Is Metabolic Syndrome a Long Term Effect of Stunting? : A Literature Review

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Abstract

Stunting is a condition resulted from inadequate nutritional intake for a long period. It is a sign of a persistent growth disease in which a child's health and nutritional issues prevent him from growing to his full height. Maternal nutritional status, breastfeeding habits, supplementary feeding routines, and virus exposure are factors that may have contributed to stunting. The presence of three of the five criteria for the metabolic syndrome—central obesity, hyperglycemia, hypertriglyceridemia, high density lipoprotein, and hypertension—is required. Stunting has short-term effects like increased morbidity and mortality, impaired cognitive and motor development, higher health care costs, and long-term effects like short stature, increased risk of obesity and other chronic diseases, risk of degenerative disease, and poorer reproductive health. Because there is a greater chance that a chronic condition may emerge, metabolic syndrome is thought to be one of the long-term effects of stunting (obesity, diabetes, heart and blood vessel disease, stroke, cancer and disability in old age). Obesity was caused by nutritional stunting, which impeded fat oxidation. The higher systolic blood pressure is also associated to hypertension. Children who are undernourished are more likely to develop central obesity due to low-grade inflammation brought on by extra visceral fat. Loss of lean mass and subcutaneous fat also contributes to metabolic dysregulation of insulin-stimulated glucose uptake and the development of metabolic syndrome.
Keywords : Stunting; Metabolic Syndrome

1. Introduction

1.1. Stunting

Stunting is a condition of chronic malnutrition caused by inadequate nutritional intake for a long time. This condition could be the result of feeding habits that do not adhere to the guidelines for proper nutrition in support of the child's growth and development according to age. [1] According to WHO anthropometric criteria, stunting is determined by dividing each child's Z-score by their age. By comparing a child's height or length to the average height of children their own age and sex in the general community, stunting conditions can be found. The term "stunting condition" refers to a chronic development disease in which a child's potential height is not reached because of dietary and medical issues. [2]

Malnutrition in childhood has been linked to a higher incidence of obesity in adulthood. [3] Malnutrition is linked to increased risk of metabolic disease in adults, impaired physical function, neurodevelopmental capacity, and morbidity and death. [4] Stunting has complicated effects that are influenced by a number of variables, including the local environment, food, and timing of developmental stages. [5] According to a study by Grillo et al. (2016), people with stunting have changed HDL cholesterol at much greater rates. [6] Numerous factors influence intrauterine development retardation, such as short mother stature, a low prenatal BMI, and a low pregnancy weight gain. [7] Nutritional deficits, high infection rates, and poor feeding techniques used by caregivers are the most prominent causes of postnatal growth retardation. Lack of one or

more nutrients, such as energy, protein, or micronutrients like iron, zinc, and vitamins D, A, or C, can lead to growth failure. Growth retardation is a symptom of phosphorus and zinc deficiency particularly. [8] By reducing food intake, reducing nutrient absorption, and increasing nutrient requirements, recurrent illness exacerbates pre-existing deficits. Growth retardation brought on by repeated infections and nutritional deficits is more likely to result in morbidity and mortality. The availability of sufficient care, time, attention, and support to address the physical, mental, and social needs of the developing kid has an impact on both nutrient intakes and health. The caregiver's training, beliefs, workload, time availability, health, and nutritional state are all crucial. [9]

1.2. Metabolic syndrome

The prevalence of metabolic syndrome is increasing in both children and adolescents. [10] The presence of three out of the five criteria for metabolic syndrome—central obesity, hyperglycemia, hypertriglyceridemia, high density lipoprotein, and hypertension—was established by the National Cholesterol Education Program (NCEP) in 2001. Type 2 diabetes mellitus, insulin resistance (on clamp), or impaired fasting glucose (110-125 mg/dL) plus two out of four criteria are the criteria used by WHO to define metabolic syndrome. WHR > 0.9 for men and > 0.85 for women, or BMI > 30 kg/m2, were considered central obesity. Systolic blood pressure of more than 140 mmHg or diastolic blood pressure of less than 90 mmHg was considered hypertension. Urinary albumin excretion was defined as less than 20 mcg/min, while hypertriglyceridemia was classified as TG 150 mg/dL. Metabolic syndrome is a concept with several element, including physiological, biochemical, clinical and metabolic factors that directly increase the risk of atherosclerosis, type 2 DM, and all cause mortality. [11] The pathogenesis of metabolic syndrome suggested that interaction of obesity, insulin resistance and inflammation is significant to development. Accumulation of free fatty acids in the liver, adipocytes, skeletal muscles and the pancreas in the setting of obesity leads to impaired insulin signaling and subsequent insulin resistance. Clinical features in metabolic syndrome shows as symptoms of obesity, dyslipidemia, hypertension, glucose intolerance and T2DM, non alcoholic fatty liver disease, polycystic ovarian syndrome and increased production of inflammatory cytokines by the visceral adipocytes. [12]

1.3. Is Metabolic Syndrome a Long Term Effect of Stunting?

Children with stunts are shorter than their peers and look two to three years younger. It is also associated with developmental delay and delayed achievement of key developmental milestones in children, such walking. A developmental impairment that begins very early in life is present with stunting. Although the growth phase can be extended until ages 20 to 22, the developmental delay may not be enough to make up for the initial growth deficit. [13] Stunting's immediate effects could lead to an increase in morbidity and death, delayed cognitive and motor development, and higher health care costs. [14] Long term impact of stunting could cause inadequate body posture so that the children are shorter than normal children, and the risk of obesity and other diseases increases, reproductive health decreases, learning capacity and performance during school time become insufficient, leading to inadequate productivity and work. [15]

Children who are stunted are more likely to acquire chronic diseases, have impaired fat oxidation that results in obesity, and have decreased glucose tolerance. [16] A research by Hoffman et al. (2000) found that nutritional stunting is strongly associated with poor fat oxidation, which leads to more fat being retained in adipose tissue. The hormones and enzymes in charge of fat oxidation have been compromised by long-term undernutrition. [17] Stunting during the first two years of life was linked to higher systolic blood pressure at the age of 7-8 years, according to a study by Gaskin et al. [18] Indirectly, stunting raises the risk of

degenerative diseases. Stunting children are more likely to develop obesity, diabetes, heart and blood vessel disease, stroke, cancer, and long-term impairment. [19]

According to reports, central obesity is more common in undernourished, stunted adults. [20] However, rather than examining particular fat compartments, the majority of studies rely on anthropometric measures of body fat. Due to the increased secretion of multiple pro-inflammatory cytokines, which may play a significant role in many diseases by promoting angiogenesis, inflammation, cell proliferation, and insulin resistance, visceral fat is associated with low grade inflammation. [21-23] In some populations, subcutaneous fat may be a useful predictor of unfavorable metabolic effects. [24] After accounting for current BMI, DeLucia et al(2018) found a connection between early stunting and increased visceral fat deposition in adulthood. Additionally, it is linked to a loss of lean mass, the buildup of subcutaneous belly fat, and the bulk of total body fat. [25]. Subcutaneous fat loss is brought on by consuming insufficient amounts of food that is low in calories and protein. [26]. When it comes to metabolic syndrome, this body composition profile could be harmful.

The largest insulin-sensitive tissue in the body is lean mass, which is important for preserving glucose metabolism. [27-28] The development of the metabolic syndrome is facilitated by decreased lean mass, which altered glucose homeostasis, including metabolic dysregulation of insulin-stimulated glucose uptake. [29] Independent of abdominal fat, low lean mass has been demonstrated to be one of the most significant risk factors for metabolic syndrome in adults. [30] The development of insulin resistance in lean mass has been linked to increased accumulation of adipose tissue and intramuscular fat, dysregulated production of inflammatory adipokines, increased renin angiotensin aldosterone system activity, and decreased mitochondrial oxidative phosphorylation flux in the muscle. [29] Reduced subcutaneous fat may also cause fat to build up in other tissues and organs. Fat tissues such visceral adipose tissue, the pancreas, muscle, and liver may store fat if fat cell production in the subcutaneous fat compartment fails when body fat levels rise. [31] This excessive storage could be linked to insulin resistance, glucose intolerance, and diabetes as well as the poor distribution of belly fat and hepatic steatosis. [32]

1.4. Conclusion

Stunting caused by insufficient nutrition has a variety of long- and short-term effects, including an increase in morbidity and mortality, delays in cognitive and motor development, and higher medical expenses. Stunting has long-term effects such as short stature, increased risk of obesity and other chronic diseases, risk of degenerative diseases, and poor reproductive health. Because nutritional stunting decreased fat oxidation and led to obesity, metabolic syndrome is thought to be one of the long-term effects of stunting. The higher systolic blood pressure is also associated to hypertension. Children who are undernourished are more likely to develop central obesity due to low-grade inflammation brought on by extra visceral fat. Loss of subcutaneous fat and lean mass also plays role in metabolic dysregulation of insulin stimulated glucose uptake, hence causing metabolic syndrome.

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