

## Knowledge, availability, and parental support on fruit and vegetable consumption behavior in adolescents: A systematic review and meta-analysis

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### Abstract

**Introduction:** Consumption of fruit and vegetables is still low, especially among teenagers, even though they play a very important role in immunity and preventing various diseases. The research objective is to analyze the influence of knowledge, availability of fruit and vegetables, and parental support on adolescent fruit and vegetable consumption.

**Methods:** Systematic review research with meta-analysis of previous primary research results that met the inclusion criteria using PICO, the database used by Google Scholar and Crossref. The keywords "Adolescent Fruit and Vegetable Consumption Behavior" or Fruit and Vegetable Consumption Behavior in Adolescents, "factors or determinants or risk factors or causal factors" and "adolescent knowledge, availability of fruit and vegetables, parental support", were obtained from 7 articles. the initial search of 5420 articles. Data analysis using the Rev.man 5.4 application.

**Results:** There was an influence of adolescent knowledge on fruit and vegetable consumption behavior ( $P=0.0003$ ), there was no influence of fruit and vegetable availability on adolescent fruit and vegetable consumption behavior ( $P=0.18$ ), and there was no influence of parental support on fruit and vegetable consumption behavior ( $P=0.26$ ) There is no publication bias.

**Conclusion:** Adolescent knowledge influences fruit and vegetable consumption behavior in adolescents. It is recommended that health workers increase education to teenagers regarding fruit and vegetables as an effort to improve behavior and will contribute to actions in consuming fruit and vegetables among teenagers.

**Keywords:** Adolescent knowledge; Availability of fruits and vegetables; Support of parents; Fruit and vegetable consumption behavior

### 1 Introduction

Fruit and vegetable consumption behavior is one of the messages contained in the balanced nutrition guidelines [1]. Currently, fruit and vegetable consumption in the world and Indonesia is still low. This can be seen from several studies in the world and Indonesia which show that fruit and vegetable consumption is still low, the study by Noiman et al. shows that fruit and vegetable intake is still low among students in the United States [2]. A systematic review conducted by Jayawardana et al. shows that residents in almost all South Asian countries consume low amounts of fruit and vegetables [3].

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Fruit and vegetables contain the main nutritional content of vitamins, minerals, and dietary fiber which are very beneficial for the body because they function as regulatory substances, antioxidants, maintaining fluid balance, and increasing the body's immune response, as well as as antibiotics [4]. Several studies show that adequate consumption of fruit and vegetables plays a role in preventing non-communicable diseases such as hypertension, stroke, heart disease, obesity, diabetes, and cancer, which are the main causes of death in Indonesia [1].

Teenagers are the highest age group that consumes less fruit and vegetables, reaching (98.4%). The Indonesian population's fruit and vegetable consumption is still low in the context of balanced nutrition, both in urban and rural areas, and is lowest in the adolescent age group [5]. Previous research, shows that teenagers in Indonesia consume less fruit and vegetables [6,7]. Teenagers tend to like fast food such as meatballs, pizza, hamburgers, fried noodles, chocolate, etc., while teenagers don't like eating fruit and vegetables [8,9]. Adolescence is the right time to develop a healthy body and eating habits because during adolescence unhealthy eating habits will harm future development. Therefore, it is important to implement a healthy diet during adolescence as a preventive measure against potential health problems in the future [10].

Adolescents who have good knowledge about fruits and vegetables have a 2.59 times greater influence compared to adolescents who have low knowledge. Knowledge about fruit and vegetables, especially regarding the benefits and recommendations for consuming fruit and vegetables, is in synergy with fruit and vegetable consumption in adolescents. If teenagers know about the benefits of fruit and vegetables that they should consume, teenagers will be aware and interested in trying to consume them, thereby increasing fruit and vegetable consumption [11]. There is a relationship between the availability of fruit and vegetables in the home environment and fruit and vegetable consumption. A bad home environment is 6.922 times more likely to result in less consumption of vegetables and fruit in teenagers compared to a good home environment [12].

Many studies have examined factors that influence fruit and vegetable consumption behavior in the world. Researchers will use systematic review methods and meta-analysis approaches to estimate the influence of adolescent knowledge, availability of fruit and vegetables, and parental support on fruit and vegetable consumption in adolescents. This research aims to analyze how much influence teenagers' knowledge, parental support, and availability of fruit and vegetables have on teenagers' fruit and vegetable consumption behavior based on previous primary research.

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## 2 Material and Methods

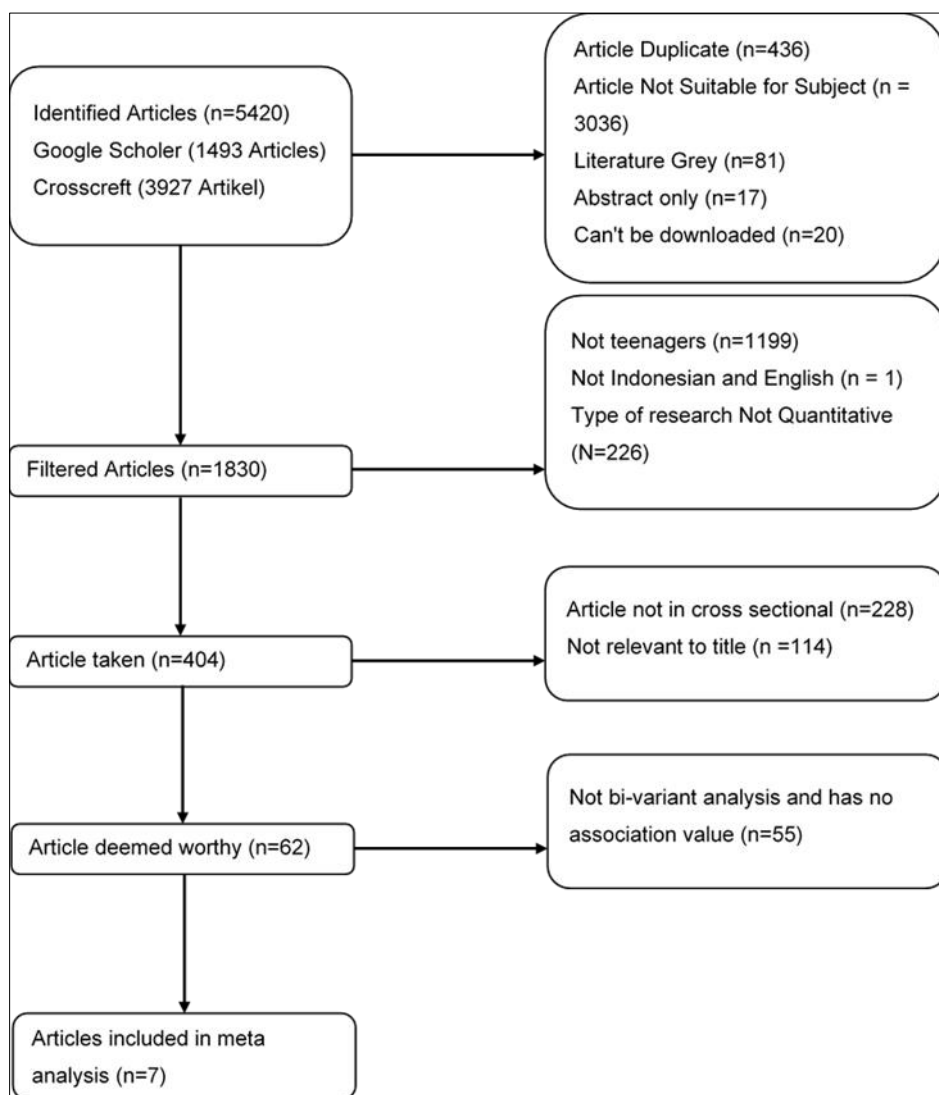
The study was a systematic review with meta-analysis using the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) flow diagram. The online database used was Google Scholar, Crossref which was published from 2018 to 2023. The keywords used in the literature search were "Fruit and Vegetable Consumption Behavior in Adolescents" Fruit and Vegetable Consumption Behavior in Adolescents, and "Factors or determinants or risks". factors or causal factors" and "adolescent knowledge, availability of fruit and vegetables, parental support" which meet the inclusion criteria requirements, namely articles in Indonesian and English, publication of articles from 2018 to 2023, type of quantitative research with cross-sectional design, adolescent responses aged 10 to 18 years, Research Variables: Adolescent knowledge, availability of fruit and vegetables, parental support, and fruit and vegetable consumption behavior. Meanwhile, the exclusion criteria are that it is not a bivariate analysis and does not have association values (PR, OR, RR, POR). Data analysis was carried out with RevMan 5.4 software.

The steps taken in a meta-analysis study consist of 1) Formulate research questions using PECO (Population, Exposure, Comparative, Outcome). The population is teenagers aged 10 to 18 years. Exposure: Low knowledge of teenagers, low availability of fruit and vegetables, low parental support. Outcome: fruit and vegetable consumption behavior in adolescents; 2) Search for primary study research articles from the online databases Google Scholar and Crossref; 3) Screen and assess the quality of primary research articles using Publish or Perish; 4) Extract and analyze data into RevMan 5.4 software; and 5) Interpret the results and draw conclusions.

Fruit and vegetable consumption is defined as the action of teenagers in consuming fruit and vegetables under the recommendation of equal or greater than 5 portions per person per day. Knowledge is teenagers' understanding of fruit and vegetables which is categorized into good knowledge and poor knowledge. The availability of fruit and vegetables is the readiness to provide fruit and vegetables at home which are categorized as good and bad. Parental support is encouragement or psychological assistance from parents regarding the consumption of fruit and vegetables in adolescents, categorized into good and bad.

The articles in this research were collected using PRISMA and analyzed using the Review Manager 5.4 (RevMan 5.4) application by calculating effect size and heterogeneity to determine the combined research model and form the final

results of the meta-analysis. The results of data analysis are presented in the form of forest plots and funnel plots. The process of searching for articles related to primary research regarding the influence of adolescent knowledge, availability of fruit and vegetables, and parental support on fruit and vegetable consumption behavior in adolescents in this meta-analysis research was carried out using two online databases, namely: Google Scholar and Crossref. There are 7 articles included in this meta analysis which can be seen in Figure 1. PRISMA Flowchart.



**Figure 1** Prism Flow Diagram

The number of articles in the initial search process was 5,420 articles with details of Google Scholar = 1,493 articles and Crosscreft = 3,927 articles. 3,591 articles were removed and 1,830 articles were screened. Of the total of 62 full-text articles deemed eligible, 7 articles met the inclusion criteria that were included in the meta-analysis. Full-text articles are included in the exclusion criteria because the main research results and interventions do not comply with the PECO criteria or formula, in this case, the research subjects are not 10-18 years old, not teenagers, the type of research is not quantitative, the research design is not cross-sectional, does not include values association, data analysis did not use multivariate analysis.

### 3 Results

**Table 1** Critical Appraisal Checklist for Cross-Sectional Studies in Meta-Analysis

Author s	Appraisal Checklist for Cross-Sectional								Score
	Are the criteria for inclusion in the sample clearly defined?	Are the subject and research setting explained in detail?	Is exposure measured in a valid and reliable?	What standard criteria are used to measure objective conditions?	Are confounding factors identified?	Are strategies to address confounding factors mentioned?	Are outcomes measured in a valid and reliable?	Was appropriate statistical analysis used?	
Muna et al. [11]	2	2	2	2	1	1	2	2	14
Hanifa et al. [13]	2	2	2	2	2	2	2	2	16
Amelia and Fayasari [7]	2	2	2	2	1	1	2	2	14
Elfana et al. [14]	2	2	2	2	1	1	2	2	14
Noviyanti and Manikam [15]	2	2	2	2	1	1	2	2	14
Astriyani [16]	2	2	2	2	1	1	2	2	14
Dhanti et al. [17]	2	2	2	2	1	1	2	2	14

Description: 0=no; 1=do not know; 2=Yes

**Table 2** Description of Major Cross-Sectional Studies Included in the Meta-Analysis

Authors	Country	Number of samples	P (Population)	E (Exposure)	C (Comparative)	HAI
Muna et al. [11]	Indonesia	97	Junior high school	Low availability of fruit and vegetables and low parental support	High availability of fruit and vegetables and high parental support	Fruit and Vegetable Consumption Behavior
Hanifa et al. [13]	Indonesia	143	College student	Low parental influence, low	The influence of parents is high, the	Fruit and Vegetable

				availability of fruit and vegetables at home	availability of fruit and vegetables at home is high	Consumption Behavior
Amelia and Fayasari [7]	Indonesia	107	Junior high school	Low availability of fruit and vegetables, low parental influence	High availability of fruit and vegetables, high parental influence	Fruit and Vegetable Consumption Behavior
Elfana et al. [14]	Indonesia	249	Junior high school	Teenagers' knowledge is low	Teenagers' knowledge is high	Fruit and Vegetable Consumption Behavior
Noviyanti and Manikam [15]	Indonesia	208	Senior high school	Adolescents' knowledge is low and the availability of fruits and vegetables is low	Teenagers' knowledge is high and the availability of fruits and vegetables is also high	Fruit and Vegetable Consumption Behavior
Astriyani [16]	Indonesia	120	Students aged between 16 to 18 years	Low parental role	High parental role	Fruit and Vegetable Consumption Behavior
Dhanti et al. [17]	Indonesia	685	Junior high school	Teenagers' knowledge is low	Teenagers' knowledge is high	Fruit and Vegetable Consumption Behavior

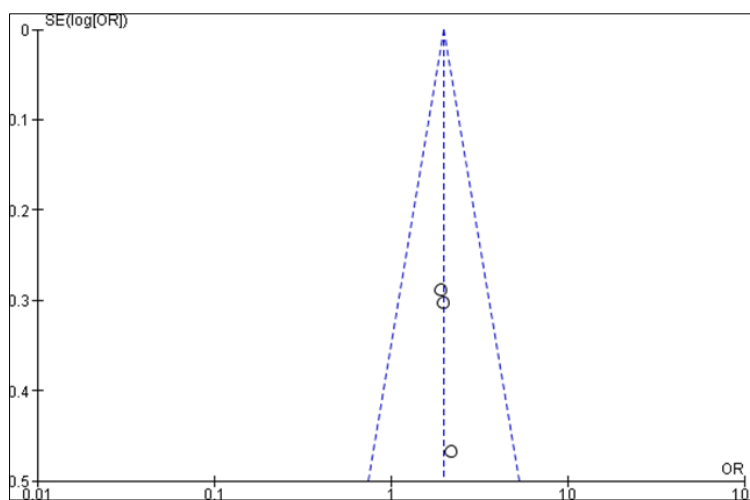
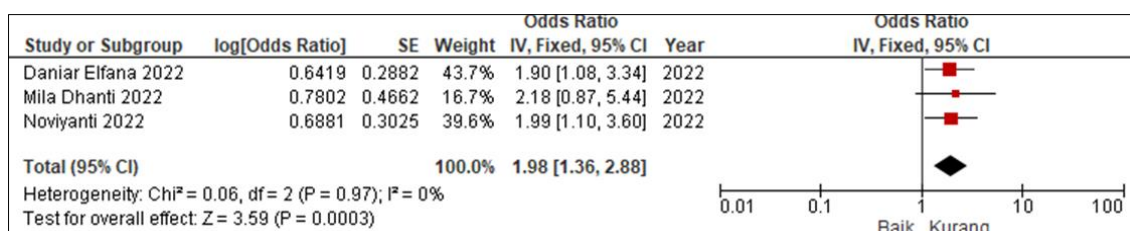
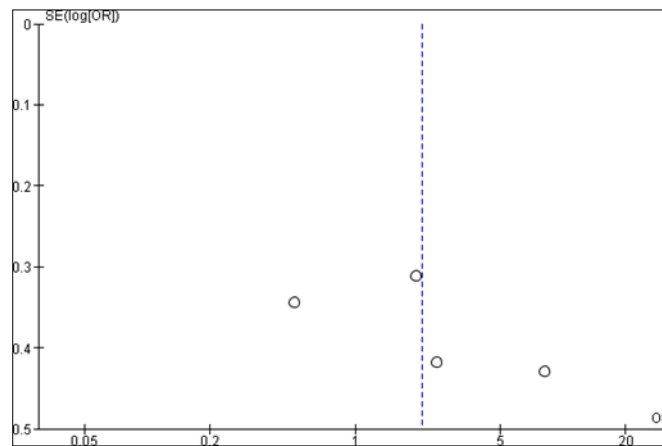
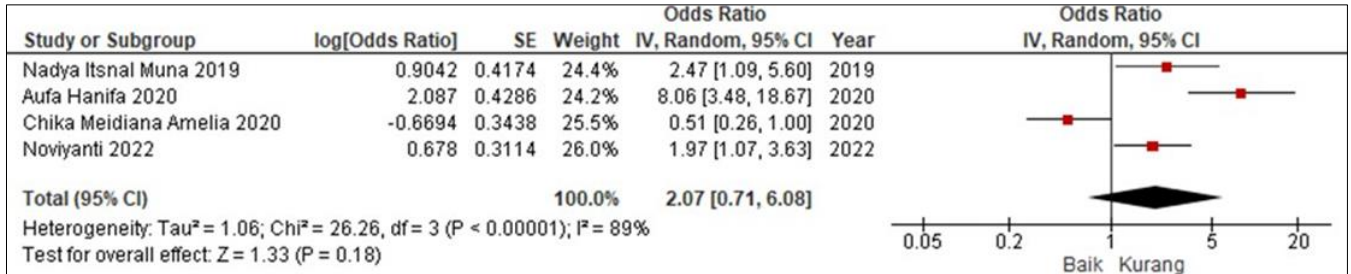


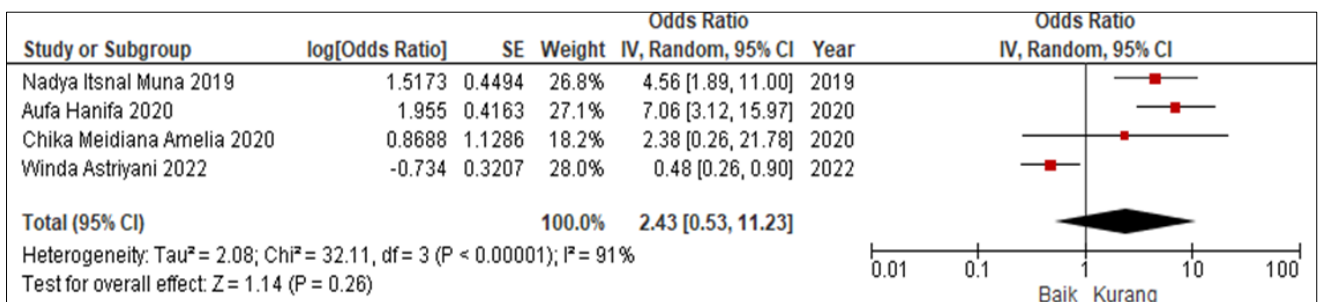
Figure 2 Influence of adolescent knowledge of fruit and vegetable consumption behavior

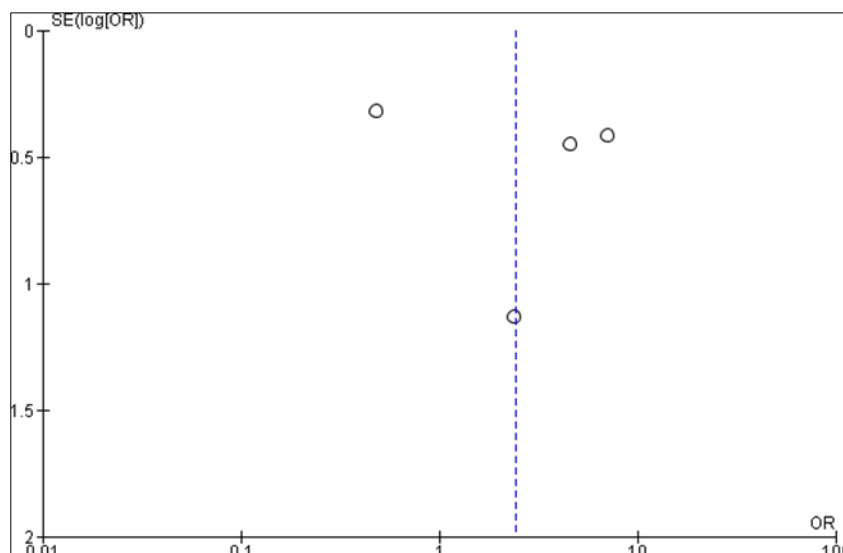
The forest plot results in Figure 2 show that the analysis of 7 articles shows a heterogeneity value of  $I^2 = 0\%$ . There is an influence of adolescent knowledge on adolescent fruit and vegetable consumption behavior ( $P = 0.0003$ ), and adolescents who have good knowledge are 1.98 times more likely to have fruit and vegetable consumption behavior compared to adolescents who have poor knowledge (SMD: 1.98; CI 95% = 1.36 to 2.88;  $P = 0.0003$ ). The funnel plot in Figure 2 shows publication bias with an overestimated effect which is characterized by an asymmetrical distribution between the right and left plots, with 1 plot on the right, and 2 plots touching the vertical line. The plot to the right of the graph appears to have a standard error (SE) between 0 and 0.50. The plot to the left of the graph appears to have a standard error (SE) between 0 and 0.30.



**Figure 3** The influence of the availability of vegetables and fruit on adolescent vegetable and fruit consumption behavior

The forest plot results in Figure 3 show a meta-analysis of 7 articles showing a heterogeneity value of  $I^2 = 89\%$ , and there is a tendency or opportunity for good fruit and vegetable availability of 2.07 times (SMD: 2.07; 95% CI = 0.71 to 6.08;  $P = 0.18$ ) for fruit and vegetable consumption behavior compared to poor fruit and vegetable availability, but the significant influence of fruit and vegetable availability on fruit and vegetable consumption behavior in adolescents has not been proven. The funnel plot in Figure 3 shows that there is no publication bias because the plots are distributed symmetrically, namely in the right plot there are 2 plots and in the left plot there are also 2 plots.





**Figure 4** The influence of parental support on adolescent fruit and vegetable consumption behavior

The forest plot results in Figure 4 show a meta-analysis of 7 articles showing a heterogeneity value of  $I^2 = 91\%$ , and there is a tendency or opportunity for good parental support of 2.43 times (SMD: 2.43; 95% CI = 0.53 to 11.23) on consumption behavior fruit and vegetables compared to poor parental support, but the significant influence of parental support on fruit and vegetable consumption behavior in adolescents has not been proven. The funnel plot in Figure 4 shows that publication bias has an overestimated effect which is characterized by an asymmetric distribution between the right plot and the left plot. There are 2 squares on the right, 1 square on the left, and 1 square that touches the vertical line.

#### 4 Discussion

This systematic review and meta-analysis research raises the theme of the influence of knowledge, availability of fruit and vegetables, and parental support on vegetable and fruit consumption behavior in adolescents. The independent variables analyzed were knowledge, availability of fruit and vegetables, and parental support. The dependent variable analyzed is the fruit and vegetable consumption behavior of teenagers.

Knowledge about fruit and vegetables, especially regarding the benefits and recommendations for consuming fruit and vegetables, is in synergy with fruit and vegetable consumption in adolescents. When teenagers know the benefits of fruit and vegetables that they should consume, then teenagers will be aware and interested in trying to consume them, thereby increasing fruit and vegetable consumption [18].

The main study of 7 articles found that there was an influence of teenagers' knowledge on teenagers' fruit and vegetable consumption behavior, and the forest plot results also showed that teenagers who had good knowledge had a 1.98 times chance of having good fruit and vegetable consumption behavior. compared to adolescents who have low knowledge (aOR: 1.98; 95% CI = 1.36 to 2.88;  $p < 0.0003$ ). The results of this research are in line with Muna and Mardiana's research which shows that teenagers' good knowledge of fruit and vegetables has a 2.59 times greater influence compared to low knowledge [11]. A relevant previous study states that knowledge about fruit and vegetables, especially about the benefits and recommendations for consuming fruit and vegetables, can make a positive contribution, namely increasing a person's consumption of fruit and vegetables and also stated that the aspect of knowledge about fruit and vegetables can have a positive impact on increasing awareness and skills or abilities in preparing fruit and vegetables for consumption so that it will increase the quantity or amount of individual consumption of fruit and vegetables [19].

The results of the forest plot in this study show that good availability of fruit and vegetables has a tendency or chance of good fruit and vegetable consumption behavior of 2.07 times compared to low availability of fruit and vegetables (aOR: 2.07; 95% CI = 0.71 to 6, 08;  $p < 0.18$ ), but it has not been proven that there is a significant influence of the availability of vegetables and fruit on vegetable and fruit consumption behavior. The results of the meta-analysis are relevant to previous studies that types of food that are available are 2.47 times more likely to be consumed than types of food that are not available [11]. According to Arbianingsih et al. One of the factors that influences fruit and vegetable consumption in adolescents is the availability of fruit and vegetables at home [20]. The availability of vegetables and

fruit in a poor home environment is 6.922 times more likely to reduce vegetable and fruit consumption in adolescents compared to a good home environment [21].

Based on 7 research articles, it was found that good parental support tended to behave well in consuming good fruit and vegetables 2.43 times compared to low parental support (aOR: 2.43; 95% CI = 0.53 to 11.23;  $p < 0.26$ ), but it has not been proven that there is a significant influence of parental support on teenagers' fruit and vegetable consumption behavior. This is in line with a previous study which states that there is a relationship between parental support and fruit and vegetable consumption in adolescents [11]. The results of this study are in line with previous research which shows that there is a strong relationship between parental support and healthy eating patterns in adolescents [22].

Relevant to research conducted by Parks et al. which shows that the role of parents/parenting patterns influences fruit and vegetable consumption in United States teenagers [23]. Previous research also shows that parental support has a 4.10 times greater chance of consuming fruit and vegetables compared to low parental support [11]. Adolescents who have parental influence are equally likely to consume vegetables and are twice as likely as respondents who have less parental influence [7]. Adolescents with good parental influence are more likely to provide fruit and vegetables at home compared to respondents with less good parental influence. So it can be concluded that parents who have a good influence will also provide fruit and vegetables at home well [18].

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## 5 Conclusion

Systematic reviews with meta-analysis of the results of previous primary research that met the inclusion criteria using PICO showed that there was an influence of adolescent knowledge on fruit and vegetable consumption behavior, there was no influence of fruit and vegetable availability on adolescent fruit and vegetable consumption behavior, and there was no influence of support. parents on fruit and vegetable consumption behavior.

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## Compliance with ethical standards

### *Disclosure of conflict of interest*

No conflict of interest to be disclosed.

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