN 4 Bekasi are given enrichment in the form of case study questions that allow students to improve understanding in a more concrete and interesting way. Enrichment is done to add insight or expand knowledge beyond the learning outcomes in the curriculum.[26] Students have scores with the criteria of complete-not remedial and complete-need enrichment because class XI students majoring in science and health have studied food nutrition material in the digestive system chapter in the odd semester.[27]

A total of 3 students (3.75%) are still in the criteria of not yet complete - partial remedial means that students have not reached the minimum score set so they need partial improvement. This is caused by several factors. First, the difference in the process of absorbing information through the sensing process carried out when learning in class or independently.[28] Good sensing will increase understanding of an object or information while students with poor sensing will hinder the formation of knowledge causing suboptimal results.[29] The second factor is that differences in individual learning styles can affect a person's ability to understand and remember information.[30] In addition, factors outside the classroom, such as social and economic status, access to nutritious food, and the environment can also affect students' ability to learn about food nutrients.[31]

The highest average score was obtained at the cognitive level of applying (C3) of 93.90 with the criteria being complete-needing enrichment. At this cognitive level, students are required to apply a concept or principle that they already have.[32] The average score indicates that students can find symptoms of certain nutrient deficiencies and apply basic concepts of nutrients such as calculating the number of food calories and calculating BMI.

The average value of the second order is evaluating (C5) which is 91.88 with the criteria of being complete-needing enrichment. This means that students can make decisions based on standardised criteria, such as checking and criticising.[33] In this case, students are asked to evaluate the principles of food safety and the importance of sanitation practices and assess the role of the government in food supervision and find solutions or reasons that can strengthen the answer.

The third order is the average value of the cognitive level of analysing (C4) which is 85.53 with the criteria of being complete-not remedial. At the analysing level, students are more emphasised on how to think critically operationally by differentiating, organising and connecting.[33] For example, students can analyse the long-term impact of certain nutrient deficiencies on physical and cognitive growth and development and differentiate between various food processing techniques such as preservation and cooking techniques.

The average score of the fourth order is understanding (C2) of 83.63 with the criteria already completed-not remedial, which means that students are able to build a meaning from the learning message by combining new food nutrient knowledge with previously known ones.[34] In the research instrument, this was tested with a question about classifying food based on nutritional content.

The average value of the fifth order is at the cognitive level of creating (C6) of 77.19 with the criteria already completed-not remedial. C6 questions require students to

design, build, plan, produce, find, renew, perfect, strengthen, beautify, rechange.[33] The question related to this ability is planning a simple solution when choosing safe and hygienic food without additional costs. These results show that students have been able to combine all components of food nutrition knowledge to form something new and logical and functional.[35]

The lowest average score was at the cognitive level of remembering (C1) which was 69.25 with the criteria for completion-not remedial. The questions included determining examples of foods that contain sources of nutrients and knowing the function of certain food nutrients in the body. Students have a low average C1 score because in learning nutrition, novice individuals often have difficulty in understanding the main concepts and principles of macro and micronutrients due to the complexity of nutritional information and lack of basic understanding of body biochemistry.[36] In addition, there can be errors in the C1 cognitive questions because students forget the material tested due to learning has been far behind.[37]

Age is one of the factors that influence knowledge.[19] Based on the data, it is known that respondents who have a category of knowledge value of food nutrients are complete-need enrichment aged 17 years compared to ages 16 and 15 years. The age stages of early adolescence (aged 10-13 years), middle adolescence (aged 14-16 years), late adolescence (aged 17-20 years).[38] This means that the higher the age of the students, the more mature the physical, psychological and social abilities that can shape knowledge patterns and affect the learning process of adolescents.[39]

Physical activity also plays an important role in achieving quality human resources in addition to eating nutritious food.[40] WHO (2021) recommends that 5-17 year olds do moderate-heavy physical activity for at least 60 minutes every day and do aerobic activity for muscle and bone strengthening at least 3 days a week. Exercise is one form of physical activity. Exercise intensity is influenced by nutritional knowledge. The better the nutritional knowledge, the better the exercise intensity.[41] Based on the research data, students who have the category of food nutrient knowledge scores are complete-need enrichment that most exercise 1 time a week. This is different from the literature study because knowing the benefits of exercise and balanced nutrition does not necessarily mean being able to apply it in everyday life. In addition, due to the focus on studies or extracurricular activities and inadequate sports facilities that hinder adolescents when they want to exercise.[42]

3.6 **Analysis of Food Choices Attitudes Score**

Food choice attitudes were measured using the FCQ which can be used to assess individual attitudes about food choices as well as the reasons behind those choices.[43] Based on the results of the mean scores from highest to lowest, it was found that the order of the reasons for choice was natural ingredient content, health, ethics, price, sensory appeal, comfort, familiarity, mood, and weight control.

A total of 41 students (51.25%) have a good food choice attitude indicating that students have shown positive reactions to food choice such as choosing foods that contain lots of vitamins, minerals, high protein, and high fibre; foods that do not contain harmful food additives, foods packaged in environmentally friendly packaging and trying foods that are unfamiliar but good for health. A total of 39 students (48.75%) have a food choice attitude with sufficient criteria which allows students to

have a food choice attitude towards good or towards less good such as choosing food at low prices, according to mood, according to sensory appeal and choosing food based on dietary reasons that do not match needs. Although a person has adequate knowledge about the needs of protein, carbohydrates, vitamins, and other nutritional elements, it cannot fully guarantee that the attitude applied is in the healthy / good category.[44] In addition, there were no students who had food choice attitudes with insufficient criteria.

The highest average food choice attitude score is in the dimension of natural ingredients, which is 80.23 with good criteria. Natural content in food reflects the attention of adolescent students about the use of additives to improve the taste, colour, and durability of food products or truly natural ingredients.[24] This is in line with research that shows 55 students (72.4%) of SMA Santa Maria 3 Cimahi have good nutritional attitudes so they are not interested in fast food that has a lot of harmful food additives.[45]

The second place is in the health dimension, which is 78.44 with good criteria. Health, which includes physical, mental and social conditions, is an important factor for everyone to carry out their activities comfortably and productively.[46,47] Based on the data, it is known that students choose foods that contain lots of vitamins, minerals, high protein and high fibre; keep the body fit and stay healthy; and foods that are good for healthy skin, teeth, hair and nails. Choosing foods that maintain healthy skin, teeth, hair and nails is important because it includes self-care that affects human health which is commonly done as a daily activity.[48]

The third place is the ethics dimension at 78.44 with good criteria. Ethics are beliefs about right and wrong actions or good and bad actions that influence things about everything related to environmental and political issues.[49] This shows that students prioritise ethical reasons behind food choice in line with research that the boycott movement against Israeli products in Indonesia through social media has become a significant phenomenon especially in food choice.[50] In addition, concern about environmentally friendly product packaging is also a concern for teenage students.

The fourth place is the price dimension, which is 77.93 with good criteria. More than half, namely 42 students (52.5%), have an allowance of 15,000-24,000, which is one of the reasons why price is a consideration in choosing food. Students with limited pocket money need to prioritise cheaper foods to meet their nutritional needs. This is in line with the research that price reasons are very influential in food choice in UNESA students.[51]

Fifth place is the sensory appeal dimension, which is 77.68 with good criteria. This shows that sensory appeal, such as smell, taste, texture, and appearance are also important factors in food choice for adolescent students. Food flavours that are influenced by seasoning, aroma, maturity, and food temperature will stimulate each sense to respond to food. The aroma that is smelled can stimulate the sense of smell, the spices added in cooking can stimulate the sense of taste as well as the maturity and temperature of the food.[52] If the taste of food is in accordance with the expectations of adolescent students, then the remaining food will be small, meaning that nutritional intake is fulfilled.

Sixth place is convenience with a score of 76.85 which is included in the good criteria. Factors covering convenience include everything related to the purchase and preparation of ingredients such as the ease of preparing the food, the availability of

food in the nearest shop, the time needed to prepare the food.[24] The convenience factor being sixth in the reasons for food choice shows that students do not place much importance on the convenience aspect in food choice because when choosing foods that are easy to make and easy to obtain they have a tendency to eat unhealthy foods such as fast food.[52]

The seventh place is the familiarity dimension, which is 73.61 with sufficient criteria. Familiarity is a person's tendency to choose food that is usually eaten rather than trying new food.[53] The familiarity dimension being the seventh shows that students of SMAN 4 Bekasi majoring in science and health do not mind if they eat unfamiliar or new foods. High freedom and curiosity in adolescence encourage them to try new things, including in terms of food.[54]

The eighth place is the mood dimension with sufficient criteria with a value of 69.63. This shows that mood is not a priority reason for choosing food because choosing food based on mood and done continuously can encourage unhealthy eating tendencies that worsen health.[6] The data shows that 7 out of 25 male students (28%) have a good mood dimension food choice attitude score compared to female students, namely 12 out of 55 students (21.8%). This indicates that male students are less affected by mood in choosing food. Males are more focused on other factors such as taste, satiety, or practicality while females are more affected by mood in choosing food such as stress, anxiety, or sadness.

The lowest mean score is the dimension of weight control with a value of 68.19 and a sufficient category. Weight control is a person's effort in maintaining body weight in normal conditions or in the desired weight condition.[24] Based on the research data, 21 students (26.25%) have BMI in the underweight category; 48 students (60%) have BMI in the normal category; 5 students (6.25%) have BMI in the overweight category; and 12 students (7.5%) have BMI in the obese category. The data shows that the majority of students have a normal BMI. This can explain why weight control is the last consideration in choosing food because those who have a normal BMI, the focus is more on a healthy and balanced diet rather than calorie restriction or special food choice for weight loss.[55]

3.7 Analysis of The Relationship between Nutritional Knowledge and Food Choices Attitude

Based on the results of the study, it is known that 34 students (42.5%) who have complete knowledge of food nutrients have good food choice attitudes; 43 students (53.75%) have sufficient food choice attitudes and no students who have complete knowledge have insufficient food choice attitudes. This shows that the higher the nutritional knowledge of students, the more likely they are to have good food choice attitudes.[56] In addition, a higher level of education will make it easier for individuals or communities to absorb information and apply it in their daily behaviour and lifestyle, especially in the field of health and nutrition.[57] Attitudes based on knowledge will be more resistant to change while attitudes that are not based on knowledge are more dynamic and more easily modified.[58]

Based on the results of the correlation test, the correlation coefficient is 0.446 indicates that the correlation is moderate. The regression equation model is $\hat{Y} = 46.71 + 0.333X$ means that if there is an increase of one score on food nutrient knowledge, it will be

followed by an additional score of 0.333 on food choice attitudes. This is in line with research that there is a positive relationship between nutritional knowledge and food choice practices and nutrition education in schools increases nutritional knowledge and influences food choices significantly.[44,59] Knowledge of food nutrients has a contribution of 19.89% to food choice attitudes in adolescents in high school, while the remaining 80.11% is determined by other factors. Other contributing factors include the role of family and the role of peers[60]; demographic factors such as differences in where respondents live[61]; allergy and intolerance factors[62]; and the influence of social media advertisements.[63]

Conclusions. Based on the results of the study, it can be concluded that adolescent students in SMA generally have good knowledge about food nutrients including knowledge of nutrient sources, food safety, processing methods, and health effects when consuming certain nutrients. Adolescent students in high school also show a positive attitude in choosing food such as choosing food that is nutritious, does not contain harmful food additives and choosing food with environmentally friendly packaging. In addition, it is known that there is a positive relationship between knowledge of food nutrients and food choice attitudes in adolescents in high school with a moderate level of relationship.

Advice. Based on the results of the study, it is recommended to add other factors that contribute to the formation of food choice attitudes such as the role of family and the role of peers, demographic factors, allergy and intolerance factors, and the influence of social media advertisements. Another suggestion is to conduct research on respondents who have a higher level of education so that the differences can be compared with research on adolescents in high school.

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