**Malnutrition in Transition: Exploring the Coexistence of Under- and Overnutrition**

**ABSTRACT**

Malnutrition is one of the debilitating conditions that affects the South Asian countries. It isdeficiencies or excesses in nutrient intake, an imbalance of essential nutrients, or impaired nutrient utilization. Childhood malnutrition, particularly undernutrition and poor early nutrition, can paradoxically increase the risk of overweight and obesity in later life, known as “double burden of malnutrition,” which is commonly seen in low- and middle-income countries. It is complex and influenced by various biological, metabolic, and socio-environmental factors. It can lead to many health consequences, such as metabolic diseases, non-communicable diseases, and chronic inflammation. Diagnosis in the early stages is helpful using anthropometric measurements. Treatment and prevention strategies include mainly lifestyle modifications such as dietary changes and physical therapy.

*Keywords: Double Burden of Malnutrition, Overnutrition, Undernutrition, Complications, Management*

**1. INTRODUCTION**

With the advent of technology, humans have taken a leap forward in the fields of technology, life expectancy, and many more, but at the same time, we have also created new and major problems, such as divide digital divide, the rich and poor divide, the nutritional divide, and the developed and underdeveloped countries divide. When we talk about the nutritional divide, we can see that according to the National Family Health Survey-5's report 2019-2021 in India, 18.7% of Indian women aged between 15-45 years were suffering from malnutrition.

According to the World Health Organization (WHO), Malnutrition refers to deficiencies or excesses in nutrient intake, an imbalance of essential nutrients, or impaired nutrient utilization.

Malnutrition encompasses a range of issues, from undernutrition (deficiencies in essential vitamins and minerals) to overnutrition (excess calories, leading to obesity)1. Childhood malnutrition, particularly undernutrition and poor early nutrition, can paradoxically increase the risk of overweight and obesity in later life2.

This phenomenon is referred to as the "double burden of malnutrition," is particularly concerning in many low- and middle-income countries, where individuals experience early undernutrition and later face lifestyle changes that lead to overnutrition3.

The double burden of malnutrition consists of both undernutrition and overweight and obesity, as well as diet-related noncommunicable diseases. Undernutrition manifests in four broad forms: wasting, stunting, underweight, and micronutrient deficiencies. India is facing the prevalence of the Trinity of Nutrition, including malnutrition, stunting, and wasting – 35.5% of children under 5 years old were stunted, 19.3% were wasted, and 32.1% were underweight4.

**2. Causes, determinants, and risk factors of double burden of malnutrition**

Undernutrition and overweight have historically been considered separate challenges affecting distinct populations, and with contrasting risk factors. Undernutrition was linked with poverty, food insecurity, and infection, whereas obesity was linked with affluence, dietary richness, and sedentary behaviour. Increasingly, the two forms of malnutrition co-occur within communities, families, and even individuals, such as those who are both stunted and overweight5.

Malnutrition harms health throughout life, but its early emergence has particularly harmful consequences. Exposure to undernutrition alters the consequences of subsequent exposure to obesity; for example, rapid gain in BMI following early undernutrition might predispose an individual to central adiposity and non-communicable diseases. Compensatory weight gain immediately following undernutrition might prioritize the accretion of fat over lean body mass through mechanisms of energy sparing. In some studies, in South America, early stunting was found to predict excess abdominal adiposity7.

South Asian populations have a high prevalence of low birthweight and stunting and relatively short adult stature, all indicative of reduced metabolic capacity, but also a high fat-to-lean ratio and abdominal adiposity, indicative of elevated metabolic load for a given BMI value 8,9.

The connection between early malnutrition and later overweight or obesity is complex and influenced by various biological, metabolic, and socio-environmental factors6:

Metabolic Factors: During periods of undernutrition, the body adapts to a low-calorie environment by slowing metabolism and becoming more efficient at storing energy. This "thrifty phenotype" is beneficial in calorie-scarce settings but can predispose individuals to obesity when calories become abundant later in life. Undernourished children may develop insulin resistance, which can later increase the risk of obesity and type 2 diabetes.

Body Composition Changes: Early malnutrition often leads to stunted growth (shorter height) and a relatively higher proportion of body fat. As they age, individuals may develop a higher percentage of fat relative to muscle, increasing their obesity risk.

When children who have experienced undernutrition gain weight rapidly later in childhood or adolescence, their bodies may favour fat storage over lean muscle gain, increasing the risk of obesity and associated diseases.

There may be other factors that can be affected, which are yet to be explored. That includes hormonal changes that may lead to altered appetite regulation, contributing to overeating and weight gain in later life, Nutritional transition - where traditional diets are replaced by diets high in processed foods, sugars, and unhealthy fats. Undernourished children may be more vulnerable to these dietary shifts, contributing to overweight and obesity and behavioural factors. Children raised in food-insecure environments may develop patterns of eating in excess when food is available, contributing to overweight or obesity when food access improves.

**3. Health Implications**

The increased risk of overweight and obesity following early-life malnutrition carries significant health consequences15:

**Non-Communicable Diseases**: Individuals who were malnourished as children are more susceptible to obesity-related diseases in adulthood, including type 2 diabetes, cardiovascular diseases, and certain cancers.

**Metabolic Syndrome**: A combination of conditions, including high blood pressure, high blood sugar, and excess body fat around the waist, increases the risk of heart disease, stroke, and diabetes.

**Chronic Inflammation**: Overweight individuals with a history of early malnutrition may experience low-grade inflammation, which can exacerbate metabolic issues and increase disease risk.

Apart from just the health, it also affects the day-to-day life of the children suffering from this. It affects their early growth and development. It affects the quality of life of such children if malnutrition has led them to become overweight or obese. It also makes them vulnerable to developing health issues in their later years of life. In this way, the double burden of malnutrition not only makes the present life of children difficult but also can affect their lives and increase the risk of various health-related consequences.

The susceptibility of non-communicable disease in South Asian populations, whether it arises from genetic factors or mechanisms of intergenerational plasticity, is unclear. However, these traits are also influenced by economic and cultural factors, including dietary preferences, migration patterns, and social inequality.

**4. diagnosis**

Diagnosis of this condition is quite difficult. Although anthropometric measurements and dual-energy X-ray absorptiometry (DEXA) scan were the outcomes to assess obesity14. The American Physical Therapy Association (APTA) has identified the involvement of physical therapists in nutrition and food intake as important for public health and beneficial to patients11.

**5. management**

Children with severe obesity are at greater risk than others for hypertension, type 2 diabetes, metabolic syndrome, non-alcoholic fatty liver disease, atherosclerosis, and adult obesity. There are several treatment options for severe pediatric obesity, which include lifestyle modification therapy, pharmacotherapy, and metabolic and bariatric surgery. It mentions that among all these, lifestyle modification should be the priority, and it should be used as the first-line therapeutic option. Lifestyle modification therapy includes dietary modification, increasing physical activity, and behavioral changes13.

Different management strategies are available that can help in resolving this issue in the younger population. One such first-line intervention strategy can be lifestyle modification, which includes dietary modifications together with a physical exercise program. The effect of physical therapy in reducing the risk of overweight in the general population of adults is well identified, but the effect of this multimodal therapeutic intervention in younger children is yet to be explored

**5.1 Dietary changes**

It focuses on new research that aims to improve food systems to provide access to healthy, nutrient-dense food, promoting healthy eating habits and lifestyles that address the root causes of malnutrition, such as poverty and food insecurity.

Food structure is an important determinant of nutrient bioavailability in the gut. Certain intact plant structures, such as the cell walls in legumes, protect the intracellular nutrients from digestion16. This results in more nutrients reaching the microbiota-rich distal gut. Here, carbohydrates become available for bacterial fermentation, yielding Short-Chain Fatty Acids (SCFAs)17. Production of SCFAs can have a beneficial impact on both ends of the malnutrition spectrum. From a weight management angle, SCFAs are known stimulants to produce appetite-reducing hormones Glucagon-Like Peptide-1 (GLP-1) and Peptide YY (PYY). Indeed, increased colonic levels of SCFAs are protective against weight gain18.

Accordingly, diets high in fibre that increase fermentation and SCFA production have been associated with lower bodyweight19. From the undernutrition angle, while high-fibre diets are usually lower in energy density, the inclusion of fibre in the diets can support the gut microbiome. This can improve gut function and inflammation and be protective against some of the negative impacts of undernutrition, such as impaired gut integrity and nutrient malabsorption.

This information indicates that feeding a diet rich in fibre and intact plant structures, such as legumes, can be beneficial from a malnutrition perspective (both under- and overnutrition). Traditional African diets are high in both fibre and legumes, a habit that is declining with the Westernisation of diets. Nutrition programmes and strategies should focus on utilising local and nutritious traditional plant-derived foods in modern African diets, such as the school feeding programmes established in Nigeria20,21. However, it needs to be recognised that the perception and acceptability of foods are complex and it is influenced by social networks. For example, certain foods may be associated with wealth or poverty, and this may have more impact on whether a food is bought and consumed than the health benefits. The purchase of Western-style fast food items may be seen as desirable since it is associated with wealth. To make a difference, there is a need to bring nutritional and social sciences together.

**5.2 Physiotherapy management**

The relationship between physical therapy and nutrition is not fully understood. However, physical therapy plays an important role in nutritional management, and evaluations, such as muscle strength and muscle mass evaluations, play an important role in nutritional screening and diagnosis7

Role of Physiotherapy in Malnutrition is important and beneficial, but yet to be explored in this population. Clarifying the relationship between physical therapy and nutrition helps all medical professionals involved in physical therapy share a common understanding and maximize function, activity, participation, and quality of life (QOL).

Physiotherapy can play a supportive role in preventing and managing the double burden of malnutrition by promoting physical activity, enhancing muscle strength, and supporting metabolic health. This approach is particularly beneficial for individuals who have experienced childhood malnutrition and may be at risk for obesity or other metabolic conditions later in life22.

**Physiotherapy Goals8**

Enhance Muscle Mass and Physical Fitness

Support Healthy Growth and Development in Children

Encourage Sustainable Activity and Mobility

**Physiotherapy strategies:**

Encouraging Physical Activity: Customized Exercise Programs, Aerobic Exercises,

Promoting Active Lifestyles in Children

Building Muscle Strength: Strength Training, Functional Training

Addressing Posture and Mobility Issues: Corrective Exercises, Mobility Training

Improving Metabolic Health: Cardiometabolic Exercise Regimens, Resistance

Training for Metabolic Benefits

Supporting Mental Health and Body Image: Motivational Counseling and Body Awareness, Mind-Body Techniques

Education on Physical Health and Nutrition: Nutritional Education Integration,

Lifestyle Education

By integrating these physiotherapy strategies with nutrition and lifestyle interventions, individuals can achieve balanced health, reducing the risk of both under- and overnutrition impacts10.

The multimodal approach is inclusive of periodized multicomponent exercise interventions combined with nutritional counselling. multimodal intervention based on fun-type skill-learning physical activities and physical conditioning with challenging circuits and games, together with nutritional counselling. multimodal supervised strategies ensured attendance, active participation, and enjoyment, compensating for the lack of strict caloric restrictions and the low volume and training frequency compared to the exercise prescription guidelines for obesity. Nutritional counselling reinforced exercise benefits and turned the intervention into a powerful educational strategy14.

**6. PREVENTION STRATEGIES**

Improving Early Nutrition and encouraging physical activity help in preventing the health complications of the double burden of malnutrition10. Ensuring adequate and balanced nutrition during pregnancy, infancy, and early childhood is essential to reduce the likelihood of metabolic adaptations that lead to obesity.

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