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NOVEL INSIGHTS IN THE METABOLIC SYNDROME IN CHILDHOOD AND ADOLESCENCE

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ABSTRACT

A metabolic syndrome is characterized by a spectrum of conditions such as central obesity, high blood pressure, high blood sugar, high serum triglycerides, and low serum high-density lipoprotein. The prevalence of metabolic syndrome is cascading rapidly in developed as well as developing countries. Children and adolescents with metabolic syndromes have an increased risk for developing metabolic disorders during adulthood and possibly an increased risk of type 2 diabetes mellitus and cardiovascular disease. Early detection of risk factors, screening for disturbances in metabolism and identification of new therapies are major aims to reduce Metabolic disorder mortality. Dietary modification and physical activity are currently the only adopted treatment approaches in order to manage metabolic syndrome.

KEYWORDS: *Metabolic syndrome, central obesity, triglycerides, children and adolescents.*

1. INTRODUCTION

Adolescence is a transitional phase between childhood and adulthood characterized by marked acceleration in growth and development. Adolescents constitute about 243 million of population in India (UNICEF, 2016). Adolescent girls are considered to be a nutritionally vulnerable segment of the population because of increased nutritional requirements related to their rapid growth spurt.

In recent years, there has been a greater concern about the presence of obesity and other metabolic syndromes among children and adolescents, which has possibly increased the risk of type 2 diabetes mellitus and cardiovascular disease during adulthood. Metabolic syndrome (MetS), a cluster of disturbed glucose and insulin metabolism, abdominal obesity, dyslipidemia, and hypertension, is observed in 35% to 40% of adults in developed countries. Its prevalence during childhood and adolescence phase has been increased from approximately 2per cent in the mid-1990s to a current estimate of 25 per cent in the United States and Western Europe. The prevalence of metabolic syndrome is cascading rapidly in developing countries (UNICEF, 2016).

In the meantime, the search for more effective childhood obesity prevention and treatment interventions continues apace. Diet and physical activity represent the current milestones of metabolic syndrome treatment. However, during the last years, contemporary therapeutic approaches have been experimented in order to optimise the management approach to the patients suffering from metabolic disorders.

2. METABOLIC SYNDROME

Metabolic Syndrome is characterized as the clustering of dyslipidaemia, hypertension, hyperinsulinemia, and central obesity and constitutes a risk factor for cardiovascular disease and type 2 diabetes mellitus. Moreover, metabolic syndrome confers greater risk than a single factor for cardiovascular disease (Singh *et al.*, 2013). Figure 1 depicts the symptoms of metabolic syndrome.

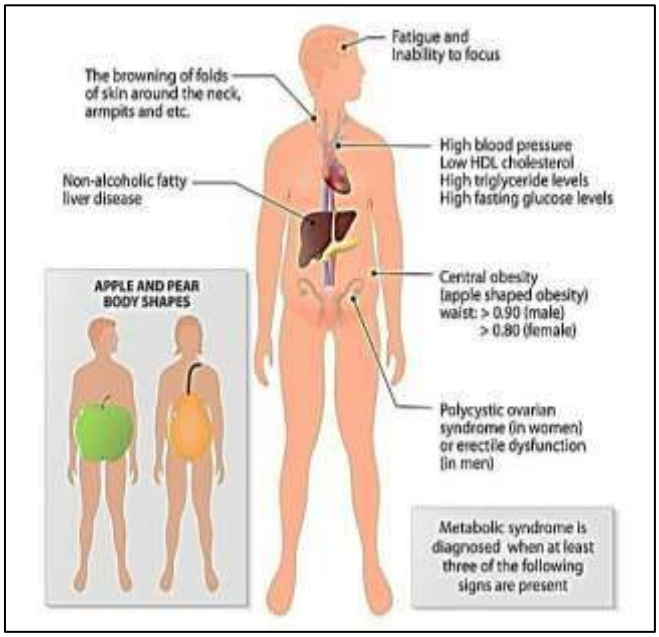

Fig. 1 Symptoms of Metabolic Syndrome

As the prevalence of obesity continues to rise, the incidence of metabolic syndrome is also increasing in both children and adolescents (Ogden *et al.*, 2016 and Flegal *et al.*, 2012). Studies have reported that the children with metabolic syndrome have an increased risk for developing metabolic disorders among adolescent and adults, and possibly an increased risk of type 2 diabetes mellitus and cardiovascular disease (Morrison *et al.*, 2008).

A cross-sectional study conducted by Sewaybrickera *et al.*, (2013) among obese children and adolescents revealed that 27.6 % of the subjects were diagnosed with metabolic syndrome. In this study, puberty and triglyceride levels showed significant ($p<0.05$) association with metabolic syndrome. Figure 2 represents risk factors and consequences of metabolic syndromes.

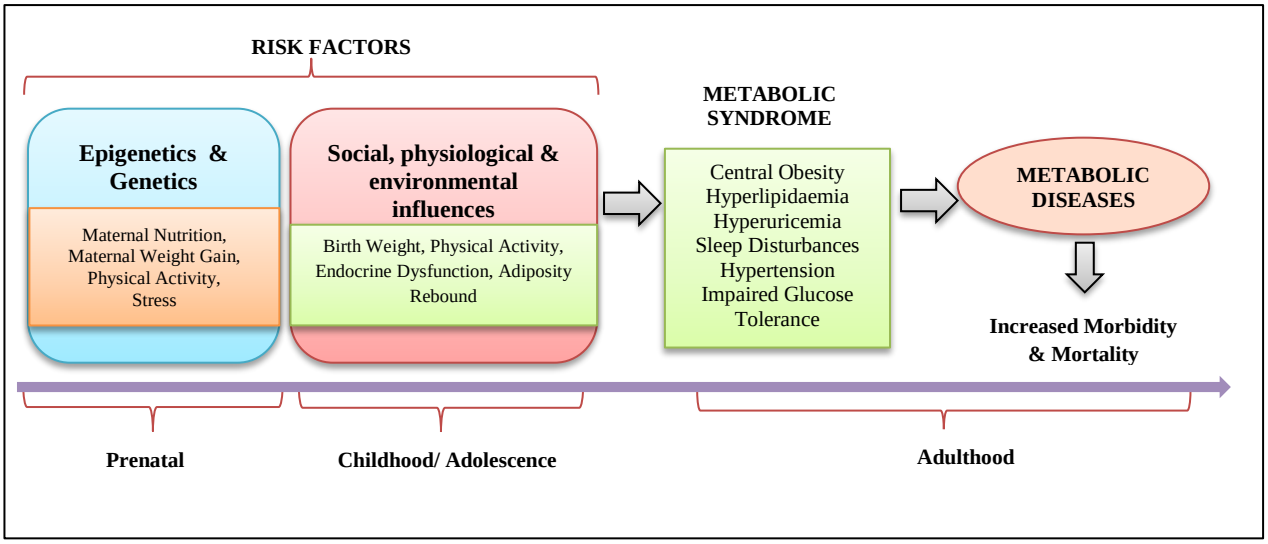

Fig. 2 Risk Factors and Consequences of Metabolic Syndromes

Various studies have shown that obesity during adolescence continues into adulthood and also have positive association with cardiovascular and metabolic diseases during adulthood (Lloyd *et al.*, 2012 and Sinha *et al.*, 2017).

A lower prevalence of metabolic syndrome was observed among younger children and less risk factors than older children and adolescents. This may happen as a consequence of a time-related exposure to factors such as hypercaloric diets, positive energy balance and sedentary lifestyle (Veugelers and Fitzgerald, 2005).

3. PATHOPHYSIOLOGY OF METABOLIC SYNDROME

The pathophysiologic origins of metabolic syndrome are in insulin resistance, a pathological condition where body cells fails to respond normally to insulin hormone. Insulin maintains the normal

blood glucose levels in the body during normal condition, but during insulin resistance, glucose accumulates in the blood, which further leads to pre-diabetic state, type 2 diabetes mellitus, dyslipidemia, elevated triglycerides, lowered high density lipoprotein (HDL) concentration etc. Figure 3 depicts the pathophysiology of metabolic syndromes.

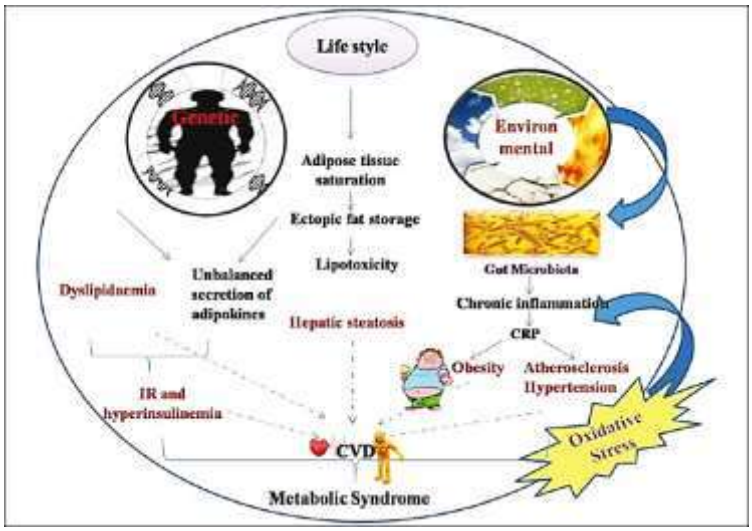

Fig. 3 Pathophysiology of Metabolic Syndromes.

Besides acting as the central regulator of glucose, insulin also plays an important role in lipid homeostasis. It has long been known that there is a highly significant relation among insulin resistance, compensatory hyperinsulinemia, and hypertriglyceridemia (Reaven, 2006). Insulin has three main influences on lipids: it enhances the synthesis of triglyceride in liver and adipose tissues, it increases the breakdown of circulating lipoproteins by stimulating lipase activity in adipose tissue, and it also suppresses lipolysis in adipose tissue and muscles (Keskin *et al.*, 2005). The presence of obesity, visceral body fat, insulin resistance, is closely associated with an impaired lipid profile (Cook and Kavey, 2011).

The finding of triglyceride (TGC) levels as an associated factor for metabolic syndrome is congruent with the report by Morrison *et al.*, (2008) in a long follow-up study, where a significant association of high TGC retained from childhood to adulthood with young adult cardiovascular disease (CVD). In this study, the association of high TGC from childhood through adulthood with adult CVD could reflect the presence of a paediatric metabolic syndrome, a known predictor of adult CVD.

Hyperuricemia has also been implicated in the pathophysiology of hypertension, chronic kidney disease, congestive heart failure, type 2 diabetes, and atherosclerosis (Ciarla *et al.*, 2014). Uric acid is the end-product of the purine metabolism in humans. High intake of purine sources or fructose are directly related to an increment in serum urate which can cause gout and urolithiasis. Various studies reported a positive correlations between serum uric acid levels and metabolic syndrome among children and adolescents (Cardoso *et al.*, 2013 and Ciarla *et al.*, 2014). For instance, every 1 kg/m^2 increment in BMI is associated with a 5.74 μmol/L increase of serum uric acid levels. These results were further supported by Jones *et al.*, (2008); Pan *et al.*, (2014) and Viazzi *et al.*, (2013).

4. IMPACT OF METABOLIC SYNDROME ON CARDIOVASCULAR DISORDERS AND TYPE 2 DIABETES MELLITUS

In adults, the metabolic syndrome is a risk factor for type 2 diabetes and cardiovascular disease that is associated with increased cardiovascular disease mortality. Autopsy studies in youth have shown that cardiovascular risk factors (including obesity, high triglycerides, low HDL cholesterol and high blood pressure) are related to the early stages of coronary atherosclerosis (Berenson et al., 1998 and McGill et al., 2002). Therefore, the high prevalence of the metabolic syndrome among overweight youth is coupled with the epidemic increase in childhood obesity, which could lead to an increment in cardiovascular diseases among adults.

Type 2 diabetes and impaired glucose tolerance have recently emerged as a critical health problem among overweight adolescents (Sinha *et al.*, 2017). Furthermore, insulin resistance and insulin secretory dysfunction, commonly found in subjects with impaired glucose homeostasis, predict the development of type 2 diabetes (Buchanan *et al.*,2002).

5. CONCLUSIONS

Epigenetics, dietary habits, life style pattern, physical activity and endocrine dysfunction etc., are likely to increase the risk of metabolic disorders among adolescents. However, there is no consensus regarding the diagnosis of metabolic syndrome in

children and adolescents. It is evident that each component of the metabolic syndrome must be identified as early as possible in order to prevent definitive lesions. Early detection of risk factors, screening for disturbances in metabolism, and the identification of new therapies are major aims to reduce Metabolic disorder mortality. Dietary modification and physical activity are currently the only adopted treatment approaches in order to manage Metabolic syndrome. Pharmacological therapies and bariatric surgery are recommended only during high-risk conditions.

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