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Vegetarian Diet in Children: Benefits, Drawbacks, and Risks

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ABSTRACT**Introduction**

Vegetarianism is an eating pattern centred on plant-based food. It encompasses many diets that differ in terms of whether they contain goods originating from animals, like milk and eggs. Nowadays, vegetarianism is increasing in popularity in developed nations, particularly in Europe. Individuals choose vegetarian diets for reasons related to health, ethics, or ecology. The rising popularity of vegetarian diets is not limited to adults but is also increasing among children. This trend can be linked to both parental choices and the personal decisions of adolescents.

Aim of the study

Vegetarian diets are generally considered to be beneficial for health. However, there are concerns over the ability to meet the dietary requirements necessary during infancy, youth, and adolescence on a vegetarian diet. Therefore, the primary aim of this systematic review is to answer questions about the efficacy of a plant-based diet in meeting the nutritional requirements of children and how to avoid the risk of nutritional deficiencies among vegetarian children.

Material and methods

This article provides an overview of the current literature about the vegetarian diet in children. The information has been collected from a comprehensive search of electronic databases, scientific journals, and statement papers published by nutrition and paediatric organisations.

Results

Following a vegetarian diet can be a beneficial decision for all children, assuming that it is properly organised and well balanced. It is important to be aware of the higher risk of deficiency in plant-based diet compared to an omnivorous.

The majority of paediatric and nutrition organisations do not recommend more strict diets for children, such as a vegan diet, which fully excludes not only meat but all animal products. While it is possible to plan a vegan diet that meets children's requirements for nutrients, it is challenging, and mistakes might result in significant and long-term health consequences.

Keywords: vegetarianism, veganism, paediatric, plant-based diet, vegetarian children, nutrition deficiency.

Introduction

Vegetarianism is an eating pattern centred on plant-based food. It encompasses many diets that differ in terms of whether they contain goods originating from animals, like milk and eggs.

The history of vegetarianism is extensive, particularly in India, where the earliest known records date back several centuries BC. Plant-based diets were presumably uncommon in ancient Europe, and during the Middle Ages, some monastic organizations abstained from eating meat but not fish for ascetic reasons [1].

These days, more and more people, especially in Europe, follow vegetarian diets. The prevalence of newborns, kids, and teenagers following vegetarian-style diets is likely increasing as well, despite the lack of representative statistics [2].

A substantial body of literature exists regarding the rationales behind the adoption of a vegetarian diet. Several justifications for abstaining from consuming meat and/or other animal-derived items include [1]:

- Ethical considerations, pertaining to the killing of animals and/or animal welfare;
- Ecological considerations, particularly the inefficiency of producing animal food (in terms of calories and protein) from edible plant foods in light of the global food situation and the increasing global population;
- Health considerations, linked to the belief that consuming substantial quantities of animal products rich in saturated fat is linked to a diverse range of diseases in prosperous societies. Another potential health factor could be the existence of impurities, chemicals, or other undesirable compounds in animal-derived products;
- Aversion to specific categories of animal-based food. This is a prevalent rationale for abstaining from one or more particular categories of animal-based foods, such as specific varieties of fish, chicken, pork, beef, lamb, etc.

The literature on the health impacts of vegetarian diets presents methodological challenges, such as the presence of variation in the composition of the diet and the reliance on self-defined vegetarians rather than a dietary inventory-based definition [1]. To avoid inaccuracies, Table 1 includes definitions of diets used in the scientific literature, collectively known as vegetarian diets.

Table 1. Types of vegetarian diets [3, 4]

Classification of vegetarian diet	Description of dietary pattern
Lacto-ovo-vegetarianism	Excludes all flesh foods Includes dairy and eggs
Lacto-vegetarianism	Excludes any items made from flesh meat, eggs, and egg derivatives Includes dairy products
Ovo-vegetarianism	Excludes any items made from flesh meat Includes eggs
Fruitarianism	Excludes all animal products Includes fresh and dried fruits, possibly nuts, seeds and a few

	vegetables
Pesco-vegetarianism	Excludes meat, wild game and poultry Includes fish (and possibly other seafood). May include dairy products and eggs
Veganism	Excludes all foods of animal origin

In high-income countries, there is a growing proportion of people adopting a vegetarian or vegan dietary pattern. The prevalence of vegetarianism among the general adult population is considered to be approximately 10%, whereas veganism is thought to be around 1%–2%. The data about the prevalence among children and adolescents remains uncertain. According to the findings of the 2015–2017 EsKiMo II study [5] conducted in Germany, the overall rate of vegetarianism was recorded at 3.4%. This is a significant rise compared to the initial EsKiMo I study carried out in 2006 (1.6% vegetarians among the 12–17-year-olds). Other research [6] conducted in the United States has indicated that approximately 32% of teenagers aged 8 to 18 report consuming at least one vegetarian meal each week, but a mere 4% of that age group adheres strictly to a vegetarian diet. Vegetarian diets were more prevalent among girls and in children from families with high economic status [5].

Advantages of vegetarian diets

Adopting a plant-based diet may have an impact on four quality of life (QoL) domains—physical, psychological, social, and environmental—that the WHO has identified. [7]

Vegetarian diets typically exhibit elevated levels of carbohydrates and fiber while displaying reduced quantities of proteins and lipids, particularly saturated fats. This dietary pattern seems to be associated with improved health outcomes and a decreased susceptibility to noncommunicable diseases, potentially enhancing the physical quality of life [8].

The current state of literature indicates that a vegetarian diet has a positive impact on cardio-metabolic health in adults. This conclusion is supported by findings from cross-sectional studies, cohort follow-up studies, and randomized intervention trials. Cardiovascular illnesses are the primary contributor to global mortality and exhibit a strong correlation with obesity and type 2 diabetes. The incidence of obesity and type 2 diabetes is also on the rise among youth, prompting an inquiry into the potential long-term advantages of a vegetarian diet for youngsters.

The prevalence of obesity is significantly correlated with the extent of animal product consumption. A study on a cohort of Taiwanese adults conducted in the years 1994–2008 compared 4,415 lacto-ovo-vegetarians, 1855 lacto-vegetarians, and 1913 vegans with non-vegetarians matched for age, sex, and study site. After various adjustments (sex, age, physical activity, and education), vegetarians had significantly lower aberrant anthropometric parameters (waist circumference > 90 cm for men and > 80 cm for women; BMI > 27 kg/m², P < 0.0001) [9]. The findings of a cross-sectional study conducted on a sample of 55,459 Swedish women revealed that the occurrence of overweight or obesity, as measured by a BMI >25, was 40% among omnivores and 25% among lacto-vegetarians [10]. Although the study focused on adults, building healthy eating habits based on a plant-based diet in young people may provide long-term health benefits and adopting a plant-based diet appears to be a rational strategy for mitigating the risk of childhood obesity.

The consumption of a vegetarian diet has the potential to reduce inflammation. When consumed in their unprocessed form, plant-based foods contain a significant amount of antioxidants. These antioxidants can directly regulate free radicals in the body, such as the antioxidant vitamins C and E. Additionally, they can indirectly influence our immune response and the production of antioxidant compounds and enzymes, leading to a decrease in inflammatory reactions [11].

Following a vegetarian diet can also have a beneficial impact on the psychological domain, eliciting pleasant emotions such as benevolence and a sense of purpose. Additionally, the desire for guilt-free, tranquil eating can also positively affect an individual's decision to embrace a vegetarian diet [12]. Hence, opting for a vegetarian diet may strengthen one's connection with others who share similar views, fortify social ties, and exert a positive impact on one's social domain of quality of life.

A strong incentive for individuals to embrace and maintain a vegetarian diet is also the desire to reside in a healthier and more sustainable world. This is due to the established evidence that a predominantly plant-based diet has a reduced ecological footprint in comparison to diets centred around animals. It has been calculated that an omnivorous diet necessitates 2.9 times the amount of water, 2.5 times the amount of energy, 13 times the amount of fertilizers, and 1.4 times the amount of pesticides compared to a vegetarian diet. Furthermore, it is worth noting that meat and dairy production account for 80 percent of the overall gas emissions resulting from food production and 24 percent of the entire greenhouse gas emissions attributed to the food industry. Livestock production accounts for

approximately 70 percent of the total agricultural area worldwide and utilizes 29 percent of the total water resources allocated to agricultural activities [13].

Overall, vegetarianism has the potential to impact various aspects of quality of life. Choosing a vegetarian diet may bring positive effects, including improved physical well-being, positive emotions associated with embracing a morally upright mindset, a heightened sense of affiliation (with a vegetarian group), and a reduced ecological footprint. However, despite the favourable consequences associated with adopting a vegetarian dietary regimen, many obstacles might be found [8].

Nevertheless, as a result of the limited range of food options available, individuals who follow a vegetarian or vegan diet must consider essential nutrients such as protein, iron, calcium, vitamin D, vitamin B12, iodine, and n-3 fatty acids, and the possibility of their deficiencies. Due to the elevated energy and dietary demands associated with growth, babies, children, and adolescents exhibit heightened susceptibility to nutrient deficiencies compared to adults [2].

Deficiencies of essential nutrients in a vegetarian diet.

Proteins

Dietary protein plays a crucial role by supplying the necessary amino acids required for the manufacture of various nitrogenous substances, such as hormones or neurotransmitters [2]. Due to the reduced bioavailability of amino acids derived from plant-based sources, vegetarians may necessitate greater daily protein consumption [14]. It is not necessary to combine different sources of protein at each meal. However, taking complementary proteins at intervals of fewer than 6 hours has been found to be beneficial in children under the age of 2 [15].

The Protein Digestibility Corrected Amino Acid Score (PDCAAS) is a metric used to quantify the protein quality of a particular type of food. The score can be calculated as: [16]

$$\frac{\text{mg of limiting amino acid in 1 g of test protein}}{\text{mg of same amino acid in 1 g of reference protein}} \times \text{fecal true digestibility (\%)} \times 100$$

The term "limiting amino acid" is used to describe the essential amino acid present in the lowest quantity in a food protein relative to a reference food protein like egg whites. The term "limiting amino acid" may also refer to an essential amino acid that does not meet the

minimal requirements for humans [17, 18]. Table 1 provides a concise overview of the PDCAAS for various food protein sources. While previous recommendations about nutritious vegetarian diets emphasized the significance of incorporating diverse plant protein sources within a single meal, subsequent studies suggest that the distribution of plant protein sources can be extended over a longer period of time. Given that a vegan diet has a PDCAAS level of 75-77%, it may be estimated that the protein needs of vegans are 1.3 times greater than those of omnivores.

Ensuring adequate protein intake for optimal growth and development can be achieved through adherence to a vegan or vegetarian dietary regimen. Typically, children and teenagers need to consume two to three portions of meat or a meat substitute every day [14].

Table 2. PDCAAS percentage for different food protein sources [16]

Protein source	PDCAAS [%]	Limiting amino acid
Egg	118	
Milk, cheese	121	
Meat, fish	92	Branched amino acids
Soy	91	Methionine, cysteine
Corn	52	Lysine
Rice	44	Lysine
Wheat	42	Lysine

The increasing popularity of vegetarianism in Western countries has motivated the food industry to create meat alternatives using soy protein isolates (specifically textured soy protein), mycoprotein and egg white, or alternative plant protein sources such as lupin flour [19]. Convenience chicken- or beef-style items are increasingly being manufactured as substitutes. Typically, these meat alternatives provide a reduced amount of saturated fat and cholesterol compared to meat. However, they are not rich in iron and do not include any vitamin B12 unless they are supplemented [20].

B12 vitamin

Vitamin B12 (cobalamin) is essential for the process of cell division and the creation of blood. To meet their vitamin requirements, vegetarians can consume fortified foods, eggs,

dairy products, or opt for a supplement. Vitamin B12 can be obtained from nonanimal sources such as cereals, breads, nutritious yeast, and certain fortified soy products. However, some study shows, that animal products are the only reliable dietary source of vitamin B12. The cobalamins present in algae and seaweeds have been shown to be non-active analogues of vitamin B12. [21]. A deficit in vitamin B12 leads to hematological conditions such as megaloblastic anemia, as well as neurological disorders including neurodevelopmental delay and regression and neuropsychiatric disorders. Due to the potential concealment of B12 insufficiency symptoms by excessive folic acid consumption, neurological symptoms may occur prior to their identification - one third of vitamin B12-deficient adults do not display megaloblastic anemia [22]. Hence, it is of utmost significance to evaluate the food consumption of young vegetarians as soon as possible. Insufficient dietary consumption necessitates the use of a B12 supplement to avoid a deficiency. Overdosing with vitamin B12 has not been described. Breastfeeding moms adhering to a vegan dietary pattern should be advised of the potential neurological disruptions that may occur in their infants in the event of a deficiency in vitamin B12 [14].

The Recommended Dietary Allowance for cobalamin is 2.4 µg/day for adults, 2.6 µg/day for pregnant and lactating women and ranges from 0.9 µg/day for toddlers to 2.4 µg/day during adolescence [23]. Dairy products contain less cobalamin (0.3–0.4 µg/100 g) than eggs (0.9–1.4 µg/100 g) or meat and fish (3 and 33 µg/100 g). However, bioavailability of cobalamin from dairy products is higher than from meat, fish or eggs [21].

Iron

Iron has a crucial role in facilitating efficient oxygen transportation inside erythrocytes. Meat, specifically red meat, provides the most readily assimilated form of iron, known as heme iron. Nevertheless, the naturally occurring iron found in plant-based food (non-heme iron) can be consumed along with a vitamin C supplement to increase absorption [24]. The presence of phytates, along with other organic substances found in legumes, nuts, and whole grains, can inhibit the absorption of iron. Therefore, it is crucial to incorporate a diverse range of foods that are rich in iron into one's daily diet. Due to the reduced bioavailability of iron from plant-based diets, vegetarians need 1.8 times more iron than omnivorous people [25].

There is significant variation in the prevalence of iron insufficiency among vegetarian children across different studies.

The literature review conducted on the iron status of vegetarian children encompassed thirteen publications that met the inclusion criteria. These articles examined various biochemical indicators, such as hemoglobin (Hb) and serum ferritin, to evaluate the iron status. The prevalence of iron insufficiency was reported separately for vegetarians and non-vegetarians in seven out of the 13 investigations. Among the vegetarian participants, five out of seven individuals exhibited a greater prevalence of iron deficiency, whereas the remaining two individuals displayed a higher prevalence of iron deficiency among non-vegetarians. The incidence of iron deficiency varied significantly, with one study reporting a prevalence of 4.3% among vegetarian individuals and another study reporting a prevalence of 73% with ferritin levels below 10 µg/L. The hemoglobin (Hb) data exhibited significant variability, with 0% of children exhibiting Hb values below 11 g/dL and 47.5% displaying Hb values below the 3rd percentile. The incidence of iron insufficiency among vegetarian children exhibits significant variation across different studies. The observed disparity in the occurrence of insufficient iron levels was consistent across research conducted in both industrialized and underdeveloped nations [26].

Nevertheless, it is noteworthy to mention that there is no evidence to suggest that vegetarians experience greater rates of iron deficiency anemia in comparison to nonvegetarians [14].

Zinc

Zinc deficiency in children can lead to serious consequences, including impaired growth and development, weakened immune system, and impaired cognitive functions [27]. Zinc absorption also is affected by the phytates that occur naturally in whole grains and legumes. In certain cases, vegetarians may necessitate a greater consumption of zinc compared to the recommended dietary requirement. Methods such as the process of soaking dried beans and thereafter disposing of the soaking water before to cooking have been found to potentially augment the absorption of zinc. However, there is no evidence of zinc shortage in Western vegans [14].

Fatty acids

The essential fatty acids (EFA): linoleic acid (18:2n-6) and linolenic acid (18:3n-3), must be determined by the dietary intake. These EFA are transformed into long-chain polyunsaturated fatty acids such as eicosapentaenoic acid (EPA; 20:5n-3), docosahexaenoic acid (DHA) and arachidonic acid (AA; 20:4n-6). Vegans, especially if eggs, fish, or large amounts

of sea vegetables are not consumed, typically exhibit a high intake of n-6 fatty acids while consuming relatively few quantities of n-3 fatty acids. Vegetarians exhibited decreased blood levels of EPA and DHA in comparison to non-vegetarians. To restore the balance of n-6/n-3, it is recommended to regularly consume micro-algae, which are rich in DHA, as well as walnuts, canola oil, or flaxseed oil, which are rich in α -linolenic acid [14, 20].

Calcium, vitamin D

A sufficient calcium intake during infancy is essential for maintaining normal bone mineral density throughout life. Rickets has been reported in vitamin D-sufficient kids on a calcium-deficient diet who consume high amounts of non-supplemented soy drink [28]. It is crucial to point out that newborns should not be exposed to commercial soy milk until the end of their first year due to the limited absorption of iron and zinc from soy [29].

There is no significant difference in bone mineral density or the risk of bone fractures between omnivores and lacto-ovo-vegetarians [30]. Vegans have a lower average calcium intake, which seems to be linked to a higher risk of bone fracture. Insufficient bone mineral density has also been observed in teenagers who have been following a macrobiotic diet with insufficient calcium intake from an early age [31].

Low-oxalate green vegetables, such as broccoli, Chinese cabbage, collards, and kale, are considered to be beneficial providers of calcium. On the other hand, the bioavailability of calcium in nuts, dry beans, and vegetables with a high oxalate content, such as spinach, is rather low [32]. Alternative sources of calcium are calcium-fortified soy drinks, rice drinks, cereals, and fruit juices.

Natural sources of vitamin D include milk and dairy products. The human body has the ability to synthesize vitamin D through exposure to sunlight. Previous studies have indicated that sufficient vitamin D intake for light-skinned children and adolescents in moderate climates can be achieved by exposing their hands and face to sunlight two to three times per week for a duration of 20 to 30 minutes [33]. Vegetarians have the option to enhance their vitamin D intake by incorporating fortified soy milk, cheese, yogurt, and cereals into their diet as dietary sources of this essential nutrient.

Nutritional advices for vegetarian children.

The dietary guidelines for children who are on a plant-based diet depend on their age.

Infants

The nutritional recommendations for vegetarian infants aged 0–12 months are dependent upon the method of feeding, which is whether the child is breastfed or bottle-fed.

For lacto-vegetarian mothers who consume meat or fish less than once a week, it is recommended to monitor the serum levels of vitamin B12 and urinary methylmalonic acid among breastfed infants. For vegan mothers, it is advised to provide vitamin B12 supplements to both the mother and child. It is also recommended to consider using an iron supplement for breastfed infants starting at 6 months of age.

For bottle-fed children, infant formula or soy formula is indicated, but rice drinks, non-adapted soy drinks, and almond drinks are not suitable milk substitutes, despite the addition of calcium.

On the matter of weaning food, it is recommended to maintain breastfeeding or provide a minimum of 400 ml of infant formula as a protein and calcium source. From the age of 6 months, pureed legumes or tofu can be introduced. Additionally, it is advisable to ensure that meals have an adequate caloric density by incorporating oils that are rich in linolenic acid, such as flaxseed, canola, rapeseed, or nut oil.

Parents should assess their knowledge of the preparation of foods and their ability to obtain a diverse range of food options. They should also see a dietician for a diet evaluation [14, 20].

Toddlers/preschool children

It is important to ensure that toddlers and preschool children consume an adequate amount of calcium through dairy products or calcium-fortified drinks. Additionally, it is important to assess the caloric density of their meals and restrict the consumption of raw, unprocessed foods. These types of foods are less easily digestible compared to cooked or fermented products and may be more challenging to ingest due to their insufficiently developed oral motor mastication abilities.

It is advisable for parents to consider the potential hazards of nut choking and to advise the practice of grinding nuts and cutting vegetables. Furthermore, assess calcium sources and the extent of sunlight exposure for B12 vitamin synthesis [14, 20].

School age

It is important for parents of school-age vegetarian children to get knowledge regarding the availability of vegetarian options in school meals. It is still advisable to assess the child's calcium consumption and provide supplements if their intake of calcium-fortified meals is insufficient. A child should be provided with unrestricted resources to engage in conversations about food options and substitutes with both peers and parents, and possess adequate understanding of their dietary habits. There is a possibility that the nutrition information provided at school may differ from the average diet consumed at home. Parents should be aware that this could be the child's initial exposure to the concept of an "alternative" diet. [14, 20]

Adolescents

It is crucial to inquire about the motivations behind adolescents adopting vegetarianism, since it may be linked to their weight-related worries and body perception. [20] Individuals who have eating disorders may choose a vegetarian lifestyle as a mechanism for weight management, as a tactic for avoiding food consumption. [34] Adolescents need to be provided with sufficient information sources, such as food guides and recipes, pertaining to healthy vegetarian diets. It is significant to assure the availability of vitamin B12 and calcium sources [20]. Additionally, it is important to encourage parental involvement and cooperation in the process of menu planning. Vegan teenagers can even encourage their omnivore parents to eat plant-based meals together.

Practical guidance on vegetarian kid nutrition

Vegetarian diets have the potential to offer sufficient nutritional value for children, provided that parents and caregivers possess the necessary understanding. A lacto-ovo-vegetarian diet has the potential to easily be well balanced and meets all the nutritional requirements of a developing child. On the other hand, a vegan diet must be supplemented with vitamin B12 while also ensuring sufficient intake of calcium and zinc, as well as energy-dense foods that contain sufficient high-quality protein for young children. The danger of inadequacies increases when the diet becomes more restricted and the child is younger.

The provision of adequate nutrition for growth and neurodevelopment through a vegetarian diet necessitates meticulous supervision, particularly during the early stages of life, specifically before the age of three years. Attention should be placed on the intake of essential nutrients such as iron, calcium, vitamin D, vitamin B12, zinc, and n-3 poly-unsaturated fatty acids. The adoption of a dietary pattern characterized by decreased consumption of red meat, mostly supplemented with chicken and fish, sometimes referred to as "flexitarianism," presents a potentially viable strategy for mitigating the likelihood of cardiovascular ailments while minimizing the potential for nutritional deficiencies [4, 20, 26].

Vegetarianism during pregnancy

Pregnancy presents a crucial period to establish dietary practices that promote the well-being of the fetus. Additionally, this state is characterized by an increased demand for energy and micronutrient intake in order to sustain the provision of vital nutrients necessary for the growth of the fetus. The majority of studies indicate that pregnant women can adhere to a well-designed vegetarian diet without experiencing any risks of deficiencies or disorders in fetal development. However, there are a few studies that suggest vegetarian diets during pregnancy may be linked to smaller neonatal size, possibly due to reduced gestational weight gain in mothers. Nevertheless, even in these studies, vegetarianism was not found to be associated with morbidities or other adverse maternal outcomes related to small-for-gestational-age [35–37]. It is imperative to acknowledge that the process of fetal development is a multifaceted phenomenon influenced by a range of factors beyond maternal diet, including maternal genetics, overall health, and socioeconomic status.

The December 2016 study, which involved a thorough examination of the electronic databases MEDLINE and EMBASE, demonstrates that the health indicators of infants, including their birth weight and length, were comparable between newborns born to vegetarian women and those born to women who consume meat and meat products. The conclusion of the report is that adhering to a vegetarian diet during pregnancy can adequately address the nutritional requirements of women at this specific phase of their lives [38].

The safety of balanced and well-planned vegetarian diets, including vegan diets, during pregnancy has been also affirmed by the American Dietetic Association and the Academy of Nutrition and Dietetics. [32] Adhering to plant-based diets during pregnancy and lactation necessitates a heightened consciousness of consuming all necessary critical nutrients and

vitamin supplements. This is because vitamin B12, vitamin D, iron, and folic acid are crucial for maintaining a healthy pregnancy and promoting optimal fetal growth [39].

Vegetarian Diets and Eating Disorders

Eating disorders, such as anorexia nervosa, bulimia nervosa, orthorexia nervosa, and Eating Disorder Not Otherwise Specified (SCID), are typically linked to restrictive dietary patterns and are more frequent among teenagers and young adults. Vegetarianism receives growing attention as a potential approach to weight control, as the diet is based on reducing animal fats [34]. When it comes to eating disorders, the disorder itself results in the exclusion or limitation of certain products. It is important to investigate various factors and causes that may contribute to this phenomenon. Based on existing scholarly research, it has been observed that a significant proportion of teenagers and young adults (from 45% to 54%) diagnosed with anorexia nervosa, particularly females, adhere to a vegetarian dietary regimen [34, 40]. Furthermore, approximately 6% of patients have said that they adhered to a vegetarian diet several years before the onset of their eating disorder. Health care practitioners should be concerned that individuals with a suspected or diagnosed eating disorder who choose to follow a vegetarian diet may be using this behavior as a socially acceptable means to justify their avoidance of food and avoid certain eating circumstances [34, 40]. In the context of a patient diagnosed with an eating problem, choosing to follow a vegetarian lifestyle based on animal rights concerns may be perceived as a more socially acceptable and less uncomfortable choice compared to explicitly pointing out weight reduction as a motivation. In this case, social acceptability bias refers to the tendency of an individual with an eating disorder to emphasize animal rights and ethics, even when their behavior may actually be motivated by a desire to restrict.

There is a reported association between vegetarianism and unhealthy and excessive weight control habits, particularly among adolescents. However, it is worth noting that several researches have shown no correlation between eating disorders and vegetarianism [41]. Therefore, it appears probable that vegetarianism, in a patient with an eating disorder and a vegetarian lifestyle, may serve as a means of limiting their eating habits as an aspect of their eating disorder pathology. Given the link between vegetarianism and eating disorders, physicians should rigorously check individuals who follow a vegetarian diet to assess the prevalence of excessive weight control attitudes and eating disorder chronicity.

Although the most common aspect of eating disorders is food avoidance, in some individuals, an interest in healthy attitudes and behaviors towards food may show obsessive signs. An excessive focus on consuming 'healthy' food may be a contributing factor to the development of orthorexia nervosa, which is characterized by an obsession with eating nutritious food. Orthorexia nervosa can be defined as an intense fixation on healthy eating based on personal criteria, such as a strong preference for organic and biologically clean products, dietary supplements, raw foods, and high- or low-carbohydrate foods. This is accompanied by excessive worry for one's health, intrusive thoughts about maintaining good health, a lack of flexibility in dietary choices, long-term planning, and a negative impact of food choices on quality of life [3]. There is a lack of agreement in the research regarding the connection between a vegetarian diet and orthorexia. There exists empirical evidence indicating that vegetarians may face a higher susceptibility to orthorexic eating patterns compared to omnivores [42]. Conversely, certain studies [43, 44] suggest that a vegetarian diet is not associated with an excessive preoccupation with healthy eating. It is noteworthy to mention that a recent study has demonstrated that the association between a vegan lifestyle and orthorexic eating behavior is not solely determined by a vegan diet itself, but rather by underlying factors such as health, esthetics, and healing [45]. The diverse guidelines for maintaining a balanced diet associated with a vegetarian lifestyle may lead to the development of disordered eating behaviors, such as the adoption of restrictive eating habits and an excessive obsession with food [34, 46, 47].

The results of the current studies can be summarized within a broader context, examining the potential negative effects of vegetarianism on mental health. According to a meta-analysis conducted in 2020, involving a sample size of 17,809 individuals, it was found that persons who followed vegan or vegetarian diets exhibited an increased susceptibility to depression, while demonstrating reduced levels of anxiety [48]. Nevertheless, a further meta-analysis, which was also published in 2020, revealed that there was no significant correlation between the adoption of a vegetarian diet and the presence of depression or anxiety [49]. The complex dynamics among vegetarianism, eating disorders, and depression need more investigation in future research efforts. A meta-analysis of 42 research has shown a long-term association between eating pathology and depression. This analysis emphasizes the need of identifying the factors that contribute to the development of both diseases [50]. The topic of vegetarian diets and their potential impact on mental health continues to be a subject of intense and ongoing debate. To conclude, some studies suggest that following strict dietary

patterns may lead to some eating disorders, but there are also studies that show that a sudden change to a more restrictive diet, including vegetarian or vegan, may be a symptom of existing eating disorders. With this in mind, children and young adults practicing vegetarian diets should be monitored for healthy eating habits.

Views of paediatric and nutrition organizations on vegetarian and vegan diets for children.

In the past two decades, numerous scientific and professional organizations within the realm of nutrition and paediatrics have released statement papers outlining their position on the appropriateness of vegetable-based diets for children and adolescents.

The American Dietetic Association asserts that well-designed vegetarian diets, such as fully vegetarian or vegan diets, are nutritious, nutritionally sufficient, and can potentially offer health advantages in the prevention and management of specific illnesses. Vegetarian diets that are carefully designed are suitable for persons across various life phases, encompassing pregnancy, nursing, infancy, children, adolescents, as well as athletes [32].

According to the Canadian Paediatric Society [4, 51], it is asserted that a meticulously designed vegetarian and vegan diet, which incorporates dietary supplements, has the potential to meet the nutritional needs of children and adolescents, provided that sufficient calorie intake is maintained. According to the British Nutrition Foundation [25], a carefully designed and well-balanced vegetarian or vegan diet can provide sufficient nourishment. More radical dietary patterns, such as rigorous macrobiotic and raw food diets, frequently lack sufficient calories and a variety of essential micronutrients, rendering them completely insufficient and unsuitable for children.

The British Nutrition Foundation maintains that a meticulously designed and harmonious vegetarian or vegan diet can provide sufficient nutritional value. Extreme dietary patterns, such as strict macrobiotic and raw food diets, frequently exhibit low calorie content and a deficiency in certain micronutrients, rendering them entirely insufficient and unsuitable for children [52].

The German Society for Paediatric and Adolescent Medicine states that a well-balanced vegetarian diet is generally sufficient to meet the nutritional needs of growing children and adolescents. However, these children face a greater risk of developing nutrient deficiencies

compared to adults due to their higher nutrient requirements per kilogram of body weight [53]. However, adhering to a strictly plant-based vegan diet can make it challenging or even unattainable to obtain a sufficient amount of certain essential elements. Vitamin B12 is considered to be the most crucial nutrient. According to The German Society for Paediatric and Adolescent Medicine , it is not advisable for pregnant women, breastfeeding women, infants, children, or teenagers to adhere to a vegan diet [51].

The European Society for Paediatric Gastroenterology, Hepatology, and Nutrition recommends that a healthcare professional should be involved with proper planning (considering recommended macro- and micronutrient intakes) and monitoring (including growth, zinc, iron, vitamin B12, and vitamin D) when implementing a vegetarian diet [54]. ESPGHAN advises against introducing a vegan diet to infants and young children. While it is theoretically possible for a vegan diet to adequately meet nutrient requirements provided both the mother and infant adhere to medical and dietary recommendations for supplementation, it is important to note that disregarding such advice can have significant consequences [55].

Conclusion

A nutritionally balanced vegetarian diet has the potential to meet the dietary requirements of children and adolescents. Nevertheless, it is important to ensure adequate caloric intake and closely monitor growth. Special emphasis should be placed on ensuring sufficient consumption of protein and obtaining sources of vital fatty acids, iron, zinc, and calcium, as well as vitamins B12 and D. Supplementation may be necessary in instances where individuals adhere to strict vegetarian diets and abstain from consuming any animal-derived products.

The majority of paediatric associations strongly support the idea that a properly planned vegetarian diet can be beneficial for maintaining good health and promoting normal growth and development during critical life periods involving pregnancy, lactation, infancy, and childhood. However, certain paediatric associations advise against the use of vegan diets for children and adolescents due to concerns about potential harm resulting from inadequate intake of essential nutrients.

Overall, it is crucial to provide the whole family, both parents and children, with a suitable education in order to help them effectively adapt to a vegetarian diet and avoid potential hazards.

Author's contribution

Conceptualization, Patrycja Proszowska and Daria Sieniawska, methodology, Adrianna Orzeł and Julia Sieniawska, software, Aleksandra Pich-Czekierda and Adrianna Orzeł, check Zuzanna Kotowicz and Patrycja Proszowska, formal analysis, Magda Madoń and Aleksandra Pich-Czekierda, investigation Adrianna Orzeł and Daria Sieniawska,, resources, Zuzanna Kotowicz and Julia Sieniawska, data curation, Zuzanna Kotowicz, writing-rough preparation, Magda Madoń, Aleksandra Pich-Czekierda, visualization, Patrycja Proszowska, supervision, Adrianna Orzeł, project administration, Daria Sieniawska, Magda Madoń and Julia Sieniawska.

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