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Introduction

World Health Organization (WHO) states that obesity is one of the most common, yet among the most neglected, public health problems in both developed and developing countries (WHO, 2000). According to the WHO World Health Statistics Report (2012), globally one in six adults is obese and nearly 2.8 million individuals die each year due to overweight or obesity. Due to the increased risk of morbidity and mortality, obesity is now being recognized as a disease in its own right. Additionally, obesity is strongly associated with other metabolic disorders including diabetes, hypertension, dyslipidaemia, cardiovascular disease and even some cancers. According to the NFHS-3 data, in the three states studied, the percentage of women who were obese was highest in Tamil Nadu (24.4%), followed by Maharashtra (18.1%) and Jharkhand (5.9%) and a similar order was reported among men in the three states with 19.8, 15.9 and 5.3 per cent being obese respectively(NFHS-3).. The phase I study of Pradeepa *et al*. (2015) revealed that the prevalence of generalized obesity was found to be 24.6 per cent among residents of Tamil Nadu, prevalence of abdominal obesity was found to be 26.6, 18.7, 16.9 and combined obesity was found to be 19.3 per cent. (Pradeepa *et al.,* 2015).Asian Indians have a greater predisposition to abdominal obesity and accumulation of visceral fat and this has been termed as "Asian Indian phenotype" (Joshi, 2003). In countries like India, the rise in obesity prevalence could be attributed to the increasing urbanization, use of mechanized transport, increasing availability of processed and fast foods, increased television viewing, adoption of less physically active lifestyles and consumption of more "energy-dense, nutrient-poor" diets (Misra *et al.,* 2010).

The term overweight refers to excess body weight for a particular height whereas the term obesity is used to define excess body fat. Overweight and obesity primarily happen either due to excess calorie intake or insufficient physical activity or both. Furthermore, various genetic, behavioural, and

environmental factors play a role in its pathogenesis. Asian Indians have a greater predisposition to abdominal obesity and accumulation of visceral fat and this has been termed as “Asian Indian phenotype” (Deepa *et al.*, 2006). Overweight was defined as a BMI ≥23 kg/m^2 but <25 kg/m^2 for both genders based on the World Health Organization Asia Pacific Guidelines with or without abdominal obesity (AO). Generalized obesity (GO) was defined as a BMI ≥ 25 kg/m^2 for both genders (based on the World Health Organization Asia Pacific Guidelines) with or without abdominal obesity (AO). Abdominal obesity (AO) was defined as a waist circumference (WC) ≥ 90 cm for men and ≥ 80 cm for women with or without GO(International Obesity Task Force, 2000).Isolated generalized obesity (IGO) is defined as a BMI ≥ 25 kg/m^2 with waist circumference of < 90 cm in men and < 80 cm in women. Isolated abdominal obesity (IAO) is defined as a waist circumference of ≥ 90 cm in men or ≥ 80 cm in women with a BMI < 25 kg/m^2.

Urbanization, modernization and Industrialization had led to drastic changes in the diet pattern and life style. Over the years it had consequently led to the development of various diseases such as obesity, Diabetes Mellitus, cardiovascular and certain type of cancer. Of all the diseases, obesity in itself is a major contributing factor for various diseases. The significant role of dietary factor in preventing life style related diseases had led to the search of novel functional food as a dietary strategy. Manipulation of dietary nutrient content with emphasis on specific food would be a logical means of alleviating this problem. Natural products particularly plant based known to possess anti-obesity effects based on any of the entitled mechanism such as inhibiting absorption of lipid, reduced energy intake, increased energy expenditure, decreased pre-adipocyte differentiation and proliferation, decreased lipogenesis and increased lipolysis. Extensive variations in culture, tradition, body composition, dietary habits, genetics, phenotype, food choices are the real challenges in developing a functional food. However, the lacuna such as physical inactivity, sedentary life style, increased consumption of junk foods, potential hazards in ready to eat and serve foods associated with these cannot be tackled without proper lifestyle and dietary modification.

Diet is a key environmental factor affecting health and the incidence of many chronic diseases. Diet factors influence occurrences of more than 2/3 of diseases (WHO, 2000).Most of these factors belong to the categories of nutrigenetics or nutrigenomics. Nutrigenetics concerns individual differences in the reaction to food based on the genetic factors. Importance of nutritional factors is explained on differences of epidemiology of the same disease in different countries and on the examples of interaction of nutrition and genes for hypertension, atherosclerosis and cancer. In the future both, nutrigenetics and nutrigenomics, will induce many changes in preventive and also in clinical medicine.

The sudden marked increase in obesity has been attributed to changes in lifestyle factors, since this escalating prevalence has been occurring in a constant genetic milieu (Hill *et al*., 2004). However, the genetic pathways leading to obesity remain elusive although the great success in genetic researches. It is of great significance for prevention and treatment of obesity by searching for candidate genes. One commonly studied candidate gene for obesity is peroxisome proliferator-activated receptor gamma (PPAR-γ) gene. Peroxisome Proliferator-activated receptor γ is a key regulator of adipogenesis, responsible for fatty acid storage and maintaining energy balance in the human body. Studies on the functional importance of the Peroxisome Proliferator Activated Receptor (PPAR Gamma), Pro 12 Ala polymorphic variants indicated that the observed alleles may influence body mass measurements. PPAR-γ is a nuclear receptor which is expressed selectively and at high level in adipose tissue. It has a key role in adipocyte differentiation, energy storage, insulin sensitization, and fatty acid metabolism. Several polymorphisms in the PPAR-γ gene have been reported. A common missense polymorphism in the PPAR-γ is the Pro12Ala polymorphism, which leads to a proline to alanine in the position 12. In recent years, several studies focus on the association between PPAR-γ Pro12Ala polymorphism and obesity, which may help to clarify the mechanism of obesity. Many studies have indicated that Ala-allele may increase the risk of obesity (Prakash*et al,* 2012). Studies evaluating the relationship of Pro12 Ala variant with

obesity, body composition, lipid profile, metabolic syndrome and their related traits among Asian population particularly young adults are very limited However, some other studies have showed that the PPAR-Gamma Pro 12 Ala polymorphism is not associated with obesity The results were inconsistent.

Pathogenesis of obesity is multifactorial and involves both genetics and environmental factors (Kelishadi, 2007). Many genes are involved in regulatory pathways for weight gain and obesity. These genes include leptin, leptin receptors, melanocortin receptor 4, mitochondrial uncoupling proteins, Peroxisome Proliferator-Activated Receptor-gamma (PPAR GAMMA), neuropeptide Y, and ghrelin as well as genes in signaling pathways (Rankinen *et al*., 2005). PPAR Gamma plays a pivotal role in the regulation of adipocyte differentiation, energy storage, insulin sensitivity, and lipid metabolism. A point mutation found on the B exon of the amino-terminal of PPARγ, substitution of proline with alanine at position 12 (PPARγ Pro12Ala SNP) (rs1801282), causes a moderate decrease in its transcription activity and adipogenic potential.

Pereira *et al* (2013) reported the association between the polymorphism and obesity, stating that obese individuals possess a 1.196 more chance of carrying the polymorphism than non-obese. Hence, Pro12Ala polymorphism from gene PPARγ2 acts out as a risk factor in obesity. Urbanization, modernization and industrialization had led to drastic changes in the diet pattern and life style. Over the years, it had consequently led to the development of various diseases such as obesity, diabetes mellitus, cardiovascular and certain type of cancer. Of all the diseases, obesity is itself a major contributing factor for various diseases.

Obesity is frequently associated with increased amounts of intra abdominal fat. A central fat pattern is associated with the deposition of intra abdominal adipose tissue, but subcutaneous abdominal adipose tissue is involved. The measurement of human body composition to quantify nutritional and health status has become increasingly important as evidence accumulates identifying relative body fat as a significant predictor of mortality (Bender, 1998). Bioelectrical impedance analysis (BIA) has emerged as a popular method of

assessing fat mass because it is quick, portable, and relatively inexpensive. BIA theory proposes that this voltage drop is caused by the relative composition of the subject's body; fat provides greater resistance to the current than fat-free mass (lean soft tissue, water, etc.), allowing quantification of each body compartment. The analysis validity and its estimates of body composition are significant issues for normal weight individuals. BIA is useful in describing mean body composition for groups of individuals, but large errors for an individual limit its clinical application, especially among the obese.The four-compartment model (4C) reduces the biological variability of the FFM assumptions

Ethnic differences in body composition and obesity are affected by differences in and associations with socio-economic status, diet, utilization of health care, and levels of genetic admixture. These associations and effects in some ethnic groups may not be clear because the health status of minority groups is frequently affected by socio-economic factors.

Metabolic syndrome is becoming more common due to a rise in obesity rates among adults. In the future, metabolic syndrome may overtake smoking as the leading risk factor for heart disease. It is possible to prevent or delay metabolic syndrome, mainly with lifestyle changes. A healthy lifestyle is a lifelong commitment. Successfully controlling metabolic syndrome requires long-term effort and teamwork with your health care providers. The term "metabolic" refers to the biochemical processes involved in the body's normal functioning. Risk factors are traits, conditions, or habits that increase your chance of developing a disease.

The significant role of dietary factor in preventing life style related diseases had led to the search of novel functional food as a dietary strategy. Manipulation of dietary nutrient content with emphasis on specific food would be a logical means of alleviating this problem. Natural products particularly plant based known to possess anti-obesity effects based on any of the entitled mechanism such as inhibiting absorption of lipid, reduced energy intake, increased energy expenditure, decreased pre-adipocyte differentiation and proliferation, decreased lipogenesis and increased lipolysis. Extensive variations in culture, tradition, body

composition, dietary habits, genetics, phenotype, food choices are the real challenges in developing a functional food. However, the lacuna such as physical inactivity, sedentary life style, increased consumption of junk foods, potential hazards in ready to eat and serve foods associated with these cannot be tackled without proper lifestyle and dietary modification.

Physical activity has a major impact on health. Some effects are well established; as a major component of energy expenditure, physical activity has a great influence on energy balance and body composition. It is also recognised that physical activity is a major independent modifiable risk factor which has a protective effect on cardiovascular disease (CVD), stroke, type 2 diabetes, colon and breast cancers, and is also associated with other important health outcomes such as mental health,injuries and falls. Physical activity is defined as any bodily movement produced by skeletal muscles that require energy expenditure. Physical inactivity (lack of physical activity) has been identified as the fourth leading risk factor for global mortality (6% of deaths globally).Increasing physical activity is a societal, not just an individual problem. Therefore it demands a population-based, multi-sectoral, multi-disciplinary, and culturally relevant approach. WHO (2012) recommends the following physical activity for adults aged 18–64, to do at least 150 minutes of moderate-intensity aerobic physical activity throughout the week or do at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week or an equivalent combination of moderate- and vigorous-intensity activity. Aerobic activity should be performed in bouts of at least 10 minutes duration. Further, for additional health benefits, adults need to increase moderate-intensity aerobic physical activity to 300 minutes per week, or engage in 150 minutes of vigorous-intensity aerobic physical activity per week, or an equivalent combination of moderate- and vigorous-intensity activity. Muscle-strengthening activities should be done involving major muscle groups on 2 or more days a week. Increasing automation and labor-saving devices over the past several decades in the home, on the job, and in the community must have resulted in ever-decreasing daily energy expenditure. Moreover, during the past 15 years, there has been a marked

increase in the prevalence of *passive* leisure-time activity (ie, computer use, TV viewing).Physical inactivity is a substantial and increasing burden on health, mental well-being and economies, making an increase in physical activity levels a global public health challenge. There is a dose-response relationship between the level of physical activity and reduction in the major non-communicable disease risk - the more physically active, the greater the benefits to health.

Functional foods and nutraceuticals may provide a means to reduce the increasing burden on the health care system by a continuous preventive mechanism. One promising avenue to reduce energy intake using functional foods,is through increased satiety. The approach to achieving this goal is to provide foods that increase the sense of fullness and encourage the individual to stop eating sooner, thereby reducing total energy intake

Fiber also reduces energy density since it contributes substantially more to food weight than to caloric content. Dietary fiber intake seems to Affect total energy intake best, with several reports of lower total energy intake with high-fiber v. low-fiber diets. There are several reasons why high-fiber diets are associated with lower food intake. First, high fiber diets may trigger maximal sensory stimulation in the mouth due to the increased need for chewing. High fiber diets also lead to slower gastric emptying and a slower rate of nutrient absorption. Finally, high fiber content reduces the energy density of the overall diet. Regardless of the reason, increasing dietary fiber is generally thought to aid in weight management. Plant foods as medicines are assuming greater importance in the primary health care of individuals and communities in many developed as well as developing countries.

A large number of phytochemicals and bioactive compounds are present in foods of plant origin. The synergistic effects rendered by a combination of bioactive compounds present in source materials and the complementary nature of phytochemicals from different sources are important factors to consider in the formulation of functional foods and in the choice of a healthy diet. Good nutrition,

physical activity, and a healthy body weight are essential parts of a person's overall health and well-being.

Therefore with the view to providing wholesome foods with bioactive ingredients that help to control or stabilize body weight were included for preparing the supplement to provide combined effects. It is well known that one or more component may have a beneficial effect singly, synergistically or additively with other active components. The genetic makeup of individuals makes them unique with regard to the response to certain intervention. Hence the present study was undertaken with the aim of providing a holistic approach to prevent obesity right from young age. The metabolic and endocrine functions are greatly influenced by composition of diet can affect. Hence the present study was undertaken with the aim of providing a holistic approach to treat and prevent obesity

The specific objectives of the study are: To

- Establish association between etiology, body composition measures and anthropometry among young adults.
- Conduct gene analysis and find the association of PPAR Gamma polymorphism in obesity.
- Evaluate the impact of interventions on body composition, anthropometry and PPAR Gamma polymorphism.
- Explore the relation between body composition, lipid profile, physical activity and genetic polymorphism.