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Nutritional Demands in Schools Children for Performance and Health: A Brief Review in India

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Abstract

The key to national and social development is subsequently influenced by children, because children are the future of the nation. A child's holistic development takes place through the school premises, where children spend most of their day. School-going age is the foundation of a child's life, which helps to strengthen future life. A healthy body, immune system, good health and a productive society are built on proper nutrition. There is a growing body of literature that recommends paying attention to school children's nutrition. This article briefly describes research conducted on the effects of nutrition on the health and performance of school children. Also done to know the prevalence of obesity, overweight, stunting and wasting among children in different states of India. Data collection sources from various reviewed studies such as BMI, anthropometric measurements, dietary recall and nutritional assessment are Google Scholar, Research Gate, PubMed, etc. Findings from various studies show that most school-aged children in India are malnourished, most of whom live in rural areas and are financially vulnerable. It concluded that tailoring diets according to age and sex, improving parental education and emphasizing seasonal crops. Finally, it was suggested that more emphasis should be placed on prevention than treatment of health problems.

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Introduction

Throughout the life cycle,—from the womb to adulthood—each child's nutritional needs, eating behaviours, and influences evolve and change. Adolescence (10-19 years as defined by WHO) is a

critical period for growth, development and establishment of personal health status (United Nations Children's Fund, 2020). For decades, researchers have shown increasing interest in looking at the impact of nutrition on academic, health and performance which is a major determinant of a country's economic growth and overall progress. Because children will later become functional members of society (Ojo, 2016). Now-a-days, health, education, poverty, food contents and nutrition continue to be essential priorities and goals for sustainable development (United Nations General Assembly, 2015). Educational institutions may have a long lasting impact on these determinants (Grosh, et al., 2009; Laurie, et al., 2013; WFP, 2013; GLOPAN, 2015). The link between school performance and children's nutrition has long been touted by educators, health professionals and parents (Taras, 2005). Students' adolescence is considered the basis for leading an active lifestyle, where it is possible to reduce physical fitness deficits, avoid potential overweight and improve basic quality of life (Fogelholm, 2010). Although school-based multicomponent and multidimensional intervention packages have potential benefits, there are still evidence gaps and research needs (GLOPAN, 2015). The purpose of this study was to highlight the nutritional status of school-age children in almost all states of India through a review of various researchers that influence performance and health. It also provides arguments for why school-age nutrition deserves more attention to maximize child growth, development, and ultimate productivity.

Focus on nutrition of school children: School age is very significant because it is the critical period of life for the body to store nutrients. These savings help children grow and develop faster. Nutrition is a child's strong immune system, less illness, functional health that helps build a productive society (Vandana, and Dahiya, 2012). Children who do not take adequate amounts of essential micro and macronutrients may not achieve their full potential in health and sports, including academics (Nabarro, et al., 2012). As the quality and quantity of children's food changes with age, a healthy diet is not only a priority for children but poor eating habits may lead to various health issues (Singh and Sharma, 2021). The six nutrients (carbohydrates, proteins, fats, vitamins, minerals and water) commonly obtained from food and beverages are essential to the human body as they support tissue growth and development, energy production, function of organs and their systems, and prevention of deficiency and degenerative diseases (Clark and Nancy, 2008).

Carbohydrates: Carbohydrates serve as the body's main source of fuel to meet energy needs during physical activity, replenish muscle glycogen stores, and maintain blood glucose levels, and especially during sub-maximal exercise (US Department of Health and Human Service, 2005). (The Institute of Medicine, 2012) recommends that school students should consume at least 130-150 grams of carbohydrates per day, which are usually found in grains, dairy products, fruits, vegetables, as well as refined grains and sugary foods should be avoided.

Protein: Protein plays an essential role in body structure, support of connective tissue in response to exercise, and tissue repair and maintenance (Clark and Nancy, 2008). According to the age of children, the minimum daily requirement of protein is 34 grams (approx) for 9 to 13 years and 52 grams (approx) for 14 to 18 years old respectively. Sources include fish, eggs, milk, lean red meat, poultry, animal liver, cheese, butter, peanuts, green beans, etc. (The Institute of Medicine, 2012).

Fat: Fat acts as fuel during low- to moderate activity, cell membrane structure, hormone production, nerve lining for proper action, process of absorption of fat soluble (A, D, E, and K) vitamins (Clark and Nancy, 2008). School-age children should get 25 to 35 percent of their daily calorie intake from fat, the sources of which are mainly saturated fat (red meat, shrimp), mono-unsaturated fat (fat that is liquid at room temperature but start to solidify when cold), poly-unsaturated fat (vegetable oils, some nuts and seeds), and trans fats (a type of trans fat that forms during cooking) (The Institute of Medicine, 2012).

Vitamin: Vitamins help to sustain the body free from various diseases and healthy (Srilakshmi, 2003). The main sources of vitamins are fish, eggs, dairy products, liver, margarine, fruits and vegetables (Ojo, 2016).

Minerals: Small amounts of essential minerals for children, especially calcium, iron, sodium, magnesium, manganese, phosphorus, iodine and zinc (Ojo, 2016). Calcium and iron need during puberty due to rapid increases in skeletal growth and lean body mass (Srilakshmi, 2003). Magnesium and manganese are essential for brain function (Ojo, 2016). Zinc is especially important in sexual maturation during puberty (Srilakshmi, 2003).

Water: Human can live without food for long time but not without water. Water helps regulate body temperature, transport nutrients to cells and tissues and eliminate waste products, and the digestive system (Srilakshmi, 2003). However, the 'Dietary Guidelines for School Students' published by "School Nutrition Association (2000)", recommends—Vegetables: ½ cup per day; Fruit: ½ cup daily; daily grains (bread and pasta); Milk and dairy products: 8 ounces daily; Cheese: twice a week; Eggs: Once or twice a week; Meat: one to two ounces daily; Fish: at least three times per week.

Nutrition and health (mental and physical): Nutrition affects mental health development (Bellisle, 2004; Sorhaindo and Feinstein, 2006) and indirectly school participation. Because malnutrition can make children susceptible to illnesses that may cause them to miss, school due to problems like stomachaches and headaches (Brown, et al., 2008). Early nutritional deficiencies in children (especially calcium, zinc, iron, omega-3 fatty acids, protein, and vitamins B and D) can affect cognitive development in school-aged children (Sorhaindo & Feinstein, 2006). Foods high in saturated and Trans fats affect learning and memory, which can have a negative impact on the brain (Gómez-Pinilla, 2008), but can also have a positive effect on overweight and obesity (Patnaik, et al., 2008). Research suggests that children's participation in breakfast programs, which lead to changes in student behavior (Stuber, 2014) specifically, improved behavior (Drake, et al., 2005; Hall, et al., 2002; Alaimo, et al., 2001; Begalle and Wahlstrom, 1991); decrease discipline problems and reduce aggression (Brown, et al., 2008); improved concentration (Redden, et al., 2002; Begalle and Wahlstrom, 1991; Pollitt and Matthews, 1998); better attendance (Begalle and Wahlstrom, 1991; Cook, et al., 1996; Meyers, et al., 1989); and better academic performance (Hall, et al., 2002; Alaimo, et al., 2001; Kleinman, et al., 1998; Meyers, et al., 1989).

Nutrition and performance: Nutrition provides the energy needed to perform an athlete's activity. Because nutrition affects performance, training, and recovery. In this case, not only the type of food is important, but the time of eating is equally important (Shirreffs and Sawka, 2011). That is why the role of nutrition before, during and after competition is so significant in sports performance (Greany, 2015; Jeukendrup and Cronin, 2011). The science of nutrients in relation to performance has progressed from empirical studies investigating the effects of dietary manipulations, particularly supplementation and restriction, to investigating the physiological basis of proper nutritional requirements for strenuous physical exercise (Greany, 2015). The main role of sports nutrition is to modify the diet for performance as the training program changes, as malnutrition promotes fatigue, injury and poor recovery (Costill and Miller, 1980). Strength and power events or muscle-strength sports require adequate carbohydrate in the diet in addition to protein (Holway and Spriet 2011). Training is often of high volume and intensity throughout the season, so energy from nutrition is needed for adaptation and recovery (Huberty, et al., 2013). The preferred primary fuel sources for working muscles during this high-intensity activity are carbohydrates and fats that are oxidized by muscle tissue (during or after) prolonged endurance exercise (Sharma, et al., 2016 and Cermak, et al., 2013). As a result, it has been shown that consuming carbohydrates over two hours during moderate to high intensity exercise helps increase endurance (Phillips and Van Loon, 2011).

Materials and Methods

Source of Data: Sources collected for this research review of various studies related to nutrition are Google Scholar, Research Gate, PubMed, British Journal of Nutrition, Sports Medicine, Indian Pediatrics, Malaysian Journal of Pediatrics and Child Health, Asia Pacific Journal of Clinical Nutrition, American Journal of Pediatrics, etc. This study focused on collecting data directly from various reviewed studies – BMI, anthropometric measurements, dietary recall, dietary habits, biochemical and nutritional assessments.

Results

The nutritional status of 897 children aged 5 to 18 years was assessed under the 'State Child Health Programme' in Fatehgarh Sahib District of Punjab. The results of the study showed that among 545 children aged 10-18 years, thin was 26.9% and stunted was 19.4%. Among the remaining 352 children aged 5-9 years, underweight, stunted and thin were 58.8%, 37.4% and 31.8% respectively (Verma, et al., 2021).

To monitor the quality of food and their resources, and assess the nutritional status of 120 school students aged 7–9 years from 3 schools in Bilaspur town, Rampur district, Uttar Pradesh; whereas 'Kuppuswamy's Socio-Economic Status Scale' was used to assess socio-economic status. Mean adequacy ratio and nutrient adequacy ratio were calculated. Results showed that poor positive relationship between diet quality and nutrient intake, but no significant relationship was found between diet quality and socioeconomic status (Jain, et al., 2018).

A cross-sectional study was conducted among 300 students in an urban slum of Berhampur city, Odisha. The results showed that 55.3% were underweight, 42% were stunted and 75% were wasted. It has also been observed that 69% of all children suffer from malnutrition due to poor feeding, maternal education, socio-economic status (Sethy, et al., 2017).

A cross-sectional study assessed the prevalence of under nutrition among 300 school children in Bikaner, Rajasthan, aged between 6 and 12 years. Obesity, overweight and underweight for age based on BMI were 1.33%, 18.33% and 30.0% respectively, and the overall prevalence of malnutrition was observed to be 49.66% (Inkhiya, et al., 2016).

A cross-sectional study was conducted on 24,108 (primary and upper-primary) students of the state of West Bengal. The results helped assess nutrition, where only 17% of students had adequate nutritional status, 54% were at risk of malnutrition and 22.8% had prevalence of malnutrition (Pal, et al., 2016).

A descriptive cross-sectional study was conducted on 820 government primary school students (rural and urban) aged 6–11 years in Karimnagar city, Telangana. Results showed that children in urban areas (22.2%) and rural areas (29.3%) were underweight for age; similarly, stunted was 16% and 21.5% respectively (Shaikh, et al., 2016).

A cross-sectional study of 284-school going children aged 6-12 years of Bijapur district of Karnataka was conducted to assess nutritional status. The results showed 34.15% were underweight and 25% were stunted (Shashank and Chetan, 2016).

A cross-sectional study was conducted on 350 tribal pre-school children aged 3 to 5 years in Kinnaur, Himachal Pradesh. The results observed that the prevalence of underweight children was 21.4%, the prevalence of wasting was 11.1% and the prevalence of stunting was 27.4% (Singh, et al., 2016).

A descriptive cross-sectional study was conducted on 101 government primary school students aged 6 to 10 years in an urban slum in Kurnool, Andhra Pradesh; the results showed that 63% were malnourished and only 37% of the children were of normal weight for their age (Cynthia, 2015).

A cross-sectional study was conducted among tribal communities (Santal-Munda) of North 24 Parganas district of West Bengal. The results of the study showed that preschool children are more

malnourished than school going children. It was also observed that there was a tendency to be underweight (38.65%), stunting (21%) and wasting (32.7%) (Ghosh and Pati, 2015).

A descriptive study of 3,793 school students in Chandigarh assessed that the prevalence of malnutrition was higher among children of high socioeconomic status than among children of low socioeconomic status in India, the study found that 1.5% of children were obese, 2.3% of children were overweight, and 73.3% of children were found to be underweight (Kashyap and Kaur, 2015).

A study was conducted on 3564 students aged 8-9 years from 183 government and government aided primary schools in West Bengal. Results showed that underweight was prevalent in 39.7% of girls and 36.5% of boys, thinness was prevalent in 65.3% of girls and 65.4% of boys, and obesity was prevalent in 22.9% of girls and 26.1% of boys (Mondal, et al., 2015).

A cross-sectional study was conducted among a total of 28,256 school-age boys (15,087) and girls (13,169) aged 5–13 years in urban areas of Ahmedabad. The results of the study showed that 8,319 children were underweight (29.44%) and only 221 children were overweight (0.78%) (Patel, et al., 2015).

A cross-sectional study was conducted to assess the nutritional status of 1566 children (from government and private primary schools) aged 6–12 years in Mysore city. Children's physical activity, dietary habits, monthly income and occupation of their parents have been identified as determinants of their nutritional status. The results of the study showed that 385 children were underweight including 226 children in government schools, 132 children were overweight and 65 children were obese (Ashok, et al., 2014).

A comparative study of cardiovascular endurance was conducted in 14 to 16 year old students of government school and private school in Dibrugarh district of Assam. Government school boys scored better in performance, attributed to socio-economic status and nutritional status. Because majority of government school representatives come from families of lower socio-economic background, on the other hand, almost all private school representatives have better family status and do less physical work than government school boys (Dr. Baro, et al., 2014).

A study on the nutritional status of 100 school going children aged 7 to 9 years from five different schools in Lucknow city revealed that stunted students were severe, moderate and mild at 15%, 22%, 25% respectively; wasted students were severe, moderate and mild 3%, 24%, 30% respectively (Saxena and Mishra, 2014).

A cross-sectional study of 484 rural school-going children in Manda district of Karnataka was conducted to assess nutritional status, where the overall prevalence of underweight was 147 (about 30.3%) and stunting was 135 (about 27.9%) (Shivaprakash and Joseph, 2014).

Nutritional status of 200 school-going children aged 6-9 years in Bhopal, Madhya Pradesh was assessed by anthropometric measurements (weight and height), 24-hour dietary recall and interview with various food frequency questionnaires. Results showed that BMI along with weight and height were also significantly lower than reference values; it was also observed that severely malnourished (47%) and children were wasted (55%). Whereas study has shown that lack of all essential major and minor nutrients, as well as poor maternal education and lack of infrastructure cause malnutrition among school-going children (Murugkar, et al., 2013).

A cross-sectional descriptive study was conducted on primary school children in Sullia, Karnataka; where thinness, underweight and stunting were 26.5%, 26.5% and 19.2%, respectively; private school children had better on anthropometric measurement than government school children, yet malnutrition was attributed to dietary risk factors and nutritional status (Amruth, 2012).

A study conducted on 1634 school students aged 6–15 years in Kochi district of Kerala, found that 21.9% were overweight and 7.5% were obese while 5.3% of girls and 3.0% of boys were obese. Further have shown that 2.5% is the lowest in low economic status and 1.5% is the highest in high economic status (Cherian, et al., 2012).

Nutritional status of school-aged children aged 5-14 years in a rural health block of Kashmir (North India) was assessed using the 'WHO Z-score system'. The observed overall prevalence of underweight, stunting and wasting was 11.1%, 9.25% and 12.3% respectively (Fazili, et al., 2012).

A cross-sectional study (community-based) was conducted in the 'Integrated Tribal Development Agency' (ITDA) area comprising nine states of India (Andhra Pradesh, Gujarat, Kerala, Karnataka, Maharashtra, Madhya Pradesh, Odisha, Tamil Nadu and West Bengal). Results prevalence of underweight was 49%, stunting was 51% and wasting was 22% which was socio-economic status, maternal literacy, type of illness among the factors for child malnutrition (Meshram, et al., 2012).

Specific deficiency disorders and personal hygiene status were assessed to assess the nutritional status of 935 upper primary school students in Gulbarga city, Karnataka. The study revealed that the mean underweight for child age was 50.05%, specific deficiency disease in children was 22.35% in which anemia in children was 10.05% and Betot's spot in children was 48.80%. However, 91.44% of children had good personal hygiene (Nigudgi, et al., 2012).

A cross-sectional study was conducted on 512 slum schoolchildren (aged 5 to 15 years) in Bareilly city, Uttar Pradesh to assess nutritional status. The results showed that 38.4% were underweight, 33.3% were wasted, 19.9% were stunted and 46.8% were normal weight, whereas the prevalence of wasting was highest between the ages of 5 and 7 years, and the prevalence of stunting and underweight between the ages of 11 and 13 years (Srivastava, et al., 2012).

In a 24-hour dietary recall study and anthropometric measurements of 200 rural school-going students of Hisar district, Haryana state; the results showed that nutrition and food intake were insufficient due to which 54.11% of children were stunted and 55.5% of children were underweight, besides anthropometric measurements were significantly less than reference values ($p<0.05$) (Vandana and Dahiya, 2012).

A cross-sectional study was conducted among 500 children of three government Urdu upper primary schools in Azad Nagar area of Bengaluru to assess nutrition. The results showed that the overall prevalence of malnutrition among school children was 260 (52%), while 99 (49.25%) among girls and 161 (53.85%) among boys. Again the prevalence of stunting was higher among boys (41.47%) than girls (38.81%) (Hasan, et al., 2011).

A study was conducted among 806 school going students of Vellore, Tamil Nadu between the ages of 11 and 18 years. The results showed that 83% of the students were underweight for age according to WHO international standards. Whereas gender, age and parental occupation significantly influenced BMI. It has also been shown that there is a need to address malnutrition among school children by providing additional healthy food and improving socio-economic-background (Navaneethan, et al., 2011).

A study on the nutrition of 499 children aged 6 to 10 years from a hill farming community in Garhwal district of Uttarakhand, observed that underweight was 60.9%, stunting 56.1%
and wasting 12.2% (Osei, et al., 2010).

A cross-sectional study was conducted to determine the nutritional status of 760 school students of Army School, Pune. The results showed that there was a prevalence of 9.87% of malnutrition, 13.81% of stunting, and 6.71% of wasting, for this result nutritional status was significantly associated with socio-economic status, educational status of parents, family size, working status of mothers (Mukherjee, et al., 2008).

Nutritional status of 862 child students from different schools belonging to Kozhikode district of Kerala state was assessed through anthropometric data. The results showed that the prevalence of underweight, stunting and wasting was 46.3%, 12.9%, 65.5%, respectively among school children from backward class and general economy class areas. Whereas under nutrition is very low and overweight (10.6%) affects students (Manjula and Aravindan, 2004).

Discussion

A review of 30 literatures covering almost all states of India between 2004 and 2021 yielded a concept. Whereas underweight, wasting, stunting, malnutrition have been closely associated with the nutritional status of school children in almost all states of India for over 2 decades, especially among government or government aided school students. In contrast, overweight and obesity are closely related to the nutritional status of private school students. In India, the average number of children under 5 years of age is 35.7% underweight and 38.4% are stunted (Annual report, 2020-21). Central government, state government and various organizations undertake breakfast, mid-day meals, nutritious meals and various programs for public schools in India. Yet BMI scores of school students across India are underweight, which according to the literature review is proportionally more than half, with a large proportion of children living in rural areas. The review found that children with lower BMI scores performed proportionally better than children with higher scores. According to Indian schools, most average private school students had higher BMI scores but average public school students performed better (Inkhiya, et al., 2016; Kashyap and Kaur, 2015; Amruth, 2012), while private schools were far ahead of public schools in sports facilities (Dr. Baro, et al., 2014). Again, in the case of public schools, the average performance of rural children was higher than that of urban children according to the residence of the students (Shaikh, et al., 2016). Tribal children had relatively lower mean BMI scores but significantly higher performance (Ghosh and Pati, 2015; Meshram, et al., 2012). Evaluation of these reviews shows that there is a positive relationship between BMI and nutritional status, and it is also clear that age, gender, parental literacy (Sethy, et al., 2017; Murugkar, et al., 2013) and economic conditions (Jain, et al., 2018; Cherian, et al., 2012), demographic status (Navaneethan, et al., 2011), family size (Mukherjee, et al., 2008) and occupation (Ashok, et al., 2014) are strongly associated with child nutrition. Nutrition also affects anthropometric variables (Vandana and Dahiya, 2012; Amruth, 2012) that influence BMI scores (Murugkar, et al., 2013; Fazili, et al., 2012). The quality as well as the quantity, absorption, digestibility and utilization of food and the availability of suitable food for different age groups can greatly influence the sufficient nutrition of children (World Health Organization, 2016). However, the role of nutrition at school age is crucial in overcoming deficiencies that occur during childhood, in maintaining health and in performance success.

Analysis

A review of different age group, sex, and caste-based studies across vast regions of India shows that the proportion of undernourishment among school-going children is relatively high. Undernutrition leads to age-related weight loss and deficiency diseases. Overnutrition results in relatively high body weight relative to age, and excess weight, which is a symptom of obesity, leads to coronary disease. Thus, both undernutrition and overnutrition affect health and performance, and have lasting effects on children later in life. A child's overall development takes place through the school premises. School-going age is the foundation of a child's life, which helps to strengthen future life. That is why international organizations are taking various steps to improve and implement school children all over the world, some of the recent steps include- 'Promoting quality physical education policy' (UNESCO, 2022); 'Making every school a health-promoting school: implementation guidance' (WHO and UNESCO, 2021); 'Making every school a health-promoting school – global standards and indicators' (UNESCO and WHO, 2021). So, one of the tools to strengthen this foundation is nutrition.

Conclusion

By reviewing various literatures, it may be concluded that the progress and implementation of nutrition requires diversity of diet, improvement of socio-economic status of families, improvement of education including parents, also proper implementation of government schemes and various feeding programs especially mid-day meal, breakfast etc. to be evaluated from time to time and

make necessary changes, with active participation of various private organizations. Nutrition should be given importance and attention in improving children's health, education and sports and everyone should take responsibility, especially teachers, parents, social workers, researchers, dieticians. However, the extent to which nutritional needs affect children's health and performance is evident even in developing countries such as India through various reviews. It may be suggested that, since school-going children spend most of the day at school, schools can play an important role in the development of every child through health; wellness and sports services; and nutrition, health education and physical education can be included in the curriculum and kept in the daily schedule. Finally, health education should emphasize prevention rather than cure when it comes to health problems.

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