

## EFFECT OF VEGETARIAN DIET ON NUTRITIONAL STATUS IN SCHOOL-AGE CHILDREN

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### ABSTRACT

*A vegetarian diet is a pattern of food consumption that comes from plants in the form of vegetables, nuts, seeds, fruits, and does not or still consume dairy products and eggs. The implementation of a vegetarian diet in school-age children can have a positive impact on reducing the risk of certain diseases. In addition, the restriction of animal food sources causes vegetarians to be at risk of having a lower nutritional status. This literature review aims to analyze the effect of a vegetarian diet on the nutritional status of school-age children. The Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) approach was used in this literature review study. The steps taken consisted of identification, analysis, evaluation, classification and categorization of previously produced articles. Data and information sources were obtained through electronic databases published on Google Scholar, ProQuest, and Scopus. The selection category is articles that have been published in the last 10 years (2014-2024) and 251 journals were obtained. After several elimination processes, a total of 6 articles met the criteria to be selected. It was found that there was a significant difference based on BMI ( $p$  value < 0.001), weight for height z-score ( $p=0.006$  and  $p=0.103$ ), BMI for age ( $p<0.001$ ), and BMI ( $p = 0.004$  and  $p = 0.001$ ) in the effect of a vegetarian diet on the nutritional status of school-age children. This is due to the lack of knowledge about vegetarian diets, proper diet planning, and fulfillment of nutrient intake, such as vitamin D, vitamin B12, calcium, and protein, through fortification or supplements.*

**Keywords:** BMI, Nutritional status, Vegetarian diet, School age

### INTRODUCTION

Children are the next generation of a country. Children will grow and develop according to their growth and development at any time. Childhood is recognized as a sensitive phase of development (Desmond et al., 2021). Good health and proper nutrition are essential for school-age children and adolescents because they can affect their growth, development, and achievement. In addition, micronutrient deficiencies and parasite infections can affect their nutritional status, cognitive development, and performance in school (dela Luna & Talavera, 2022).

This poses a challenge for children on a vegetarian diet. The risk of undernutrition in children is influenced by the younger age of the child and strict food restrictions. Restricting animal foods on a vegetarian diet may affect protein intake of selenium, vitamin D (calciferol), vitamin A (retinol), vitamin B12 (cobalamin), calcium, zinc, essential fatty acids, iron, and riboflavin. Iron

and vitamin D levels were also found to be low in children. Children on vegetarian diets remain at higher risk due to inadequate and/or excessive fiber intake and other nutrients (Kiely, 2021).

Currently, the application of vegetarian diets is increasingly in demand, marked by the number of evidence-based publications on vegetarian diets (Melina et al., 2016). A vegetarian diet is a plant-based diet of vegetables, nuts, seeds, and fruits, or still consumes dairy products and eggs (Baroni et al., 2019). Vegetarian diets are popular for many reasons. Vegetarian diets are believed to positively affect health, morale, and have a much lower negative environmental impact. However, other factors include sociocultural, gender, economic aspects, and limitations in obtaining animal food sources (Hargreaves et al., 2021). A vegetarian diet has benefit in lowering blood pressure, decreasing the chances of type 2 diabetes, hypertension, and is effective in weight control (Wang et al., 2023).

Implementing a good vegetarian diet must be prepared to prevent excess and deficiency

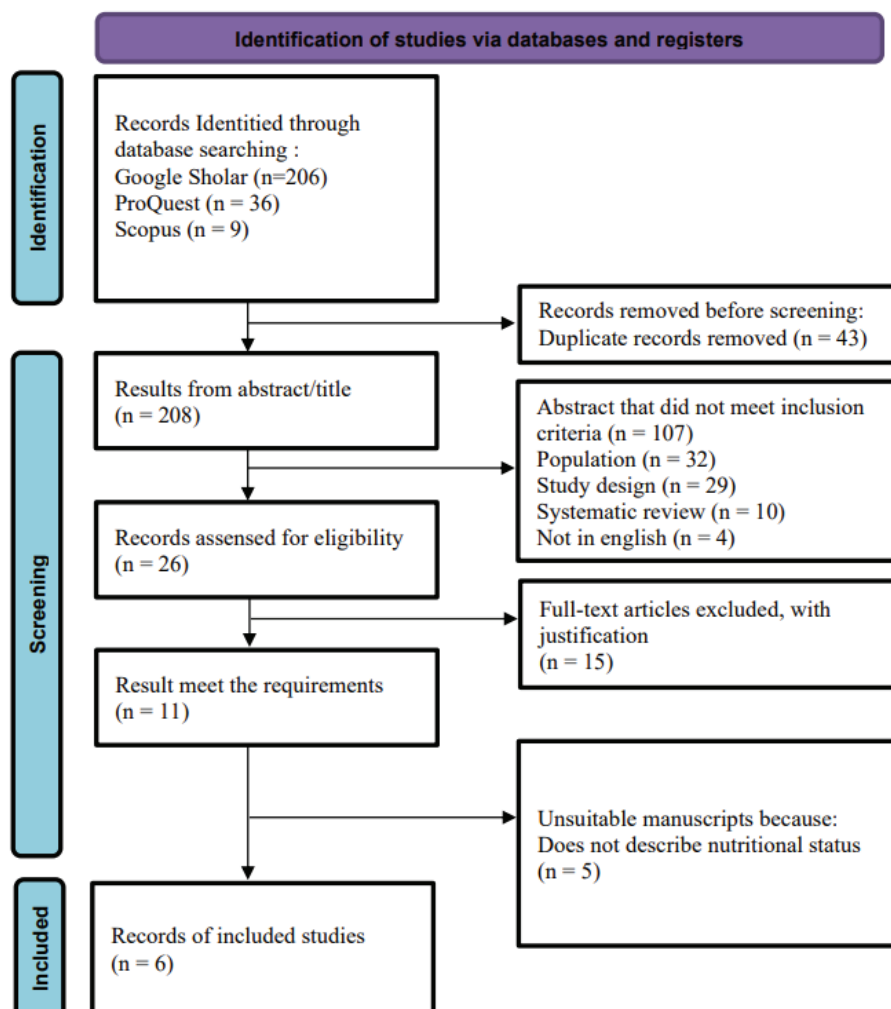
of certain nutrients. The limited food sources consumed affect the intake of micro and macronutrients in vegetarians (Simeone et al., 2022). Adopting a vegetarian diet without proper planning may increase the risk of vitamin D, iodine, selenium, calcium, iron, and vitamin B12 deficiencies. (Gibbs & Cappuccio, 2024). Some of these nutrients are derived from animal products. Therefore, it is necessary to fulfill the needs of certain nutrients through supplements to support the psychophysical development of vegetarian groups.

Many studies on the effects of vegetarian diets on nutritional status have been published. Research by Pimentel C et al. (2019) mentioned that individuals who implement a vegetarian diet have a higher percentage of normal BMI and waist circumference than individuals who do not implement a vegetarian diet. In Gan et al. (2018), vegetarians were reported to have lower mean

values on BMI, percent body fat, and systolic blood pressure compared to non-vegetarians. Furthermore, the percentage of overweight and obesity was higher in the non-vegetarian group. However, a study by Elliott et al. (2022) showed different results. The results showed no difference in BMI for age in children who implemented a vegetarian or non-vegetarian diet. The main purpose of this literature review is to determine the effect of vegetarian diets on nutritional status in school-age children.

## METHODS

The Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) approach was used in this literature review study. The steps taken consisted of identification, analysis, evaluation, classification and categorization of previously produced articles. Systematic Review



**Figure 1.** PRISMA Flowchart of Literature Review

is carried out in a structured and planned manner. Data and information sources were obtained through electronic databases published on Google Scholar, ProQuest, and Scopus. The keywords in this literature review consist of “BMI” AND “Nutritional status” AND “Vegetarian diet” AND “School age”. The population studied was school children aged 6-18 who adopted a vegetarian diet. The selection category is articles that have been published in the last 10 years (2014-2024), using English, full text, research articles and discussions on the effect of a vegetarian diet on nutritional status in school-age children. Perform paper selection using AI RAYYAN, then document the number of papers at each search stage and enter them in the prism table.

## RESULTS AND DISCUSSION

The growth process can be recognized by observing changes in body size and shape, including height, weight, head circumference, upper arm circumference, and others. One of the indicators used to measure body composition and identify individuals at risk for malnutrition is the Body Mass Index (BMI) (Owino et al., 2019). Studies on growth in school-aged children or adolescents have focused on the effects of protein intake associated with vegetarian diets. In some other studies, adolescents on a vegetarian diet have the same growth rate as non-vegetarian adolescents. However, there are studies showing that vegetarian adolescents can have lower height compared to non-vegetarians. However, this may be due to other factors such as sociodemographic, genetics, biology, and nutrient intake (Adrizain et al., 2024).

A study conducted by (Magnazi et al., 2023) shows that children who receive anthroposophical education have a better BMI. These children have an environment that supports a healthy lifestyle compared to children who receive conventional education. A healthy environment can be created through dietary habits in the education system and households. Eating and physical activity habits are not limited to the education system but continue in the child's social and family environment after school (Magnazi et al., 2023). The findings of this study are consistent with previous studies that have

identified social and environmental risk factors for childhood obesity. Factors that can affect the nutritional status of children include environmental aspects, including schools, health facilities, and other community environments (Ayala et al., 2015). Another study also revealed that family social status affects children's nutritional status (Hooshmand, 2014). This is also evidenced by previous research, which examined the influence of school characteristics on the risk of obesity in students. Healthy school food environments have lower obesity rates. Other related factors include parental education, socioeconomic status, physical activity, rest time compliance, sociodemographic, and parental involvement in school (Ayala et al., 2008).

Children need protein for muscle growth and development and to repair body tissues. In vegetarian diets, protein sources such as meat and eggs are not consumed, so children need protein from plants like soy products, nuts, and seeds. Research conducted in India emphasizes the importance of food management for school children, especially in the management of vegetarian menus, such as in the provision of a quality protein diet that can include legume products, low-fat milk, cereals, curd, paneer, in meals for vegetarians. The Food Safety and Standards Authority of India (FSSAI) suggests that at least 80% of the menu should include vegetables, pulses, fruits, grains (cereals/legumes), whole and high-fiber grains, lean meat, eggs, low-fat milk, lean meat, fish, paneer, curd, etc. (Varte LR, 2016).

Without proper planning, vegetarian diets can lead to protein deficiencies that hinder children's growth and development (Melina et al., 2016). Animal products are one of the best sources of vitamin B12, which plays an important role in the formation of red blood cells and the development of the nervous system. B12 deficiency can cause anemia, fatigue, neurological problems, and developmental disorders in children. It has been established that vegetarian children who do not consume foods or supplements fortified with vitamin B12 are at higher risk of developing a deficiency in this essential nutrient (Niklewicz et al., 2022).

**Table 1.** Study Results on the Effect of Vegetarian Diet on Nutritional Status in School-Aged Children

Research Title	Author	Year	Method	Instrument	Sample	Outcomes	Results	Reference
Children in the Anthroposophical Education System Have Lower Rates of Obesity, and Higher Rates of Health Promoting Behaviors	Moran Blaychfeld Magnazi et al.	2023	Cross-sectional study	Questionnaire, BMI Measurement, body weight and body height, WHO Chart Percentile	Primary school first graders who have taken screening and anthropometric measurements from the Ministry of Health's National Anthropometric Measurement Survey between 2018 - 2020. Parents of first-grade elementary school children in Israel comprised 72 parents of anthroposophical school children and 142 parents of conventional school children.	Prevalence of obesity in first-grade children of anthroposophical (schools that advocate a vegetarian diet) and conventional schools.	The population of children who received anthroposophical education emphasizing the consumption of whole, fresh foods, fruits, and vegetables from the garden had a better BMI. These children had a supportive environment for a healthy lifestyle compared to children who received conventional education. There is a significant difference between overweight and obese children in both educational systems. Children with conventional systems have higher levels of overweight and obesity than anthroposophy educational systems (11.2% and 7.8%, vs 9.6% and 4.8%, respectively; p value < 0.001)	(Magnazi et al., 2023)
Anthropometric measurements determinant nutritional status of urban primary school children in selected areas of Iran and India: A comparative study	Sahar Hooshmand and Shobha Udipi	2014	Comparative study	Anthropometric measurements with Portable Scale, nutritional status (WHO AnthroPlus)	The were 4570 participants from Mumbai, Nigeria, and Ahwaz Iran aged 6-9 years old.	Anthropometric measurements, nutritional status (height for age, weight for age, weight for height).	Based on weight for height z-score data there was a significant difference in the age group of school children in India (vegetarian) with p=0.006 and in Iran (non-vegetarian) with p=0.103. In Iran 1.7% (p=0.004) and 4.1% of India children (p=0.000) were wasted.	(Hooshmand, 2014)

Research Title	Author	Year	Method	Instrument	Sample	Outcomes	Results	Reference
An Epidemiological Cross-Sectional Comparative Study of Nutritional Status between Government and Private Primary School Children of Meerut City, Uttar Pradesh	Shruti Sehgal et al.	2017	Cross-sectional study	Semi-structured questionnaire, height measuring tape, and standardized scales	There were 1210 children aged 6-12, 501 of whom were from government schools and 709 of whom were from private schools.	To assess and compare the status of malnutrition.	The nutritional status of private school children based on the type of diet in the vegetarian diet and mixed diet groups has a significant difference characterized by ( $p < 0.001$ ). The nutritional status of public school children based on the type of diet in the vegetarian diet and mixed diet groups is a significant difference characterized by ( $p < 0.006$ ).	(Sehgal et al., 2017)
Nutrient Intake and Status of German Children and Adolescents Consuming Vegetarian, Vegan or Omnivore Diets: Results of the VeChi Youth Study	Ute Alexy et al.	2021	Cross-sectional study	Anthropometry seca 799 (body weight), stadiometer 222 (body height), and questionnaire	There were 401 samples aged 6-18 years who adopted vegan, vegetarian and omnivorous diets in three Germany study centers.	Height, body weight, BMI-SDS, macronutrient Intake, micronutrient Intake, nutrient status and blood lipids	In the nutritional status between vegetarian, vegan, and omnivore groups there were no significant differences in BMI-SDS ( $p = 0.1506$ ), height ( $p = 0.4902$ ), and weight ( $p = 0.4902$ ).	(Alexy et al., 2021)
Body Mass Index (BMI) of vegetarian and non-vegetarian children in Nepal	Usha Acharya and Jun Nakanishi	2021	A descriptive cross-sectional study	an anthropometer (manufactured by GPM) and a weighing scale	There were 1,251 children (6-14 years old) from the Yadav and Koiri castes.	BMI	The non-vegetarian and vegetarian groups ( $p = 0.004$ in boys) ( $p = 0.001$ in girls) showed significant differences. The BMI values of vegetarian children showed lower values compared to non-vegetarian children.	(Acharya & Nakanishi, 2021)

Research Title	Author	Year	Method	Instrument	Sample	Outcomes	Results	Reference
Nutritional Status Based on Z-Scores of Boys With Two Dietary Habits in a Sainik School	Varte LR et al.	2021	A comparative observational study based on anthropometric data.	SECA 767 Electronic Scale (for height), Tanita TBF-310 Body Composition Analyzer (for body weight and body composition), and Inelastic tape measure (for upper arm circumference) and Questionnaire.	There were 342 boys (13-18 years old) Groups: 193 vegetarian and 149 non-vegetarian children	Nutritional status and body composition	Vegetarian and non-vegetarian boys at Sainik School have a nutritional status that shows no significant differences when assessed based on anthropometric indicators, including BMI-for-age ( $p = 0.208$ ), height-for-age ( $p = 0.772$ ), and weight-for-age ( $p = 0.545$ ). In the vegetarian group, 98.4% had normal BMI, 12.4% were stunted, and 5.7% were underweight. In the non-vegetarian group, 99.3% had a normal BMI, 11.4% were stunted, and 3.4% were underweight. However, the non-vegetarian group showed higher values in parameters such as percent body fat ( $p = 0.037$ ), fat mass ( $p = 0.018$ ), and upper arm circumference ( $p = 0.037$ ), all statistically significant compared to the vegetarian group.	(Varte LR, 2016)

Calcium is necessary for forming strong bones, while vitamin D is important for calcium absorption. Vegetarian children who do not consume type of dairy or calcium- and vitamin D-fortified alternatives may be at risk of deficiency. This may lead to bone growth problems, such as rickets, osteoporosis, and fracture in the future (Tucker, 2014). Based on research Tong et al. (2020) related to the risk of fractures in vegetarians, it shows that the risk of fractures in vegetarians is higher than meat eaters. This risk difference may be due to a lower average BMI, lower average calcium and protein intake in vegetarians. Iron sources in plant products (non-heme iron) have a lower absorption rate than iron sources from animal products (heme iron). Iron deficiency can lead to anemia, affecting children's concentration, energy, and learning ability (Melina et al., 2016). Some studies suggest that vegetarian children, especially strict vegans, may experience delays in growth if their calorie and nutrient intake is insufficient.

A vegetarian diet can lead to certain nutrient deficiencies, hence the need to consider dietary intake to avoid clinical complications such as stunted growth in school-aged children (Rudloff et al., 2018). One of the negative impacts of vegetarianism is the risk of vitamin B12 deficiency from meat and fish or due to low milk consumption. Therefore, vitamin B12 supplementation is needed in vegetarian children and adolescents (Alexy et al., 2021). Vitamin B12 availability in vegetarian groups needs regular monitoring. Vegetarians are recommended to consume foods or supplements fortified with vitamin B12. In the vegetarian diet group, school-age children should take vitamin B12 supplements with a daily dose of 25 - 50 µg/day (Agnoli et al., 2017).

## CONCLUSION

Children and adolescents on a vegetarian diet have different growth to non-vegetarian diet, with some studies showing that vegetarian adolescents were significant results based on BMI ( $p$  value < 0.001), weight for height z-score ( $p=0.006$  and  $p=0.103$ ), BMI for age ( $p<0.001$ ), and BMI ( $p = 0.004$  and  $p = 0.001$ ) compare

to non-vegetarian diet. This may be due to inadequate nutrition. However, it can also be caused by other factors such as genetics, physical activity, socioeconomics, parental role, and community environment. A vegetarian diet for school children can have a negative impact if not optimally planned. Vitamin B12 supplementation in vegetarian children and adolescents is also necessary. A vegetarian diet may lead to nutritional risks if not properly planned. There is a risk of inadequate intake of micronutrients such as protein, calcium, and various vitamins, especially vitamin B12 and vitamin D. Fortification or supplementation on certain micronutrients is required to meet the daily needs of vegetarian children and adolescents.

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