MILLETS IN METABOLIC SYNDROME- TIME TO TAP THE POTENTIAL

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ABSTRACT

BACKGROUND

The prevalence of metabolic syndrome, which consists of a group of metabolic abnormalities associated with increased cardiovascular risk has been on the rise in India. Unbalanced dietary habits have contributed to this. The cereal millets have been thought to have beneficial properties in combating this illness. Hence, this study set out to compare the effect of millet versus non-millet-based diets on the parameters of metabolic syndrome.

METHODS

This was a cross sectional study where adults with metabolic syndrome, diagnosed in accordance with the International Diabetes Federation (IDF) criteria were enrolled. Anthropometric data and blood pressure measurements were recorded, followed by determination of fasting (FBS) and postprandial blood sugars (PPBS) and fasting lipid profile. All participants answered a questionnaire regarding their dietary patterns and accordingly were divided into the 'millet based diet group' and 'non-millet-based diet group'.

RESULTS

Of the 142 participants in the study, the millet-based diet group consisted of 69 patients and non-millet-based diet group had 73 patients. The millet based diet group had significantly lower body mass index (26.78 vs. 28.99 Kg/m2, p = 0.08), systolic BP (130.8 vs. 137.8 mmHg, p= 0.023), FBS (113.2 vs. 152.2 mg/dl, p= 0.001), PPBS (122.7 vs. 214 mg/dl, p= 0.001), total serum cholesterol (170.1 vs. 211.2 mg/dl, p= 0.001), serum Low Density Lipoproteins (99.1 vs. 121.1 mg/dl, p= 0.001) and serum triglyceride levels (114.2 vs. 179.8 mg/dl, p= 0.001) and significantly higher HDL (40.7 vs. 36.6 mg/dl, p= 0.021) levels compared to the non-millet based diet group.

CONCLUSIONS

Findings in this study demonstrate the potential benefits of millet consumption and suggest that their incorporation into the diet may help to curb the ever-growing metabolic syndrome pandemic.

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BACKGROUND

It is common knowledge that the incidence of 'lifestyle related disorders' such as type 2 diabetes mellitus, hypertension, dyslipidaemia and obesity have been on the rise in India. There have been tremendous changes in the patterns of physical activity and diet in our country during the past few decades and these have contributed to outbreak of such non-communicable disease 'pandemics'. It is therefore the need of the hour to take action on a large scale in order to reduce the occurrence of these disorders in the general population as well as to enhance the control of these conditions in patients already suffering from them via not just pharmacotherapy, but by promoting healthy lifestyle practices.

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Metabolic syndrome (MS) is a condition characterized by increased insulin resistance and visceral adiposity. The rise in the incidence of metabolic syndrome has been attributed to lifestyle changes such as sedentary habits, increased psychological stress and dietary indiscipline. Changes in dietary patterns may be the one of the most important factors contributing to the increase in the incidence of metabolic syndrome in Asia.[1] In the southern states of India, the staple diet has been based on the cereal rice for many centuries. It is hypothesized that Asians have a higher glycaemic response than Caucasians to processed white rice.[2] Over the past several generations, when the main form of occupation was rigorous farming practice, traditional diets had been low on total caloric intake in which simple carbohydrates served as the main source of fuel. But in modern times, a shift towards a less physically active lifestyle coupled with easy availability and consumption of these mainly rice-based diets may have contributed to the high load of metabolic syndrome patients in India.

There has been growing interest regarding millet-based diet and their positive impact on health in the recent years. The health benefits associated with millet consumption have been known for several years but their impact on metabolic syndrome in the Indian population has been unclear. Hence

in this study, we set out to compare the parameters of metabolic syndrome in patients who consume millet-based diet and in those consuming non millet-based diet.

METHODS

Study Design

Cross sectional study.

Inclusion Criteria

Adults aged 18 years or more of both sexes attending the Ramaiah medical college hospital medicine out-patient department diagnosed to have metabolic syndrome according to International Diabetes Federation (IDF) guidelines after taking informed consent. According to IDF criteria, patients were diagnosed to have MS by the presence of:

Waist circumference in Men ≥ 90 cm & Women ≥ 80 cm (thresholds for south Asians)

Plus

at least two of the following:

1. Triglycerides ≥150 mg/dL or treatment for elevated triglycerides.
2. High density lipoprotein (HDL) cholesterol <40 mg/dL in men or <50 mg/dL in women, or treatment for low HDL.
3. Systolic blood pressure ≥130 mm Hg, diastolic blood pressure ≥85 mm Hg, or treatment for hypertension.
4. Fasting blood sugar (FBS) ≥100 mg/dL or previously diagnosed type 2 diabetes mellitus.

Exclusion Criteria

1. Pregnant women.
2. Pre-existing chronic illnesses associated with anorexia or mal-absorption.
3. Conditions interfering with body weight measurement such as ascites or oedema.

All participants were given a questionnaire regarding their dietary intake patterns in the local language. Clinical examination was done to record their weight, height, body mass index (BMI) and Waist–Hip ratio (WHR). Investigations including Fasting (FBS) and postprandial blood sugar levels (PPBS) by hexokinase method and fasting serum lipid levels by enzymatic colorimetric method were performed. Based on their dietary pattern determined by a food frequency questionnaire, people consuming at least three millet-based meals per week for at least the past 2 years were classified as millet-based diet group and the rest of the participants constituted the non-millet-based diet group.

The study was conducted after obtaining Ethical Committee approval. Qualitative data was analysed by using chi square test while quantitative data was analysed using independent t test using the SPSS 20.0 software.

RESULTS

A total of 142 participants diagnosed to have metabolic syndrome participated in this study and were in turn divided into 2 groups based on their dietary patterns. The group with millet-based diet comprised of 69 patients whereas the non-millet-based diet group had 73 patients. The different characteristics for the participants of the two groups are shown in table 1. The predominant millet in the diet of millet based diet group was ragi (finger millet) in the form of 'mudde' (lumps) or malt, followed by jowar (sorghum) and fox-tail millet, whereas rice followed by wheat ('chapathis') were the basis of diet in members of the non-millet group.

Variables	Mean (Standard Deviation)		p Value
	Millet	Non-Millet	
Age (Years)	50.06	51.3	0.562
Males	39	37	0.486
Low HDL	59	55	0.091
Elevated Triglycerides	14	42	0.000
Hypertension	48	54	0.560
Type 2 Diabetes Mellitus	61	58	0.148

Table 1. Characteristics of The Two Groups

Most participants were residents of rural areas from agricultural background and none of them followed a dedicated physical exercise regime.

In accordance with the IDF criteria for diagnosis of metabolic syndrome, all the selected participants had a high waist circumference, along with presence of at least 2 additional criteria – impaired blood glucose, elevated BP, low HDL and elevated triglycerides or were already being treated for these. The two groups did not differ significantly in these respects with the exception of the number of patients with hypertriglyceridemia that was seen to be significantly higher in the non-millet-based diet group (42 vs. 14, p = 0.000).

Comparison of the two groups with respect to the various parameters of metabolic syndrome revealed that the participants from the millet based diet group had significantly lower BMI (26.78 vs. 28.99 Kg/m^2, p = 0.08) although there was no significant difference between their waist to hip ratios, neither in males (0.942 vs. 0.909, p = 0.138) nor in females (0.910 vs. 0.901, p = 0.141). The millet based diet participants also had lower readings for systolic BP (130.8 vs. 137.8 mm Hg, p = 0.023), fasting blood glucose (113.2 vs. 152.2 mg/dl, p = 0.001), total serum cholesterol (170.1 vs. 211.2 mg/dl, p = 0.001), serum LDL (99.1 vs. 121.1 mg/dl, p = 0.001) and serum triglyceride levels (114.2 vs. 179.8 mg/dl, p = 0.001) as well as having higher HDL values (40.7 vs. 36.6 mg/dl, p = 0.021) compared to the non-millet based diet participants, and these differences were found to be statistically significant. These are Highlighted in table 2.

Parameters of Metabolic Syndrome	Millet Based Diet Mean (± Std. deviation)	Non-Millet Based Diet Mean (± Std. deviation)	p
BMI (Kg/m^2)	26.78 (±5.37)	28.99 (±5.13)	0.08
Waist/Hip Ratio			
Males	0.942	0.909	0.138
Females	0.910	0.901	0.141
Total Cholesterol (md/dl)	170.1 (±33.7)	211.2 (±43.8)	0.001
Diastolic BP (mmHg)	84.43 (±9.84)	86.7 (±10.1)	0.097
Systolic BP (mmHg)	130.8 (±18.2)	137.8 (±22.0)	0.023
Serum HDL (mg/dl)	40.7 (±10.4)	36.6 (±12.0)	0.021
Serum LDL (mg/dl)	99.1 (±28.9)	121.1 (±38.0)	0.001
FBS (mg/dl)	113.2 (±31.4)	152.2 (±56.2)	0.001
PPBS (mg/dl)	122.7 (±40.2)	214 (±107)	0.001
Serum Triglycerides (mg/dl)	114.2 (±50.8)	179.8 (±86.7)	0.001

Table 2. Comparison of The Two Groups with Respect to Components of Metabolic Syndrome

The post prandial blood glucose was also significantly lower in the millet group (122.7 vs. 214 mg/dl, p = 0.001), though none of the participants of the study were made to compulsorily consume a millet-based meal prior to drawing the postprandial blood sample. The diastolic BP was lower in the millet-based diet group, but this was not statistically significant (84.43 vs. 86.7 mm Hg, p = 0.097).

DISCUSSION

In the quest to counter the ever-rising incidence of lifestyle related disorders, several dietary substances considered to be having health related benefits are being explored to be advised as a part of medical nutrition therapy in the management of non-communicable diseases. Such food products have been given the name of 'nutraceuticals'.

The cereal crop Millets, for example finger millets (ragi), jowar and fox-tail millet have been a part of the diet in certain rural areas of south India for many generations and have been thought to have several beneficial properties.

Compared to other cereal crops such as rice, wheat and maize, whole millets are high in protein content, gluten-free, and have lower Glycaemic index (GI). They provide high energy, high dietary fiber, protein with balanced amino acid profile, many essential minerals, some vitamins, and antioxidants. They are also hardy crops that require much lesser amount of water for cultivation.[3]

In the present study, it was observed that patients who consumed millet-based diet, though satisfying the criteria for diagnosis of metabolic syndrome, had a lower BMI than those on non-millet-based diet. Despite this, there was no significant difference in their waist to hip ratios both in the males and females. This was possibly due to the fact that a high waist circumference was an essential inclusion criterion in accordance with the IDF criteria for diagnosis of metabolic syndrome. Several other studies have described a reduction in BMI with millets while failing to show a beneficial effect of millets on waist to hip ratio of patients.[4,5] The reduction in weight and BMI are probably due to appetite suppression as a result of elevated leptin levels in the blood.[5]

It was also noticed that members of the millet-based diet group had lower values of systolic BP. The diastolic BP was also lower in the former group, but this difference fell just short of statistical significance. There have been studies that have found a reduction in systolic and diastolic BP values with millet intake.[4,5] This has been suggested to be due to the combined contributions of high dietary fiber, protein, calcium and potassium content, as well as polyphenols in unprocessed millets in addition to the effect of weight loss. All these components have been shown in several studies to lower BP.[6-10]

The fasting and post prandial blood glucose levels were also significantly lower in the millet-based diet group. Previous studies have described the effect of millets in helping to lower not only the post prandial,[4,5,11] but also the fasting blood glucose[5,12] levels. Millets like finger millets have been proposed to lower glycaemic effect due to the presence of 'anti-nutrients' which reduce starch digestibility and absorption. Finger millet seed coat phenolics and dietary fiber content act as inhibitors decreasing the postprandial hyperglycaemia by blocking the action of enzymes (amylase, alpha-glucosidase) needed for hydrolysis of complex carbohydrates.[13-16] It has also been suggested that intake of millets increases leptin concentrations, which could reduce appetite. Low-grade inflammation characterized by elevated tumour necrosis factor (TNF) α and interleukin (IL) 6 levels, is a common feature in subjects with T2DM that interferes with insulin signalling pathways. It is said that this mild inflammation in diabetics decreases due to the anti-oxidant activity of millets thereby enhancing insulin sensitivity.[5] The reduction in both appetite and inflammation are possibly the factors that help to reduce fasting blood glucose levels.

Finally, the levels of all the serum lipids were significantly better in the millet-based diet group. But the impact of dietary millets on serum lipids has been inconsistent in previous studies.[4,5,17] We also observed that the number of participants with high serum triglyceride levels at inclusion were significantly higher in the non-millet based diet group. Soluble dietary fiber component of the grain reduces reabsorption of bile acids and decrease the LDL cholesterol. Fermented finger millet is said to be a source of metabolites, like statin and sterol. Statin acts as an enzyme inhibitor of the cholesterol biosynthetic pathway whereas dietary sterol helps in reducing serum LDL level without affecting HDL.[18]

The limitations of this study include the fact that the sample size of both groups was small and that this study was conducted on patients seeking medical attention at the hospital rather than on the general population at a community level. Also, the influence of a number of confounding factors for instance physical activity and compliance to medications was difficult to eliminate, something that a study with a larger sample size in the future may better address.

CONCLUSIONS

In today's age, where there is an ever-growing burden of non-communicable diseases, there is a need for measures to be employed on a large scale for the prevention and control of metabolic syndrome. The cereal crop millet holds great potential to be powerful nutraceuticals in combating the metabolic syndrome pandemic.

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