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Physiological Changes During Childhood and Adolescence and Their Implications for Nutritional Requirements: A Narrative Review

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ABSTRACT

Childhood and adolescence are critical periods in the human life cycle characterized by physical growth, cognitive development, organ maturation, as well as rapid hormonal and psychosocial changes. Physiological changes occurring at each developmental stage influence nutritional requirements and dietary patterns needed to support optimal growth and development. This article aimed to review physiological changes during childhood and adolescence and their implications for nutritional requirements based on scientific literature. This article employed a narrative review method through literature searches conducted in several electronic databases, including PubMed, ScienceDirect, Google Scholar, and Garuda. The search strategy used combinations of keywords related to physiological changes, nutritional requirements, diet, children, and adolescents. The selected literature was determined based on thematic relevance, full-text availability, and its association with physiological changes and nutritional requirements in children and adolescents. The review findings indicated that preschool and school-age children require adequate energy and nutrient intake to support growth, physical activity, and cognitive development. Meanwhile, adolescents experience increased requirements for energy, protein, iron, calcium, and vitamin D due to accelerated growth and hormonal changes during puberty. In addition to physiological factors, dietary patterns among children and adolescents are also influenced by family environment, lifestyle, and social media exposure, which may increase the risk of obesity, anemia, and micronutrient deficiencies. Therefore, adequate nutritional intake according to developmental stages and the role of healthcare professionals in nutrition education are essential to support optimal growth and development in children and adolescents.

Keyword: Adolescents; Children; Dietary Patterns; Nutritional Requirements; Physiological Changes

INTRODUCTION

Childhood and adolescence are critical periods in the human life cycle characterized by rapid and dynamic physical growth, cognitive development, organ maturation, and psychosocial changes (Jimenez *et al*., 2024; Mastorci *et al*., 2024). During these stages, adequate nutritional intake plays a crucial role in supporting optimal growth and development. Imbalances in nutritional intake throughout the growth period may lead to impaired physical development, decreased cognitive function, compromised immune response, and an increased risk of metabolic diseases later in life. The World Health Organization states that nutritional problems among children and adolescents remain a global public health challenge, including undernutrition, micronutrient deficiencies, as well as the increasing prevalence of overweight and obesity (WHO, 2025).

Physiologically, childhood and adolescence consist of several developmental stages with distinct growth characteristics and nutritional requirements. Preschool children are generally categorized within the age range of 3–6 years, whereas school-age children range from 6–12 years old (Andriani *et al*., 2019; Damayanti *et al*., 2019). During these periods, motor development, language skills, physical activity, and cognitive abilities continue to improve, thereby influencing energy and nutrient requirements. Adolescence, meanwhile, represents a transitional phase from childhood to adulthood characterized by rapid growth (*growth spurt*), hormonal changes, and maturation of the reproductive organs (Herting & Sowell, 2017). These physiological changes result in significantly increased requirements for energy, protein, iron, calcium, and various micronutrients compared with earlier developmental stages.

In addition to physiological changes, modernization has also influenced dietary patterns among children and adolescents. Urbanization, technological advancement, increased exposure to social media, and changes in modern lifestyles have contributed to a shift from traditional diets toward fast food, ultra-processed foods, and sugar-sweetened beverages (Arafa *et al*., 2024; Masztalerz-Kozubek *et al*., 2024). These dietary changes

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contribute to various nutritional problems among children and adolescents, including obesity, anemia, micronutrient deficiencies, and eating disorders. In Indonesia, nutritional problems among school-age children and adolescents remain a significant concern due to the high prevalence of adolescent anemia, overweight, and low consumption of fruits and vegetables (Rachmi *et al*., 2021).

Adequate nutritional intake according to developmental stages and physiological changes is essential to support both short-term and long-term health outcomes. Therefore, healthcare professionals, including nurses, play an important role in providing nutrition education, promoting healthy dietary habits, and preventing nutritional problems among children and adolescents. Understanding the relationship between physiological changes and nutritional requirements is also necessary as the basis for developing appropriate dietary patterns according to developmental stages.

Based on these considerations, this article aims to review physiological changes during childhood and adolescence and their implications for nutritional requirements based on current scientific literature.

METHODS

This article was conducted using a narrative review method with a PRISMA approach in the process of literature identification and selection. Literature searches were performed through several electronic databases, including PubMed, ScienceDirect, Google Scholar, and Garuda. The search strategy employed a combination of keywords and free text searching, including "physiological changes," "nutritional requirements," "diet," "children," "school-age children," "adolescents," and "growth and development," combined using Boolean operators AND and OR.

The review question was formulated using the PEO (Population, Exposure, Outcome) framework, consisting of Population: preschool children, school-age children, and adolescents; Exposure: physiological changes during growth and development; Outcome: nutritional requirements and dietary patterns. Based on this framework, the review question in this article was: "How do physiological changes during childhood and adolescence influence nutritional requirements and dietary patterns?"

The literature included research articles, review articles, textbooks, and official guidelines relevant to the study topic. Articles were selected based on thematic relevance, availability of full-text access, and their association with physiological changes and nutritional requirements among children and adolescents. No strict limitation on publication year was applied, considering that several classical references were still used as theoretical foundations. The selected literature was then analyzed and synthesized descriptively according to the themes discussed in this review.

RESULTS AND DISCUSSION

Physiological Changes and Nutritional Requirements in Preschool and School-Age Children

Preschool and school-age periods are critical stages of growth and development characterized by physiological changes, increased physical activity, and the development of cognitive and social abilities. In preschool children, the rate of growth tends to slow down compared to earlier developmental stages; however, both fine and gross motor development progress rapidly (Flores *et al*., 2023; Hurtado-Almonacid *et al*., 2024). In addition, dietary patterns, food preferences, and eating habits begin to develop during this phase and may influence children's nutritional status later in life (Ródenas-Munar *et al*., 2024). Physiologically, preschool children also experience maturation of the digestive system and a relative decrease in appetite due to the slower growth rate (Białek-Dratwa *et al*., 2022; Leung *et al*., 2012).

As children enter school age, growth becomes more stable and consistent, accompanied by increased physical activity, learning capacity, and more complex cognitive development (Dong & Wang, 2026; Shapiro & Hartzell, 2024). The stability of growth during preschool and school-age periods is associated with relatively stable metabolic processes and gradual tissue development. Increased participation in play, light exercise, and learning activities consequently elevates energy and nutrient requirements during this stage.

Physical activity is one of the primary factors influencing energy requirements among preschool and school-age children. In addition to physical activity, dietary habits, picky eating behavior, meal regularity, and family environment also affect children's nutritional adequacy (Aziseh & Hakiki, 2024; Muthohiroh *et al*., 1970; Scaglioni *et al*., 2018). During school age, sex differences begin to influence energy and nutrient

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requirements due to variations in body composition and physical activity levels (Capra *et al*., 2024; Shah *et al*., 2020). Consequently, children in this developmental stage are vulnerable to various nutritional problems, including undernutrition and overnutrition, commonly referred to as the double burden of malnutrition (Davis *et al*., 2020; Renyoet *et al*., 2026). The consumption of foods high in sugar, salt, and fat through unhealthy snacks also contributes to the increased risk of obesity, anemia, and other health disorders. Therefore, the role of parents and the surrounding environment is essential in establishing healthy dietary habits among children.

Nutritional requirements in preschool and school-age children include both macronutrients and micronutrients that are essential for supporting growth and development. Carbohydrates function as the primary energy source for physical activities and learning processes, while healthy fats serve as energy reserves and support brain development (Arshad *et al*., 2025; Capra *et al*., 2024). Protein is necessary for tissue formation, growth, and maintenance of immune function (Ajomiwe *et al*., 2024; Escobedo-Monge *et al*., 2025). Meanwhile, micronutrients such as calcium and vitamin D play important roles in bone formation and maintenance, whereas iron is essential for preventing anemia and supporting concentration during learning activities (Hong, 2025; Savarino *et al*., 2021). Zinc functions as a cofactor for various enzymes involved in growth and immune function, while B-complex vitamins contribute to energy metabolism (Agraib *et al*., 2023; Padoan *et al*., 2024).

Meeting the nutritional needs of preschool children requires attention to food texture and variety to ensure that foods are easy to chew and acceptable to children (Bettocchi *et al*., 2025). The consumption of vegetables, fruits, and iron-rich foods should be encouraged from an early age to support growth and prevent micronutrient deficiencies (Al Fadhillah & Prasetyo, 2025; Wiafe *et al*., 2023). In addition, attractive food presentation may help improve children's appetite and interest in eating during this stage.

In school-age children, nutritional intake should be adjusted according to increased physical activity and cognitive development. School-age children are generally capable of selecting their own foods; therefore, parental supervision of dietary habits and snack consumption becomes increasingly important (Olfert *et al*., 2019; Russell *et al*., 2015). Establishing regular breakfast habits, consuming healthy snacks, engaging in regular physical activity, and implementing clean and healthy lifestyle behaviors are necessary to maintain balance between energy intake and expenditure. Dietary patterns among school-age children generally consist of three main meals and two snacks per day to maintain stable energy levels during learning and play activities (The royal children's Hospital, 2013).

Physiological changes occurring during childhood and adolescence influence nutritional requirements, dietary patterns, and susceptibility to nutritional problems. Each developmental stage possesses distinct physiological characteristics that require specific nutritional approaches to support optimal growth and development. A comparative overview of physiological characteristics, nutritional requirements, nutritional functions, and common nutritional problems across developmental stages is presented in Table 1.

Table 1. Physiological Changes, Nutritional Requirements, and Nutritional Problems Across Developmental Stages

Developmental Stage	Physiological Characteristics	Main Nutritional Requirements	Nutritional Functions	Common Nutritional Problems
Preschool children	Slower growth, digestive maturation, motor development	Carbohydrates, protein, calcium, iron	Energy, tissue growth, bone development	Picky eating, undernutrition
School-age children	Stable growth, increased physical activity and cognition	Energy, protein, iron, healthy fats	Learning support, physical activity, immunity	Obesity, unhealthy snacking, micronutrient deficiency
Adolescents	Puberty, hormonal changes, growth spurt	Protein, iron, calcium, vitamin D	Muscle growth, reproductive maturation, bone mass formation	Anemia, obesity, eating disorders

Physiological Changes and Nutritional Requirements in Adolescents

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Adolescence is a transitional phase from childhood to adulthood characterized by rapid physiological, hormonal, and psychosocial changes. Increased levels of hormones such as testosterone in males and estrogen and progesterone in females during puberty trigger *growth spurts*, increased muscle mass, changes in body fat distribution, and maturation of the reproductive organs (Kabotyanski & Somerville, 2021; Wójcik *et al*., 2023). These rapid changes in body composition result in significantly increased energy and nutrient requirements compared with previous developmental stages.

In addition to physical changes, adolescents also experience psychosocial development and the formation of a strong *body image*. Consequently, adolescents' eating behaviors are influenced by various factors, including peer influence, social media exposure, dietary trends, and modern lifestyles (Malloy *et al*., 2024; Sinai *et al*., 2021). The increasing consumption of *junk food*, *fast food*, and sugar-sweetened beverages among adolescents may contribute to obesity and metabolic disorders. Conversely, social pressure related to body appearance may also trigger extreme dieting behaviors and eating disorders such as anorexia nervosa and bulimia (Suhag & Rauniyar, 2024).

Nutritional requirements during adolescence should be adjusted according to the accelerated growth and hormonal changes that occur during puberty (Soliman *et al*., 2022). Protein is essential for supporting the growth of muscle mass and body tissues, whereas iron plays a particularly important role in adolescent girls due to blood loss during menstruation (Garcia-Iborra *et al*., 2023; Söderman *et al*., 2025). In addition, calcium and vitamin D are required to support optimal bone mass development during puberty. Imbalances in nutrient intake during this stage may increase the risk of anemia, obesity, growth disturbances, and reproductive health problems later in life.

Implications for Nursing Practice and Nutrition Promotion

Understanding physiological changes in children and adolescents is essential for healthcare professionals, particularly nurses, in determining nutritional requirements according to each stage of growth and development. Nurses play an important role in assessing nutritional status through the identification of age, physical activity level, dietary patterns, breakfast habits, snack consumption, and the risk of nutritional problems such as obesity, anemia, and malnutrition (Gomathi, 2024). In addition, nurses are also responsible for providing education regarding healthy dietary patterns, developing dietary interventions, and promoting healthy lifestyles to support optimal growth and development among children and adolescents (Abdelrahman *et al*., 2025).

CONCLUSION

Physiological changes during childhood and adolescence influence nutritional requirements and dietary patterns at each stage of development. Preschool and school-age children require adequate energy and nutrient intake to support growth, physical activity, and cognitive development, whereas adolescents experience more complex nutritional demands due to accelerated growth, hormonal changes, and psychosocial development during puberty. In addition to physiological factors, dietary patterns and eating behaviors are also influenced by family environment, lifestyle, and social media exposure, which may increase the risk of various nutritional problems such as obesity, anemia, and micronutrient deficiencies. Therefore, adequate nutritional intake according to developmental stages, as well as the role of healthcare professionals, particularly nurses, in nutrition education and the promotion of healthy dietary habits, are essential to support optimal growth and development among children and adolescents.

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