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Is a Vegetarian Diet Safe to Follow During Childhood?

Çocukluk Döneminde Vejetaryen Beslenme Güvenli mi?

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ABSTRACT

Vegetarianism is characterized by the exclusion of all animal flesh foods from the diet, including meat and fish. The more restricted form is a vegan diet that excludes all animal-derived food, including milk, dairy products, and eggs. During past decades questions have been raised about whether vegetarian diets are suitable during all stages of life and during the fast growth period. Nutrition during pregnancy and lactation is a potentially modifiable risk factor as it is an important determinant of lifetime disease risk. Therefore, it is of great importance to encourage mothers to have adequate and balanced nutrition during pregnancy and lactation. Infancy, childhood, and adolescence are critical periods, and nutritional requirements become crucial to be met during this time. Children on vegetarian diets might be at risk of certain nutrient deficiencies such as n-3 fatty acids, vitamin B_{12}, iron, and zinc. Furthermore, the nutritional habits acquired during this period may influence dietary patterns and the risk of disease later in life. Most of the studies investigating the effect of vegetarian diets on children are outdated. There is a lot of controversy regarding the safety of vegetarian diets in childhood, and more longitudinal studies are needed. This review focuses on the effects of vegetarian diets in children and the health consequences of vegetarian diets.

Keywords: Children, nutritional status, vegetarian diet, vegan diet, health, safety

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ÖZET

Vejetaryenlik, et ve balık dahil olmak üzere tüm hayvan etlerinin diyetten dışlanması ile karakterize edilmektedir. Vegan diyet ise daha kısıtlı olup süt ürünleri ve yumurta dahil olmak üzere tüm hayvansal kaynaklı gıdalar dışlanmaktadır. Vejetaryen diyetlerin yaşamın tüm aşamalarında ve özellikle hızlı büyüme döneminde uygun olup/ olmadığı konusu sıklıkla sorgulanmaktadır. Gebelik ve emziklilik döneminde beslenme, yaşam boyu hastalık riskinin önemli bir belirleyicisi olduğu için potansiyel olarak değiştirilebilir bir risk faktörüdür. Bu nedenle, gebelikte ve emzirme döneminde annelerin yeterli ve dengeli beslenmeye teşvik edilmesi büyük önem taşımaktadır. Bebeklik, çocukluk ve ergenlik kritik dönemler olup, bu dönemlerde beslenme gereksinimlerinin karşılanması çok önemli hale gelmektedir. Vejetaryen ve vegan çocuklar n-3 yağ asitleri, B12 vitamini, D vitamini, kalsiyum, demir ve çinko gibi bazı besin ögesi eksiklikleri ile karşı karşıya olabilir. Ayrıca, bu dönemde edinilen beslenme alışkanlıkları ve beslenme düzeni, yaşamın ilerleyen dönemlerinde hastalık riskini etkileyebilmektedir. Vejetaryen beslenmenin çocuklar üzerindeki etkisini araştıran çalışmaların çoğu güncelliğini kaybetmiştir. Çocuklukta vejetaryen diyetlerinin güvenliği konusunda pek çok tartışma söz konusu olup yeterli uzunlamasına çalışma bulunmamaktadır. Bu derleme, çocuklarda vejetaryen diyetlerin etkilerine ve sağlık üzerindeki sonuçlarına odaklanmaktadır.

Anahtar Kelimeler: Çocuk, beslenme durumu, vejetaryen diyet, vegan diyet, sağlık, güvenlik

1. Introduction

Vegetarian diets are characterized by the exclusion of flesh foods such as meat and meat products, poultry, fish, and seafood. Vegetarian diets may include eggs, milk, and dairy products and are rich in plant-based foods such as vegetables, fruits, grains, legumes, nuts, and seeds. On the other hand, a vegan diet excludes all animal-derived food, including milk, dairy products, eggs, and even honey [1]. Different types of vegetarian diets [2-3] are described in table 1. A growing number of people are following vegetarian diets because of ethical, environmental, and health concerns [4]. The primary motivation behind following a vegetarian diet is animal protection, but it is also due to concerns about hormone and antibiotic use in animals or environmental concerns [5].

There are many longitudinal studies, the results of which suggest that vegetarians have a lower risk for certain diseases such as ischemic heart disease, hyperlipidemia, and hypertension [6,2,7]. But there are much less data available on the health consequences of vegetarian diets in infants and children. Therefore, the evidence may not be sufficient to conclude that a well-planned vegetarian diet is suitable for all stages of life [6]. If not appropriately planned, following a vegetarian diet may result in a reduced intake of specific nutrients such as n-3 fatty acids, vitamin D and B12, iron, zinc, and calcium. Academy of Nutrition and Dietetics (AND) states that well-planned vegetarian diets are appropriate for all stages of the life cycle and may provide some health benefits in the prevention of certain diseases [2,6]. On the other hand, the German Nutrition Society (DGE) is against all plant-based diets for infants, children, and adolescents [8]. The recent literature regarding the safety of vegetarian diets for children will be discussed further in this review.

Table 1: Different types of vegetarian diets

Lacto-ovo-vegetarian	Consumes eggs, milk and dairy products
Lacto-vegetarian	Consumes milk and dairy products but not eggs
Ovo-vegetarian	Consumes eggs and egg products, but not milk and dairy products
Semi-vegetarian	Consumes red meat, poultry and fish less than once per week and more than once per month
Pescatarian	Consumes seafood, fish, eggs, milk and dairy products but no red meat and poultry
Vegan	Excludes any kind of animal derived foods including eggs, milk, dairy products and honey
Raw vegan	Consumes mainly uncooked fruits, vegetables, nuts and seeds, grains and legumes.

Vegetarian Diets in Children

Even though there are various reasons why people adopt a vegetarian diet style, vegetarianism in children is primarily the parents' decision [9]. The prevalence of vegetarianism in children varies around the world. According to National Surveys, 0.7% of children aged 6-12 and 1.3% of children ages 12-19 years are vegetarians in the United States. Similarly, in the United Kingdom, approximately 2% of children reported being vegetarian [10]. Although vegetarian diets are perceived as healthy, there are some concerns about the nutritional requirements during infancy, childhood, and adolescence [11]. In growing children, height and weight and cognitive and psychomotor development are influenced by the quality of the diet they consume. Therefore, infants and children must get their nutritional requirements met. In the fast-growing period, vegetarian children might be at risk of certain nutrient deficiencies such as n-3 fatty acids, vitamin B12, iron, and zinc. Furthermore, the nutritional habits acquired in this period may influence dietary patterns later in life [12].

The period from birth to 1 year is a critical period to meet the nutrients needed to support extremely fast growth. Particular attention should be paid to normal growth and neurodevelopment targets at this stage. In the second half of the first year of life, breast milk alone is not enough to provide enough energy, protein, zinc, iron, and fat-soluble vitamins (vitamins A, D, K). Thus, complementary feeding is a crucial stage in an infant's growth, and it may play a significant role later in life [13]. Recently ESPGHAN [European Society for Paediatric Gastroenterology, Hepatology, and Nutrition Committee on Nutrition] stated on its position paper that vegan diets should be discouraged during complementary feeding [8].

The nutritional status of vegetarian children depends on the parents' level of education and knowledge [9]. Several cases of infant hospitalization were reported due to various nutrient deficiencies which developed after these infants were weaned with vegan regimes. An 11-month-old infant weaned with a vegetarian diet was hospitalized because of a severe B12 deficiency. In 2016 a 2-years-old child was hospitalized with severe nutritional deficiencies because he was exclusively breastfed by a mother following a vegan diet [3].

Nutrients that are likely to require special attention for vegetarian children include iron, zinc, vitamin B12, and additionally for vegan children calcium and vitamin D. Daily protein intakes of young vegetarians' usually meet recommendations, while protein needs of vegan children vary because of differences in amino acid composition and protein digestibility. Vegetarian diets are associated with limited absorption of iron and zinc due to their high content of phytates. Still, deficiencies of these minerals in children are not very common in industrialized countries. Children on vegan diets should be strictly monitored for Vitamin B12, iron, and zinc status [2].

Macro And Micronutrient Status in Children on a Vegetarian Diet

Children need more energy, macro, and micronutrients per body weight unit compared to adults to maintain healthy growth and development [14]. Therefore, nutrient status in children following a vegetarian or a vegan diet is important for their growth and development. Studies on macro and micronutrient intake of vegetarian children are limited and outdated [15]. Thane and Bates [16] included 13521 children (1.5-4.5 years) from the National Diet and Nutrition Survey to analyze and compare dietary intakes and nutrient status of vegetarian and non-vegetarian Asian preschool children. They found that vegetarian children had a higher energy intake from carbohydrates than non-vegetarian children. Serum ferritin levels were lower in vegetarian children, while antioxidant vitamin status was higher compared to non-vegetarian children. Although the authors concluded that lower intakes of fat, sodium and higher intakes of antioxidant vitamins may be beneficial, low serum ferritin levels may be a potential risk for impairment in growth for these children [16]. Alexy et al. [17] compared the dietary intakes of vegetarian (n =149), vegan (n =115), and omnivore (n = 137) children and adolescents (6–18 years) in Germany. The total energy intake was not significantly different between groups. Intake of carbohydrates was significantly higher among vegans and vegetarians compared to omnivores. The median protein was lowest among vegetarians. The authors did not report any specific nutritional risks among vegetarian and vegan children and adolescents [17]. In the study Peddie et al. [18] conducted, adolescent girls between the ages of 15-18 were assessed via 24-h diet recalls. Vegetarian adolescents had similar carbohydrate and fat intakes compared to non-vegetarians; however, their protein intake was lower. Vegetarian adolescents also ate less saturated fat, more polyunsaturated fat, and 5 g/day more fiber than non-vegetarians [18].

Protein

It is stated by AND that when energy intakes are sufficient, vegetarian diets [including vegan] meet recommended protein intakes. AND also states that different sources of plant-based protein eaten during the day to be enough to supply all of the essential amino acids. The regular consumption of soy and legumes may provide adequate protein intake for vegetarians [2]. Plant-based proteins such as soy or gluten, due to antinutritional factors, may have a lower digestibility than animal proteins. Even though all the essential amino acids are present in plant-based foods, certain amino acids are relatively low in some foods, such as lysine in rice and methionine in legumes. Concerning these essential amino acids, a combination of cereals and legumes may help to provide the needed daily amino acid composition [5].

EPA/DHA

A vegan diet consists of no EPA (eicosapentaenoic acid) or DHA (docosahexaenoic acid), while vegetarian diets can provide some DHA from eggs [6]. A small percentage of ALA (a-linolenic acid) from plants is converted to EPA and DHA in the human body. These fatty acids are essential for maintaining the cell membranes, brain, and retina during fast growth [2]. It is known that DHA is crucial for brain development, especially during the first years of life. Deficiencies of EPA and DHA are associated with some neurocognitive consequences, including autism spectrum disorders, ADHD [attention-deficit hyperactivity disorder], and dyslexia [6].

While ALA [a-linolenic acid] intakes of vegetarians are similar to those not following a vegetarian diet, their intakes of EPA and DHA are much lower. Therefore, in vegetarians, levels of these long-chain n-3 fatty acids may get significantly lower compared with non-vegetarians [2]. The suboptimal levels of DHA and EPA may put infants and children at risk for impaired CNS (central nervous system) development [6]. The plant-based sources of long-chain n-3 fatty acids are flaxseed, chia, canola, walnuts, and their oils [2]. For complementary feeding, n-3 rich oils such as walnut, soybean, and rapeseed may be added to one meal a day. DHA supplementation of 100mg/day is recommended from 12 months and on. The intake of n-3 fatty acids should be ensured with foods rich in ALA, including flaxseed, walnuts, chia, and soybean oil in children and adolescents. To meet the recommendations of DHA and EPA, algae-based supplements should be considered [5].

Vitamin D

Vitamin D levels closely correlate with sun exposure and the consumption of fortified foods or simply taking supplements. The degree of vitamin D production after sun exposure depends on many factors

such as latitude, season, time of the day, clothing, sunscreen use, skin pigmentation, and age. Low vitamin levels are detected in vegetarian and non-vegetarian populations, especially during winter and in higher latitudes. Fortification of vitamin D is done via cow's milk, plant-based milk, margarine, fruit juice, and cereals [2]. In the lack of consumption of fortified foods or/and supplementation, vegan and vegetarian children can be at risk of vitamin D deficiency and vitamin D-related rickets [5]. In the study, Ambroszkiewicz et al. [19] conducted, no significant difference was found regarding vitamin D status between vegetarian prepubertal children and their non-vegetarian counterparts. Supplementation of vitamin D is crucial for vegan and vegetarian children. Monitorization of 25[OH]D3 levels and supplementation even outside winter periods are necessary elements for optimizing vitamin D levels [5]. In the study Hovinen et al. [14] conducted, children following a vegan diet showed much lower vitamin D levels even though they were reported to take daily supplements.

Vitamin B12

Vitamin B12 does not have a plant-based source. Thus, vegans must regularly consume vitamin B12 fortified foods or supplements. Especially infants in the fast growth period and children may be at risk for vitamin B12 deficiency. Vegetarian children might also be at risk of vitamin B12 deficiency since 200 ml of milk and one egg per day provides approximately 2/3 of the RDA (Recommended Dietary Allowance) value [2]. In the study, Osei-Boadi et al. [20] conducted, vitamin B12 intakes of vegetarian Ghanaian children were much lower compared to non-vegetarian children based on 24-hr food recall. Severe vitamin B12 deficiency symptoms include fatigue, poor cognition, numbing of the fingers and toes, anorexia, megaloblastic anemia, failure to thrive [2]. Signs of vitamin B12 deficiency can be detected around 4-10 months, even though they may be seen earlier or later in life. In young children and infants, irreversible cognitive damage can occur due to severe vitamin B12 deficiency, and cases of deaths have been reported regarding B12 deficiency. Most of the B12 deficient infants are known to be exclusively breastfed by vegan or vegetarian mothers [8].

Due to its stability, cyanocobalamin is commonly used in supplements and fortified foods [2]. Foods fortified with vitamin B12 such as cereals, non-dairy milk, and soy products may provide sufficient amounts for young growing children. Still, it can be more challenging for infants whose vitamin B12 sources are limited [8]. EFSA (European Food Safety Authority) set an adequate intake of vitamin B12 for children seven months- 6 years as 1.4 µg/day [21]. Therefore, parents of vegan infants and children need to optimize their children's vitamin B12 intake with the help of a pediatric dietitian [8]. Even though vegetarians can achieve sufficient B12 levels with supplementation, some can still be deficient, and maintaining adequate levels via supplementation is much more difficult for the children [6].

Iron

Iron is an essential element that plays a vital role in growth and development. Iron is required in energy metabolism for the citric acid cycle and is a cofactor for many enzymes [22]. Iron deficiency in children may lead to anemia, weakened immune system, lethargy, and impaired growth and cognitive performance [23]. The most readily digested form of iron is heme iron which is found in meat, poultry, and fish. In vegetarian and vegan diets, most of the iron comes from non-heme sources [22]. Even though vegetarians may have similar intakes as non-vegetarians, their iron status may be worse than those of non-vegetarians. The bioavailability of non-heme sources is influenced by some inhibitors such as phytates and some boosters such as vitamin C and some organic acids. Diet has an important impact on non-heme iron absorption; thus, iron absorption can substantially increase when serum ferritin levels are low [2].

In a study designed to assess the prevalence of anemia in Indian school children, it was shown that vegetarian children were more anemic at almost all ages than non-vegetarians [24]. In the study Bryne [23] conducted on vegan and vegetarian children (4-8 years old), no significant difference was found for iron intakes. Osei-Boadi et al. [20] conducted a cross-sectional study to investigate Ghanaian children's dietary intake and iron status (9 months-11 years old) following a vegetarian diet. Plasma ferritin levels were lower in vegetarian children compared to their non-vegetarian counterparts, but there was no difference in plasma transferrin receptor concentrations. They found the prevalence of anemia around 25% in both groups, which was attributed to their diets lacking iron-rich foods. A study in Poland investigated the effect of a vegetarian diet on iron metabolism and parameters, including serum hepcidin and soluble transferrin receptor (sTfR) concentrations in 43 vegetarian and 46 non-

vegetarian children [4.5-9.0 years old]. Vegetarian children had a similar iron and vitamin C intake compared to non-vegetarians. Serum transferrin levels were similar in both groups, whereas ferritin concentrations were significantly lower in vegetarians [25].

Calcium

Calcium has a structural function in bone health and integrity and has a vital role in regulating muscle contraction, vasodilation, and activation of enzymes [26]. While the primary calcium sources include milk and dairy products, some plant sources such as green vegetables, nuts, and legumes contain significant amounts of calcium. The bioavailability of plant-based calcium sources depends on the levels of phytate and oxalate present in these foods. Since bone mineralization makes a peak during the growth period, adequate calcium intake is vital in children and adolescence [5]. Studies investigating calcium status and bone health in children and adolescents are contradictory. Some studies suggest that calcium intake and bone mineral density (BMD) of vegetarian children were similar to non-vegetarians. Some suggest that although calcium intakes are within the reference range, the BMD was lower than non-vegetarians [27, 19]. There are no studies in vegan adolescents investigating fracture risk regarding decreased BMD, but a meta-analysis showed that vegan adults have an increased fracture risk [28].

Infants breastfed by a mother on a vegan diet are not exposed to deficiency since calcium in breastmilk is derived from maternal bone mineral reserves. In older children and adolescents, consuming plant foods rich in calcium and low in oxalate and phytate is required for those on a vegan diet. Supplementation is always needed for this population to meet the adequate calcium intake per day [5].

Zinc

Severe zinc deficiency consequences include growth retardation, stunting, developmental delays, and increased infectious diseases. Suboptimal zinc status is attributed to the dietary patterns in developing countries, which show similarities with vegetarian diets as they are predominantly plant-based with limited intakes of meat. Higher intakes of zinc are recommended for vegetarian infants to catch up on the differences in digestibility between plant-based and animal-based sources of zinc [10]. In an experimental study, three different complementary feeding approaches- meat, iron, and zinc fortified cereal or iron-fortified whole-grain cereal- were compared to meet infants' zinc requirements. At 9 months of age, only the meat and zinc fortified cereal group achieved the EAR (Estimated Average Requirement) for zinc [29].

Studies regarding zinc status in vegetarian populations show that compared with non-vegetarian counterparts, they have similar zinc intake but lower serum zinc concentrations. There is insufficient evidence that the zinc status in vegetarian at-risk groups such as infants and children are lower than non-vegetarians [10, 2]. In a study conducted on children, zinc intakes tend to be lower but not significantly different in vegetarian children compared to non-vegetarians. [30].

Vegetarian sources of zinc include legumes, grains, soy, cheese, nuts, and seeds. To increase zinc bioavailability by reducing the effects of phytic acid, food preparation techniques such as soaking legumes, grains, and seeds can be applied [2]. Choosing leavened whole-grain bread and fermented soy foods such as miso and tempeh can be considered since phytate is hydrolyzed during leavening and fermentation and no longer inhibits zinc absorption [31].

Iodine

Optimal iodine intake is crucial for normal physical and neurological development in children. Main sources of iodine for children include iodized salt and milk products. The risk of inadequate iodine intake increases with the exclusion of fish, meat, eggs, and milk, such as in vegan diets [26]. Low intakes of iodine due to the exclusion of the primary sources may result in thyroid dysfunctions [5]. Vegan children, in particular, may be at risk of insufficient iodine intake when they do not consume enough from the main sources of iodine, such as sea vegetables and iodized salt [2]. Vegans were found to have lower intakes of iodine (30 mg/day) compared to that of omnivore children (110 mg/day) and adolescents (130mg/day) [32]. For infants, the introduction of iodized salt is recommended with

complementary feeding. Even though the exclusion of animal source foods increases the risk of iodine deficiency, the use of iodized salts may provide the required intake [5].

Health Risks Associated with Vegetarian Diets for Children

Growth and Nutritional Status

Vegetarian children tend to overeat certain foods with low nutrient density. Therefore, an improperly planned vegetarian diet can negatively affect growth and nutritional status [33]. The systematic review of Schürmann et al. [11] showed that physical growth between vegetarian and non-vegetarian children was generally similar regarding height, weight, and BMI (body mass index). In another review, vegetarian children were reported to be thinner than non-vegetarian children with BMI becoming more discrepancy being more pronounced in adolescence [34]. Vegetarian children are more likely to eat plant-based foods than non-vegetarian children, and thus, they consume more low-energy-density meals. Therefore, when not planned appropriately, a vegetarian or a vegan diet may cause a risk for specific nutrient deficiencies. A diet that is too high in dietary fiber may lead to malabsorption of some minerals, and increased satiety may result in inadequate energy intake [35].

Choi et al. [36] investigated the effects of Lacto-ovo vegetarian and non-vegetarian diets on nutrient intake and health status of elementary school children. They found that non-vegetarian children consumed more milk, dairy products, fish, meat, eggs, and tofu than vegetarian children. Vegetarian children consumed more bread, potatoes, and fruits; meanwhile, non-vegetarian children consumed more ice cream and carbonated beverages. They found that vegetarian children were not getting sufficient calcium and experienced higher rates of fatigue [36]. In the study Segovia-Siapco et al. [37] conducted on 534 adolescents [12-18 years old], both vegetarian and non-vegetarian adolescents consumed an adequate diet. They observed that vegetarian adolescents had higher intakes of carbohydrates and total protein but lower intakes of fats, animal protein, and zinc than non-vegetarians [37]. In the Vegetarian and Vegan Children Study, energy, macronutrient intake, and anthropometrics of 430 vegans, vegetarian and non-vegetarian children (1-3 years old) were assessed. There was no significant difference in energy intakes or anthropometrics between the three groups. Non-vegetarian children had the highest intake of protein meanwhile vegetarian children had the highest intake of carbohydrates and fiber. The authors concluded that a vegetarian or a vegan diet could provide the same amount of energy and macronutrients for normal growth compared to non-vegetarian children [38]. On the other hand, there are some case reports of infants at risk of developmental delay and malnutrition caused by improper infant feeding and lack of supplementation [39, 40]. Lemale et al. [41] conducted a research that showed thirty-four children who were exposed to the health consequences of long-term consumption of dairy substitutes during infancy. Therefore, the tone of the European statements seems to reflect a growing concern about veganism among children due to the high risks involved and the need for continued supervision and supplementation [40].

Bone Health

Even though they are associated with factors that promote bone health, vegetarian diets may lead to impairment of bone homeostasis when intakes of calcium, vitamin D, and protein are low [2]. Movassagh et al. [42] conducted a longitudinal study on 125 adolescents (mean age=12.7 years) to investigate the effects of different dietary patterns on bone health. They found that a vegetarian diet rich in dark green vegetables, fruits, low-fat milk, eggs, legumes, nuts, and seeds during adolescence was associated positively with BMC (bone mineral content) and BMD (bone mineral density). They concluded that higher adherence to a vegetarian diet during adolescence results in higher BMC and BMD during young adulthood average 15 years later [42]. In the study conducted by Ambroszkiewicz et al. [43], 53 vegetarian and 53 non-vegetarian prepubertal children were analyzed for body composition, BMD, and bone turnover markers. They showed that vegetarian children had a significantly higher ratio of c-OC (osteocalcin)/ uc-OC. They also observed that mean values of total BMD-z score and spine BMD z-score were lower in vegetarians, possibly due to increased PTH concentrations. These results suggest that vegetarian children may be at risk of impaired bone health [43].

Psychological Status

The rate of depression among young people has been increased drastically in developed countries [6]. Some studies suggest vegetarianism as a risk factor while others as a protector for mental health problems [44,45]. Evidence shows that supplementation with EPA can improve depression [46, 6]. In the meta-analysis Li et al. [47] conducted, an association was observed between low fish intake and depression. This study suggests that children and adolescents on a vegetarian or vegan diet might have an increased risk for depression [6]. A survey conducted on Turkish adolescents (17-21) found that vegetarians were more prone to depression, suicidal ideas, and substance use compared to non-vegetarian counterparts [48]. Santivanez-Romani et al. [44] conducted a study on adolescents between the ages of 14-15 years and found no significant difference among emotional symptom scores between vegetarian and non-vegetarian adolescents.

Planning the Diet of Vegetarian Children

In 2019 Journal of the Academy of Nutrition and Dietetics published vegetarian food guidelines - VegPlate Junior (VPJ) designed for dietary planning in infancy, childhood, and adolescence. VPJ includes all of the criteria for a well-planned vegetarian diet and is thus characterized by a wide variety of foods such as vegetables, fruits, grains, legumes, nuts, and seeds. Dairy and eggs are considered optional, and for n-3 fatty acid sources-flaxseeds, chia, and walnuts are recommended [4]. For infants, current guidelines recommend that solid foods should be provided by 6 months in all children, and an introduction of a variety of food is encouraged [49, 3]. For infants, VJP recommends similar practices as non-vegetarian infants regarding introduction to solid foods and continuing breastmilk until at least one year of age. VJP recommends soy-based or rice-based infant formulas for vegan babies if the mother is not breastfeeding [4]. The use of soy formula in infants is debated; some defend that these infants develop normally. Others suggest that exclusive soy-based products should not be introduced in the first year since their bioavailability is lower than cow's milk. However, soy-based formulas are recommended for vegan infants who cannot be breastfed [3]. The growth rate decreases slightly after the first year of life. However, it still continues quite rapidly until the 24th month. After that, weight and height increase steadily until adolescence. In the adolescence period, a sudden increase in growth rate occurs again. VPJ is an exemplary model for meeting the nutritional needs of children and adolescents from 12 months to 17 years of age. VPJ contains six food groups: grains, vegetables and fruits, healthy fats, protein-rich foods, and seeds. It also includes calcium and omega-3-rich food groups as extra two categories. In the VPJ model, the number of daily servings to be consumed from each food group is given for the different needs of various age groups [4]. Families who decide to feed their children vegan should be warned against multiple nutritional deficiencies such as vitamin D, vitamin B12, calcium, iron and iodine [3].

2.Conclusion

Vegetarian and vegan families may want their children to grow up according to their dietary patterns. However, the effects of vegetarian and vegan diets on the growth and development of their children as well as the risk of nutrient deficiencies, should be explained. They should also be informed about the consequences of failing to achieve their children's proper supplement and diet regimen, which may lead to irreversible cognitive damage. Special care is needed when communicating with parents and their children on a vegetarian or vegan diet. It is crucial to ensure adequate nutrition during breastfeeding and weaning periods. Vegan and vegetarian children can become deficient in several essential nutrients that may disrupt their normal growth and development. It is important to provide additional fortified foods and supplements in case of inadequate nutrient intake and deficiencies. The evidence on the long-term effects of vegetarian and vegan diets on children is insufficient and outdated. Therefore, well-planned longitudinal studies are required to investigate the impact of vegetarian diets on future health outcomes among children.

Professional experience and opinions of nutritionists and pediatricians agree that "well-planned" vegetarian diets are appropriate for all childhood and adolescence stages. Regardless of whether the child is vegetarian or omnivorous, nutritional status needs to be evaluated. This assessment should primarily include monitoring the child's physical, psychomotor, and pubertal development. Vegetarian children can show healthy development when fed an adequate and balanced diet. Any unbalanced diet can lead to nutrient deficiencies. Parents of vegetarian children may face difficulties in providing nutritious foods. In addition, some foods that play an essential role in a vegetarian diet are not liked or

popular by many children. This can create more difficulties for parents of vegetarian children to establish an appropriate diet. Vegetarian diets in children raise concerns about insufficient intake of calcium, zinc, iron, vitamin B12, vitamin D, energy, protein, and omega-3 fatty acids. Therefore, parents should be aware of the best sources of these nutrients in their child's diet. All children on a vegan diet should have access to reliable vitamin B12 and vitamin D sources through fortified foods or supplements. Indications for vitamin D supplementation for other types of vegetarian diets are not different from the guidelines for omnivorous children. However, regular monitoring of serum ferritin, 25-OH-vitamin D, and vitamin B12 levels is crucial for these children. Parents should seek help from nutritionists in planning appropriate vegetarian diets. In addition, children and their families should be trained explicitly on enriching vegetarian diets and improving dietary absorption by adjusting food preparation techniques and the right food choice and combinations.

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