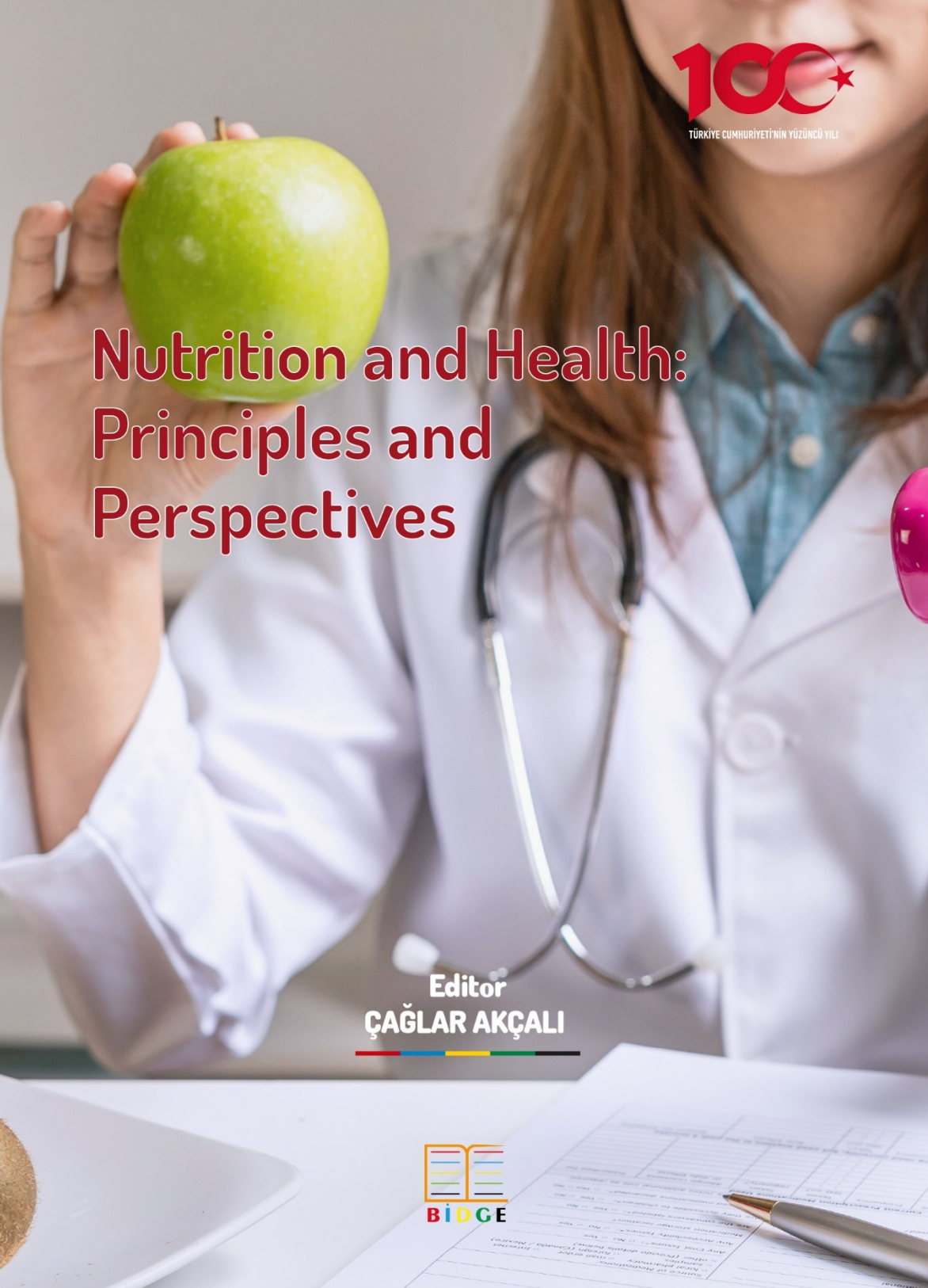

Nutrition and Health: Principles and Perspectives

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Content

CHAPTER I

Sports and Nutrition in Secondary and High School Students

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Introduction

Adolescence is defined as a life stage in which biological, psychological and social changes accelerate and interact intensively with each other (Alpaslan, 2012). Individuals reach 15% of their adult height, 50% of their weight and 40% of their total mineral content during this period (Yaman, 2019). Nutrition is defined as the intake and utilisation of nutrients into the body, which enables a person to grow, develop and be healthy and productive for a long time (Aydoğan, 2018). Since adolescence is the period of the fastest development after infancy, it is important for the nutrition of the adolescent individual (Erten, 2021; Korkmaz, 2010). Sport is an entertaining activity that requires the coordinated movement of the whole body, involves a struggle with competitors, includes

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competitions for this struggle and preceding trainings, is carried out individually or collectively within the framework of certain rules, and contributes to both mental and physical development. It is also a multifaceted discipline and phenomenon that supports the physical, cognitive, emotional and social development of the individual (Öztürk, 1982). Nutrition, physical activity, mental health and personal development of children and adolescents are factors that are interconnected with each other. Sports can be an effective way for children and adolescents to create their own self. Therefore, individuals in this period should be encouraged to do sports. However, energy and nutrient requirements increase while doing sports. Special nutrition program can be followed for adolescents who have the habit of doing sports to be healthy and to achieve growth and development.

The World Health Organisation (WHO) defines the period between the ages of 10-19 as adolescence (Akkaya et al., 2019). Unlike the WHO, the Public Health Institution of Turkey evaluates adolescence within different age limits for boys and girls. According to the Public Health Institution of Turkey, it is defined as the period of rapid growth, development and maturation, transition from childhood to adulthood, which starts between the ages of 11-14 for boys and 10-12 for girls and continues between the ages of 12-18 (Yaman, 2019). During adolescence, individuals try to find a place for themselves in the social world while trying to create and realise their personal plans and goals. In our country, individuals between the ages of 10-19 constitute approximately 15% of the total population (TÜİK, 2023).

Obesity is an excessive increase in the ratio of body fat mass to lean mass, which varies according to age. According to the WHO, obesity is defined as “abnormal and excessive increase in fat in adipose tissue”. Recently, the risk of obesity has increased in children and adolescents, who constitute the majority of the population, due to the increase in technological developments, the spread of nutritional disorders and the adoption of a sedentary lifestyle. According to data published by the WHO in 2002, sedentary life causes 1.9 million people to end their lives annually

(WHO, 2002). According to the data of Turkey Health and Nutrition Survey (TBSA) 2010, it was reported that 8.2% of children between the ages of 6-18 were obese, 14.3% were overweight, 14.9% were underweight and 3.9% were very underweight (TBSA, 2010).

Obesity, the prevalence of which is increasing today, causes a decrease in self-esteem and self-awareness in children and adolescents due to changes in physical appearance and causes them to have problems in communicating. Self-esteem can be defined as a state of positive thoughts and contentment about oneself, which begins to form in childhood and sees oneself as equal to others. With the formation of healthy self-esteem, a person first of all creates respect and love for himself/herself, and on the other hand, reaches a position that is accepted by other people. Studies have shown a positive correlation between mother's education level and self-esteem (Eriş & İkiz, 2013; Sarıbaş & et al., 2019). During adolescence, attempts related to weight gain-loss, disliking one's own body, ensuring healthy or unhealthy weight control, etc. behaviors are common (Özmen & et al., 2007). Changes occur in many systems during adolescence. The rapid change and development in the musculoskeletal system maximizes the amount and density of bone mineral (Yaman, 2019).

Since adolescence is a psychologically intense period, it is common for individuals to become depressed. Depression is reported to be the most important and common mental health problem. Depression can cause negative behaviors such as decreased academic success, deterioration in family and friend relationships, psychiatric comorbidities, suicide attempts, use of addictive substances, tendencies toward violence, and legal problems (Alparslan, 2021).

Being in an emotionally unstable period can cause changes in the nutrition of children and adolescents. Individuals may prefer to eat in response to negative emotional states or, conversely, may avoid eating. Eating attitudes may differ depending on biological, psychological and social reasons. The main reasons for eating attitude are as follows;

- Biological reasons; satisfying hunger, satiety and energy needs.
- Psychosocial reasons; cultural value of food, appetite, social media and advertising influence, depression or anxiety disorder (Ozier & Henry, 2011).

The two best solutions to mental health problems in children and adolescents are physical activity (sports) and nutrition.

1.1. Physical Activity (Sport)

Physical activity can be defined as body movements that are produced as a result of the movements of skeletal muscles and cause individuals to expend energy. Physical activity is the most fundamental factor that ensures the physiological development of children and adolescents (Ahraz, Bekir & Cengiz, 2021). Sports are fun activities that increase physical, mental and characteristic development and protect health through the coordinated work of the human body as a whole, competitions and trainings held collectively or individually according to certain rules. It is a discipline that provides physical, intellectual, emotional and social development of individuals (Ergen, 2002). High-level performance in sports depends on various factors such as the individual's personal characteristics, training intensity, nutritional habits, physical and mental health, fitness for sports and environmental factors (Akkaya & et al., 2019). Sports allow individuals to express themselves in society (Öztürk Karataş, Savaş & Karataş, 2021). Sports habits acquired during childhood can support the physical development of individuals and contribute to a healthier life in adulthood. While sports have positive effects on children's peer relations, mental development and emotional states, they can also accelerate their physical development. The purpose of sport;

- Ensuring that musculoskeletal systems work in coordination,
- Prevention of posture disorders,
- To be able to live in harmony with society and respect other people,
- Ability to provide crisis management and gain self-confidence,
- Understanding the feeling of losing, appreciating the opponent even if they win and fighting fair-play, etc.

General habits related to sports and health begin in the family, which is the first educational environment of the individual, and are shaped by the influence of the environment. The most important environmental factors are school and friends. When sports become a habit during childhood or adolescence, it is possible for individuals to be at peace with themselves and adapt to society more easily. With the development of technology and the increase in concrete structures, the decrease in areas where sports can be practiced may prevent families from encouraging their children to do sports. With family encouragement, the tendency of children at the primary school level (7-10 years old) towards sports increases to a great extent. The idea that it will negatively affect children's educational life prevents families from encouraging their children to sports.

1.2. Nutrition

Nutrition is the process of consuming the nutrients needed for an individual to grow, develop, be healthy and productive and using them in the body (Aydoğan, 2018).

1.2.1. Nutrients

The nutrients that the human body needs every day vary. On average, more than 40 nutrients can be analyzed in 6 main groups. These are;

- Carbohydrates
- Proteins
- Fats
- Vitamins
- Minerals
- Water

Carbohydrates and proteins provide 4.1 kcal of energy per gram, while fats produce 9 kcal of energy per gram. Of the daily energy requirement, 55-60% should be met from carbohydrates, 12-15% from proteins and 25-30% from fats.

1.2.1.1. Carbohydrates

It is the primary source of energy for the body. It is the most abundant nutrient in foods. Legumes, whole grains and vegetables containing complex carbohydrates have positive effects on health.

1.2.1.2. Proteins

Proteins form the basic structure of cells and play an important role in organ function, growth, development and repair of tissue damage. The main sources of protein are eggs, milk and dairy products (yogurt, cheese, kefir, etc.), red and white meat varieties and legumes (dried beans, chickpeas, lentils, etc.). The quality of proteins in foods is as important as their quantity. Breast milk contains the highest quality protein.

1.2.1.3. Fats

It is the nutrient that provides the most energy (9 kcal/g) among macronutrients. It is essential in the production of some hormones and vitamins.

1.2.1.4. Vitamins

They regulate biochemical activities (B group vitamins), contribute minerals to the content of bones and teeth (vitamin D), prevent damage to cells and have antioxidant properties (vitamins A, C, E).

1.2.1.5. Minerals

Key functions of minerals include forming the structure of bones and teeth (Calcium, Phosphorus), maintaining the body's fluid-electrolyte balance (Sodium, Potassium), transporting oxygen to tissues and energy formation (Sodium, Potassium), and supporting the immune system (Zinc, Selenium).

1.2.1.6. Water

It plays a role in many vital functions, such as regulating body temperature, aiding digestion, transferring nutrients to tissues,

and eliminating toxic substances from cells through the lungs and kidneys.

Diet refers to all nutrients consumed daily and is recommended to be personalized. The content of the diet varies depending on an individual's gender, height, weight, age, daily eating patterns, physical activity, and social and cultural lifestyle. The recommended daily intake of food groups and portion sizes includes:

- Milk and dairy products: 3-4 servings/day
- Meat and meat products: 2 servings/day
- Grain and grain products: 3-6 servings/day
- Vegetables and fruits: at least 5 servings/day (Aydoğan, 2018).

1.3. Nutrition in Child and Adolescents

The points to consider when evaluating nutrition in adolescents can be summarized as follows;

- Height and body weight should be measured and compared with previously recorded values, if available. Any deviations from the target height and body weight values should be documented.
- Physical activity levels should be assessed.
- The number of meals consumed per day and the content of the food eaten at those meals should be determined.
- A history of sexual development, including details about menstruation, should be obtained.

Anxiety and dissatisfaction with physical appearance are common among adolescents. Consequently, they often attempt to control their weight through either healthy or unhealthy methods (Potter et al., 2004). Daily energy requirements of adolescents vary according to their basal metabolic rate (BMR), growth and development rates, and the content and duration of their physical activities. Unconscious regulation of food intake in adolescents may cause retardation in growth and development, decrease in lean muscle mass and metabolic imbalances (Parlak et al., 2011).

Adolescent nutrition programs should include a diet rich in vegetables, fruit and cereals; moderate in low-fat dairy products and lean meat; and low in sugar, salt and fat. In addition, adequate daily water consumption should be ensured (Erkan, 2011).

It is observed that today's adolescents consume a lot of foods that pose a risk to health such as carbonated drinks, fried products, packaged foods, fast food; while they consume less foods that have positive effects on health such as vegetables, fruits, milk and dairy products (Muslu & Kermen, 2020). Examples of unhealthy eating habits include fast food consumption, skipping breakfast, skipping lunch with snacks, and excessive consumption of carbonated and sugary drinks. Adolescents who maintain this eating pattern for an extended period may face growth and development deficiencies, obesity, being underweight, or delayed puberty (Erten, 2021).

Skipping meals is a common occurrence in adolescent nutrition. Body dissatisfaction, anorexia linked to depression, and challenges in time management due to their busy educational lives often lead adolescents to skip meals. In the study conducted by Yücecan et al. 65.4% of adolescent students have regular meal habits. Among those with irregular meal habits, 62.0% skipped lunch and 30.6% skipped the breakfast (Yücesan et al., 1993). The breakfast can be considered the most important meal of the day. If it is not consumed after prolonged fasting during sleep, fatigue, headaches, and distraction may occur (Lakmali & et al., 2022). It is also necessary to pay attention to the fluid consumption of children and adolescents. The daily fluid requirement of individuals in the 6-11 age group is 1.6 litres. Urine color can be used as a marker to understand adequate fluid consumption. Urine should be light yellow, abundant and odorless (Aydoğan, 2018).

The most fundamental factors that help protect adolescents from negative situations such as anxiety, low self-esteem, obesity, and poor academic performance, while supporting them in achieving target body weight and height values and maintaining good health, are doing in sports and learning proper nutrition (Bégin & et al., 2018). It is important for individuals who show rapid development

and change during childhood and adolescence to receive nutrition education. The best environment where they can receive this education is schools (Karadaş, Akçalı & Ayhanci, 2024). In addition, families and school instructors could encourage adolescents to participate in sports. By doing so, they might benefit from the potential positive effects of sports on physical, mental, and emotional development. Adolescents could grow into individuals who may be self-sacrificing, possess leadership qualities, and be capable of making radical decisions and taking responsibility.

Researches has shown that practicing sports under a certain discipline positively affects adolescent mental health. Thanks to sports, individuals have the opportunity to challenge themselves and, if applicable, compare their performance with that of their competitors. These situations can be associated with positive effects on self-esteem and mental development. It is seen that individuals who play sports get away from stress, depression and anxiety. It is observed that children and adolescents who are interested in sports are less likely to conflict with their parents and use addictive substances, and are more successful in their educational life (Alpaslan, 2012; Kiluk, 2009; Nabkasorn, 2005).

1.4. Nutritional Status in Child and Adolescent Athletes

The aim of athlete nutrition is to maximize the performance of the athlete and to ensure that he/she is healthy. Nutrition and energy requirements of child and adolescent athletes vary depending on gender, age, body weight, training intensity and frequency. Therefore, personalised nutrition program should be implemented for athletes. Adequate and balanced nutrition ensures both achieving ideal growth and development goals and maximum performance in the sport (Aydoğan, 2018; Demir & et al., 2018).

In addition, sports have a positive impact on the nutrition of children and adolescents. Many adolescents increased their intake of fresh vegetables, fruits, milk, yogurt, cheese, and beverages after engaging in sports. They also reduced their consumption of fats, sugary foods, bread, rice, and similar items (Çıplak & Eler, 2020; Heikkilä et al., 2020).

Sport contributes significantly to mental health, nutrition, physical and mental development; one of the most important rules is to ensure a balance in the nutrition of individuals in the developmental period. Performing sportive activities with inadequate nutrition may cause developmental delay. In addition, sports nutrition can also affect sports performance. The catabolic mechanism caused by continuous training causes fatigue in athletes. Since the growth and development rates of adolescent athletes are high, their energy requirements are greater than those of adults. Inadequate energy intake may occur in athletes with insufficient nutritional knowledge, as their food choices and portion adjustments might be incorrect (Capra et al., 2024).

Adolescent athletes with adequate and balanced nutrition;

- It reduces the incidence of diseases in athletes and accelerates the recovery process in case of illness.
- Ideal body weight and height ratio can be achieved.
- Cognitive functions (memory capacity) can be stronger and more effective.
- The probability of achieving growth and development goals increases.
- A significant increase in physical endurance and muscle strength levels can be achieved.
- Performance level can be optimized in training and competitions.
- Physical and mental recovery processes after training and competition are completed in a shorter time (Barry et al., 2003; Malina et al., 2005; Mulasso et al., 2019).

1.5. Fundamental Principles of Sports Nutrition

1.5.1. Maintaining Fluid Balance

Adequate fluid intake should be ensured before exercise and competition, and fluid and electrolyte needs should be met during and after exercise (Redwood et al., 2021).

1.5.2. Ensuring Energy Balance

Energy stores should be adequately replenished before training and competition, energy intake should be maintained during training, and energy stores should be restored after training (Juita et al., 2024).

1.5.3. Supporting the Recovery Process

After training, adequate nutrition should be provided to replenish energy stores, repair muscle damage and prevent muscle loss. It is also important to restore fluid and electrolyte balance. An athlete nutrition plan organized in line with these fundamental principles is critical for improving performance, accelerating physical and mental recovery, and maintaining general health status (Juita et al., 2024; Seccato et al., 2019;)

In the nutrition of adolescent athletes, the aim is to achieve ideal growth and development alongside optimal performance (Aydoğan, 2018). Inadequate energy intake during the growth and development period may cause late puberty, underweight, stunting, underdeveloped musculoskeletal systems, high injury risks, and insufficient macro and micronutrient deficiencies. Healthy dietary patterns should be implemented to achieve high performance. Optimal nutrition in terms of health can be achieved with a nutrition program that is high in carbohydrates, low in fat and sufficient in protein (Dunford, 2006). A nutrition program low in carbohydrates can lead to rapid depletion of glycogen stores in the muscles and liver and therefore to a decrease in performance. As the amount of carbohydrates stored in the body increases, the strength and endurance of the athlete increases. In addition, carbohydrate is the first and most utilized nutrient during exercise/competition (Altıncı, 2017).

Unhealthy eating habits of child and adolescent athletes may lead to nutritional disorders, vitamin and mineral deficiencies, growth and developmental delay and malnutrition. In children and adolescents, fat is usually used as the first source of energy. They have less glycogen stores and less capacity to catalyze glucose. In addition, inadequate thermoregulation may be observed due to lower sweating levels (Akıcı & et al., 2011). Therefore, the nutrients included in nutrition programs should be adequate. Since the growth and development rate is high, they should be frequently monitored, and a new program should be organised if necessary. General health, growth and development screening is recommended at least once a year (Kohro & et al., 2008).

The appropriate nutrition program for athletes depends on age, gender, type of sport, and training and competition levels, and it should be followed in a disciplined approach. The minimum daily energy requirement for adolescent male athletes is estimated to be between 2500 and 2800 calories on average, whereas for female athletes, it is approximately 2200 calories (Akkaya & et al., 2019).

1.6. Requirements for Child and Adolescent Athletes

1.6.1. Energy Requirements in Child and Adolescent Athletes

Children and adolescents should meet their daily energy requirements for optimal growth and development. This requirement depending on age, body weight, height and physical activity level. The type of sport can differ the level of energy requirements. Child and adolescent athletes have higher energy requirements than adults. The primary reason for the higher energy requirement per kilogram for physical activity in this age group is the lack of coordination between agonist and antagonist muscles.

In calculating the energy requirements for child and adolescent athletes, it is recommended to add 20–25% to the adult energy requirement for those aged 8–10 years and 10–15% for those aged 11–14 years. However, various health problems may arise if child and adolescent athletes do not consume sufficient energy from food to meet their increased energy expenditure. Inadequate energy

intake may lead to delayed growth and development, decreased bone mineral density, increased risk of injury, prolonged recovery, menstrual disorders, fluid loss and nutrient deficiencies. Therefore, energy requirements of children and adolescent athletes should be carefully evaluated and adequate intake should be ensured (Twible et al., 2020; Wright, 2009).

1.6.2. Carbohydrate Requirement in Children and Adolescent Athletes

Inadequate carbohydrate intake leads to rapid depletion of glycogen stores, resulting in decreased performance. To prevent this, child and adolescent athletes should obtain at least 50% of their daily energy requirements from carbohydrates. To effectively restore glycogen stores, the consumption of carbohydrate-rich foods should be increased, and training intensity should be reduced at least 24–48 hours prior to the competition. In the human body, a total of 300-400 grams of glycogen can be stored in muscle cells and 75-100 grams in liver cells (Homer, Cross & Helms, 2024).

1.6.3. Protein Requirement in Children and Adolescent Athletes

While the recommended protein intake for adults is 0.8-1 g/kg/day, it is 1.1-1.2 g/kg/day for children aged 7-10 years and 1 g/kg/day for children and adolescents aged 11-14 years. Protein intake of 1.2-1.7 g/kg/day is recommended for adult athletes interested in endurance and strength sports. Depending on the training intensity of adolescent athletes, the protein requirement may increase up to 1.7-2.12 g/kg/day. However, excess protein intake does not contribute to additional muscle development. When adequate protein intake is provided by nutrition, additional protein supplements should not be used. Nitrogen is formed during the metabolism of proteins. Excess protein intake can cause nitrogen accumulation in the body, which places additional burden on the liver and kidneys and can lead to kidney stone and bone damage (Petrie, Stover & Horswil, 2004).

1.6.4. Fat Requirement in Children and Adolescent Athletes

Considering the fat requirement in children and adolescents athletes, the recommended amounts of linoleic and α-linolenic acids were determined as 12 g/day and 1.2 g/day for boys aged 9-13 years, 16 mg/day-1.6 mg/day for adolescent boy athletes aged 14-18 years, 10 g/day-1 g/day for adolescent girl athletes, and 11 g/day and 1.1 g/day for adolescent girls, respectively. A body fat percentage of less than 7% for boys and 14% for girls is a health risk (McLain & Conn, 2016).

1.6.5. Micronutrient Requirements in Children and Adolescent Athletes

Vitamins and minerals perform similar functions in children and adolescents who are and are not athletes. Since vitamin and mineral requirements can be met with adequate and balanced nutrition, additional vitamin or mineral supplements are thought to be unnecessary. However, in many countries, nutrients such as folic acid, calcium, iron and vitamin D may be risky for children and adolescents (Aydoğan, 2018). Vitamins play essential roles in physiological processes, growth and development, immune function, and overall health, with deficiencies potentially leading to significant health problems:

- Vitamin A deficiency can lead to stunted growth and development, visual impairment and malformed teeth in children.
- Vitamin D is critical for calcium balance and bone health.
- Vitamin E supports the immune system thanks to its antioxidant properties.
- Vitamin K is crucial for producing a liver protein that aids in clotting. Its deficiency can cause prolonged bleeding and has adverse effects on bone health.
- Vitamin B1 is used in energy metabolism. Deficiency of this vitamin leads to beriberi.
- Vitamins B2 and B3 are involved in carbohydrate, fat and protein metabolism.
- Vitamin B6 supports the immune system.

- Vitamin B7 plays a key role in carbohydrate metabolism and supports energy production.
- Vitamin B9 is essential for DNA and RNA synthesis.
- Vitamin B12 supports the immune and nervous systems, aids in protein metabolism, and is crucial for blood cell formation, DNA and RNA replication.
- Vitamin C is necessary for the production of collagen and some connective tissues. The daily vitamin C requirement is 45 mg for children aged 9-13 years, 75 mg for male adolescents aged 14-18 years and 65 mg for female adolescents (Erkan, 2011).

Adequate intake of these vitamins and minerals is critical for healthy development and performance of children and adolescents (Li, 2024).

Minerals are critical for the healthy development and performance of children and adolescents. In particular, minerals such as calcium, iron, zinc and iodine play a vital role in the growth and development of children. Calcium is essential for bone health and adequate intake during childhood reduces the risk of osteoporosis in later life (Abrams, 2021). Furthermore, iron deficiency can lead to anaemia, which can negatively affect children's cognitive development (Kaboré et al., 2022). Adequate iron intake of children increases their energy levels by increasing haemoglobin levels and improves their general health status (Merkiel & Chalcarz, 2014).

Inadequate mineral intake of children can lead to growth disorders and other health problems. For example, iodine deficiency can adversely affect thyroid function and cause growth retardation (Shankar, 2020). In addition, zinc is essential for the proper functioning of the immune system and its deficiency can increase susceptibility to infections in children (Maggini et al., 2017). It is critical for children and adolescents to ensure adequate mineral intake through a healthy diet, not only for their physical health but also for their cognitive and emotional development (Perlitz et al., 2019).

As a result, adequate mineral intake of children and adolescents is essential for healthy growth and development. Since

inadequate mineral intake can lead to long-term health problems, parents and educators should be aware of this issue (Stang, 2000). Ensuring that children get the necessary minerals from a balanced diet will improve their general health status and quality of life (Goodswil, 2020).

1.6.6. Weight Control in the Child and Adolescent Athletes

If it is aimed to reduce weight in a healthy way in children and adolescents, the required energy should be reduced or energy expenditure should be increased by paying attention to growth and development ideals. At the same time, care should be taken to ensure adequate intake of all nutrients (Aydoğan, 2018).

The main factors affecting athlete performance are adequate and balanced nutrition, correct training program and genetic characteristics (Pratikta et al., 2019). Rapid replacement of lost fluid with fluid intake during training or competition can helps reduce recovery time. Nutrition education for child and adolescent athletes according to the sport they are interested in can help them achieve maximum performance.

In order to ensure appetite and glycemic control, meals should be consumed at maximum 3-4 hours intervals and for a total of 4-6 meals per day (Aydoğan, 2018). For the best performance, feeding times should also be adjusted. While the main meal can be consumed at least 3 hours before the training or competition, snacks can be consumed at least 1-2 hours before.

- The main rules of the meal before training or competition should be high in carbohydrate content, sufficient in protein and liquid, low in fat and fiber. The foods to be consumed should be foods that the athlete's preferences and to which his/her body is accustomed. It is recommended to consume an average of 500-600 ml of water 2-3 hours in before.
- Carbohydrate loading is recommended after the athlete has undergone a certain duration of training. Sports drinks are the most suitable alternatives as they contain liquid and

carbohydrates. It is recommended to consume 200-300 ml of water every 15-20 minutes during training.

- The best way to accelerate recovery after training and to replace energy and glycogen stores is to consume foods with rich carbohydrate content within the first 2 hours (Purcell, 2013).

According to research on the effects of nutrition on athlete performance;

a. Carbohydrates are used as the primary energy source in high intensity traning.

b. Athletes who consume more foods with high carbohydrate content use carbohydrates more during traning than athletes who consume more foods with high fat content.

c. Athletes adhering to a carbohydrate-rich diet may exhibit greater endurance compared to those consuming a fat-heavy diet.

d. As training duration increases, the reliance on fats for energy synthesis also increases (Ergen, 1990).

Macronutrient requirements can differ according to the type of sport of interest;

- Athletes who are interested in endurance sports (long distance running, marathon running) should get 60% of their daily energy requirements from carbohydrates.
- Athletes who are interested in combat sports (Judo, Karate, Boxing, etc.) should get 50% of their daily energy from carbohydrates. In addition, the intake of protein and fat should be moderately increased.
- Athletes who are interested in power sports (shot put, weightlifting, etc.) require more protein. Therefore, carbohydrate consumption should be reduced and protein consumption should be increased. These athletes require 50% of their daily energy from carbohydrates.

- In team games (Football, Handball, Tennis, Basketball, etc.), 60% of the daily energy required should be provided from carbohydrates (Altundağ & Payas, 2011; Mor, İpekoğlu & Arslanoğlu, 2018).

Conclusion

As a result, it has been determined that individuals who acquire sports habits during childhood and adolescence pay more attention to healthy nutrition. This reduces the risk of disease in adulthood and allows them to live a more healthy life. Adolescents who do sports not only achieve healthy body, but also increase their self-esteem and self-confidence, improve their communication skills, and develop a sense of responsibility as they achieve the body they desire. It is known that adolescents go through a psychologically intense period. For this reason, spending their free time doing sports can also help them relax in this process. In addition healthy eating and sports habits in children and adolescents can prevent obesity and reduce the risk of other chronic diseases.

In order for children and adolescents to gain healthy nutrition and sports habits, family members and educators at school have great responsibilities such as promoting sports, revealing the interest of individuals in a sports branch and discovering their talents. Participating in sports has numerous benefits for children and adolescents, such as revealing leadership qualities, fostering team spirit, encouraging one-to-one and group work, regulating their behavior towards competitors, creating a sense of responsibility, improving their communication skills and ensuring that they have healthy target weight-to-height ratios.

Consequently nutritionists should be consulted to regulate unhealthy eating habits in children and adolescence athletes and to promote healthy eating habits. In this way, a nutrition program that will meet the children's requirements and adolescents can be prepared by a nutritionist and this program can be made sustainable with the training they receive. In addition, parents can be made aware of this issue, and they can be trained to provide positive guidance to their children.

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CHAPTER II

Infant Nutrition Formulas: A Microbiological and Chemical Quality Perspective

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Introduction

The World Health Organisation (WHO) emphasises the importance of access to adequate, safe and nutritious food for sustaining life and improving health, and states that many diseases can occur with the consumption of unsafe foods (WHO, 2024).

Breast milk provides as an optimal source of nutrition with significant biological value, supplying all the essential fluids, nutrients necessary for the healthy growth, energy and development of the baby. Breast milk is not only a food but also protects the baby against infectious and chronic diseases, strengthens the immune system and supports the sensual and cognitive development of the baby (CDC, 2022; WHO, 2022). Breast milk is the primary choice

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of nutrition for infants, but infant formulas are utilized when breastfeeding is insufficient or not feasible (Martin et al., 2016).

Adequate and safe infant nutrition is of key importance for the health of infants. Infants have high nutritional requirements due to their rapid growth and development. Feeding dependent on only one or a few foods in the first months of their lives causes them to have health problems in the future (Koletzko et al., 2012).

Turkish Food Codex Communiqué on Infant Formulas and Follow-on Formulas (Communiqué no: 2019/4)

Products intended for infant and young child nutrition in our country are produced in accordance with the Turkish Food Codex (TFC) Communiqué on Infant Formulas and Follow-on Formulas (Communiqué no: 2019/4) published by the Ministry of Agriculture and Forestry (TFC, 2019). The Communiqué defines infant formula as food designed for use by infants (0-12 months) from the early months of life, fulfilling their nutritional needs until the introduction of suitable complementary feeding. Follow-on formula is described as food prepared for consumption by infants and young children (1-3 years) after the start of appropriate complementary feeding and contribute to their increasingly varied diet and fluid intake. Infant formula and follow-on formula are classified according to the protein source used in their production. Infant formulas and follow-on formulas produced entirely from cow's milk or goat's milk proteins are called ‘infant milk’ and ‘follow-on milk’ respectively. In contrast, infant formulas and follow-on formulas made from sources other than cow's milk or goat's milk proteins are referred to as "infant formula" and "follow-on formula," respectively.

The Communiqué specifies the requirements for the composition, labeling, presentation, and advertising of infant formulas and follow-on formulas, as well as the informational standards for infant and young child nutrition. As specified in the Communiqué;

- The use of genetically modified organisms (GMOs) and their derivatives in infant formulas and follow-on formulas is strictly prohibited.

The pesticide residue level in infant formulas and follow-on formulas must not exceed 0.01 mg/kg for each active substance. However, as an exception, the maximum residue limits specified in Annex 4 apply to the active substances listed in Table 1.

Table 1: TFC Communiqué on Infant Formulas and Follow-on Formulas (Communiqué no: 2019/4) Annex-4

Pesticide or Pesticide Metabolite	**Maximum Residue Limit (mg/kg)**
Cadusafos	0.006
Fipronil (the sum of fipronil and fipronil-desulfinyl is expressed as fipronil)	0.004
Etoprofos	0.008
Demeton-S-methyl/demeton-S-methyl sulfone/oxydemeton-methyl (expressed alone or together as demeton-S-methyl)	0.006
Propineb/propylenethiourea (propineb ve propylenethiourea toplamı)	0.006

Infant formulas and follow-on formulas should be exclusively manufactured using agricultural products that are cultivated without the application of plant protection products containing the active substances specified in Annex 5. These products must adhere to strict regulations that ensure they are free from harmful chemicals, so safeguarding the health and safety of infants. The use of such ingredients is essential to comply with established standards that prioritize the well-being of young children. However, if the residue level does not exceed 0.003 mg/kg, these plant protection products are considered not to have been used, as specified in Table 2.

Table 2: TFC Communiqué on Infant Formulas and Follow-on Formulas (Communiqué no: 2019/4) Annex-5

Chemical Name (Residue Description)
Disulfotone (total of disulfotone, disulfotone sulfoxide and disulfotone sulfone is expressed as disulfotone)
Heptachlor and trans-heptachlor epoxide, expressed as heptachlor
Fensulfothione (total of fensulfothione, fensulfothione oxygen analogues and their sulfones is expressed as fensulfothione)
Haloxyfop (total of haloxyfop, haloxyfop salts and conjugated esters of haloxyfop expressed as haloxyfop)
Fentin is expressed as triphenyltin cation
Nitrofen
Terbufos (total of terbufos, terbufos sulfoxide and terbufos sulfone is expressed as terbufos)
Endrin
Hexachlorobenzene
Aldrin and dieldrin are expressed as dieldrin
Omethoate

The specific requirements for nutrition reporting are summarised in Table 3.

Table 3: Specific requirements for nutrition reporting

Nutrient	Minimum	Maximum
Energy	60 kcal/100 ml	70 kcal/100 ml
Protein		
- Cow's milk or goat's milk protein	1.8 g/100 kcal (Continuation formula: 1.6 g/100 kcal)	2.5 g/100 kcal
- Soya protein isolates or soya protein isolates + cow, goat milk protein mixture	2.25 g/100 kcal	2.8 g/100 kcal
- Protein hydrolysates	1.86 g/100 kcal	2.8 g/100 kcal
Infant formula and follow-on formula should contain the usable amount of each essential and semi-essential amino acid contained in the reference protein (breast milk). (TFC Communiqué on Infant Formulas and Follow-on Formulas, Communiqué no: 2019/4, Annex-3)		
L-Carnitin	1.2 mg/100 kcal	-
Taurin	-	12 mg/100 kcal
Colin	25 mg/100 kcal	50 mg/100 kcal
Fats (sesame and cottonseed oil are prohibited)	4.4 g/100 kcal	6 g/100 kcal
Linoleic acid	500 mg/100 kcal	1200 mg/100 kcal
Alpha linolenic acid	50 mg/100 kcal	100 mg/100 kcal
Docosahexaenoic acid	20 mg/100 kcal	50 mg/100 kcal
Other long-chain fatty acids may be added. In this case, the n-6 polyunsaturated fatty acid content cannot exceed 2% of the total fat content (for arachidonic acid, it cannot exceed 1% of the total fat content).		
The content of eicosapentaenoic acid cannot exceed the content of docosahexaenoic acid.		
Phospholipids	-	2 g/L
Inositol	4 mg/100 kcal	40 mg/100 kcal
Carbohydrates	9 g/100 kcal	14 g/100 kcal
Fructooligosaccharides and galactooligosaccharides (*may be added*)	-	0.8 g/100 ml
Each vitamin and mineral other than molybdenum should be added and reported by taking into account the amounts specified in the Communiqué (TFC Communiqué on Infant Formulas and Follow-on Formulas, Communiqué no: 2019/4, Annex-1).		
*Nucleotides can be added, but they should be added in a way not to exceed the upper limits specified in the Communiqué, and a nutrition report should be made (TFC Communiqué on Infant Formulas and Follow-on Formulas, Communiqué no: 2019/4, Annex-1).****		

Table 4: TFC Communiqué on Infant Formulas and Follow-on Formulas (Communiqué no: 2019/4) Annex-1 (Infant formulas produced from cow's milk or goat's milk proteins or protein hydrolysates)

Minerals	At 100 kJ Minimum	At 100 kJ Maximum	At 100 kcal Minimum	At 100 kcal Maximum
Sodium (mg)	6.00	14.30	25.00	60.00
Potassium (mg)	19.10	38.20	80.00	160.00
Chlorine (mg)	14.30	38.20	60.00	160.00
Calcium (mg)	12.00	33.50	50.00	140.00
Phosphorus (mg)*	6.00	21.50	25.00	90.00
Magnesium (mg)	1.20	3.60	5.00	15.00
Zinc (mg)	0.12	0.24	0.50	1.00
Iron (mg)	0.07	0.31	0.30	1.30
Iodine (µg)	3.60	6.90	15.00	29.00
Copper (µg)	14.30	24.00	60.00	100.00
Selenium (µg)	0.72	2.00	3.00	8.60
Manganese (µg)	0.24	24.00	1.00	100.00
Molybdenum (µg)	-	3.30	-	14.00
Flor (µg)	-	24.00	-	100.00

* Total phosphorus

The calcium/available phosphorus molar ratio cannot be less than 1 or greater than 2. The available phosphorus content is calculated as 80% of the total phosphorus for infant formulas produced from cow's milk proteins, goat's milk proteins, or protein hydrolysates.

Vitamins	At 100 kJ Minimum	At 100 kJ Maximum	At 100 kcal Minimum	At 100 kcal Maximum
Vitamin A (µg-RE) (1)	16.70	27.20	70.00	114.00
Thiamine (µg)	9.60	72.00	40.00	300.00
Vitamin D (µg)	0.48	0.72	2.00	3.00
Niacin (µg) (2)	0.10	0.36	0.40	1.50
Riboflavin (µg)	14.30	95.60	60.00	400.00
Pantothenic acid (µg)	40.10	0.48	0.40	2.00
Folate (µg-DFE) (3)	3.60	11.40	15.00	47.60
Biotin (µg)	0.24	1.80	1.00	7.50
Vitamin B6 (µg)	4.80	41.80	20.00	175.00
Vitamin B12 (µg)	0.02	0.12	0.10	0.50
Vitamin K (µg)	0.24	6.00	1.00	25.00
Vitamin E (mg α-tocopherol) (4)	0.14	1.20	0.60	5.00
Vitamin C (mg)	0.96	7.20	4.00	30.00

1. Preformed vitamin A; RE = all-trans retinol equivalent.
2. Preformed niacin.
3. Dietary folate equivalent: 1 µg DFE = 1 µg folate from food = 0.6 µg folic acid from infant formula.
4. RRR-α-tocopherol is based on the vitamin E activity.

Nucleotides	mg/100 kJ Maximum	mg/100 kcal Maximum
Cytidine 5'-monophosphate	0.60	2.50
Uridine 5'-monophosphate	0.42	1.75
Inosin 5'-monophosphate	0.24	1.00
Adenosine 5'-monophosphate	0.36	1.50
Guanosine 5'-monophosphate	0.12	0.50

The total concentration of nucleotides must not exceed 5 mg/100 kcal (1.2 mg/100 kJ).

Table 5: TFC Communiqué on Infant Formulas and Follow-on Formulas (Communiqué no: 2019/4) Annex-3

Amino Acids	per 100 kJ (mg)	per 100 kcal (mg)
Cystine	9	38
Isoleucine	22	90
Histidine	10	40
Leucine	40	166
Methionine	5	23
Lizin	27	113
Phenylalanine	20	83
Tryptophan	8	32
Valin	21	88
Threonine	18	77
Tyrosine	18	76

1 kj = 0.239 kcal

The use of additives in products covered by this Communiqué is governed by the provisions of the Turkish Food Codex (TFC) Regulation on Food Additives, as published in the Official Gazette on June 30, 2013, Issue No. 28693.

Flavourings and flavouring food ingredients are not permitted in the products covered by this Communiqué. For these products, the provisions of the TFC Regulation on Contaminants, published in the Official Gazette on December 29, 2011, with issue number 28157, are applicable, as detailed in Table 6.

Table 6: Provisions of the TFC Regulation on Contaminants for Infant Formula and Follow-on Formula

Contaminated	**Maximum Limit**
Aflatoxin M1	0.025 mcg/kg
Aflatoxin B1	0.10 mcg/kg (food for special medical purposes for infants)
Ochratoxin A	0.5 mcg/kg (food for special medical purposes for infants)
Heavy Metals	**Maximum Limit (mg/kg wet weight)**
Lead (Pb)	0.02
Polycyclic Aromatic Hydrocarbons (PAH)	**Maximum Limit (mcg/kg)**
Benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene and chrysene	1.0
Total of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene and chrysene	1.0

Products covered by this Communiqué must follow the rules set by the Food Hygiene Regulation, published in the Official Gazette on December 17, 2011 (Issue No. 28145). They also need to meet the standards listed in Table 7 of the TFC Regulation on Microbiological Criteria, which appeared in the Official Gazette on December 29, 2011 (Issue No. 28157). These regulations are in place to ensure that production processes meet strict food safety and hygiene standards, safeguarding consumers and promoting public health.

Table 7: Provisions of the TFC Food Hygiene Regulation and Microbiological Criteria Regulation for Infant Formulas and Follow-on Formulas

Microorganisms/toxins/metabolites	Sampling Plan (n)	Sampling Plan (c)	Limits (Min.)	Limits (Max.)
Bacillus cereus	5	2	5×10^{1}	5×10^{2}
Cronobacter sakazakii	10	0	0/25 g-ml (kob/g-ml)	-
Listeria monocytogenes	10	0	0/25 g-ml (kob/g-ml)	-
Salmonella	10	0	0/25 g-ml (kob/g-ml)	-

*cfu: colony forming unit (on solid medium) n: number of samples c: number of samples allowed to have a value between min. and max. limit.

The most frequently reported pathogenic microorganisms in infant formula are: *Cronobacter sakazakii (C. sakazakii), Bacillus cereus (B. cereus) and Staphylococcus aerus (S. aureus)* (Esin & Özmen Toğay, 2023).

Cronobacter sakazakii is the most commonly reported harmful bacterium in infant formula and is considered a key marker of microbiological quality. (Xie & Liu, 2021). This bacterium can cause severe infections in infants, including meningitis, sepsis, and necrotizing enterocolitis—conditions that can be life-threatening, with mortality rates as high as 40% (Strysko et al., 2020; Xie & Liu, 2021). Its heat resilience, capacity to persist in dry environments for more than two years, and tendency to form biofilms on surfaces (which are difficult to remove with antimicrobial treatments) make management extremely difficult.

The issue of contamination in facilities producing powdered infant formula, hospitals, and even homes is a major concern (Henry & Fouladkhah, 2019). These challenges demonstrate the urgent necessity for sound sanitation safety practices and vigorous risk-reduction strategies. A spore-forming bacterium, *B. cereus*, forms spores that are extremely resistant to drying, freezing, heat, disinfectants, ultraviolet and radiation (Pei et al., 2018). Similarly, heat-stable toxin-producing bacteria such as the foodborne pathogen, *S. aureus,* can survive certain conditions in food (Wang et al., 2012).

Even though *B. cereus* and *S. aureus* are classified as low-risk contaminants by the Food and Agriculture Organization (FAO) and WHO in infant formula (WHO, 2004), these microorganisms are hardy and can result in contamination, necessitating effective prevention and monitoring throughout food production settings. Besides the presence of bacteria in infant formula itself, insufficient cleaning of feeding bottles, incorrect mixing of formula, and warming of baby formula can also contribute to the growth of these microorganisms (Sani et al., 2013). The WHO has therefore released guidelines to limit contamination during the production, handling, and storage of baby formula (WHO, 2007). The guideline recommends:

The surface where the food will be prepared should be cleaned and disinfected.

Hands should be washed with soap and water and dried with a disposable napkin.

Adequate amount of water should be boiled.

The appropriate amount of boiled water should be cooled (>70°C) and transferred to a sterilised feeding container or feeding bottle.

Add the amount of formula stated on the label and mix well.

Quickly bring the prepared formula to room temperature by holding it under running water or placing it in a container filled with ice.

Dry the outside of the feeding bowl or bottle with a disposable napkin.

The temperature of the formula should be checked before feeding the baby so that the baby's mouth does not burn, and if necessary, it should continue to cool.

Formula that is not consumed within two hours should not be used.

In the report titled 'Food safety and Cronobacter infections in early infancy' published by the United States Centres for Disease Control and Prevention, Cronobacter infections between 1961-2018 were examined. According to this report, it was reported that most of the infected infants were newborns (67%), 38% of those infected died, and 79% of these cases had recently consumed powdered infant formula (Strysko et al., 2020).

The FAO and WHO classified the microorganisms that can be found in powdered infant formula and cause infections in infants according to the risks they pose, and *C. sakazakii* was shown in class A, the highest risk group (WHO, 2004). In a meta-analysis conducted in Türkiye, the prevalence of *C. sakazakii* in infant formulas was found to be 1% (0.00-0.01) (Al et al., 2020).

Although the FAO/WHO classifies *B. cereus* as a low-risk bacterium (category C) associated with infant formula contamination (WHO, 2004), its prevalence in infant formula is high enough to contribute to foodborne illness outbreaks (Pei et al., 2018). A study analyzing 6.656 powdered formula samples in China revealed that 7.53% were contaminated with *B. cereus* at levels of ≥10 cfu/g, with 1.1% exceeding 100 cfu/g (Pei et al., 2018). Similarly, the prevalence of *B. cereus* in infant formula has been reported at 20.9% in Korea (Kim et al., 2011) and a striking 64.3% in Libya (Shadlia-Matug et al., 2008). These statistics underscore the pressing need for enhanced surveillance and robust quality control protocols to mitigate the risks associated with *B. cereus* contamination in infant formula products.

In Türkiye, *B. cereus* contamination rates in newborn formula have been documented at varying levels: 25% (Esin & Özmen Toğay, 2023), 10% (Sezer, Vatansever & Bilge, 2015), 7% (Bahçeçi, Sancar & Özpınar, 2018), and 6.3% (Var et al., 2021). The widespread presence of *B. cereus* spores in powdered foods, coupled with their ability to proliferate under favorable conditions, presents significant challenges. Inappropriate formula preparation, cooling, and storage practices can promote spore multiplication and toxin production, exacerbating health risks (Sadek et al., 2018).

Infant formulas pose a potential risk for the development of *S. aureus* and staphylococcal enterotoxin formation due to their pH, water activity, structure and nutritional composition (protein and starch) (Genç & Vural, 2021). In some of the studies conducted with infant formulas and follow-on milks (Ergün & et al., 2002; Var & et al., 2021), *S. aureus* was not detected in accordance with the TFC Communiqué on Infant Formulas-2008. However, in a new study conducted in 2023, *S. aureus* was detected in a total of 4 formulas (11.1%), including one of the powdered foods and 3 of the dairy cereal supplements. (Esin & Özmen Toğay, 2023). Similarly, Wang et al. (2012) detected *S. aureus* in 11.2% of the powdered infant formulas they examined (Wang et al., 2012). *S. aureus* is generally transmitted from humans to foods, and contamination of raw materials in food production and/or contamination during production and preparation can cause the development of *S. aureus* in foods (Genç & Vural, 2021).

According to the TFC Regulation on Microbiological Criteria (2011), bacteria in the *Enterobacteriaceae* family should not be present in foods. This family includes coliform, faecal coliform and *C. sakazakii.* The presence of coliform and fecal coliform bacteria in infant formulas is associated with fecal contamination, low hygienic quality of the raw material from which the formula is obtained, especially milk, inadequate pasteurisation practices and contamination after cooking and pasteurisation (Buchanan & Oni, 2012). In Türkiye, 12.9% (Tokatli-Demirok & Arıcı, 2019), 22% (Sezer et al., 2015) coliform bacteria were detected in infant formulas, and 20.8% coliform and 16.6% faecal coliform bacteria were detected in another study (Esin & Özmen Toğay, 2023).

Heavy metals:

Infant formulas are known to contain varying levels of heavy metals, which can pose significant health risks (Bargellini et al., 2018; Zorlu, Ogut & Polat). Lead (Pb) is particularly harmful, affecting multiple organs such as the kidneys, lungs, and liver, as well as various systems including the cardiovascular, nervous, and reproductive systems. Its exposure is linked to a range of diseases

and an increased risk of mortality (Engwa et al., 2019; Rahman & Singh, 2019). Similarly, cadmium (Cd) exposure is associated with kidney toxicity, an increased risk of cancers, particularly lung and prostate cancers, and adverse effects on cardiovascular and neurological health (EFSA, 2009; Engwa, 2019). Arsenic (As) is known to increase the risk of several types of cancer (Hughes, 2011; Christoforidou et al., 2013), inhibit neurodevelopment in children (Rodríguez-Barranco, 2013), impair immune function (Dangleben, Skibola & Smith, 2013), and lead to the development of diabetes and cardiovascular diseases (Abhyankar et al., 2012; Thayer et al., 2012). Mercury (Hg), once absorbed into the body, can rapidly diffuse into all tissues, including the brain, where it can cause severe neurological damage (Brombach et al., 2017).

Heavy metals are non-biodegradable and can exhibit toxic effects even at low concentrations. Therefore, the health of infants exposed to heavy metals may be at risk (Sharafi et al., 2019). The heavy metal content in one serving of infant formula is unknown. The WHO emphasizes that data on food contamination and exposure are not always available from individual countries and recommends calculating exposure based on actual dietary intakes to accurately assess health risks to children (WHO, 2004). The European Food Safety Authority (EFSA) reported tolerable weekly intakes as Cd 2.5 mcg/kg (EFSA, 2009), Hg (for mercury) 1.3 mcg/kg (EFSA, 2012b) and Pb 25 mcg/kg (EFSA, 2010), Aluminum (Al) 1 mg/kg (EFSA, 2011) and did not specify a safe amount for As (Başaran, 2022).

When the studies on infant formulas in the literature are analysed; in a study conducted in Türkiye (Başaran, 2022), 36 infant formulas were evaluated and 24-hour food consumption records of infants were taken for exposure. At the conclusion of the study, the average concentrations of Pb, Cd, As, and Hg in infant formulas were found to be 0.025, 0.002, 0.021, and 0.0001 mg/kg, respectively. It was observed that the Pb content exceeded the maximum permissible limit of 0.02 mg/kg, as outlined in the TFC Communiqué on Infant Formulas and Follow-on Formulas. However, upon evaluating the risk ratios, it was determined that exposure to Pb, Cd, and Hg did not pose a health risk, with the

exception of inorganic arsenic (especially in infants aged 0-6 months).

Domínguez et al. (2017) detected contamination in 30 infant formula samples designed for infants aged 6 to 12 months, with Al levels at 4.02 mg/kg, Cd at 0.01 mg/kg, and Pb at 0.07 mg/kg. These findings highlight the presence of pollutants in infant formula and underscore the critical need for continuous monitoring to ensure the safety of these products for vulnerable populations. Similarly, Elaridi et al. (2021) examined 78 infant formula samples in Lebanon and reported Pb contamination ranging from 31.0 to 1040 μg/kg, Cd from 38.0 to 476 μg/kg, and As from 12.0 to 251 μg/kg. These results further emphasize the necessity of stringent safety measures to protect infants from exposure to harmful substances.

Conclusion

Safe production, handling, and storage of infant formula ensure healthy nutrition for infants. Because infants have an immune system that is not strong enough for their weaker body weight and dependence on a limited choice of foods, the vulnerability to microbial, chemical, and toxic threats within these products is significant. Inappropriate infant formula preparation and storage were identified as providing the conditions necessary for the growth of pathogenes and toxins produced by various species that pose a threat to health. To reduce such risks, infant formula must be manufactured and delivered in full compliance with national and international health standards.

The regulations in Türkiye require quality control of infant formula to be by way of strict analysis expressed already by limits set very strictly on pesticide and heavy metal limits as well as microbial contaminants. Minimum requirements must be established and periodically revised to ensure their continued effectiveness in protecting infant health.

Routine chemical analysis, specifically for heavy metals and pesticide residues, is very important in reducing health risks to zero and confirming product safety. The three most severe microbial

hazards associated with infant formula are *C. sakazakii*, *B. cereus,* and *S. aureus;* their control demands the adoption of strict hygiene measures throughout handling. A series of advice should be taken from the WHO and planned with strong influences on contamination prevention as the important steps to take for the sake of infants' health.

A total approach is necessary for assuring the safety of infant formula. This includes proper education for parents and health workers regarding hygiene and preparation techniques, along with imposing periodic tests by manufacturers on quality products and strict regulations by the supervising authorities.

These initiatives are further leveraged with the engagement of international bodies to ensure that the most recent scientific discoveries are integrated into the political framework. Such all-round strategies-when adopted-empower us to enhance the safety of infant formula and, in this way, deliver better protection to society's youngest and most vulnerable members.

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CHAPTER III

Vegetarian Nutrition

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Introduction

Nutrition is constantly changing and evolving in line with people's collective living habits, ethical principles, moral values and religious beliefs. The invention of fire made it possible to cook meat, which led to an increase in its consumption and made it easier for people to adapt to carnivorous eating habits. However, over time, eating habits and dietary patterns have diversified depending on social, cultural and individual factors. Nowadays, one of the most well-known and widely preferred dietary patterns is the vegetarian and vegan diet (Seçim, Akyol & Kaya, 2022).

Vegetarianism and veganism are become increasingly acknowledged as notable nutritional approaches in modern societies. There are multiple reasons why omnivorous individuals adopt vegetarian or vegan eating habits over time. These reasons include

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religious beliefs, ethnicity, desire to stand against animal exploitation, awareness of environmental protection and health concerns. Especially individuals who are aware of environmental impacts prefer vegetarian diets for ecological reasons, which increases the popularity of this lifestyle (Vatan & Türkbaş, 2018).

Vegetarianism and veganism is a lifestyle that individuals can adopt for more than one reason. Individuals who adopt this lifestyle have certain sensitivities about nutrition in their daily lives. In particular, vegans attach importance to details from the production processes of the foods they consume to the ingredients they contain. In line with these sensitivities, vegetarians and vegans expect their preferences to be respected and valued in every aspect of their lives. Increasing sensitivity towards such dietary habits in the society in general is considered as an important development both at individual and social level (Tunçay, 2018).

Nutrition

Individuals need to meet their fundamental requirements in order to survive, and nutrition is one of the most vital of these needs. Nutrition plays a fundamental role in the healthy life, growth and development of individuals. It is also the main factor in meeting the daily energy needs of individuals. Nutrition includes the consumption of foods of both animal and plant origin and this process is indispensable for the continuation of human life in a physically and mentally balanced condition. The main purpose of nutrition is to support human growth and development, to enable them to lead a productive life and to help them survive for a long time in a healthy way. In order to achieve this aim, it is of great importance that the necessary nutrients are taken in sufficient quantities and used appropriately in the body. The main issue in nutrition is to consume the foods taken both adequately and in a balanced way. Inadequate intake of nutrients can lead to number of health problems, while an unbalanced diet can have negative effects in the long term (Geraets & Heinz, 2023). Therefore, nutrition is not only a necessity of life but also an important factor determining the quality of life of an individual. In this context, it is critical for

individuals to organize their diets in accordance with their daily energy needs in order to protect both their physical and mental health.

Vegetarian Nutrition

Although the word “vegetarian” is thought to derive from the English word “vegetable” meaning vegetable because it connotes a vegetable-heavy diet, it actually originates from the Latin word “vegetus”. “Vegetus,” meaning healthy, vibrant and energetic, is a deeper expression of the vegetarian diet. The first definitions of vegetarian diet were officially put forward in 1842 and the term started to be used in the modern sense (Seçim, Akyol & Kaya, 2022). However, some individuals incorrectly define the term vegetarian as a diet in which chicken, cheese and fish are consumed instead of red meat (Ongan & Ersoy, 2012).

The dietary habits of societies and cultures show geographical, cultural and belief-based differences. These differences base dietary patterns on beliefs, traditions and customs. Throughout history, vegetarian diets have been seen as the natural and sustainable diet of humanity. Vegetarianism is a diet based on the consumption of mainly plant-based foods. In this lifestyle, animal foods (such as red meat, chicken, fish, milk and dairy products, eggs) are either completely avoided or consumed in limited quantities. The term vegetarian is used to describe individuals who adopt this dietary habit (Karabudak, 2012).

In recent years, the tendency towards vegetarian diets has increased. This is often linked to reasons such as weight loss targets or animal rights sensitivities. In addition, individuals' awareness of environmental protection and their seeking a healthy life also support this tendency. Vegetarian individuals are categorized into groups according to their different eating habits. For example, subgroups such as lacto-ovo vegetarians, ovo-vegetarians and vegans are classified according to individuals' dietary preferences and lifestyles (Sarıışık, 2021).

This increase leads to changes not only in the lifestyles of individuals but also in social eating habits. Nowadays, the vegetarian diet is considered from a more comprehensive perspective and is preferred for different motivations.

Types and Characteristics of Vegetarian Diet

1. Lacto-ovo vegetarian diet: This type of diet excludes meat, poultry and fish. In addition to plant-based foods, milk, dairy products and eggs are consumed.

2. Lacto-vegetarian diet: The diet excludes meat, poultry, fish and eggs. It consists only of milk, dairy products and plant-based foods.

3. Ovo-vegetarian diet: The diet excludes meat, poultry, fish, milk and dairy products. However, plant-based foods and eggs are consumed (Taşçı & Alp, 2021).

4. Vegan diet: This diet excludes all animal foods. Products such as meat, poultry, fish, milk, dairy products, eggs and honey are not consumed. Some vegans also do not use animal products such as leather and silk. There are also different types of vegan diet.

5. Semi-vegetarian diet: This diet excludes the consumption of red meat. In addition to plant-based foods, limited amounts of poultry meat and seafood are consumed. Milk, dairy products and eggs are also included.

6. Pesco-vegetarian diet: This type of diet excludes meat and poultry. However, fish, milk, dairy products and eggs are consumed.

7. Polo-vegetarian diet: The diet excludes meat and fish. In addition to plant-based foods, poultry meat is included in the diet.

8. Macrobiotic diet: This type of diet consists of grains and cereals. Animal foods are not part of the diet (Özcan & Baysal, 2016).

Vegan Nutrition

The word vegan is derived by combining the first and last syllables of the word “vegetarian”, which means “vegetarian” in English. The term was first used by Donald Watson, one of the founders of The Vegan Society, in the 1900s to clarify the difference

between vegans and vegetarians, and found its place in the literature with the establishment of the Vegan Nutrition Association (Aymankuy & Topal, 2022). Considered as the strictest practitioners of vegetarian nutrition, vegans refuse to consume and use all types of animal products (Kara & Bilim, 2022). For example, some vegans refuse to consume honey and even chocolate containing milk. They also refuse to use clothes made from animal silk, leather products, woolen clothes and soaps containing animal fat.

Vegan' sensitivities are not limited to consumption. They also refuse on ethical grounds to participate in activities that use animals, such as circuses, bullfights, trips to the zoo or horse races. The main difference between vegan and vegetarian diets is that vegans completely reject all types of animal products, while vegetarians consume these products in limited amounts or not at all (Gökçen, Aksoy & Özcan, 2019).

Veganism is more than just a way of eating, it is a multidimensional lifestyle that is addressed within the scope of various disciplines such as philosophy, sociology, gastronomy and tourism. Sociology of food examines the cultural dimensions of veganism and explores its effects on food and cuisine. Gastronomy and tourism, on the other hand, focus on exploring different flavors within the context of veganism and developing vegan-friendly tourism experiences. Sociology of food and cuisine, an emerging field within sociology, analyzes the social dimensions of a vegan diet. Although there is an increasing attention in this field, the sociological dimensions of veganism still have an important place in the discipline of sociology (Aksürmeli, 2019).

While veganism continues to be studied from an interdisciplinary perspective, it is being adopted by more and more individuals around the world for ethical, environmental and health reasons. This multifaceted lifestyle creates a significant transformation in all areas of life in parallel with the social, cultural and environmental values of individuals.

Types and Characteristics of Vegan Diet

Fruvitarians or Fruitists: Individuals who follow this diet eat only fruits and vegetables with seeds, such as squash, peppers and tomatoes, which are botanically considered fruits. Fruvitarians value the fact that the food they consume is returned to the earth to continue the cycle of growth. For this reason, they prefer to consume their food raw, without any cooking process. It is also noted that a significant number of fruvitarians believe in reincarnation and have developed a philosophy of life in line with this belief (Melina & Davis, 2010).

Zenmacrobiotic Diet: The zenmacrobiotic diet is a diet consisting of grains, vegetables, fruits and legumes. However, some individuals follow a stricter version of this diet, eliminating vegetables, fruits and legumes and adopting a grain-based diet. This approach is often favored by individuals who advocate a simple lifestyle and minimal food processing (Ratzin, 2022).

Ravists: Ravists are individuals who believe that cooking destroys the nutritional properties of food and therefore consume all food raw. Those who adopt this way of eating believe that cooking causes a reduction in vitamins, minerals and other bioactive components. Therefore, they believe that food should be consumed in its most natural form (Karabudak, 2012). These different dietary patterns reflect not only individuals' health preferences but also their life philosophies and belief systems, offering a remarkable diversity in modern dietary approaches.

Vegetarian Athletes

Vegetarianism is becoming increasingly popular, not only among non-sporty individuals, but also among athletes. If practiced in an adequate and balanced way, this diet can offer a healthy alternative to traditional eating habits. Vegetarian diets can be an effective solution to support energy levels and improve performance when planned in accordance with an individual “s health goals and needs (Amawi et al., 2024).

Depending on the type of vegetarian diet, the variety of foods consumed and methods of achieving nutritional balance can differ

significantly. For example, lacto-ovo vegetarian diets may be more flexible when it comes to providing protein and other important nutrients, as they include animal foods such as dairy and eggs. Vegan diets, on the other hand, completely exclude all animal products and may need to obtain these nutrients from plant sources or supplements (Yangılar, 2024).

A properly planned vegetarian or vegan diet can provide all the nutrients the body needs. A balanced intake of protein, iron, calcium, omega-3 fatty acids, vitamin B_{12} and other micronutrients makes these diets effective for health. When required, nutritional deficiencies can be avoided through the use of dietary supplements under the guidance of a nutritionist. In this way, a healthy and sustainable diet can be created for both athletes and other individuals (Fink & Mikesky, 2012).

The Effect of a Vegetarian Diet on Sports Performance

Vegetarian diets and lifestyles can provide protective effects against chronic diseases. Research shows that vegetarian individuals have lower rates of coronary heart and vascular diseases, some types of cancer, obesity and diabetes compared to meat-eating individuals (Kumar et al., 2022). However, nutrient deficiencies caused by vegetarian diets are more common in women than in men. This is often associated with inadequate intakes of iron (Fe) and calcium (Ca). Women may be more susceptible to these deficiencies due to their increased need for these minerals (Bera, 2021).

For athletes, a vegetarian diet may offer beneficial effects for high training and competition performance. This is mainly due to the fact that vegetarian diets more easily provide athletes with the recommended high carbohydrate intake. High-carbohydrate diets may improve performance by supporting energy stores, especially in endurance sports (Ongan & Ersoy, 2012).

There are several mechanisms explaining the association of plant-based diets with sports performance and three possible scientific theories have been proposed. According to the first theory, the high carbohydrate content of vegetarian diets may improve

physical performance by increasing glycogen stores. The second theory states that because these diets are rich in phytochemicals and antioxidants, they strengthen the immune system by reducing oxidative stress associated with prolonged exercise. The third theory states that the consumption of large amounts of fruits and vegetables in vegetarian diets produces an alkaline environment in the body by regulating the acid-base balance, which may have positive effects on performance (Mete, 2021). These findings suggest that vegetarian diets may have positive effects not only on health but also on physical performance. However, for these benefits to be completely achieved, the diet needs to be carefully planned and adapted to the requirements of the individual.

Reasons for Choosing Vegetarianism

Vegetarian diets are preferred for different reasons. Historically, vegetarianism is a way of eating that has emerged on economic grounds and the idea of more efficient use of resources. It has been shaped by the observation that production on limited agricultural land can feed more people at lower cost and in the short term compared to animal husbandry. In addition, the fact that long-term food sources such as the milk of cattle and sheep and the eggs of some poultry are quickly depleted if these animals are slaughtered has been an important factor in the preference for vegetarianism. Based on these observations, religions such as Buddhism and Jainism, for example, prohibit the consumption of killed animals. Religions such as Islam, Judaism and Christianity prohibit the consumption of certain animals (e.g. pigs) for health reasons (Keilbart, 2021).

In recent years, moral values against the killing of animals and environmental awareness have also contributed to the spread of vegetarianism. Thanks to the active work of animal protection organizations, many countries are taking a stand against the killing of animals and advocating the elimination of meat consumption from the diet. Moreover, the number of individuals adopting vegetarianism not only for religious reasons but also for health reasons is increasing rapidly. Individuals who prefer vegetarian diets

to prevent chronic diseases such as cardiovascular diseases, hypertension, diabetes and cancer prioritize the health benefits of this lifestyle (Karabudak, 2012).

The preference for a vegetarian diet is generally based on two main factors: ethnic and health-based motivations. Research shows that ethnic factors are a stronger motivator than health reasons. In addition, the reasons for choosing vegetarianism include ecological, economic, ethnic, ethnic, religious, health and political factors, animal welfare and interest in eastern philosophies. In addition, reasons such as concern about environmental damage also have an important place among these preferences (Mansouri, 2024; Özcan & Baysal, 2016). When these factors come together, it is seen that vegetarianism is not only an individual choice, but also a social, cultural and environmental movement. Today, vegetarianism continues to attract attention both on an individual and global level as a more sustainable way of life.

The Historical Process of Vegetarianism and Veganism

The origins of the vegetarian diet are thought to date back to classical Ancient Greece (Shipman, 2021). Although there is no exact information on exactly when and how vegetarianism originated, the first written sources on this lifestyle were produced in Ancient Greece by the Orphaeans, who did not consume meat (Mauro, 2017). The philosopher Empodocles, who lived in the 5th century BC, is known to have embraced vegetarianism and spread his ideas, arguing that not killing other living creatures was a moral virtue. This is an important starting point for the understanding of vegetarianism at that time. It is seen that the vegetarian lifestyle dates back to approximately 3000 years ago and is preferred for ethical reasons or health reasons in religions such as Hinduism, Jainism and Buddhism. In these religions, the understanding of not harming living beings and avoiding violence constitute the fundamental foundations of vegetarianism. Historically, this understanding has contributed greatly to the development of vegetarianism in the moral and religious context (Restrepo & Lastella, 2016).

Nowadays, vegetarian diets continue to spread worldwide. However, since the proportion of vegetarian individuals in the total population is quite low, it is very difficult to identify and analyze this group in epidemiological studies. One of the influential figures in the spread of vegetarianism is Pythagoras, the Greek philosopher and mathematician who brought the idea of reincarnation to the agenda. Pythagoras believed that every animal consumed was once human and would be reincarnated as a human being in the future. Because of this belief, he is considered the pioneer of ethical vegetarianism. Pythagoras' views influenced many thinkers and scientists in the 19th century, leading them to adopt a vegetarian lifestyle. These ideas were an important turning point in the development of ethically based vegetarianism. At present, vegetarianism draws attention as a global movement due to its historical origins as well as ethical, religious and health-based reasons (Bozfırat & Düzce, 2021).

Religious Evaluation of Vegetarianism/Veganism

The influence of religion on social issues is seen as a determining factor in people's food production, trade and consumption, along with the important roles it plays in daily life. Processes such as which animals and plants are considered food, how they are produced and marketed are often shaped by religious rules and traditions. These rules, combined with social norms and cultural habits, are a strong guiding factor in food consumption and production (Sezgin & Ayyıldız, 2019).

Historically, it is known that religious people in Egypt did not consume animal meat, while Greek philosophers Plato, Socrates and Pythagoras advocated a vegetarian diet. The Inca civilization also adopted a vegetarian diet as one of its fundamental principles and practiced this lifestyle. In India, Gotama Buddha warned his disciples not to consume red meat, which created a strong opposition to meat consumption in Buddhist beliefs. There are also theories that early Christian and Jewish communities, as well as Taoist saints, may have adopted a vegetarian lifestyle.

Nowadays, about one-third of India's population is vegetarian. Since ancient times, Hindus have approached

vegetarianism as a moral philosophy of life and considered meat as a product of slaughter. For this reason, the vegetarian population in India is quite high compared to other countries. According to Hindu beliefs, the consumption of red meat is considered a great sacrilege. In addition, Buddhist beliefs also oppose the consumption of the meat of poultry and birds (Sezgin & Ayyıldız, 2019).

The cuisines of China and India are important examples to understand the place of veganism in world cuisines, reflecting the strong influence of religious beliefs in these countries. For individuals who follow religions such as Buddhism and Jainism, or those who adopt a vegan diet, the consumption of legumes, grains, vegetables and fruits is quite common in these cuisines, and eating such foods makes it easier for these individuals. Brahmans (Hindu priests) avoid consuming animal-based foods. Indian vegan cuisine emphasizes the therapeutic properties of foods and their protective effects against diseases, with reference to sacred written sources such as Ayurveda. Especially in South India, the avoidance of red meat is widespread and coconut milk is preferred over dairy products in this region (Aydın et al., 2019). This information reveals the profound influence of religious beliefs on vegetarian and vegan diets and the cultural and regional differences of these diets. This interaction plays a decisive role not only at the individual level, but also in the gastronomic understanding of societies.

Vegan/Vegetarianism from a Health Perspective

In the international literature, there are many academic studies suggesting that a vegetarian diet offers positive health effects. However, there are also studies that argue that a vegetarian diet may have negative effects on health. Therefore, there are different opinions about the health effects of a vegetarian diet. However, in general, studies show that the health status of vegetarian individuals is better compared to other individuals (Dell'Oro, 2021; Tunçay, 2018). Especially in Western countries, vegetarian diets have become an important part of nutrition and academic studies have extensively addressed the long-term and short-term health benefits of these diets (Kendilci, 2020).

It has been found that vegetarian individuals have lower blood cholesterol levels and are less likely to suffer from chronic diseases such as cardiovascular diseases, obesity, diabetes, and high blood pressure. It is also suggested that vegetarian individuals have a lower risk of developing cancer due to their higher consumption of healthy foods such as legumes, walnuts, nuts, fruits, vegetables and grains. However, it should be emphasized that adequate and balanced nutrition is a fundamental requirement for the sustainability of the beneficial effects of this diet.

On the other hand, it has been reported that vegetarians, especially vegans, may develop health problems such as anemia due to folic acid and iron deficiency, vitamin B_{12} deficiency, osteoporosis due to calcium or vitamin D deficiency. This is particularly prevalent in individuals who completely exclude foods of animal origin. Therefore, it is important to carefully formulate vegetarian or vegan diet plans and support them with nutritional supplements when necessary (Tunçay, 2018).

Furthermore, dietary diversity and content are known to have positive effects on gut bacteria and microbiota, thereby improving the molecules produced. Vegetarian diets rich in fiber has positive effects on digestive system hormones, especially incretins, and may reduce the risk of type 2 diabetes by regulating postprandial insulin release. The features of this diet that improve intestinal health and contribute to metabolic processes further increase its positive effects on health (Kargar & Kızıltan, 2022).

In conclusion, a vegetarian diet can offer many health benefits when planned carefully. However, it is critical for the long-term sustainability of this lifestyle that individuals get the essential nutrients they need in a balanced way and take precautions against potential deficiencies.

Health Benefits

A vegetarian diet has various positive effects on health, reducing the risk of chronic diseases. Animal foods are rich in total fat, saturated fat and cholesterol, which are much higher in a

vegetarian diet. Especially red meat consumption is known to increase the risk of coronary heart disease. Studies show that coronary heart disease is 30% more common in individuals who consume red meat compared to vegetarian individuals (Lé, 2019).

A vegetarian diet is also effective in reducing the risk of hypertension. According to individuals who eat a mixed diet, especially those who consume more meat, vegetarians are less likely to develop hypertension. These favorable effects are due to the fact that vegetarian diets have low total fat, saturated fat and cholesterol content, as well as being rich in plant foods such as fiber, vegetables, fruits and legumes. In addition, diets rich in blood pressure-regulating minerals such as potassium (K), magnesium (Mg) and calcium (Ca) and low in sodium (Na) have a positive effect on blood pressure (Mashau & Ramashia, 2021; Trautwein & McKay, 2020).

It is known that vegetarians have lower rates of cancer than people who eat a meat-based diet. This is due to the fact that a vegetarian diet is rich in nutrients such as legumes, nuts such as walnuts and hazelnuts, fresh vegetables, fruits and whole grain foods. These foods increase the intake of antioxidant substances such as vitamin E, vitamin C, carotenoids, bioflavonoids and other bioactive compounds known to protect against cancer.

Osteoporosis (osteoporosis) is a condition in which bones become brittle due to a decrease in bone mineral content. Individuals who eat a mixed diet are more likely to develop osteoporosis. Excessive consumption of high-protein foods, especially meat, can lead to calcium loss from the bones. In contrast, vegetarian diets can reduce the risk of osteoporosis by providing adequate calcium intake, provided they include sufficient amounts of low-fat or fat-free dairy products.

A vegetarian diet is also a diet rich in fiber. Diabetes is less common in individuals who follow a high-fiber diet compared to those who follow a low-fiber diet. In addition, the high fiber content of vegetarian diets contributes to the health of the digestive system and has a protective effect against disorders such as constipation.

Finally, individuals who adopt a vegetarian diet are not at risk of developing kidney stones and gallstones. These features support the positive effects of vegetarian diet on general health (Karabudak, 2012).

Health Risks

Vegetarianism does not always mean leading a healthy lifestyle, nor is a vegetarian diet always a consistent choice within the framework of a healthy diet. Although a vegetarian diet has positive health effects, several health problems can occur if the diet is not planned in a balanced and adequate way.

If vegetarians do not have enough food diversity and do not include iron-rich foods in their diet, they may be at risk of iron deficiency. As a result, they are more likely to develop anemia. Vitamin B_{12} deficiency is also common, among vegans. Not only can vitamin B_{12} deficiency lead to anemia, but it can also cause serious irreversible damage to the nervous system. This may make it necessary for vegans to take vitamin B_{12} supplements.

In adults and growing children on vegetarian diets, inadequate consumption of calcium sources such as milk and dairy products can negatively affect bone health. In particular, calcium deficiency can lead to decreased bone mineral density and serious health problems such as osteoporosis later in life.

In addition, when dietary diversity is lacking and animal-based foods such as eggs and milk are not consumed in sufficient quantities to meet vitamin B12 requirements, homocysteine levels may rise in the body. Increased homocysteine levels are a major risk factor for cardiovascular disease. It is therefore important for vegetarians to plan their diets carefully and, if necessary, take supplements under expert guidance (Karabudak, 2012). A vegetarian diet can be part of a healthy lifestyle when practiced correctly. However, preventing deficiencies and ensuring a balanced dietary plan are critical to the long-term sustainability of this diet.

Vegan and Vegetarian Nutrition in Infants and Children

The content of breast milk from vegetarian mothers is similar to that of non-vegetarian mothers and is considered adequate in terms of nutrients and nutritionally appropriate. Therefore, breast milk is considered to be a source of nutrients that support healthy growth and development for infants of vegetarian mothers. However, soy-based products (e.g. soy milk) are often considered the only alternative for vegan infants who cannot receive breast milk.

The physical development of lacto-ovo-vegetarian children is quite similar to that of non-vegetarian children. However, it has been observed that vegan children are generally shorter and thinner during growth and development. This makes it important to carefully plan the content of vegan diets and provide the necessary nutrients.

In a study of 50 vegetarian and omnivorous children, it was found that vegetarian children had adequate levels of vitamins B_{12} and B_9. However, vitamin D deficiency was commonly observed in this group (Roeren et al., 2022). In another study, it was reported that vegetarian children had lower ferritin levels than omnivorous children, but there was no significant difference between the two groups in terms of zinc (Zn) mineral levels. These findings suggest that vegetarian children may be at risk for some nutrients (Sutter & Bender, 2021).

Pregnant women, lactating mothers and children should be followed with special care during their growth and development. Especially for individuals following a vegetarian or vegan diet, nutrient intake should be evaluated regularly to ensure that it is adequate. In case of deficiency, appropriate supplements should be taken under the guidance of a physician or nutritionist (Ayaz, 2018).

Vegan and Vegetarian Cuisine in Turkish Cuisine

Individuals who follow vegan and vegetarian diets face a variety of barriers, especially when it comes to food and beverage choices and participation in tourism activities. For vegans, eating out poses a greater challenge due to their avoidance of animal products. Many restaurants and food establishments may fail to offer options

that suit the needs of vegans, making it difficult for vegans to maintain their lifestyle (Kara & Bilim, 2022).

The increasing number of individuals who prefer vegetarian diets in societies has led to the need to develop more comprehensive nutrition guidelines to meet the balanced and adequate nutritional needs of these individuals. The dissemination and updating of guidelines such as Türkiye Nutrition Guide 2022 (TÜBER) in Türkiye has been an important step in meeting this need. In addition, creating menus that meet the daily nutritional needs of vegetarians has become a necessity for both food establishments and individual nutrition plans.

Turkish cuisine has a rich structure that offers many options suitable for vegetarian diets. In Türkiye, geographical location, vegetation, food diversity and the civilizations it has interacted with throughout history have shaped the diversity and richness of Turkish cuisine. In addition, with the influence of modern dietary concepts, Turkish cuisine offers a wide range of both traditional and contemporary vegetarian dishes.

Turkish cuisine has a wide variety of dishes suitable for a vegetarian diet. Soups, vegetable dishes with olive oil, legume dishes with olive oil, pilafs, pastries, salads, pastries and desserts are some of the vegetarian-friendly food categories of this cuisine. Especially olive oil dishes and vegetable-based recipes attract attention because they are both healthy and nutritious. In this respect, Turkish cuisine has a great potential for vegetarian individuals and has a culinary structure that can be taken as an example at the international level (Sezgin & Ayyıldız, 2019).

The Impact of Vegetarianism on Sustainability

Considering Marlow's work, important data have been obtained assessing the environmental impacts of dietary differences between vegetarians and non-vegetarians. In this study, the production of 11 different food items consumed in non-vegetarian diets was examined and it was determined that non-vegetarian diets require 290% more water, 250% more primary energy, 1300% more

fertilizers and 140% more pesticides than vegetarian diets. These data make it clear that non-vegetarian diets place a greater burden on the environment. The biggest difference between the two diets was found to be the high consumption of red meat in non-vegetarian diets.

The results show that non-vegetarian diets impose a greater environmental cost than vegetarian diets. In particular, red meat-based food systems require more energy, land and water resources than lacto-ovo vegetarian diets. This highlights the negative impacts of red meat production on environmental sustainability. In this context, a lacto-ovo vegetarian diet has been shown to be a much more sustainable option than the average red meat-based diet. It is understood that lacto-ovo vegetarian diets have a significant potential for both more efficient use of environmental resources and reducing negative impacts on the environment (Aymankuy & Topal, 2022).

Conclusion

Studies reveal that the reasons for preferring a vegetarian diet are mainly due to ethical, religious, health and animal rights factors. In this context, it is vital that individuals who become vegan for ethical reasons pay attention to the necessary nutrients to maintain a healthy diet. Vegan and vegetarian individuals face significant difficulties especially when it comes to eating out. In addition, it is stated that vegetarian diets are more advantageous in terms of environmental sustainability and make more positive contributions to the environment compared to non-vegetarian diets.

Although it is stated that a vegetarian diet can be healthier than a non-vegetarian diet, it is emphasized that such a diet should be planned in a balanced and healthy way. Otherwise, health problems such as vitamin B_{12} deficiency and anemia (anemia), obesity due to carbohydrate-heavy diet and susceptibility to cardiovascular diseases may occur. Especially in the case of complete abstinence from animal products, individuals need a careful diet plan to ensure the necessary vitamin and mineral intake.

From a health perspective, instead of recommending a vegetarian diet completely in certain situations, it is suggested that meat consumption with portion control can be beneficial for human health. The main reason for this is that the body needs protein and especially vitamin B_{12}, which is found in animal products. Protein and vitamin B_{12} deficiency can lead to nervous system disorders, weakened immune system and various health problems in the long term.

For individuals who are vegetarian for religious or ethical reasons, their diet should include adequate protein intake and vitamin B_{12} supplementation in accordance with their body needs. This approach will enable individuals to maintain their ethical or religious values and meet their health needs. In this way, vegetarian and vegan diets can be practiced in a sustainable and healthy way in the long term. Such a dietary model can improve the quality of life of individuals, while at the same time offering societal and environmental benefits.

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