A COMPREHENSIVE ANALYSIS ON NUTRITION AND RELATED FACTORS AMONG SCHOOL STUDENTS

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Abstract

Middle childhood and early adolescence have received less scientific attention than other life stages, especially regarding diet and wellness. The rational focus on the first 1000 days of life and the understanding that early impairments and consequences may not always be reversed are positive aspects. Additionally, compared to infancy or late adolescence, these life stages may appear less "eventful" on the surface. Finally, historical language has been murky and inconsistent depending on whether "childhood" is viewed from physiologic, sociological, legal, or other viewpoints. The growth and development trajectories of the body and mind do, however, undergo considerable alterations, turning points, and sexually motivated divergence during this age group, which for most people includes the majority of the years spent in primary and elementary school. Middle childhood and early adolescence are crucial and final windows of opportunity to impact productivity and long-term health because these changes are transformative. This study aims to understand better how nutrition functions, the short- and long-term impacts of inadequate nutrition, and the general nutritional state of middle childhood and early adolescence (5 to 15 years old). Additionally, it emphasizes how differently children of school age grow and develop. It is important to revisit priorities occasionally to maximize people's potential and contributions to society. This essay explains and supports the necessity of prioritizing nutrition for school-age children.

Keywords – *nutrient, adolescence, growth, infant, productivity*

1. Introduction

Academic and public health programs enthusiastically acknowledged the importance of early nutrition as a key element of lifelong health during the past three decades [1]. Over the past few decades, the prenatal period through the first two years of life (the first 1000 days) and early childhood through age five have received their due attention. However, a seamless transition from infancy to maturity is necessary to realize a person's potential [2]. The following two life phases, "early adolescence" (10–15 years), often known as "early adolescence," and "middle childhood," which is defined as ages 5 to 9, are frequently referred to as the "school years."

The generally steady growth between the ages of 2 and 5 and middle childhood and early adolescence is the penultimate stages of maturation before adulthood [3]. The growth and development process goes through several significant turning points at this time, and behavioral and emotional changes take place as puberty approaches. These inflections signify

fundamental shifts in the body's composition, the brain's ability to process information, linear organ systems, bone mineralization, and growth [4]. During this stage, there are also significant divergences in growth and development that are sex-driven. Children's nutrition throughout this time is essential for supporting these developments. Additionally, it can aid in reversing nutritional excesses that have existed throughout childhood and aid in overcoming early deficits [5]. Thus, the years spent in school constitute the final real chance to influence a person's growth, development, and subsequent health repercussions in later life [6]. Sadly, school-age nutrition has gotten disproportionately little scientific attention compared to other life stages. It is partly due to the incorrect notion that early growth and developmental problems cannot be reversed [7] – [8]. Over the past few years, academic, scientific, and public health voices have emphasized this stage of life as a key and maybe final significant intervention window for maximizing people's capacity as valuable contributors to society.

This review aims to argue why school-age nutrition deserves more attention by emphasizing the crucial dietary, growth, and development components of these critical years in school, the challenges, and the knowledge gaps connected with their attention to maximizing students' growth, development and development and ultimate productivity.

2. School-age health and nutrition terminologies

In this review, we want to emphasize how important nutrition, growth, and development are during these early years of education, the associated difficulties and knowledge gaps, and offer justifications for why school nutrition merits additional consideration [9] – [10]. It also highlighted these early school years' critical growth, development, and long-term productivity-enhancing components [11].

Most organizations' public databases track children's stunting rates, malnutrition, and other health indicators, although they typically only do so up until the age of 5, and then they stop tracking until adolescence or maturity. Middle childhood nutritional data (5 to 10 years old) are hard to find in regional or worldwide databases [12]. Extrapolations are a common method used in reviews for this age group; using data from the DHSs (Demographic and Health Surveys) for kids between the ages of 4 and 5 or adding responses from children aged 10 to 14 in surveys of children are two examples [13]. Contrarily, among those of school age, the majority of research and data for kids between the ages of 10 and 15 (early adolescence) are occasionally mixed up with adult data; such include data from the DHS and Multiple Indicator Cluster Surveys (MICS) for women between the ages of 15 and 19. As will be covered below, research on infant development and the idea that nutritional and environmental damages during the first two years of life had permanent impacts came from cognition [14]. An underestimation of the enormous middle childhood and adolescence offer the chance for growth and developmental catch-up may have led to decreased interest and a bias in the research.

Because this age group is viewed through various filters, including physiologic, reproductive, social, legal, or educational, there needs to be more clarity, consistency, and overlap in terminology, which contributes to the need for proper study in this age group. Young

adulthood, adolescence, school age, early childhood, middle childhood, and late childhood are common terms that frequently overlap [15]. According to general physiologic theory, "middle childhood" (between the ages of 5 and 9) is a period of expansion and stabilization. Then, between the ages of 10 and 14, there is an adolescent growth spurt, followed by a last growth consolidation between the ages of 15 and the early 20s; this is then followed by adult development. The three main categories of the life cycle's developmental phases are physical development, growth of the mind and the socio-emotional/psychosocial self. Furthermore, despite their interdependence, each life-stage division might advance differently, making it challenging to suggest an entirely chronological or age-based strategy [16].

3. Body composition and nutrition factors

Significant shifts in trajectory and sex divergence are also marked by changes in body composition during the school years. Although some estimations and extrapolations have been made, there are few large-scale normative data regarding changes in body composition during middle childhood and the first few years of adolescence. Data from various cross-sectional investigations of populations from Europe and America have been combined to calculate Body mass, the mass that is not fat, and body fat percentage. Actual fat mass in kilos during preschool is comparable between the sexes. Girls gain fat mass more quickly than boys between the ages of 5 and 10, acquiring about more than men by 6% (2 kg). Girls will gain 1.14 kg of fat with the onset of puberty, while males will keep their fat mass steady [17]. Girls' fat mass will have increased throughout their school years, up until age 15, by about 5-fold, whereas the fat mass of men will have increased around thrice. The percentage of body fat will eventually increase from 10% to 12% it was at birth, depending on the gender. 15% of young men and 25% of young women are affected. Following a pre-pubertal rise, the body fat percentage of boys decreases during puberty and stabilizes into maturity [18]. Up to the beginning of puberty, the rate at which fat-free mass (including muscle growth) develops is similar between the sexes. When puberty sets in boys, they will acquire lean muscle considerably more quickly than girls for a longer period. While muscle development is primarily fuelled via a rise in the mass of muscle cells (hypertrophy), adipose tissue gains are often fed by a rise in fat cell size and number. Boys' increased lean tissue throughout puberty is mostly responsible for weight gain.

4. Role of nutrition in school age

The school years are particularly important because of the multiple changes and dynamics of growth discussed above delicate, as well as the fact that the majority of final growth and development is completed at this point, it will restrict one's physical, mental, and social capabilities if not. These alterations happen in genetics that shapes physical and behavioral development and is exhibited in various social and environmental contexts. Proper nutrition is the foundation for these changes with all life cycle phases. During this final stage of growth and development, inadequate nutrition will halt or dull the trajectories of physical and neurocognitive development, which will have long-term effects and limit an individual's potential [19]. A person's genes determine the growth trajectory, eventual height, and overall body form if environmental factors, especially diet, are favorable. If higher nutritional

demands are not satisfied, the accelerated and altered chance of stunted growth and development rises with the growth trajectories listed above. The school years are essential for supplying the nutrition needed Due to the dynamics of growth at this age, and one can either (a) maintain healthy growth trajectories till adulthood; or (b) ensure a seamless transition to productive adulthood, address imbalances and deficiencies (deficits and excesses) the European Food Safety Authority (EFSA), the WHO, the US Institute of Medicine, and other regional authority organizations concur that calorie, macronutrient, and micronutrient requirements differ from other life stages during early childhood and early adolescence, when people are of school age [20]. This review includes articles published from 2014 to 2022 which is completely based on national and international status. The review on national status is gathered from various states which includes the diet plan and students nutrition condition in India.

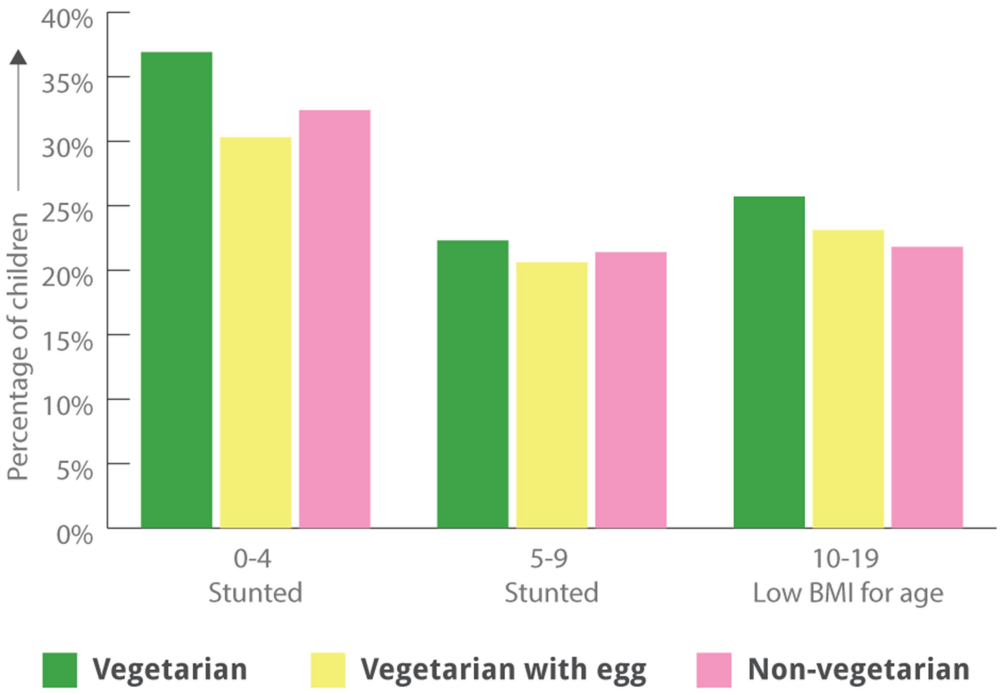

Fig 1 Type of diet followed by adolescents and children [1]

5. Impact of poor nutrition on school-age children

Inadequate diets, which various circumstances can cause, are why school-aged children need to get more nutrients. On the one hand, access, safety, and food provision are essential. As opposed to that, choosing the right foods for a healthy diet entails considering various environmental factors, including those from the family, the neighbourhood, the school, and the larger society. These factors not only affect the provision of enough food but also have a long-term impact on children's behaviour and dietary preferences. Influences are very important at this age since Cognitive, decision-making, self-image, and awareness development are all connected to socio-emotional and psychosocial development. It is still essential to address these issues to improve your chances of maintaining long-term health [21]. The focus of this review extends beyond discussing them.

Loss of body fat and lean body mass (thinness, wasting, low BMI) are the direct and most obvious effects of inadequate nutrition. Long-term marginal micronutrient provision is frequently accompanied by micronutrient deficiency and low height for one's age (slows linear growth). In both situations, inflammatory illnesses such as infections and enteropathies brought on by subpar sanitation can heighten the need to release proteins from muscle tissues triggered by a negative nitrogen balance. Inhibit linear bone growth for an effective immunological response. In the same population, stunting and wasting frequently co-occur in the same child. Longitudinal studies have shown that stunting comes before wasting 67. Delay in pubertal onset, which affects growth patterns in school-age children, is also associated with low BMI and wasting. When a person's height exceeds two standard deviations below WHO guidelines, this stunting norm for their age continues to be the most common clinical sign of malnutrition, including deficits in micronutrients [22].

When youngsters are of school age, some nutritional deficits, either alone or in combination, are easily identifiable or frequently occur. Beyond the scope of this review are the effects of these other factors. For this discussion, it will suffice to say that persistent deficiencies are a prime example of the necessity of maintaining adequate levels or correcting deficiencies during the school years. There are two examples of a lengthy iron deficiency (and its consequences on long-term cognitive performance) and a deficiency in calcium and vitamin D (and the chance to prevent osteoporosis and fractures long into adulthood) [23].

6. Global nutrition status of school-age children

Information on the consequences of dietary status from middle childhood to adolescence is still needed, except for a recent increase in adolescent years compared to infant data. A 2004–2017 literature search using the terms "health," "mortality," or "cause of death in the first 20 years of life" revealed that 95% of PubMed articles and 99% of Google Scholar articles centered on young children (under five). The WHO, CDC, UNICEF, UNESCO, and UNAIDS Global School-based Student Surveys have primarily only included 13- to 17-year-olds. Furthermore, it can be difficult to distinguish data for this age group from "adolescents," which may include children as young as 10, from studies on "childhood," which may include pre-schoolers and school-age children.

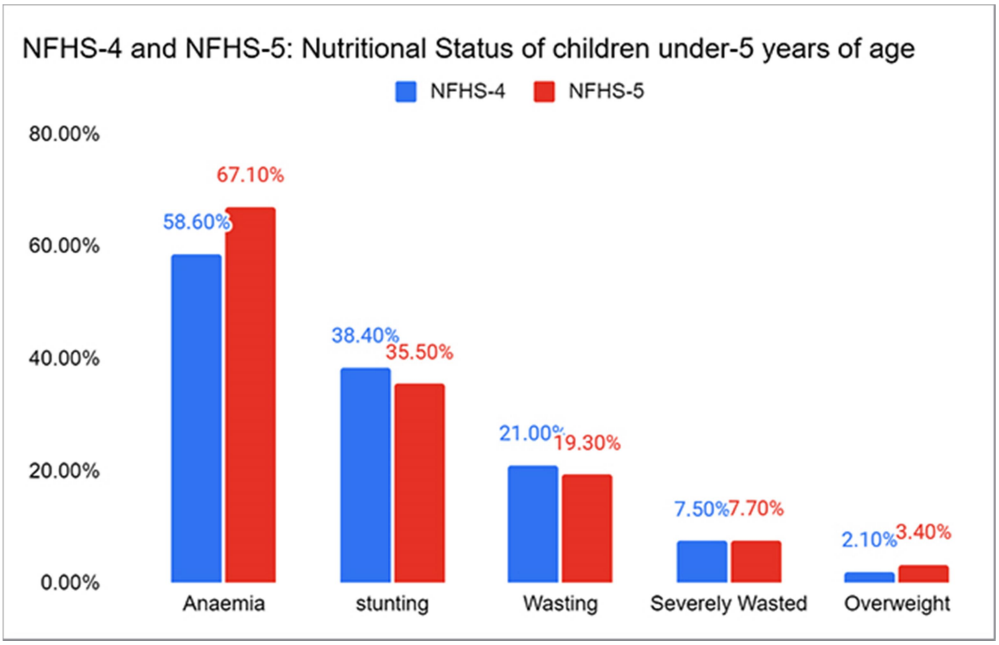

Fig 2 Global nutrition report-2021

Comparing 0-5 years, 15-19 years, and 5-9 years, 10-14 years, and 0-5 years, 15-19 years have the fewest research data sources for evaluating risk factors for morbidity and death. In a more recent big population-based analysis, it was shown that 78.9% of the studies that offered information on Children who are of school age: height, weight, and BMI only included information for kids between the ages of 15 and 19; only 50.3% had data on children aged 10 to 14, and 39.9% had data on children aged 5 to 9.79 In a different, more comprehensive analysis, data from fewer than half of the studies (5–9 years old) than from over 90% of the studies (10–19 years old) included information on middle childhood. Overall, there are large regional and national data quantity and quality differences. Even so, middle childhood has a noteworthy overall relative data shortage, making it difficult to compare the nutrition or growth results to people in the earlier or later stages of life for this age group [24].

The prevalence of underweight and thinness was highest in South-East Asian and African nations (21%-36%) and lowest in Latin American countries (8%-6%), a study that focuses on the school-age population in low- and middle-income countries (LMICs), from 6 to 12 years old, according to thorough study. Latin America has the greatest rate of overweight and obesity (26%) compared to Southeast Asia (13%) and Africa (7%). In Southeast Asia, the mean prevalence of iron insufficiency was 20%, 14% in Latin America and 29% in Africa. The most frequent deficits are zinc, vitamin A, and iodine. The range of zinc deficiency prevalence was 54% in Africa, and 9% for vitamin A deficiency in Latin America is around 9% of the global average [25].

7. Recovery from nutrition deficiency

It is abundantly obvious from studies and thorough evaluations of micronutrient supplementation and fortification that their status can be raised in school-aged children.

Clinical impacts, such as growth and morbidity, are demonstrated in various ways. The greatest research has demonstrated that iron supplementation and fortification decrease anemia in school youngsters (5–12 years old) and improve their iron status. Iron supplementation has been found to have a good impact on cognitive development, and intriguingly, effectiveness seems to be higher for children over the age of 7 than for younger children. Less is known about how micronutrient supplementation affects growth and morbidity.

The early recognition of the significant impact of nutrition until 2 years of age and the perception those stunting and cognitive delays were irreversible until recently may have contributed to the lack of attention paid to middle childhood and adolescence as windows of opportunity for recovery, particularly as related to stunting and cognitive deficits [26]. The information at hand shows that this is untrue. Even though the results are only occasionally reliable, multiple longitudinal studies involving populations of school-age children (6 to 11 years old) demonstrate that several micronutrient supplements can enable linear catch-up. Extra protein, vitamin A, and other micronutrients, particularly zinc, can improve linear growth in children who have already experienced early stunting, according to a recent systematic review and meta-analysis of the effectiveness of various nutrition-based interventions after the age of two years old (where more than half of the studies included children older than five years of age). However, even after addressing anemia or other deficiencies, supplementation with additional micronutrients, Food-based therapy, iron, calcium, and iodine showed no appreciable effect on development.

The goals for school-aged children seem to be pretty straightforward: supplying enough amounts of protein and calories (while avoiding excesses), lowering sodium and simple carbohydrate intake, as well as deficiencies in vitamin D, calcium, zinc, folate, vitamin A, iron, and iodine. There isn't enough long-term study in this area, and it doesn't seem like there is a "magic bullet" for boosting nutrient consumption while avoiding extremes. However, the case for school-based initiatives is becoming more and more compelling that emphasize diet and physical exercise to address and prevent deficits in children who are overweight or obese. Teaching kids about diet and nutrition will help improve localized diet quality. The school environment has enormous potential to provide a sizable amount of daily consumption. There is still untapped potential [27]. Table 1 depicts the student's characteristics to be examined.

Table 1 Students characteristic to be examined

S. No	Child characteristics
1	Boy or Girl
2	Ethnicity (%)
3	BMI (kg/m^2)
4	Underweight (%)
5	Normal weight (%)
6	Overweight (%)
7	Sports (%)
8	Dietary plans

8. Revisiting priorities

Adolescence health and diet in middle childhood have received growing attention in the last 4 to 5 years, along with calls for action. Even more recently, UNICEF's Nutrition Strategy for 2020–2030 Framework called for "strategic shifts" in defending children's rights to nutrition and ending all forms of child hunger as part of the global Sustainable Development Goals. The Approach explicitly states that "nutrition during middle childhood and adolescence is both a right and a window of opportunity for growth, development, and learning, particularly for girls, and for breaking the intergenerational cycle of malnutrition." A full life cycle approach to nutrition programming is also included in the Strategy, and the diet of mothers and babies over the first 1000 days is also a key element of UNICEF programs. The Strategy's first two quantifiable Results areas are nutrition for young children and nutrition for adolescents and middle childhood [28]. In its Guidelines for Nutritional Programs in Middle Childhood and Adolescence, Unicef recommends nourishing meals, active play, and healthy eating for school-aged children deworming and micronutrient supplementation. While a lifecycle approach to nutrition does not disregard early-life nutrition, early adolescence and middle childhood require additional effort and consideration. The school-age years offer unique chances that must be seized, especially considering the current COVID pandemic and the global impacts of climate change.

9. Statistical analysis

Stunting, indicated by a height-for-age z-score (HAZ) < -2one, was one of the study's main outcome factors. A weight-for-age z-score (WAZ) < -2 indicates underweight, but a BMI-for-age z-score (BAZ) <-2 indicates thinness. The height, weight, and BMI measurements were converted into z-scores for the HAZ, WAZ, and BAZ indices using the WHO Anthro software, version 3.2.2. Frequency and percentage were used to summarize categorical variables, whereas mean and standard deviation was used to summarize continuous variables. The Student's t-test and the Chi-square test were used to compare continuous and categorical data qualities. We assessed the age differences in height, weight, and BMI using a one-way ANOVA. Univariate and multivariate logistic regression analysis investigated child undernutrition's extent and root causes. The Statistical Package for Social Sciences (version 20) was used for all analyses. The utilized statistical significance level was 0.05 [29]. Table 2 shows the sample socio-economic profile of children in Tamil Nadu.

Table 2 Sample socio-economic profile of children in Tamil Nadu [27]

	Percentage of children
Gender	
Boys	55%
Girls	45%
Age	
11 years	39.67%
12 years	14.67%
13 years	19.33%
14 years	26.33%

Socio-economic status	
Class 1	1.67%
Class 2	17%
Class 3	38%
Class 4	42.67%
Class 5	0.67%
Modified Kuppusamy's scale	

10. Limitations

Despite its effective sampling strategy, sizable sample size, and thorough analysis, this study has some things that could be improved. This study examined various determinants affecting children's nutrition, but some crucial confounding factors like the absence of food insecurity in the household, physical exercise, parasite infection, a child's medical background, and regular intake. The study design's cross-sectional nature makes it difficult to pinpoint specific causal relationships between predictors and outcome variables, which limits the use of cross-sectional data. Instead of a cross-sectional investigation, cohort research is needed to understand the potential temporal relationship between predictors and undernutrition in children. Desirability bias may affect socio-demographic traits and monthly income. It is, therefore, possible to overstate how closely associated the predictors and outcome variables are. By focusing on the parent's field of work, we might decrease this probable prejudice. Furthermore, we did not include any biochemical measurements in our assessment of undernutrition; only anthropometric indices were used [30].

11. Conclusion

The nutrition people receive during their early years still serves as the cornerstone for their long-term well-being and effectiveness. For a good reason, the first five of these important years have received much attention recently. The decrease in infant mortality, which includes the vicious cycle of starvation and sickness, and a greater understanding of the developmental determinants of health and disease, have enhanced our attention to and awareness of the critical first few years of life. Little focus was placed on the remaining childhood years, notably middle childhood and the first few years of puberty. In addition, the shakily backed notion was that delays or harm in the first two years of life were irrevocable. Adolescence and the early adolescent years continue to be the most underrepresented life stages in terms of clinical, nutritional, and epidemiological data.

Because of the numerous changes and turning points in a person's growth and development trajectories, the years spent in school represent the most dynamic age of change in a person's physical and cognitive development before maturity. Long-term effects result from deficiencies in growth, bone health, cognitive development, and body composition at this time. Interventions can and should be made while children are in school to: The objectives of nutrition are to: (a) maintain a healthy course of physical and mental development and act as a transition into adulthood; b) eliminate or address overnutrition deficiencies and prevent

long-term effects; c) rectify under nutrition deficits and "catch-up" to the normal course of growth and development. Thus, the period between middle childhood and adolescence is the last crucial window of opportunity to benefit development, nutrition, and the ensuing long-term health and cognitive outcomes.

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