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Recommended Dietary Measures in the Management and Prevention of Type 2 Diabetes Mellitus

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Abstract

Type 2 diabetes has always remained one of the perturbing chronic diseases which cause numerous mortality rates globally. Proper and recommended dieting as well as lifestyle modification has been one of the approach in the treatment of Type 2 Diabetes Mellitus. Adherence to these nutritional approaches from several studies have shown positive results in the delay of the progression of these disease. More so, an increased risk for developing type 2 diabetes is associated with overweight and obesity, physical inactivity and high intake of saturated fats. Therefore, recommended nutritional diets and regular physical activity remains the part and parcel of the management of Type 2 Diabetes Mellitus.

Keywords: Type 2 diabetes mellitus, Physical Activity, Nutritional Diets, Lifestyle Modification, Overweight, Obesity.

INTRODUCTION

Type 2 diabetes mellitus (T2DM) formerly known as non-insulin-dependent diabetes is characterised by dysregulation of carbohydrate, lipid and protein metabolism, which is as result of impaired insulin secretion, insulin resistance or a combination of both. T2DM is mainly caused by progressive impairment of insulin secretion by pancreatic β-cells, usually upon a background of pre-existing insulin resistance in skeletal muscle, liver and adipose tissue.[1] It is estimated that in 2000 there were approximately 150 million individuals with the disease and that the number is likely to double by 2025.[2]

Epidemiological evidence has shown the continues increment of the prevalence T2DM globally due to ineffective prevention and control programmes,[3] also a dramatic change in the incidence and prevalence of T2DM have been seen in communities where there have been major changes in the type of diet consumed especially in Industrialised and developing countries[4] and changes in lifestyle related factors such reduction in Physical Activity.[5] In T2DM, those with complications has been seen to have increased mortality rate, retinal diseases and proteinuria are some of the risk factors. Hyperlipidaemia, hypertension and smoking each contribute disproportionately to death rates among those with T2DM.[6] Increased mortality rates was also found to be increasing with duration of the disease.[7] The majority of cases of type 2 diabetes in the future will occur in developing countries with India and China having more global cases than any other country.[2]

Risk factors responsible for the development of type 2 diabetes mellitus are majorly divided into Modifiable and non-modifiable risk factors, modifiable risk factors which can be modified by lifestyles include Physical inactivity and obesity and non-modifiable risk factors include race, age, familial aggregation, gender and genetic factors.[8] Dietary recommendations often require patients to alter behaviours that have been present for a lifetime, and are based upon strong and entrenched preferences. Regardless, diet is considered a cornerstone for management of Type 2 diabetes and is usually proposed as first-line therapy.[9] The aim of this paper is to review related articles and come up with recommended dietary measures for management and prevention of type 2 diabetes mellitus.

CARBOHYDRATES

Does high intake of either carbohydrate or fat deleterious or predisposes individuals to diabetes? But some controversies were found to be surrounding the optimal ratio of Carbohydrate-to-fat in the diet with respect to the prevention of T2DM.[10] There are marked differences in different countries of the world with respect to Carbohydrate-to-fat ratios consumed by different populations[11] but this evidence is based on epidemiological studies as result of paucity of controlled trials. A positive significant association was shown between consumption of dietary fat and the proportion of overweight population, this conform with the idea of reduced fat intake and high carbohydrate intake as a preventive measure for chronic diseases[12] including Type 2 diabetes Mellitus.[13] however, increased intake of carbohydrates reduces HDL levels and raising plasma triacylglycerol concentrations.[14]

As was shown in two cohorts studies[15,16] and a review,[17] no significant association was seen between total carbohydrate and diabetic risk. High carbohydrate intake increases the requirement for insulin secretion for the maintenance of glucose homeostasis.[18] It is likely that continual stimulation of a high insulin output by a high carbohydrate diet could speed up an age-related decline in insulin secretion and lead to an earlier onset of type 2 diabetes.[10,19,20]

In a most recent American dietary guideline, intake of a variety of grain products (including whole grains) was recommended equating to six or more servings a day.[21] World Health Organisation recommend that carbohydrate in the diet should contain at least 55% of total energy intake in 'normal' healthy individuals.[22] Therefore, no specific carbohydrate guideline that is aimed at the preventing type 2 diabetes. however, a wide range of carbohydrate

intakes may be acceptable in terms of achieving a low risk of type 2 diabetes.

Glycaemic index and Dietary fibre

Glycaemic Index (GI) is a measure of the post-prandial glucose response after carbohydrate consumption. Dietary fibre in this context which can be found in food is composed of non-starch polysaccharides (NSPs), plus lignin, oligosaccharides and resistant starch. An inverse relationship between fibre intake and blood insulin levels was shown,[23] implying that fibre improves insulin sensitivity, another cross-sectional studies suggest that lack of dietary fibre may be a causative factor in type 2 diabetes.[24] Many studies reported that glycaemic load is associated with risk of diabetes.[15] Some studies have found that foods with a high GI increase fasting triacylglycerol concentrations, even when the amount of carbohydrate is kept constant.[25,26]

In over-all context of recommended fibre intake in terms of NSPs, it has been set at an average of intake of 18g (12-24g) of NSPs per day for adults.[27] Good sources of NSPs are legumes, pulses, Brussel, sprouts, whole wheat bread, rye bread, whole meal pasta, whole grain cereals and bran cereals.[28]

DIETARY FAT

Glucose tolerance and insulin sensitivity may be modified by both the amount and quality of dietary fat consumed.[29] high fat content (excluding n-3 fatty acids) may lead to deterioration of glucose tolerance by several mechanisms in the body including decreased binding of insulin to its receptors, impaired glucose transport (IGT), decreased proportion of glycogen synthase and build-up of stored triglycerides in skeletal muscles.[30,31] In limited human intervention studies, the effects of high fat, low carbohydrate diets have been examined on diabetes risk, and the results was found to be inconsistent.[32,33]

In epidemiological studies, intake of high saturated fat has been associated with higher risk of IGT[34,35] and higher fasting glucose[36,37] and insulin levels.[38,39] Higher proportions of saturated fatty acids in serum lipids/muscle phospholipids have been associated with higher fasting insulin levels,[40] lower insulin sensitivity[41] and higher risk of developing type 2 diabetes.[42] lower risk of type 2 diabetes have in turn been associated with intake of higher vegetable fat (unsaturated fat) and PUFA.[43-44]

The role of trans fatty acids

A documented report from the Nurses' Health Study,[45] has shown a positive association between trans-fatty acid intake and risk of type 2 diabetes. In mouse islet cells, trans fatty acids potentiate insulin secretion compared with cis-isomers.[45] it was also shown that a 6-week diet high in trans fatty acids (20% of energy) increased postprandial c-peptide and insulin responses compared with a diet high in cis-monounsaturated fatty acids.[46]

The role of n-3 fatty acids

The n-3 fatty acids improve insulin resistance induced by high-fat feeding, this was shown in rodent studies.[47,48] Other studies reported an inverse association between fish intake and risk of IGT.[34,49]

MICRONUTRIENTS

Investigators have measured the possibility that factors other than fibre contained in cereals and legumes may influence the risk for chronic diseases.[50] These include micronutrients such as selenium and vitamin E, antioxidants, phytochemicals, isoflavins and lignans. Since many of these factors occur together in cereals it is hard to define the precise benefits of each.

Vitamin E

Increased level of oxidative stress has been seen in patients with T2DM[51] but little is known concerning Vitamin E in prevention of oxidative stress among patients with T2DM.[52] A published cohort study reported that a low plasma level of this anti-oxidant vitamin is associated with a 3.9-fold elevated risk of developing the disease.[53] Individuals with a high serum Vitamin E level had a 39% lower risk of diabetes compared to those with a low level of Vitamin E.[54] Contrary to the previous study,[53] this association disappeared when the risk ratio was adjusted for various coronary heart disease risk factors which suggest that a high level of Vitamin E may be merely a marker for a healthy lifestyle.

Magnesium

There is strong negative association between intake of magnesium and risk of type 2 diabetes. This was realised in the Health Professionals Follow-up Study carried out on men aged 40–75,[55] the Nurses Study carried out on women aged 40–65,[15] and the Iowa Women's Health Study carried out on women aged 55–69.[15] In each of these case the protective association in the extreme quintiles showed a risk ratio of about 0.7, after correcting for correlated variables such as age, BMI, smoking and physical activity. While the association was weakened after adjusting for cereal fibre, an important source of magnesium, in which the protective association remained strong and statistically significant. In contrast, some studies reported no association between magnesium intake and risk of type 2 diabetes mellitus.[56]

Lifestyle Modifications and Physical Activity

Two randomised controlled trials have demonstrated that an increase in physical activity and dietary change including reduction in total and saturated fat and increased dietary fibre causes weight loss and this can ultimately reduce the incidence of diabetes.[57,58]

In an article documented by Tunde *et al.* 2021, it was reported that physical activity and exercise programme have shown to be of significant importance in prevention and management of diabetes mellitus.[59]

CONCLUSION

Conclusively, based on the strength of available evidence regarding diet and lifestyle in the prevention of type2 diabetes, lifestyle modifications such as Physical activity and proper nutritional dieting have shown promising results in curtailing the menace caused by the progression of T2DM. Non-starch polysaccharides, omega3 fatty acids and low glycaemic index foods are likely to be associated with a decreased risk and may play a protective role.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

RECOMMENDATIONS

1. Saturated fat intake be less than 7% of the total energy intake. Total fat intake should not exceed 30% of total energy intake

2. Intake of a variety of grain products (including whole grains) was recommended equating to six or more servings a day.

3. In over-all context of recommended fibre intake in terms of NSPs, it has been set at an average of intake of 18g (12-24g) of NSPs per day

for adults. Adequate intakes of NSPs can be achieved through whole grain cereals, legumes, vegetables and fruit

4. Lower risk of type 2 diabetes has been associated with intake of higher vegetable fat (unsaturated fat) and PUFA.

5. Physical activity and exercise programme (moderate or greater level of intensity) to at least 1hr every day for most days of the week, have shown to be of significant importance in prevention and management of diabetes mellitus.

6. Prevention/early treatment of overweight and obesity, particularly in high risk groups is a key point in preventing the development of type 2 diabetes mellitus.

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