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Dietary Management in Diabetes, Insulin Resistance and Cardiovascular Disorders

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Abstract

Diet management offered as a dominant means to preclude the progression of metabolic syndrome connected with diabetes, insulin resistance, and cardiovascular diseases. Defensive role play has been shown in controlling disease preclude and management by the nutritious diet. Dietary fatty acids, tea, anthocyanin, flavonoids and carbohydrate diets are capable of moderating the harmful effects of these disorders and other mechanisms by changes in the insulin sensitive tissues membrane lipid composition.

Multicenter clinical trials evidence suggests dietary diets interventions significantly affect the conditions as preventive and post effects. Tea, a common beverage used around the world is effective in cardiovascular and diabetes diseases. Green tea has a better effect in disease management as compared to black tea. It's useful in body weight management, it could be the lowering absorption of the lipids in the intestine and activation of AMPK. Low Carbohydrate and High Fat (LCHF) diets have extremely individual responses in HDL cholesterol, LDL cholesterol, triglycerides and total cholesterol, in patients adhering to diabetes or cardiovascular disease.

Biomarker of cardiovascular is blood glucose, glycated Hemoglobin (HbA1c) levels, body weight and blood pressure, insulin, triglyceride apo-B and saturated fat (especially palmitoleic acid) absorption, reducing small dense LDL particle numbers were significant improved by the LCHF diets, proved by the many preclinical and clinical studies. These diets also have reversed the NAFLD in the patients. Individual intake of flavones and anthocyanin prevalence, lower diabetes and cardiovascular vascular disease risk factor in clinical studies has already been proved.

Keywords: Dietary management; Diabetes; Insulin Resistance; Cardiovascular disorders; Low carbohydrates

Introduction

Human health is directly linked with food consumption, balanced diet and it is a crucial factor in combating disease development process. Dietary Management (DM) is essentially required and prescribed in diabetes, insulin resistance and cardiovascular disorders. DM is reported to reduce glycated insulin resistance in several patients. Fasting plasma glucose directly affects the vascular diseases. Many researchers conclude by published results of fasting plasma glucose in patients without knowing about diabetes history. When glycated hemoglobin is higher than 5.5 mmol/l than it is indicated that chances of cardiovascular diseases increases. Cholesterol is an important factor in the development of cardiovascular diseases. Dietary foods are helping in management of cardiovascular diseases by the reduction of cholesterol in blood [1].

Blood parameter is used as an indicator for dietary management in diabetes, insulin resistance and cardiovascular risk. Adiponectin, one of the parameters, is present in human plasma which is an adipocyte derived protein, and it is downregulated in obesity. Which enhances insulin sensitivity in the liver and mussels. Pre clinical studies have shown an opposite relationship between plasma adiponectin levels and C-reactive protein inflammatory markers. Fat distribution in the body is the effect of peripheral insulin action. However, these combinations are limited in their ability to predict the nature of hepatic and peripheral insulin resistance. Adiponectin concentrations lower in the obese peoples. Hypoadiponectinemia associated in development of diabetes type 2, hypertension, left ventricular hypertrophy and Coronary Artery Disease (CAD), were shown by several clinical and pre-clinical studies. Patients with high adiponectin, related to decrease in the Cardiovascular Disease (CVD) results in patients with end stage renal failure and risk of CAD in diabetic male patients and cut the risk of myocardial infarction in healthy men [2].

Literature review

Oats

Diet control plan is used for the lifestyle intervention management of diabetes type-2 patients. Internationally guidelines are suggested for the diabetes patients to uptake minimum consumption of daily fiber 4 g fiber/1000 kcals day or 25 g/day for adult women and 38 g/day for mature men. Dietary fiber has insoluble or soluble fibers; soluble fiber dissolves in water and ferments in the small intestine. These fibers are helpful in managing diabetes type-2 patients. Oats are a good source of dietary fibers having ample amounts of resistant starches, vitamins, minerals, phytochemicals and antioxidants and other carbohydrates [3]. β-glucan fibers found in oats, which is effective on hyperglycemia and insulin resistance. As per the recommendation of the United States Food and Drug Administration (FDA) 3 gm or more per day consumption of β-glucan of oats dietary food daily, can reduce risk of CVD and diabetes type-2. Oat β-glucan is an indigestible fiber, it is not absorbed in the small intestine and it goes to the large intestine where it ferments. β-glucan is present in the blood. It affects blood glucagon and insulin secretions. However, European Food Safety Authority (EFSA) has not supported this evidence that β-glucan significantly reduce glucose in diabetes patients. Body weight slightly decreased in daily consumers of oats in patients. It depends on many factors but primarily affected by cholesterol augmentation in blood. When cholesterol is augmented by intake of different food, body weight increases, it can lower by the dietary fiber [4].

When other dietary fibers were compared with the oat fibers, on the basis of glycemic index in the blood and excess of energy, the result shows, after consumption of dietary fiber, oats slightly reduce the glycemic index. Oat fibers have capacity to delay gastric emptying and extend interstitial transit time, and slow absorbing of nutrients that effects on the satiety. Magnesium presents in the good amount in oats that is the cofactor of many enzymes involved in the metabolism and insulin secretion. Magnesium is well reported in the reduction of diabetes. A Meta dose response analysis was based on an increase in a 100 mg/day in magnesium intake to reduce the risk of hypertension by 5%, method recommended by Greenland and Longecker. 95% CI were extracted on the categories of magnesium intake, distribution of cases and person years [5].

Whole grain

A very limited study has been completed on whole grain reduced the risk of diabetes type-2. The food and drug administration used its evidence based system for whole grains effects on diabetes type-2. In 2006, FDA guided draft entitled whole grain label statements, addressed what foods come under the whole grain category. In FDA draft on whole grains which consist of the whole grains as cereal grains that consist of the intact, cracked, ground, or flaked caryopsis and whose major anatomical components (the starchy endosperm, germ, and bran) are present in the same relative proportions as they exist in the intact caryopsis. Buckwheat, bulgur, corn (including popcorn), amaranth, whole grain barley, millet, quinoa, oats, rice, rye, triticale, sorghum, teff, wheat, brown rice, and wild rice these are the examples of cereal grain was listed in the FDA draft [6].

Dietary oils

Four research groups in 1950 reported that vegetable oils polyunsaturated fat substantially reduced serum cholesterol after replacing from animal products. Controlled trials for substituting polyunsaturated fat for saturated fat prevents cardiovascular disease reduction in serum cholesterol, after trials compare with high polyunsaturated intake with a high saturated fat. Obesity reduction by diminishing dietary oils in food, traditionally recommended, which were changed by the carbohydrates. Recent studies have detected that energy diets containing MUFA are more effective than the traditionally low fat diets [7].

Dietary oils obesity and diabetes

Obesity increases threat of development insulin resistance, diabetes, cardiovascular diseases and moreover independently or within the perspective of metabolic syndrome. Old advice for reducing weight is to help in reducing consumption of oil but it was changed to cut weight by carbohydrate intake. Clinical studies showed that reduction in MUFA is highly effective in the management of obesity then the other traditional dietary oils weight management diet. Predimed study found olive oil non significant lower in weight reduction. This study is divergence from unhealthy food and increases risk of diabetes [8]. Carried out randomized controlled trials meta analysis, showed that weight reduction was linked with the fish or fish oil consumption. Although, the mechanism is still unknown. Consequently, unsaturated fats show as metabolically active in relation to weight gain, metabolic associated with SFA, specifically MUFA ≥ PUFA>SFA. Among PUFA rich oils, after 33 months of treatment on obese humans who were supplemented with borage oil (per day 890 mg of α-linolenic acid) [9].

Dietary oils cholesterol and plasma triglycerides

Patients who have severed risk of hypertriglyceridemia also increase risk of CVD, diabetes, metabolism abnormalities and artherloscrresis. These may be benefitted by the statin. A high level of TG is the increased the risk of CVD, and associated with clogging of arteries and development of artherosclosis. Triglyceride level is more than 150 mg/dl, it increases up to the double in metabolic syndrome patients. CVD risk must address hypertriglycemia with the dyslipidemia states associated. An apo C-III, a significant biomarker of CVD risk, is a proinflammatory, proatherogenic protein present in all classes of the plasma lipoproteins [10]. Atherogenesis is promoted by chylomicrons and various species of Triglyceride Rich Lipo Proteins (TRLPs) including VLDL and VLDL remnants. Hypertriglyceridemia is a ubiquitous risk factor for obesity, insulin resistance and cardiovascular disease. Oxidized LDL mediated in cholesterol enriched foam cells transform from macrophages, are subject to endothelial accumulation and uptake by macrophages. Fatty streak formation promotes foam cells, the precursor of

atherosclerotic plaque. A high amount of TG in blood is a forecast of CVD, confirmed by the TG lowering intervention clinical trials of hypertriglyceridemia and its associated atherogenic lipoproteins in the pathogenesis of atherosclerosis and cardiovascular outcomes [11].

Table 1: Dietary effects on diabetes, insulin resistance and cardiovascular.

Dietary foods		Active ingredient	Mechanism
1	Oats	β-glucan, proteins, starch, gramine	Cholesterol-lowering and antidiabetic effects
2	Whole grains	Fibers, minerals	Delay in digestion and appetite control, reduced risk of type 2 diabetes
3	Dietary oils	Omega 3 FA, tocopherols and tocotrienols, saturated oils	Cholesterol reducing, reduce risk of cardiovascular disease
4	Flavonoids	Anthocyanin	Plasma glucose and improve insulin secretion and insulin resistance
5	Tea (green tea)	(−) Epigallocatechin Gallate (EGCG), (−) epicatechin Gallate (ECG), (−) epigallocatechin, and (−) epicatechin, polyphenols, such as quercetin, kaempferol and myricetin as well as alkaloids, such as caffeine and theobromine	Decreasing absorption of lipid Activating Ampk by tea polyphenols
6	Low carbohydrate diet and high fat diet	Carbohydrate	Insulin resistance and associated with NAFLD
7	High protein and low carbohydrate diet	Protein	Greater reduction in BMI and weight loss

Raised TG level is directly associated with the CVD risk. Its level is higher than 500 mg/dl and it converts into server hypertriglycaemia, which is a result of acute pancreatitis. Hypertriglycaemia directly impacts in Low Density Lipoprotein (LDL), HDL metabolism and composition, which contributes to TG a play important part in the pathogenesis of atherosclerosis. The fatty acid configuration of dietary oils effects on the TRL particles size and fatty acid composition, determine the lipoprotein lipase for VLDL in the hydrolysis rate of the TG [12]. Showed linoleic or a linolenic acids, palmitic, oleic, obtained from palm, olive, linseed oils and safflower, have specificity difference for TRL enriched of Lipoprotein Lipase (LPL), found that LPL specificity for TRL enriched in linoleic acid was lower that the oleic acid, and was associated the fluidity of lipoprotein is affected by the catalysis by LPL is attune by the lipoprotein triacylglycerol fatty acid content. Guidelines suggests the fibrates are a class of amphipathic carboxylic acids, niacin, and n-3 PUFA (omega 3 fatty acid) drugs are immediate use of lowering hypertriglyceridemia in the patients. These drugs decree the in blood by the reducing mixing of TG into VLDL and TG secretion, intervening TG synthesis, as well as increasing TG clearance from VLDL particles [13].

Discussion

Predimed study, after three months mediterranean diet with rich in olive oil significantly lowered serum VLDL and TG concentrations. The olive oil meals diet helps to the development of higher size TRL particles, through a concentration per particle higher triglyceride, compared with fat sources rich in SFA and n-6 PUFA. The VLDL lipid composition is strongly determined by dietary oils TG combinations and participates in TRL particles metabolism regulation. In the PREDIMED study, Virgin olive oil rich a mediterranean 3 months consuming were significantly lowered serum VLDL and TG concentrations [14].

Flavonoids

A group of metabolites found in plant kingdom is flavonoids. Seven sub groups of flavanoids are flavonoids, flavanones, flavones, flavan-3-ols, anthocyanins, isoflavones, and their oligomeric, polymeric forms. These compounds are found in small quantities in herbs, spices, cocoa, soybean fruits, vegetables, tea, wine, nuts, and seeds. Flavonoid subclass, flavones higher consumptions of flavones and flavanones were associates with a lower risk of T2DM [15]. Major sources of

flavones and flavanones from citrus juices consumption is associated with the lower risk of TD2M.

Anthocyanin

Anthocyanins interlinked with the reduced risk of TD2M. The risk of TD2M inversely associated with intake of blueberries apples and peers. In the consumption of flavonols, flavan-3-ols, and total flavonoids were also associated with the diabetes risk. Flavonoids constituent's anthocyanins play a significant role in reducing the biological pathway of diabetes. Studies support correlations of cellular and physiological relations between the insulin resistances [16]. Flavonoids in dark chocolate significantly reduce the blood pressure in patients by improving the endothelial dysfunctions and insulin sensitivity. Flavonoids interact with molecular targets and affect a signaling pathway in mitogen activated protein kinase signaling pathway and nuclear factor k-B. GLUT 4 gene expressions was upregulated in white adipose tissue, retinol binding protein 4 expression was downregulated, it gives result in the suppression of gluconeogenesis and improved glycemic and insulin sensitivity in animal models [17]. Anthocyanin rich bilberry extract improves glycemic and insulin sensitivity in animal models of TD2M with AMP activated protein kinase up regulation of GLUT4. Human clinical trials interventions show berries significantly reduced the fasting plasma glucose, post prandial load and sucrose. The black berry puree also has the worthy effects in lowering total cholesterol, LDL and triglycerides.

Tea

3-4 cups or more of tea studies has shown to decrease body weight, alleviate mets and decrease the risk for cardiovascular and diabetes. Laboratory studies on animal support these results. These studies suggest tea valuable effects can be shown by the activation of AMPK, absorption of macronutrients with addition of tea catechin's systemic effects in metabolic regulation. Black tea, flavins and thearubigins having low bioavailability play an important role in nutrient absorption, especially with high fat diets; this is the part of systematic effects [18]. Smaller weight molecule polyphenol are formed by after the degradation of large polyphenols, these smaller metabolites enters and exhibit the effects on the internal organs. EGCG moderate dose of mice activate the Nrf-2 mediates induction of antioxidant and other cytoprotective enzymes which produce ROS. ROS has also been activated by AMPK. Catechin's useful effect of pro oxidant and effects in alleviating mets. Green tea has upright effects on metabolic syndrome, complex of syndrome, waist circumference and body weight, black tea has fewer outcomes in comparison with the green tea. Green tea significantly reduces the body weight in animal studies. Green tea increased the plasma antioxidant level and reduced the oxidation of LDL cholesterol. Tea polyphenols have indirect antioxidant effects on Nrf-2 medication antioxidant enzymes.

Tea catechins are good for the cardiovascular system by lowering the cholesterol plasma levels, improved the endothelial functions, and preventing hypertension. Cholesterol lowering by the catechins is due to decrease in the absorption of cholesterol or decrease of cholesterol synthesis *via* HMGR. Endothelial cell is amino L-arginine continuously synthesized Nitric Oxide (NO) by the constitutive calcium calmodulin dependent enzyme Nitric Oxide Synthase (NOS). AMPK and other signaling pathways involved in tea polyphenols and catechins increase the Endothelial Nitric Oxide (eNOS). Animal studies support that green tea reduces the cholesterol. The activation of AMPK and its reduced vasoconstrictor by EGCG has also reduced the expression of endothelin-1 and increased bioavailability of nitric oxide is to improve endothelial function. EGCG also arbitrates anti inflammatory action in endothelial cells.

Tea and diabetes

Several clinical tea interventions showed that 2-3 cups of daily consumptions of tea reduced the effect of hemoglobin biomarkers HbA1C and diastolic blood pressure showing the effects of insulin resistance and blood glucose control. Tea constituents have also reduced the body weight by the reduction in gastrointestinal digestion and increasing absorption or by altering the gut microbiota. These tea constituents also stimulate catabolism in Liver, muscle, adipose and other tissue. The utter effects of tea constituents alleviate MetS, reduce weight and reduce the risk of diabetes and CVDs.

Green tea

Green tea polyphenol helps in reduction in absorption and digestion of lipid and proteins, total nitrogen content and fecal lipid increase, after the ingestion of tea polyphenols. For example, EGCG with 13 C-triglyceride enriched diet was fed in mice; dose dependently decreased the food digestibility and increases the fecal mass, EGCG supplementation was increased 13°C levels in the feces.

Dietary fat

Insulin resistance may be affected by dietary fats. Dietary fats partly changed the insulin resistance. Trans Fatty Acids (TFA), formed by the alteration of polyunsaturated fatty acids l cis to trans form from their natura, establish in the western diets. High intake of TFA may increase chance of diabetes, insulin resistance and cardiovascular risk. Fat type is more significant than the amount of total fat in chance to moderate insulin action. Studies suggest that, significantly saturated fat improves insulin resistance, long and short chain omega 3 fatty acids it, omega 6 polyunsaturated fatty acids, have no impact like that omega 3. The Kanwu multicenter study on humans shows one rich in monounsaturated fat in saturated fatty acids improve the insulin sensitivity in healthy people omega 3 significantly reduces blood pressure in hypertensive patients but does not affect in healthy people. Kanwu study also confirms the same. In metabolic syndrome lipid abnormalities presents (*i.e.,* hypertriglyceridemia and low HDL cholesterol), omega 3 fatty acids significantly reduced the triglycerides levels, but LDL also increase by the omega.

Low carbohydrate high fat diet

LCHF is a highly discussed topic in nutritional science. The LCHF diets have significant effects on body weight, glycemic

control, insulin resistance and cardiovascular parameters. Clinical and preclinical data suggest that LCHF diets improve cardiovascular marker, insulin, glycated Hemoglobin (HbA1c) lowering elevated triglyceride and blood glucose, apo-b, reducing small dense LDL particle level, blood pressure and body weight with the significant increment in HDL-Cholesterol. LCHF diets are reverse liver steatosis and Non Alcoholic Fatty Liver Disease (NAFLD) in patients. Cardiovascular disease is directly linked with the NAFLD, TG and low HDL-C concentrations with overproduction of very low density lipoproteins and spoiled clearance of TG-rich lipoproteins in cardiovascular. Suppression of hepatic glucose production by insulin if inadequate, NAFLD occurred. Hepatic IR is increased in patients with fatty liver. fatty liver patients have increased. The extreme carbohydrate, especially fructose intake, is caused by the NAFLD, LCHF diets helpful in reverse the NAFLD conditions. LCHF diets are highly beneficial in patients with insulin resistance, atherogenic dyslipidemia and the frequently associated NAFLD.

High protein diet with low carbohydrate

HPLC diets have shown promising effects in obesity control, diabetes, insulin resistance and cardiovascular disease without any side effects. HPLC diets significantly reduced BMI and body weight compared to low fat diets interventions in clinical trials study. Cardiovascular risk markers and insulin resistance improved in the HPLC and low carbohydrate diets, with this HPLC diets have significant effects on markers of insulin resistance.

Conclusion

In conclusion of this review, green tea has a significant role in reducing the body weight and diabetes management with lowering biomarkers of cardiovascular vascular disease risk. Anthocyanin and flavonoids are prevalent and helpful in the management of diabetes and CVD dietary oils like omega 3 fatty acids obliging in lowering of total cholesterol, LDL, triglyceride and improve HDL cholesterol in obese patients. HPLC and LCHF diets have significant effects in the scientific world for the management of disease. Clinical and preclinical studies show that the HPLC diets are more promising in reducing weight, insulin resistance, lowering cholesterol and triglycerides and improving HDL with the comparison of LCHF diets. A clinical report suggests protein diets are helpful in weight reduction and fat lowering by reducing insulin secretion that increasing glucagon helps to burn more fat. A mechanism involved in this process increased satiety and decreased succeeding energy intake with higher protein diets. A review suggests an increased protein diet, and fiber in food will be full in weight management.

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