ISSN 2618-1576 Vol. 7, Issue 1: 60-64, DOI: 10.25236/FSR.2025.070109

Research progress on the impact of malnutrition on children's physical fitness

Yu Yao[1], Yu Li[2]

[1]*Capital University of Physical Education and Sports, Beijing, China, 100000*
[2]*Shandong Women's University, Jinan, Shandong, China, 250300*

Abstract: *Research has shown that malnutrition has a profound impact on children's physical ability and overall development. Protein energy deficiency and trace element deficiency can lead to a 12-15% decrease in height and weight in children, and significantly weaken their motor function, manifested as an 18% decrease in grip strength and a 22% decrease in lung capacity. At the same time, neuropsychological development is also constrained, with cognitive test scores decreasing by up to 30%. It is worth noting that targeted nutritional interventions can effectively reverse some of the damage, such as continuous supplementation of vitamin B12 and folic acid for 6 months, which can increase the exercise capacity of large muscle groups by 45%, while a comprehensive plan combined with ball sports can improve the BMI index of overweight children by 28%. Based on these findings, experts propose combining dietary optimization (such as increasing daily intake of high-quality protein by 15 grams), systematic growth monitoring (quarterly assessment of developmental indicators), and regular exercise (three times a week of moderate intensity training), especially during the growth spurt stage of 5-12 years old, to form a multidimensional health promotion mechanism.*

Keywords: *nutrition, malnutrition,motor ability, children*

1. Introduction

Malnutrition, particularly protein-energy malnutrition (PEM), refers to a condition caused by inadequate intake or insufficient absorption and utilization of food. It prevents the maintenance of normal physiological metabolism, leading to the body consuming its own components, resulting in weight loss, growth stagnation, significant reduction in subcutaneous fat, and muscle atrophy. In severe cases, it can cause dysfunction of various systemic systems, decreased immunity, and anemia, which may further inhibit physical development, manifesting as both emaciation and short stature, and even negatively impacting intellectual and motor ability development. Previously, malnutrition was commonly referred to as protein-energy malnutrition; however, when children suffer from malnutrition due to low intake of protein and energy in their diet, their diet is also often deficient in many micronutrients. Studies have shown that deficiencies in zinc, iron, and iodine are associated with poor physical development in children, and other micronutrients may also affect development. Therefore, in many studies supplementing calories and protein, micronutrient supplementation should also be provided [1]. Childhood, as a critical period for human growth and development, has an extremely sensitive need for nutrition [2]. Adequate nutrition is fundamental for children to fully realize their potential [3]. Malnutrition not only reduces children's resistance to diseases but also affects their physical development, motor abilities (i.e., the comprehensive manifestation of factors such as body composition, fitness, function, skills, and psychological abilities), and even has a negative impact on their brain and intellectual development [2]. Malnutrition not only lowers children's resistance to diseases but also diminishes their influence and affects their motor abilities and overall capabilities. Studies have found that malnutrition can have a negative impact on various developmental and cognitive domains, including motor development. Children with adequate nutrition are more likely to fully realize their developmental potential in terms of cognition, motor skills, and socio-emotional abilities, and create positive social effects. However, if the development of these skills is restricted in early development, it increases the risk of neuropsychological issues, mental illnesses, and poor academic performance [4]. Therefore, sufficient attention should be paid to the issue of malnutrition during childhood.

Research on the impact of malnutrition on children's motor abilities abroad started earlier and is more numerous, with scholars successively publishing studies on the relationship between protein and children's intellectual development [1] and on improving motor skills in children by enhancing folate and

ISSN 2618-1576 Vol. 7, Issue 1: 60-64, DOI: 10.25236/FSR.2025.070109

vitamin B12 levels in peripheral tissues [5]. However, these studies are mostly based on experimental research conducted abroad, and there may be differences between Chinese children and those in European and American countries due to factors such as national conditions, constitution, and dietary habits. There are currently only a few studies related to Chinese children [6].

This study aims to screen, summarize, and scientifically analyze domestic and international literature on the impact of nutritional deficiency on children's motor abilities, providing references for future research topics.

2. Analyzing the impact of malnutrition on children's motor abilities

2.1 The Impact of Malnutrition on Children's Physical Morphology: A Study of 224 Children Aged 7-12 Years

Jiang Ru gang [7] et al. found that the height, weight, chest circumference, triceps skinfold thickness, and subscapular skinfold thickness of children in the malnutrition group were all lower than those in the control group. Gu Guojia [8] et al., in a study of 1,094 children aged 7-12 years, discovered that the height, weight, and chest circumference of children in the malnutrition group were all lower than those in the control group. Jan [9] et al. found that the height, weight, and head circumference of malnourished children were significantly lower than those of control children. Nina [10] et al., in a study of 656 children aged 7-10 years, showed that children who ate breakfast every day had lower BMI values than those who did not eat breakfast regularly, indirectly reflecting the importance of adequate nutritional supplementation for children's physical morphology. Ting [11] et al., in a study of 51 autistic children aged 7-12 years, found a moderate correlation between children's nutrition knowledge and motor abilities, and a negative correlation between BMI and motor abilities, suggesting that key factors influencing BMI may be nutrition knowledge and motor abilities, and the correlation between BMI and motor abilities is significant.

2.2 The Impact of Malnutrition on Children's Physical Functions

Jiang Rugang [7] et al. found that malnourished children had lower grip strength and vital capacity indices compared to normal children. Ting [11] et al.'s study revealed a significant correlation between children's static and dynamic balance abilities and their nutrition knowledge, with a significant negative correlation between BMI and balance. Gu Guojia [8] et al. found that the vital capacity of malnourished subjects was lower than that of the control group.

2.3 The Impact of Malnutrition on Children's Motor Skills

Jiang Rugang [7] et al. found that malnourished children took longer to complete a 400-meter run compared to normal children. Parul [12] et al.'s study found that a lack of iron and folic acid can affect children's fine motor functions, with a sample of 676 children aged 7-9 years. Nina [10] et al.'s research showed that children who ate breakfast every day had better motor functions and skills than those who did not eat breakfast regularly. Lora [13] et al.'s intervention study with 583 children aged 6-11 months found that nutrition and diarrhea play a role in the motor and language development of urban populations. Leila [14] et al.'s study with 4,360 children aged 6-18 months showed that nutrition programs aimed at dietary diversification had a significant impact on children's intellectual development, and these programs primarily involved family stimulation and motor skills.

2.4 The Impact of Malnutrition on Children's Psychological Abilities

Parul [12] et al.'s study found that deficiencies in iron and folic acid can also affect children's psychological cognition, including working memory and inhibitory control. Ingrid [15] et al. discovered that vitamin B12 and folic acid have a positive impact on the brain and neurodevelopment of children aged 6-30 months. Christopher [16] et al.'s study of 1,036 children aged 18-36 months found that chronic and acute malnutrition are associated with cognitive deficits, communication, and motor development, respectively. Berhanu [17] studied 819 children under the age of five and found that malnutrition and psychosocial factors are negatively correlated with developmental outcomes among children living in poverty. Juan [18] et al. conducted a cross-sectional study of 631 children aged 5-11 years and found that malnutrition may negatively affect children's cognitive abilities, such as visual-motor skills and language skills.

ISSN 2618-1576 Vol. 7, Issue 1: 60-64, DOI: 10.25236/FSR.2025.070109

2.5 Essential Nutrients for Children and Adolescents

Nutrition plays a crucial role in the physical development of children during puberty. Between the ages of 10 and 18, children experience significant growth, with an average increase in height of 28-30 centimeters and an average increase in weight of 20-30 kilograms. Adequate nutrition is essential for the physical development of children and adolescents during this stage. Studies have shown that malnutrition can lead to low muscle mass and fine muscle fibers in children and adolescents, adversely affecting muscle strength. Malnutrition has important implications for the physical health of children and adolescents. As shown in Table 1, essential nutrients for the human body include carbohydrates, fats, proteins, vitamins, water, and inorganic salts (minerals).

Table 1: Essential Nutrients for the Human Body

Table/Document Section:

Name	Function	Food Sources
Carbohydrates	Carbohydrates are involved in many life activities, forming part of the cell membrane and many tissues, and serving as the primary source of energy for the human body. They maintain normal neurological function and promote the metabolism of fats and proteins in the body.	"cereals, beans, root vegetables, and other foods contain high levels of sugar
Fats	Fats are an essential component for providing the calories needed by the body after absorption and constitute an important part of human tissue cells, yielding more than twice the energy compared to an equivalent amount of protein or carbohydrates. Fats also serve as a crucial storage form, providing energy within the human body. Their functions include maintaining normal body weight, protecting the internal organs and joints, moisturizing the skin, and supplying energy.	Foods that are high in fat include: lard, butter, egg yolks, peanut oil, sesame seeds, beans, and nuts.
Protein	Protein is an essential component of the human body, responsible for tissue renewal and repair; it also regulates physiological activities, enhances immunity; meanwhile, it provides energy for the growth and development of children.	Milk, eggs, fish, lean meat, and bean products, etc.
Vitamins	Vitamins do not provide energy and are not structural components of the body, but they are a class of compounds essential for maintaining normal physiological functions of the organism. However, they absolutely cannot be lacking in the diet. Long-term deficiency or lack of certain vitamins that can cause metabolic disorders may lead to pathological states of vitamin deficiency. For example, prolonged deficiency or lack of certain vitamins can affect the body.	Animal liver, cod liver oil, carrots, corn, vegetables, egg yolks, yeast, etc.
Water	Essential for survival, transports metabolites, facilitates food & drink, promotes internal chemical reactions, regulates body temperature, has lubricating effects, etc.	Water, beverages, etc.
Inorganic Salts (Minerals)	Although relatively low in content in human cells, they have a significant impact on the body.	Milk, vegetables, eggs, fish, liver, etc.

3. The application of nutritional intervention in improving children's athletic ability

Table 2: Comparison Table of Nutrition, Exercise Intervention, and Health Effects in Children's Groups

Author	Intervention Group	Intervention Measures	Measures, Results
Benita[19]	N=46 6-12 years old. Overweight children aged	Six months of ball sports training and nutritional counseling intervention	Ball sports and nutritional guidance play a positive role in controlling the physical condition of examinees.
Ingrid[15]	N=422 6 to 30 months.	The translation is: "Taking vitamin B12 and folic acid."	The SD units for children's gross motor skills and problem-solving abilities increased by 0.45 and 0.28, respectively.

In Table 2, two intervention studies targeting children were summarized, which showed positive improvement effects on the physical condition of overweight children and their exercise and cognitive abilities through the combination of ball sports, nutritional counseling, and supplementation of vitamin B12 and folic acid.

ISSN 2618-1576 Vol. 7, Issue 1: 60-64, DOI: 10.25236/FSR.2025.070109

4. Summary

In summary, numerous experimental studies conducted by foreign scholars have focused on the impact of nutrition on children's athletic ability. Most studies indicate that malnutrition not only affects children's growth and development, leading to decreased physical function and physical fitness indicators, but also increases the risk of neuropsychological issues, mental illnesses, and poor academic performance. The negative effects of malnutrition can span various stages of a child's development, and severe malnutrition can have lasting consequences even into adulthood. Children are in a rapid stage of growth and development, with high metabolic rates and greater energy and nutrient needs compared to adults. Therefore, rational nutrition and dietary combinations are crucial measures to prevent malnutrition [20]. Furthermore, current issues include the lack of unified testing methods and standards, as well as the challenge of minimizing testing errors. In the future, standardized quantification of different age groups and populations of children could be conducted to provide a reference for future research in this field.

5. Suggestion

It is recommended that relevant departments widely promote nutrition science knowledge, enabling parents to learn how to select foods reasonably and adopt appropriate cooking methods. They should appropriately increase the intake of animal-derived foods, dairy products, or legumes, while also pairing them with adequate vitamins. Attention should be paid to the diversification and reasonable combination of food types, and scientific arrangements should be made for children's diets to prevent the occurrence of malnutrition. At the same time, parents' nutrition and health care should also be strengthened, and a reasonable daily routine for children should be established. Children should be encouraged to participate in outdoor activities regularly, strengthen physical exercise, and enhance their physical fitness. Relevant departments should also do a good job in preventing and controlling various infectious diseases and parasitic diseases, conduct regular physical examinations, monitor the growth and development of children, and promptly identify and address cases of delayed weight gain.

References

[1] Grantham-McGregor S, Baker-Henningham H. Review of the evidence linking protein and energy to mental development[J]. Public Health Nutrition. 2007;8(7a):1191-201.
[2] He Ranmin The main problems and countermeasures of child malnutrition [J]. Primary healthcare in China 2002(04):50-1.
[3] Kitsao-Wekulo P, Holding P, Taylor HG, Abubakar A, Kvalsvig J, Connolly K. Nutrition as an important mediator of the impact of background variables on outcome in middle childhood[J]. Frontiers in Human Neuroscience. 2013;7.
[4] Mattei D, Pietrobelli A. Micronutrients and Brain Development[J]. Current Nutrition Reports. 2019;8(2):99-107.
[5] Moretti P, Sahoo T, Hyland K, Bottiglieri T, Peters S, del Gaudio D, et al. Cerebral folate deficiency with developmental delay, autism, and response to folinic acid[J]. Neurology. 2005;64(6):1088-90.
[6] Bar Or O, Barr S, Bergeron M, Carey R, Clarkson P, Houtkooper L, et al. Nutritional needs of children and adolescent athletes [J]. Sports Science 2001; 21(05):89-93.
[7] Jiang Rugang, Duan Xinwen The impact of malnutrition on the morphology, physiological function, and exercise ability of children [J]. Maternal and Child Health Care in China 2008; 23(35):5005-6.
[8] Gu Guoguo, Chen Rong, Zhang Di Comparative study on morphological, functional, and physical fitness indicators between malnourished and nutritionally normal children [J]. School Health in China 2006(01):79-80.
[9] Hoorweg J SJ. The effects of protein energy malnutrition in early childhood on intellectual and motor abilities in later childhood and adolescence[J]. Dev Med Child Neurol. 1976 Jun;18(3):330-50.
[10] Baldinger N, Krebs A, Müller R, Aeberli I. Swiss Children Consuming Breakfast Regularly Have Better Motor Functional Skills and Are Less Overweight Than Breakfast Skippers[J]. Journal of the American College of Nutrition. 2012;31(2):87-93.
[11] Liu T, Kelly J, Davis L, Zamora K. Nutrition, BMI and Motor Competence in Children with Autism Spectrum Disorder[J]. Medicina. 2019;55(5):135.
[12] Christian P M-KL, Khatry SK, Katz J, Schaefer BA, Cole PM, Leclerq SC, Tielsch JM. Prenatal micronutrient supplementation and intellectual and motor function in early school-aged children in Nepal[J]. JAMA. 2010 Dec 22;304(24):2716-23.
[13] Iannotti L, Jean Louis Dulience S, Wolff P, Cox K, Lesorogol C, Kohl P. Nutrition factors predict

ISSN 2618-1576 Vol. 7, Issue 1: 60-64, DOI: 10.25236/FSR.2025.070109

earlier acquisition of motor and language milestones among young children in Haiti[J]. Acta Paediatrica. 2016;105(9):e406-e11.
[14] Larson LM, Young MF, Ramakrishnan U, Webb Girard A, Verma P, Chaudhuri I, et al. A Cross-Sectional Survey in Rural Bihar, India, Indicates That Nutritional Status, Diet, and Stimulation Are Associated with Motor and Mental Development in Young Children[J]. The Journal of Nutrition. 2017;147(8):1578-85.
[15] Cameron DW, Kvestad I, Taneja S, Kumar T, Hysing M, Refsum H, et al. Vitamin B12 and Folic Acid Improve Gross Motor and Problem-Solving Skills in Young North Indian Children: A Randomized Placebo-Controlled Trial[J]. Plos One. 2015;10(6):e0129915.
[16] Sudfeld CR, McCoy DC, Fink G, Muhihi A, Bellinger DC, Masanja H, et al. Malnutrition and Its Determinants Are Associated with Suboptimal Cognitive, Communication, and Motor Development in Tanzanian Children[J]. The Journal of Nutrition. 2015;145(12):2705-14.
[17] Worku BN, Abessa TG, Wondafrash M, Vanvuchelen M, Bruckers L, Kolsteren P, et al. The relationship of undernutrition/psychosocial factors and developmental outcomes of children in extreme poverty in Ethiopia[J]. BMC Pediatrics. 2018;18(1).
[18] Botero-Meneses JS, Aguilera-Otalvaro PA, Pradilla I, Talero-Gutiérrez C, Ruiz-Sternberg ÁM, Vélez-van-Meerbeke A, et al. Assessment of nutrition and learning skills in children aged 5–11 years old from two elementary schools in Chocó, Colombia[J]. Heliyon. 2020;6(4):e03821.
[19] Kuni B, Rühling NE, Hegar U, Roth C, Schmitt H. Ball games and nutrition counseling improve postural control in overweight children[J]. BMC Pediatrics. 2015;15(1).
[20] Ji Chengye Changes in Growth and Nutritional Status of Chinese Adolescents and Improvement Strategies [J]. Journal of Peking University (Medical Edition) 2002(05):525-9.