INTRODUCTION

“Let food be your medicine and medicine your food” said Hippocrates about 2500 years ago. This aptly holds good for the present generation where mankind is ravished with diseases related to dietary irregularities and sedentary lifestyle that are taking a toll on the human race by increasing the incidence of degenerative diseases like Type 2 Diabetes Mellitus, Cardio vascular disorders and Hypertension.

Type 2 diabetes is one of the major public health challenges of the 21st century. Today there is a significant change in the lifestyle of people owing to the rapid industrialization, improved socio-economic status, enhanced health facilities and increased life expectancy. Economic affluence coupled with sedentary lifestyles and changing food patterns are contributing to several chronic degenerative diseases such as diabetes mellitus, cardiovascular diseases, cancer, etc. Diabetes mellitus is a silent disease and is now recognized as one of the fastest growing threats to public health in almost all countries of the world. Around 150 million people suffer from diabetes in the world, of which above 35 million are Indians, the highest number in any country. Diabetes is on an increase in India. The revised World Health Organization figures for the year 2025 is 57.2 million diabetics, the chief reason being urbanization and life style, besides heredity, race, age, nutritional status, stress, altered immune function, altered physiological and metabolic status, drugs and hormones. Within the allotted span, India shall also have the dubious distinction of having the maximum number of diabetics in the world. Western data suggests that Indians are more centrally obese at a given level of body mass index compared to white Caucasians and that Indians are more insulin resistant even at lower levels of body mass index. It is a fearful scenario for India since it has to tackle twin problems of communicable and non-communicable diseases in the next millennium.
Diabetes is an endocrine disorder which is characterized by a deficiency of and/or resistance to the hormone insulin. Insulin is produced in the beta-cells of the pancreas and is an important regulator of the glucose metabolism. Insulin is responsible for the uptake and storage of glucose from the blood and thereby reduces blood glucose levels. If the glucose metabolism is disturbed, hypoglycemia (low blood glucose levels) or hyperglycemia (high blood glucose levels) might occur. In addition, insulin plays an important role in fat and protein metabolism.

Type 2 diabetes (DM2) (and insulin resistance) usually develops in the obese adult, and the risk for type 2 diabetes is closely associated with the body mass index (BMI). Conversely, weight loss clearly reduces the risk for DM2 in obese subjects and can result in a marked improvement of blood glucose levels in obese DM2 patients. Other factors associated with insulin resistance and the development of DM2 are physical inactivity, dietary intake, smoking, age, family history of diabetes and ethnicity. Besides hyperglycemia, DM2 is clearly associated with other cardiovascular risk factors such as dyslipidemia and hypertension.

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. In addition, 44% of the diabetes burden, 23% of the ischaemic heart disease burden and between 7% and 41% of certain cancer burdens are attributable to overweight and obesity. The global age-standardized prevalence of obesity nearly doubled from 6.4% (95% uncertainty interval 5.7-7.2%) in 1980 to 12.0% (11.5-12.5%) in 2008. Half of this rise occurred in the 20 years between 1980 and 2000, and half occurred in the 8 years between 2000 and 2008. The age-standardized prevalence of overweight increased from 24.6% (22.7-26.7%) to 34.4% (33.2-35.5%) during the same 28-year period. (Stevens et al., 2012).

The degree and duration of obesity is associated with many serious health conditions. In addition, obesity represents a risk factor for developing
metabolic syndrome (Bray, 2003). Metabolic syndrome is characterized by a group of several metabolic problems: hypertension, dyslipidemia – high triglycerides, low high density lipoproteins, high low density lipoproteins and hyperglycemia (Bray 2003; ADA, 2010). People with type 2 DM who have some of all of the characteristics of metabolic syndrome are at higher risk of long-term complications.

In Indian Scenario incidence and Prevalence of Diabetes has increased from last decade. India today leads the world with the largest number of people with diabetes in any given country. As depicted in the table below the Prevalence of type 2 diabetes mellitus in India is showing a progressively upward trend.

The International Diabetes federation (IDF) reports that in 2007 there were 46.5 million people in India with diabetes and that this number is expected to go to 80.3million by 2025 (IDF,2006). The IDF estimates that worldwide there were 194 million people with diabetes in 2003 and this will increase to 334 million by 2025.

<table>
<thead>
<tr>
<th>Year</th>
<th>Author</th>
<th>Place</th>
<th>Prevalence (%)</th>
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</thead>
<tbody>
<tr>
<td>1971</td>
<td>Tripathy et al.</td>
<td>Cuttack</td>
<td>1.2</td>
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<tr>
<td>1972</td>
<td>Ahuja et al.</td>
<td>New Delhi</td>
<td>2.3</td>
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<td>1979</td>
<td>Guptha et al.</td>
<td>Multicentre</td>
<td>3.0</td>
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<tr>
<td>1984</td>
<td>Murthy et al.</td>
<td>Tenali</td>
<td>4.7</td>
</tr>
<tr>
<td>1986</td>
<td>Patel JC</td>
<td>Bhadran</td>
<td>3.8</td>
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<tr>
<td>1988</td>
<td>Ramachandran et al.</td>
<td>Kudremukh</td>
<td>5.0</td>
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<tr>
<td>1989</td>
<td>Kodali et al.</td>
<td>Gangavathi</td>
<td>2.2</td>
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<td>1989</td>
<td>Rao et al.</td>
<td>Eluru</td>
<td>1.6</td>
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<tr>
<td>1991</td>
<td>Ahuja et al.</td>
<td>New Delhi</td>
<td>6.7</td>
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<tr>
<td>1992</td>
<td>Ramachandran et al.</td>
<td>Madras</td>
<td>8.2</td>
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<tr>
<td>1997</td>
<td>Ramachandran et al.</td>
<td>Madras</td>
<td>11.6</td>
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<tr>
<td>1998</td>
<td>Shekar Shah et al.</td>
<td>Assam</td>
<td>8.2</td>
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<td>2001</td>
<td>Ramachandran et al.</td>
<td>Madras</td>
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A study by Anjana RM et al., estimates that, in 2011, Maharashtra will have 6 million individuals with diabetes and 9.2 million with prediabetes,
Tamilnadu will have 4.8 million with diabetes and 3.9 million with prediabetes, Jharkhand will have 0.96 million with diabetes and 1.5 million with prediabetes, and Chandigarh will have 0.12 million with diabetes and 0.13 million with prediabetes. Projections for the whole of India would be 62.4 million people with diabetes and 77.2 million people with prediabetes.

Dietary modification, weight control, and regular exercise are the main approaches in the management of diabetes, diet being the sheet anchor. Because the risk of developing long term complications can be dramatically reduced with appropriate glycemic control, food ingredients that can attenuate postprandial glucose in persons with diabetes would be useful. New research findings in this area indicate the potential value of diets in prevention of such disorders. In fact, the preventive role of corrective nutrition is an ever evolving process. Currently, the challenge is to identify hypoglycemic diet supplements to control blood glucose levels.

Rapid urbanization involving changes in occupation patterns, life styles, family structures and value system reflected as changes in practices and in the level of physical activity. A large shift from consumption of coarse grains such as sorghum, barley, rye, maize and Millet to more refined cereals, like polished rice and wheat is seen especially among the urban population and higher income groups (Poongodi and Jemina, 2009). Minor millets are claimed to be future foods for better health and nutrition security. In the recent years, they are recognized as important substitutes for major cereal crops to cope up with the world food shortage and to meet the demands of increasing population of both developing and developed countries (Veena et al., 2004). India produces nearly 17.7 million tons of millet annually, amounting to 40% of its global production.

It is also termed as ‘nutricereal’ in view of its good nutritional specialties such as complex carbohydrates, high proportion of dietary fibre and other of phytochemicals with nutraceutical qualities. However, it has remained as the food for poor and traditional consumers because of non-availability of
ready-to-use or ready-to-eat convenience food products from the millet and also the limited efforts made to diversify its food uses by application of traditional and contemporary food-processing methods. They are used in several forms such as in preparation of rice, porridges, laddu, nippattu, maldi, annam, muruku, karappawosa, ariselu, sangatti and roti (Pushpamma and Chittemma Rao, 1981 and Geetha et al., 1994). Minor millets are a group of grassy plants with short slender culm and small grains possessing remarkable ability to survive under severe drought.

Minor millets are high energy, nutritious foods comparable to other cereals and some of them are even better with regard to protein and mineral content. They are particularly low in phytic acid and rich in dietary fibre, iron, calcium and B vitamins. As the millets are consumed by the poor, they guard them against food and nutritional insecurity imposed by various agronomic, socio economic and political factors. Minor millets can thus act as a shield against nutritional deficiency disorders and provide nutritional security. The nutritive value of millets is comparable to other staple cereals like wheat and rice. Some of the millets are nutritionally better than common cereals in protein, fat and mineral contents.

Glycemic index (GI) of food stuff is the blood glucose response after consumption in comparison with glucose as a reference food. Since the introduction of glycemic index concept, many studies have shown potential benefits of low GI foods. The low GI foods reduce hunger and increase satiety (Miller, 1993). Improvement in insulin sensitivity has also been reported with the consumption of low GI foods. The prolonged absorption of carbohydrate after the consumption of low GI foods help in lowering the blood glucose concentration (Salmeron et al., 1997 a and b and Frost et al., 1999). Studies have indicated advantages of inclusion of low GI foods in both diabetics and nondiabetics to lower the fasting blood glucose (Lawes et al., 2004).
The potential health benefits of dietary fibre have been demonstrated almost four decades ago by Burkitt et al., (1972). It was reported that dietary fibre reduces intestinal transit time, provides fecal bulk and in turn prevents constipation. Thus, it helps in providing protection against duodenal ulcers and colorectal cancers (Nyman and Asp, 1982). Millets have been reported to be the rich sources of dietary fibre (Wisker et al., 1985). Resistant starch (defined as any starch that escapes digestion in small intestine) was also reported to exhibit a wide range of health benefits such as lowering caloric density and low glycemic response (Jenkins et al., 1982 and Ring et al., 1988). It was also reported to lower digestibility and act as a fecal bulking agent (Ranhotra et al., 1991). Minor millets, with their low carbohydrate content, low digestibility and water soluble gum content (β-glucan) have been attributed to improve glucose metabolism. These grains release sugar slowly in the blood and also diminish the glucose absorption (Chen et al., 1984 and Anderson et al., 1991). The dietary fibre and resistant starch of minor millets have been attributed to exhibit hypoglycemic and hypolipidemic effects (Mani et al., 1993, Slavin and Dwyer, 1994, Krishna Kumari and Thayumanavan, 1997 and Pathak and Srivastava, 1998).

ADA 2008, guidelines reported that Diet alone cannot do magic Diabetes education plays an important role in management of type 2 diabetes and also in prevention of further complication which involves physical activity, self-management and knowledge on diabetes. Self-management in diabetes goes beyond medication adherence. Self-management consists of behavioural, cognitive, and emotional responses to a constantly changing state of one’s condition (Barlow, Wright, Sheasby et al., 2002). On a behavioural level, specific meal planning and sufficient physical activity are highly important self-management behaviours Additionally, diabetics have to take their medication as described and patients have to adapt their medication dose or time schedule to specific daily circumstances. What is most difficult is finding the optimal balance between food intake, physical activity and medication
effects (Bonnet, Gagnayre, and d'Ivernois, 2001). Furthermore, diabetics have to monitor their condition either hypo or hyperglycemia along with proper diet therapy and physical activity.

Physical activity has been identified as an integral part in primary prevention of type 2DM in high risk people and in secondary prevention of associated complications in people already diagnosed with diabetes. Physical activity contribute to improve insulin sensitivity, decrease blood glucose and blood pressure level, weight loss, reduce triglycerides and cholesterol, increase muscle tone, improve circulation, stress relief and well-being feelings (ADA, 2008).

Mainly, Disease acceptance is important but difficult; when people are diagnosed with diabetes, they are confronted with a chronic illness which most often cannot be cured and lifelong disease management is required. Moreover, patients should deal effectively with their environment. Getting social support and finding optimal ways to communicate with health care professionals is also part of self-management. Hence an collaborative effort is required in the management of Type 2 Diabetes, an Nutritionist, Diabetes Educator and a physician along with patient and their family support Diabetes can be prevented and if diabetics then its helps in management and avoid further associated complications.

**Origin of Research Problem**
The incidence of diabetes has rapidly increased in the last 20 years and has become a national and global epidemic. It is a risk factor for other chronic diseases such as cardiovascular disorder, cancer, stoke and hypertension. Obesity is the main cause for diabetes. Although the characterization of several important obesity genes over the past 10years has resulted in a quantum leap of insight into the pathophysiology of obesity.
Firstly food industry and media is heavily promoting Soy food, Oats, American Rye and many more products of the same for variety of conditions including prevention of diabetes, prevention and treatment of osteoporosis and as a cholesterol lowering agent for the prevention of Cardiovascular disorder without much scientific evidence.

Secondly today’s sedentary lifestyle and addiction to highly saturated and fast foods are galloping the youth’s, who are prone to degenerative diseases in later stage of life. Hence, India has become a capital for Diabetes.

To combat this issue a traditional health benefit product for quicker consumption and economically affordable is needed which is designed with research evidence with value added benefits and economically affordable (traditionally used product) which is grown in our own country is been introduced.

Hence, an attempt is made to promote our traditional crops as they are a nutrient store house with therapeutic values. In the present study, effort is made to see the effect of these millets in management of glycemic control in Type 2 Diabetes.

1.2 Aims and objective

Aim: To study the influence of Minor millet along with education intervention in management of Type 2 Diabetes Mellitus.

Brief objective of the Study:

1.2.1 Main Objective

- The objective of the study is to evaluate the effect of minor millets in management of type 2 Diabetes by providing 4 exchanges of minor millets (Finger millet / Ragi, Sorghum / Jowar, Foxtail millet / navanae, Pearl millet / Sajjae) in any of the meal in a day’s menu.
• To evaluate the effect of Diabetes education in Management of type 2 Diabetes by providing diabetes intervention programme.

1. Control group consuming normal diabetic diet with no millet incorporation and with very negligible to no knowledge on Diabetes.

2. Experimental group consuming any one among the 4 minor millets in a day’s menu (4 exchanges in any of the meal) along with Diabetes intervention programme using education modules, for 4 months with weekly review.

1.2.2 Specific Objective

To study the following:
• Dietary intake.
• Anthropometric measurements
• Biochemical estimations.
• Physical activity pattern.
• Associated diseases and conditions.
• Dietary intervention
• Knowledge level regarding diabetes.

1.2.3 To Suggest:
• Dietary modifications.
• Food supplements-incorporation of demonstrated recipes using minor millets in a day’s menu
• Exercise and physical activity
• Self management
• Diabetes education

1.2.4 Hypothesis

Minor millets and education do not have any influence in the management of Type 2 Diabetes.