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INTRODUCTION

Big fat express the truth about diet, exercise and obesity
You give what you eat, Fight against obesity

The prevalence of obesity is rising globally and in India. Overweight, obesity and related diseases need to be delineated in Asian Indian women. Women have higher prevalence of overweight and obesity as compared with men in India and that obesity are increasing in the youth (Chopra *et al*., 2013). Overweight and obesity have reached epidemic proportions globally. According to the recent estimates in 2010, approximately 1.0 billion adults were overweight and 475 million were obese (IOTF, 2010).

Overweight and obesity are the fifth leading risk for global deaths. At least 2.8 million adults die each year as a result of being overweight or obese. Sixty five per cent of the world's population live in countries where overweight and obesity kills more people than underweight (WHO, 2013). Most studies show an increase in mortality rates associated with obesity. Individuals who are obese have a significantly increased risk of death from all causes, compared with healthy weight individuals (BMI 18.5 to 24.9), and most of this increased risk is due to cardiovascular causes which may lead to death.

Obesity results when too much fat accumulates in the body. A person is normally considered obese when his or her weight is 20 per cent over the normal body-weight for height, age and the Body Mass Index (BMI) measures 30 or more (WHO 2013). Obesity has now become an important health problem in developing countries particularly in India which is currently experiencing a rapid epidemiological transition. The epidemiological transition has its positive side in that it has resulted in an increased life expectancy and a decrease in infant mortality rates and deaths.

Obesity is a leading preventable cause of death worldwide, with increasing prevalence in adults and children, and authorities view it as one of the most serious public health problems of the 21st century (Barness *et al*., 2008). Obesity is stigmatized in much of the modern world (particularly in the Western world), though it was widely perceived as a symbol of wealth and fertility (Woodhouse, 2008). Data from the National Health and Nutrition Examination Survey, 2009–2010 reveals that more than one-third of adults and almost 17 per cent of youth were obese in 2009–2010. There was no change in the prevalence of obesity among adults or children from 2007–2010. Obesity prevalence did not differ between men and women. Adults aged 60 and over were more likely to be obese than younger adults. National Center for Health Statistics (NCHS, 2008) data reveals that the prevalence of obesity increased from 13.4 to 35.1 per cent in U.S. adults age 20 to 74 (Cynthia *et al.,* 2008)

It was not until the 20th century that obesity became common. In 1997 the World Health Organization (WHO) formally recognized obesity as a global epidemic (Caballero, 2007). As of 2005 WHO estimates that at least 400 million adults (9.8 per cent) were obese with higher rates among women than men. As of 2008, The World Health Organization claimed that 1.4 billion adults, aged 20 and older, were overweight and of these over 200 million men and nearly 300 million women were obese. The WHO also predicted that by 2015, 2.3 billion adults will be overweight and more than 700 million will be obese.

The world today is more affluent than it ever was; this means that more people have access to a multitude of dietary options. People now-a-days are also less active than their predecessors, however the calorific content of their diet hasn't decreased; instead it has increased. Diets around the world have drastically changed; we have transitioned from a high-protein, low-fat diet to a high-carbohydrate, high-fat diet *(*www.obesitysurgeryindia.com*).*

Industrialization and urbanization which lead to rise in standards of living, also promote weight gain and obesity rates begin to rapidly rise thus posing a

growing threat to the health of the nation. Now recognized as a serious medical problem, obesity affects about 30 per cent of adults, and about 14 per cent of children and adolescents in the United States.

As per NCHS (2010), rising obesity rates in the United States are not only a serious public health challenge but a critical economic issue as well. Over the past half century, the percentage of Americans who are obese or extremely obese has been on a pronounced upward trajectory. In 1961 about 14.3 per cent of the public was obese or extremely obese; by 2008 more than 40 per cent fell into these categories**.**

Obesity is associated with over 112,000 excess deaths due to cardiovascular disease, over 15,000 excess deaths due to cancer, and over 35,000 excess deaths due to non-cancer, non-cardiovascular disease per year in the U.S. population, relative to healthy-weight individuals (www.providence.net.com).

The United States will continue to hold the highest population of those with obesity, with 81 million people estimated to be overweight and 113 million obese by 2022. This will be followed by Brazil, with 64 million cases of being overweight and 26 million obese people by 2022. It is estimated that 2.8 million people in the world die each year due to obesity and its associated conditions (www.rnrmarketresearch.com).

Morbid obesity affects 5 per cent of the India's population in the 21st century. India is following a trend of other developing countries that are steadily becoming more obese. Unhealthy, processed food has become much more accessible following India's continued integration in global food markets. Indians are genetically susceptible to weight accumulation especially around the waist.

Unlike most complications, obesity doesn't have a single cause; there are several. Recent research by Tirosh *et al*. (2011) opine that the rise in obesity is primarily due to altered sedentary lifestyles, energy-dense diets and low-levels of

physical activity. An elevated BMI during adolescence strongly associates with the risk of developing obesity-related disorders later in life.

Cardiovascular and other chronic diseases are becoming the major causes of morbidity and mortality in most of the countries including India, especially in the southern Indian States. A study by Suganthan *et al*., (2008) state that various behavioural risk factors namely smoking, unhealthy diet, stress at home and work place, consumption of alcohol, sedentary life style, *etc*., are known to be risk factors for many such diseases.

India is currently passing through an epidemiological transition due to rapid urbanization coupled with economic growth (Jagadesan *et al*., 2010). This could have major implications on the present and future disease patterns in India, with particular reference to an increase in prevalence of non-communicable diseases (NCDs) like obesity, diabetes, and coronary artery disease.

Childhood obesity is a forerunner of obesity in adulthood, which in turn has a strong association with Non Communicable Diseases (NCD's) such as Type II diabetes and cardiovascular disease (Jeemon *et al.,* 2009). Obesity is a serious challenge, because malnutrition and stunted growth often coexist, and there is thus a double burden of underweight and overweight among Indian children and adolescents. The prevalence of obesity in 5 to 12 year old children in New Delhi, India, increased from 16 per cent to 24 per cent from 2002 to 2007, while the overall prevalence of overweight/obesity in urban children in New Delhi increased from 16 per cent in 2002 to 24 per cent in 2006–2007. (Bhardwaj *et al*., 2008).

The World Health Organization predicts that overweight and obesity may soon replace more traditional public health concerns such as under nutrition and infectious diseases as the most significant cause of poor health. In the developing world urbanization is playing a role in increasing rate of obesity. World trends in active leisure time physical activity are less clear. The World Health Organization indicates people worldwide are taking up less active recreational pursuits (WHO, 2008).

Obesity negatively impacts the health of women in many ways. Women being overweight or obese increase the relative risk of diabetes and coronary artery disease. Women who are obese have a higher risk of low back pain and knee osteoarthritis. Abdominal obesity may be more harmful in women than BMI or weight alone (Teresa *et al*., 2011).

A sedentary lifestyle plays a significant role in obesity. Worldwide there has been a large shift towards less physically demanding work, and currently at least 60 per cent of the world's population gets insufficient exercise. This is primarily due to increasing use of mechanized transportation and a greater prevalence of labour-saving technology in the home (Ness and Apovian, 2006). Obesity is an independent risk factor for the development of Coronary Artery Disease (CAD) in women and is an important modifiable risk factor for prevention of CAD. The mechanism of action is likely the relationship between obesity and insulin resistance (Weiss, 2009).

Genetic risk factors influence energy metabolism and makes some individuals susceptible to weight gain and obesity. Even with genetic susceptibility, however, a nutritious diet and regular physical activity enable maintenance of a healthy weight. Heredity influences the distribution of fat tissue. Generally, heavy newborns grow into heavy adolescents, more so when either parent is overweight. Moreover, weight regulation in the human body depends upon various genetically determined factors such as hormones. Any abnormality in these factors could result in substantial weight gain. Almost 60 per cent of obese people are said to have inherited this condition. There are several genetic conditions that also contribute or lead to weight gain (Bujjirao and Ratna Kumar 2013).

Loos and Bouchard (2008), states that some people are genetically predisposed to obesity due to hormonal imbalance or glandular problems. Cushing syndrome, hypothyroidism, hypogonadism in men and polycystic ovarian syndrome in women, hypothalamic lesions like tumours, infections or severe trauma are some of the genetic causes that are known to lead to obesity.

Like many other medical conditions, obesity is the result of interplay between genetic and environmental factors. Polymorphisms in various genes controlling appetite and metabolism predispose to obesity when sufficient food energy is present. As of 2006 more than 41 of these sites have been linked to the development of obesity when a favourable environment is present (Poirier *et al.,* 2006).

Certain drugs are now known to accelerate weight gain such as corticosteroids, sulfonylureas for diabetes, steroidal contraceptives and anticonvulsants for epileptic therapy (Strychar, 2006). Antipsychotics, anti-depressants, mood stabilizers like lithium are also known to possess the same properties. The risk of overweight and obesity is higher in patients with psychiatric disorders than in persons without psychiatric disorders. (Chiles and Wattum, 2010).

Green tea brings a wide range of health benefits, and one of the major benefits is that it can help with weight loss. It has been proven that green tea can help the body burn calories and fats (www.fitday.com). Moreover, the consumption of empty-calorie foods like alcohol, aerated drinks, candies etc. has also risen sharply. All this, coupled with a sedentary lifestyle, makes the ideal combination for susceptibility to obesity and diabetes.

A Study by Chiolero *et al*., (2008) reveals that smoking has a significant effect on an individual's weight. Those who quit smoking gain an average of 4.4 kilograms (9.7 lb) for men and 5.0 kilograms (11.0 lb) for women over a period of ten years. However, changing rates of smoking have had little effect on the overall rates of obesity.

Bell and Zimmerman (2010), opines that shortened sleep duration in early life is a modifiable risk factor with important implications for obesity prevention and treatment. Insufficient night time sleep among infants and preschool-aged children may be a lasting risk factor for subsequent obesity. According to Vergara *et al.,* (2010), there is a relationship between the weight status, fruit and vegetable consumption and soda drink intake of children and those of their parents.

Apart from total body fat mass, accumulating data suggest that regional fat distribution also substantially affects the incidence of co-morbidities associated with obesity. High abdominal fat content is strongly correlated with worsened metabolic and clinical consequences of obesity. As a result, android obesity, which is predominantly abdominal and has a relatively peripheral distribution, is more predictive of adipose-related co-morbidities than gynecoid obesity (Wijga *et al*., 2010).

Obesity burdens the health care system, strains economic resources, and has far reaching social consequences. The disease is associated with several serious health conditions including Type 2 diabetes mellitus, heart disease, high blood pressure and stroke. It is also linked to higher rates of certain types of cancer. Obesity is an independent risk factor for heart disease, hypoxia, sleep apnea, hernia, and arthritis (Laren, 2008).

Obesity is considered to be the link between insulin resistance and metabolic abnormalities inclusive of diabetes, hypertension and dyslipidaemia, all of which are risk factors for coronary artery disease. In the recent INTER HEART study, abdominal obesity assessed by waist-to-hip ratio showed a strong association with myocardial infarction (Mohan and Deepa, 2006).

According to James (2008), obesity increases the likelihood of various diseases, particularly heart disease, Type 2 diabetes, obstructive sleep apnea, certain types of cancer, and osteoarthritis cases. Obesity is most commonly caused by a combination of excessive food energy intake, lack of physical activity, and genetic susceptibility, although a few are caused primarily by genes, endocrine disorders, medications or psychiatric illness.

Obesity is thought to be the primary cause of Type 2 diabetes in people who are genetically predisposed to the disease. Globally as of 2010, it was estimated that there were 285 million people with Type 2 diabetes making up about 90 per cent of diabetes cases. This is equivalent to about 6 per cent of the world's adult population. Diabetes is common both in the developed and the developing world

(Meetoo *et al.,* 2007). It remains uncommon, however, in the underdeveloped world. Women seem to be at a greater risk as do certain ethnic groups.

Obesity-related hypertension may be a distinct hypertensive phenotype with distinct genetic determinants (Theodre and Kotchen, 2010). Mechanisms of obesity-related hypertension include insulin resistance, sodium retention, increased sympathetic nervous system activity, activation of rennin, angiotensin, aldosterone and altered vascular function. In overweight individuals, weight loss results in a reduction of blood pressure (Kotsis *et al*., 2010)**.**

The saying 'prevention is better than cure' holds true in the case of obesity also. While many genetic factors that may cause obesity are beyond a person's control. The other factors that prevent obesity are through education, knowledge, a good diet, and exercise. Children taught with healthy eating, exercise and awareness of the dangers associated with obesity is highly likely that they will carry this knowledge and these behaviours into their adulthood and avoid obesity (www.obesitytopics.com).

A variety of treatments exist for obesity includes diet and behaviour therapy, medicine and surgery. The treatments usually depend on the levels of BMI, while others may be an individual choice. While diet therapy involves a prescribed diet and exercise plan, behaviour therapy teaches new behaviours that promote weight loss. If a person's condition demands so, a doctor may recommend a combination of both. For a person having a BMI of more than 40 accompanied by serious medical problems, doctors usually recommend gastrointestinal surgery (Erkila *et al*., 2005).

The American Association of Cereal Chemists (AACC) has defined soluble fibre this way “Dietary fiber is the edible parts of plants or analogous carbohydrates that are resistant to digestion and absorption in the human small intestine with complete or partial fermentation in the large intestine”. Dietary fiber includes polysaccharides, oligosaccharides, lignin and associated plant substances (www.aaccnet.org). Dietary fibers promote beneficial physiological effects including

laxation, and/or blood cholesterol attenuation, and/or blood glucose attenuation (Lattimer and Haub, 2010).

Dietary fibre consists of non-starch polysaccharides such as arabinoxylans, cellulose, and many other plant components such as resistant dextrins, insulin, lignin, waxes, chitins, pectins, beta-glucans, and oligosaccharides (USDA, 2009).

Dietary fibre and whole grains contain a unique blend of bioactive components including resistant starches, vitamins, minerals, phytochemicals and antioxidants. As a result, research regarding their potential health benefits has received considerable attention in the last several decades. Epidemiological and clinical studies demonstrate that intake of dietary fiber and whole grain is inversely related to obesity, Type 2 diabetes, cancer and cardiovascular disease (Lattimer and Haub, 2010).

Oats, known scientifically as *Avena sativa*, a hardy cereal grain is able to withstand poor soil conditions in which other crops are unable to thrive. Oats gain part of their distinctive flavour from the roasting process that they undergo after being harvested and cleaned (Erkila *et al*., 2005). Although oats are then hulled, this process does not strip away their bran and germ allowing them to retain a concentrated source of their fiber and nutrients.

The polyphenols contained in outer layers of whole-wheat can be consumed on a regular basis. The consumption of whole-wheat flour, which contains polyphenols, is expected to possibly prevent metabolic disorders such as diabetes, obesity, and the metabolic syndrome (AIST, 2013).

Alterations in the composition of gut microbes have been proposed to contribute to the development of obesity, thereby supporting the potential interest of nutrients acting on the gut microbes (Neyrinck *et al*., 2012). Non-digestible fermentable carbohydrates present in cereals influence the gut microbiota composition.

Ayurveda's understanding of obesity is different from modern medicine or any other systems of medicine. In Ayurvedic medicine, there is no single approach to treat obesity. Depending on the Prakriti the medications, purification therapies and diet varies. Usage of Barley, Green gram, Red gram and Horse gram is recommended for obesity treatment (www.health.sify.com).

In 2010, the Department of Health and Ageing (DOHA) in Australia promotes healthy eating plans, increased physical activity and behavioural modification as the first approach to manage obesity for individuals, bringing about a range of health benefits. As per WHO (2013) nutrition and physical activity jointly is essential for prevention and treatment of overweight and obesity. Because of its complex etiology, no single approach to weight management is adequate. Considering that obesity is difficult to reverse and that weight reduction and maintenance of weight loss are complex tasks, emphasis should be on lifelong prevention through good nutrition and physical activity.

Recent data from Mark and James (2008) recommends that including oats and oat-based products as part of a lifestyle management program may confer health benefits that extend beyond total cholesterol and low-density lipoprotein cholesterol reductions. Study by Leila *et al*., (2011) reveal that the weight-reducing diet resulted in significant change in triglycerides, systolic blood pressure and weight among men and women.

People who are obese tend to have energy-dense diets. High fibre foods, such as wholegrain breads and cereals, can be an effective part of any weight loss program. They take longer to digest and create a feeling of fullness, which discourages overeating. They also help to lower the energy density of the diet. Whole grains are also naturally low in saturated fat and contain beneficial polyunsaturated fatty acids, including omega 3 fatty acids (www. fitnessanddietdetails.com).

A study by Liu and colleagues concluded that weight gain in 74,091 US nurses between 1984 to 1996 was related to the intake of refined grain products

(like white bread, white pasta). Women who consumed more fibre and whole grain products consistently weighed less than did women who consumed less whole grains (www.apjcn.nhri.org).

Beta glucan (β-glucan) is a soluble fibre readily available from oat and barley grains has been gaining interest due to its multiple functional and bioactive properties. The fermentability of β-glucans and their ability to form highly viscous solutions in the human gut may constitute the basis of their health benefits. Consequently, the applicability of β-glucan as a food ingredient is being widely considered with the dual purposes of increasing the fiber content of food products and enhancing their health properties (Khoury *et al*., 2012).

The Food and Drug Administration (FDA) has approved two health claims for dietary fibre. The first claim states that, along with a decreased consumption of fats (<30per cent of calories), an increased consumption of dietary fibre from fruits, vegetables and whole grains may reduce some types of cancer.

Dietary fibre consists of many different constituents; some are of particular interest and include arabinoxylan, inulin, β-glucan, pectin, bran and resistant starches. These individual components of dietary fibre have been shown to significantly play an important role in improving human health.

Recent studies by Moura *et al.,* (2009) support this inverse relationship between dietary fiber and the development of several types of cancers including colorectal, small intestine, oral, larynx and breast. First dietary fiber resists digestion in the small intestine, thereby allowing it to enter the large intestine where it is fermented to produce short chain fatty acids which have anti-carcinogenic properties. Second, since dietary fiber increases faecal bulking and viscosity, there is less contact time between potential carcinogens and mucosal cells. Third, dietary fiber increases the binding between bile acids and carcinogens. Fourth, increased intake of dietary fibre yield increased levels of antioxidants. Fifth, dietary fiber may increase the amount of oestrogen excreted in the faeces due to an inhibition of oestrogen absorption in the intestines.

Epidemiological and clinical studies of Tucker and Thomas (2009) demonstrate that consumption of dietary fiber and whole grain is inversely related to obesity, Type 2 diabetes, cancer and cardiovascular disease. Fiber does not bind to minerals and vitamins and therefore does not restrict their absorption; rather evidence exists that fermentable fiber sources improve absorption of minerals, especially calcium. The advantages of consuming soluble fiber is the production of healthful compounds during the fermentation stages and the advantage of insoluble fiber are to increase bulk, soften stools, and shorten transit time through the intestinal tract (Health Zest 2013).

More recent studies found interesting data illustrating that for every 10 g of additional fibre added to a diet the mortality risk of Coronary Heart Disease (CHD) decreased by 17 to 35 per cent. Risk factors for CHD include hypercholesterolemia, hypertension, obesity and Type 2 diabetes (Ito *et al.,* 2011).

Bran is the outer most layer of a cereal grain and consists of the nuclear epidermis, seed coat, pericarp and aleurone. The aleurone consists of heavy walled, cube shaped cells which are composed primarily of cellulose. It is low in starch and high in minerals, protein, and fat. However, due to its thick cellulosic walls, these nutrients are virtually unavailable for digestion in monogastric species.

The AACC defines oat bran as the food which is produced by grinding clean oat groats or rolled oats and separating the resulting oat flour by sieving bolting, and/or other suitable means into fractions such that the oat bran fraction is not more than 50 per cent of the original starting material and has a total beta glucan content of at least 5.5 per cent (dry-weight basis) and a total dietary fibre content of at least 16.0 per cent (dry-weight basis), and such that at least one-third of the total dietary fiber is soluble fiber.

Bran from a wide array of cereal grains have been shown to have an effect on postprandial glucose levels, serum cholesterol, colon cancer, and body mass. In a recent study of healthy adults, 31 g of rye bran decreased peak postprandial glucose levels by 35 per cent when compared to the control (Ulmius *et al*., 2009).

This effect may be due to the high Arabinoxylan content in bran. It may increase intestinal viscosity and slow nutrient absorption.

Study by Banerjee *et al*., (2004) suggests that bran did not delay nutrient absorption in the small intestine but hindered it. In addition to a possible effect on carbohydrate absorption and metabolism, bran also seems to have the same effect on lipids. In a long term clinical study, Jensen *et al., (*2004) reported that an increased daily consumption of bran significantly decreased the risk of coronary heart disease in healthy adult men.

A study from the National Institute of Advanced Industrial Science and Technology (AIST, 2013) reveals that the consumption of whole-wheat flour containing polyphenols is expected to possibly prevent metabolic disorders such as diabetes, obesity, and the metabolic syndrome.

The reduction in serum triglyceride levels may be a result of a decreased absorption of fat from the small intestine (Mozaffarian *et al*., 2011). Specific dietary and lifestyle factors are independently associated with long-term weight gain, with a substantial aggregate effect and implications for strategies to prevent obesity.

Green tea contains high levels of polyphenols, which are supposed to have a number of positive health effects in the prevention of lifestyle-related diseases including cardiovascular disease and carcinogenesis. Tea catechins are also thought to be useful as antiobesity compounds (Klaus *et al.,* 2005). The key to success is to achieve an energy balance between calories consumed on one hand, and calories used on the other hand (www.who.int).

Limited energy intake, limit intake of sugars, increase consumption of fruit and vegetables, as well as legumes, whole grains and nuts from total fats and shift fat consumption away from saturated fats to unsaturated fats. To increase the amounts of calories used, at least 30 minutes of regular, moderate-intensity activity was recommended on most days (Mathus and James, 2011).

As per WHO (2013), physical inactivity is the fourth leading risk factor for global mortality. Increasing levels of physical inactivity are seen worldwide, in high-income countries as well as low- and middle-income countries. However, given a supportive environment, increasing levels of physical activity bring health benefits across age groups. WHO provides recommendations for the optimal amounts of activity, doing some physical activity is better than doing none.

WHO has developed the 2008-2013 action plan for the global strategy for the prevention and control of non-communicable diseases to help the millions who are already affected cope with these lifelong illnesses and prevent secondary complications. This action plan aims to build on, the WHO Global Strategy on diet, physical activity and health. The action plan provides a roadmap to establish and strengthen initiatives for the surveillance, prevention and management of NCD's (www.who.int/mediacentre).

Obesity should be recognised as a disease and treated accordingly, because it increases the risk of several diseases. Weight loss (5 to15per cent of the body weight) in obese individuals reduces the risk factors associated with obesity (Curoini and Lourence, 2005).

Lifestyle-related factors, such as dietary habits, sedentary behaviour and physical activity play an important role in creating an obesogenic environment. In Saudi Arabia and other countries in the Eastern Mediterranean region, the pattern of food consumption has changed enormously over the past four decades (Popkin *et al.,* 2012).

Overweight and obesity exhibited significant associations with less frequent vigorous physical activity, and less frequent consumption of breakfast, vegetables and sugar-sweetened beverages (Musaiger *et al.,* 2012). A better understanding of the relationships between obesity and lifestyle factors is necessary for effective prevention and management of obesity.

According to yoga theraphy, obesity is related to lifestyle behind all kinds of mental and physical illness. The way the life determines, susceptibility to the

different causes of disease, whether physical, chemical or infectious agents, immunological reactions, genetic, environmental or nutritional imbalances (www.yogamag.net).

Among the several strategies for obesity treatment, diet and exercise are considered useful for losing weight in moderately obese adults. However, it seems that even losing weight with these approaches, most obese individuals do not maintain the loss for long periods. Unfortunately, there are no accepted rules to guide interventions promoting behaviour and lifestyle changes for an effective and permanent weight loss (Curioni and Lourenco, 2005).

Hence the present study on "**Obesity related health risks and its impact on dietary intervention and life style modification**" is framed and carried out with the following objectives

- Elicit information on demographic profile, dietary and lifestyle pattern of the selected obese subjects
- Assess the nutritional status of the obese subjects
- Impart knowledge through health and nutrition education campaign
- Create awareness on the need for lifestyle modification
- Dietary intervention and lifestyle modification among obese women
- Evaluate the impact of interventions through various parameters

It is hoped that this study will bring to lime light the effect of selected high fiber mix on obesity by scientific validation and by proving its therapeutic efficacy. This may help the obese subjects to control their metabolic disorder without any side effect.