

Diet, Nutrition and Cardiometabolic Health

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Abstract

Nutrition plays a key role in the prevention of cardiometabolic diseases, which contribute significantly to the development of cardiovascular disease, the leading cause of death worldwide. Day to day diet, influences a broad spectrum of cardiometabolic risk factors, including hypertension, excess weight, obesity, metabolic syndrome (a cluster of known metabolic risk factors), dyslipidemia, impaired glucose metabolism, type-2 diabetes and vascular diseases. According a report by Houston and associates, 80% of the coronary vascular disease [CVD] can be prevented with optimal Nutrition, coupled with of course, exercise, weight management, mild alcohol consumption, and smoking cessation. Among all of these factors, optimal nutrition provides, the basic foundation for prevention and treatment of CVD. Bergeron and associates have put together a comprehensive monograph, on Nutrition and Cardiometabolic Health. Cover page of the book states, "international experts present state-of-the art reviews of dietary and lifestyle effects on metabolic systems associates with cardiovascular health and disease. It covers broad range of topics, including biological and behavioral process regulating food intake: lifestyle and various approaches to weight loss; nutritional considerations for optimal cardiometabolic health across life span; the relationship of macronutrients, whole foods, and dietary patterns to diabetes and cardiovascular disease; and diet as modulator of gene expression, epigenetics and the gut microbiome and the relationship of these traits to disorders of metabolism". In a short overview like this, we will not be able to discuss all of these very important topics. We will discuss few examples to illustrate the importance of diet, nutrition, and lifestyle for better cardiometabolic health.

Keywords: Diet; Risk Factor; Nutrition; Cardiometabolic

Introduction

In a view point published in JAMA titled, "The challenge of reforming nutritional epidemiological research", Loannidis writes, "Some scientists and much of the public, often consider epidemiologic associations of nutritional factors represent causal effects, that can inform public health policy and guidelines [1]. However, the emerging picture of nutritional epidemiology, is difficult to reconcile with good scientific policies. The field needs radical reform." To explain the complexity, he further states, that in recent updated meta-analyses of prospective cohort studies, almost all foods revealed statistically significant associations with mortality risk [2]. In a short review like this, it is rather difficult to cover all aspects of diet, nutrition, as they relate to cardiometabolic health, -another

complex subject, hence I have referenced some important articles related to this topic and verbatim reproduced the salient features of a comprehensive book on this topic of great public health importance [2-6]. Just to further illustrate this point, Seidelmann and associates, write in the Journal Lancet, that both high and low percentages of carbohydrate diets were associated with increased mortality, with minimal risk observed at 50-55% carbohydrate intake [7].

Of all the metabolic diseases, such as hypertension, excess weight, obesity, type-2 diabetes, and vascular disease, cardiovascular disease [CVD] is the most common cause of death, among adults in the USA. Thomas Schwenk, the deputy director of NEJM journal

watch on medicine, writes in the March issue of NEJM, 2017, that nearly half of the deaths are related to poor nutrient consumption, including high sodium intake, and low intake of nuts and seeds. Micha and associates from School of Nutrition Science and Science Policy, collaborating with the researchers of MRC Epidemiology unit, University of Cambridge, England, and Office of community and population health, Montefiore Medical Center, New York have identified, that consumption of 10 foods/nutrients associated with cardiometabolic diseases: fruits, vegetables, nuts/seeds, whole grains, unprocessed red meats, processed meats, sugar sweetened beverages, polyunsaturated fats, seafood, omega-3-fats, and sodium. They conclude, "Dietary factors were estimated to be associated with substantial proportion of deaths from heart disease, stroke, and type-2 diabetes. These results should help identify priorities, guide public health planning, and inform strategies to later dietary habits and improve health [8-17]".

Now that we have briefly reviewed, some aspects of the complexities of diet, and nutrition, as they relate to cardiometabolic diseases, let us examine what the professional societies like American Heart Association, American Diabetes association, International Society of Hypertension and The Obesity Society USA, have to say on this topic. American Heart Association recommendations are as follows: Start by knowing how many calories you should be eating and drinking to maintain your weight. Nutrition and calorie information on food labels is typically based on a 2,000-calorie diet. You may need fewer or more calories depending on several factors including age, gender, and level of physical activity. If you are trying not to gain weight, don't eat more calories than you know you can burn up every day. Increase the amount and intensity of your physical activity to match the number of calories you take in. American Diabetic Association [ADA] in their scientific statement on nutrition therapy, state, that evidence suggests, that there is no ideal percentage of calories from carbohydrates, protein, and fat for all people with diabetes, therefore, macronutrient distribution should be based on individualized assessment of current eating patterns, preferences and metabolic goals [18,19]. They also mention that currently there exists insufficient evidence of benefit from vitamin or mineral supplementation in people with or without diabetes in the absence of an underlying deficiency. I urge readers, to refer to original articles on the dietary recommendations for hypertension and obesity [20,21].

Discussion

Metabolic diseases such as hypertension, excess weight, obesity, and diabetes [type-2] have reached epidemic proportions worldwide [22-27]. According to Global Burden of Disease Study Group, as well as Noncommunicable disease risk task force [NCD-risk], obesity has increased two-fold in the last three decades, and diabetes by four-fold worldwide [28-35]. On the other hand, during the same period diabetes has increased 17-fold in China, the current capital of Diabetes. Shen and associates speculate, that potential risk factors contributing to this observed rapid increase in the incidence of diabetes in Chinese population, to rapid social economic development, urbanization, dietary pattern, and Westernized lifestyle [36]. This is true in majority of the developing countries. According to their report the Da Qing Lifestyle Intervention Study has demonstrated beneficial effects of diabetes prevention. After 6 years of intervention, all of the treatments, seem to be effective at reducing the incidence of diabetes, exercise and diet plus exercise were more beneficial than the diet treatment only. They also noticed that many Chinese adults who experienced undernutrition in early life are now adapting Westernized diets and lifestyle. According to them, this is one of the important risk factors for the elevated diabetes prevalence in China. Although they feel confident, that educational model that they have developed for behavioral counseling is doing a good job, they feel that it may not work very well with adolescents and young adults, who are already hooked on the Western lifestyle. Global Burden of Disease Group and other international collaborative groups have published a series of articles on obesity related problems [37-41].

We have briefly discussed the problems and the solutions developed to combat diabetes epidemic in China with the largest number of diabetics, now let us discuss how early this preventive intervention should be started. The epidemiologic observations have demonstrated, that smaller size or relative thinness or low-birth weight during early growth and infancy, is associated with increased rates of metabolic diseases including coronary artery disease, stroke and type-2 diabetes [41]. Studies done in UK, India, and other Asian countries, have demonstrated that greater than 30% of the children born in Asian and developing countries, are of low birth weight. Researchers at the CSI Holdsworth Mission Hospital, Mysore, India, and the MRC Epidemiology group at UK have demonstrated that these low-birth weight babies, when they grow to adolescence or adulthood are at risk for developing

metabolic diseases. Based on the results of such studies, a hypothesis was developed by the British Epidemiologist David Barker, that intrauterine growth retardation, low birth weight, and premature birth have a causal relationship to the origins of hypertension, coronary artery disease, non-insulin dependent diabetes, in middle age [42]. Since the original observations of Barker, it has become clear that environmental factors during prenatal and postnatal life, can have profound effects on the programming of intracellular signals, cell-to-cell interactions, and metabolic pathways. Having said that, I want to urge readers to refer to a Harvard study, in which maternal multiple micronutrient supplementation helped the outcomes of interest, low-birth weight, small size, perinatal mortality and neonatal mortality [43]. Several other studies also have shown that multiple micronutrients supplementation for pregnant women, reduces low birth weight and has been recommended in low-and middle-income countries [44].

Obesity, both childhood as well as adult, has become a major health problem. No country has halted, reduced, or reversed obesity in the last three decades. McPherson in the Journal Lancet writes that technological revolution in food science, the sale of junk food, sugary drinks, modern lifestyle and increasing disposable income play an important part in the obesity problem [45]. In the USA, about 32% of the adult men and 34% of women are obese, compared with 21% in both sexes in Western Europe. According to various experts, rapid increase in obesity in most countries, seem to be driven mainly by changes in the global food system, which is producing more processed, affordable, energy-dense food [45-47]. Risk factors for obesity and diabetes are sedentary lifestyle, high intake of energy-dense, micronutrient-poor foods, heavy marketing of energy-dense foods and fast food outlets, sugar sweetened soft drinks and fruit juices. It is well known, that overweight children and teens, are much more likely to become obese as adults compared to normal weight children. Furthermore, it is more challenging for adult obese individuals, to lose weight and keep weight off, once they become obese. There are three phases in the life of an individual a preventive strategy could be implemented. Primordial prevention refers to keeping healthy weight normal throughout childhood and into the teens. Primary prevention should aim at overweight children and prevent them from becoming obese. Secondary prevention is similar to diabetes management, directed towards treatment of obesity to reduce comorbidities associated with obesity.

According to Mayo Clinic, Rochester, Minnesota, people with prediabetes are more likely to develop diabetes within 10 years. The core of Berlin Declaration was "A collective ambition for policy change to drive early action in type-2 diabetes." According to Foreword of this declaration, in less than one year, the Early Action in Type-2 Diabetes initiative, has spread to more than 30 countries around the world. Key Aims of the Berlin Declaration are; 1) outline the key early action principles that each country should work towards to reduce incidence and improve the lives of people with type-2 diabetes, 2) Offer inspiration and advice on the type of policies that should be- and in some places have been – implemented. 3) Focus attention on a small number of achievable, measurable early action targets, to monitor progress and ensure that patient centered change is being delivered. In the recent meetings of the European Association for the Study of Diabetes in Berlin, Germany [Oct. 2018], Japanese researchers presented their findings on early detection of prediabetes. Sagesaka and associates reported that trajectories of fasting plasma glucose [FPG], body-mass index [BMI], and the single point insulin sensitivity index, could detect trend towards development of adult diabetes, ten years before the diagnosis of prediabetes. Considering it takes another ten years for prediabetic to become diabetic, appropriate prevention strategies can be implemented 20 years before, an individual develops diabetes [48]. Yet another predictor for diabetes is the elevated levels of plasma free amino acids. This emerging technology may also help in early action initiatives for the prevention of diabetes.

Prevention of the global obesity and diabetes is proving increasingly hard, - partly for physiological reasons. With respect to calorie intake, weight change is a buffered and self-limiting process [35]. According to a recent article in the Journal of Lancet, the burden of obesity shifts progressively from the wealthier to the poorer groups with rising income [39]. In addition, undernutrition in early life seems to increase the risk for obesity and comorbidities later on in life, if the environment is obesogenic [40]. Professor Garg and associates of University of Texas, South Western Medical Center, claim that less nutritious dietary choices made the South Asians living in developed countries like the US, a key contributor to the group's rising rate of type-2 diabetes. The new UT South-western study showed, that South Asians with diabetes consumed fewer calories but also consumed less beneficial nutrients, than healthy South Asians. The researchers recommend, that South Asians may need to improve their dietary habits, to achieve nutri-

ent intakes recommended by the Institute of Medicine [49]. South Asians with diabetes, according to these researchers, as compared to control subjects, consumed less total energy (mean difference 499kcal/d) linoleic acid (3.6g/dl), dietary fiber (8.6g/d), Vitamin A (262 ug/d), Vitamin E (2.7 mg/d), potassium (754 mg/d) and β -carotene (1761 ug/d).

Nutrition therapy seems to be a key component of hyperglycemia management in the diabetics, yet evidence about what constitutes ideal nutrient diet is still elusive. However, Diabetes UK have had a research breakthrough in DIRECT, one of the largest funded studies on low-calorie mediated reversal of type-2 diabetes, conducted by Professor Roy Taylor and associates at the Newcastle University. The most recent analysis reflects opinion not only from the UK, but also among the experts from the US and other countries. Type-2 diabetes, according to the UK experts, is caused by buildup of fat in the pancreas, which stops insulin production. Restricting diet to the very low-calorie, will burn up this fat, and allow pancreas to start functioning normally [50]. Now together with Mike Lean, Professor of Human nutrition, University of Glasgow [Eat Balanced Nutrition Guru], Professor Taylor is leading a five-year study to determine, whether such a diet may become routine NHS treatment. Type-2 diabetes is considered a progressive disease, that will only get worsen. The good news is, according to Professor Roy Taylor, there is a way out, it does not involve a pill or a doctor, -just a diet.

Apart from the known metabolic diseases that we have discussed, hypertension, excess weight, obesity, diabetes and vascular diseases, there are couple lesser known metabolic risks which significantly contribute, to the progression of metabolic diseases. They are oxidative stress, associated elevation of reactive oxygen species and the resulting cellular damage. Yet another risk is the low-grade chronic inflammation, that is associated with these conditions. When it comes to dietary factors that could influence these early metabolic alterations, in particular, intakes of energy, carbohydrate, protein, total fat, cholesterol, saturated fatty acids, vitamin B-12, and iron have been considered as proinflammatory factors, whereas dietary intakes of monounsaturated fatty acids, poly unsaturated fatty acids (ω -3, ω -6), niacin, thiamine, riboflavin, vitamin B-6, magnesium, vitamin A, vitamin C, vitamin D, vitamin E, folic acid, β -carotene, anthocyanidins, flavan-3-ol, flavonols, flavonones, flavones, isoflavones, alcohol, fiber, garlic, ginger, pepper, onion, and tea are considered as anti-inflammatory factors. All of these components are linked to 6 major inflammatory biomarkers:

IL-1 β , IL-4, IL-6, IL-10, TNF- α , and C-reactive protein. There is a great opportunity for the nutritionists and food science technologists, to develop appropriate interventions to prevent these metabolic risks [51,52].

Various metabolic alterations such as oxidative stress, chronic low-grade inflammation, excess weight, obesity, type-2 diabetes, contribute significantly to the development of vascular diseases and ultimately precipitate acute events like heart attack and stroke. Framingham Heart Study group initiated by the National Heart, Lung, and Blood Institute [NHLBI], 70 years ago, developed information about modifiable risk factors for the development of cardiovascular diseases [53]. This formed the basis for strategies in preventive cardiology. These discoveries also formed the basis for drug development for the observed CVD risk factors. At the same time, Ancel Keys was starting long-term studies on Heart-diet hypothesis. He led the studies in Minnesota as well as in the Seven Countries of the World to study the role of diet and lifestyle on CVD incidence and mortality [54]. In addition to these studies, WHO sponsored MONICA project as well as 26-Countries study on CVD mortality, showed a decline in CVD mortality in the industrialized nations [55,56]. Professor Salim Yusuf and associates of McMaster University, conducted a large 52 countries, case-control studies and concluded, " Abnormal lipids, smoking, hypertension, diabetes abdominal obesity, psychological factors, consumption of fruits, vegetable and alcohol, and regular physical activity account for most of the risk of myocardial infarction worldwide in both the sexes and at all ages in all regions This finding suggests that approaches to prevention can be based on similar principles worldwide and have the potential to prevent most premature cases of myocardial infarction [57]".

One of the seminal studies on the CVD prevention at the population level was the Finnish study done at North Karelia, Finland. According to Pekka Puska Reports, "Prevention in Action", in 1960s, Finland had the highest rate of deaths from coronary artery disease, especially in the province of North Karelia. In 1971, representatives of the Province signed an appeal to the National authorities, for urgent help to reduce the burden of CVDs in this area. Finnish authorities, with the help of WHO, launched the North Karelia Project: "Thirty Years Successfully Preventing Chronic Diseases." These studies have demonstrated the strong influence of diet, especially the quality and quantity of the dietary fat, on the levels of blood cholesterol. A high intake of salt, saturated fat, and low intake of

fruits and vegetables, were likely the cause of high blood cholesterol and high blood pressure in this population. According the Pekka Puska Report, the age-standardized mortality rate for CVD in North Karelia in 2006 was 85% lower than during the period 1969-71; nationally the reduction was a whopping 80%. The North Karelia project was the first and one of a kind comprehensive community-based program to demonstrate a positive impact of dietary fat on CVD death and disability [58].

Nutrition work initially focused entirely, on the nutrition deficiencies and diseases associated with such nutrient deficient diet. The fact that there was a rapid increase in the cardiovascular disease in the industrialized nations, shifted the attention to a so called, diet-heart hypothesis [M]. Americans on an average consume 250 to 300 grams of carbohydrate a day, accounting 55% of their daily intake. Studies done in several laboratories have demonstrated the beneficial effects of Mediterranean and low carb diets, compared to the low-fat diet. Professor Stephen Phinney and associates have demonstrated that contrary to what one may expect, dietary fat intake was not directly related to blood fat. Rather the amount of carbohydrates in the diet appears to be potent contributor. In view of these observations, there is some renewed interest in Ketogenic diet for weight loss as well as diabetes management. "Fat is not the problem" says Dr Walter Willet, Chairman of the Department of Nutrition at the Harvard School of Public Health (LA Times, 2/20/2016). "If the Americans could eliminate sugary beverages, potatoes, white bread, pasta, white rice and sugary snacks, we would wipe out almost all the problems we have with the excess weight, diabetes and other metabolic diseases." Low-calorie diets, Ketogenic diets as well as suggestions of Professor Walter Willet, sound great as short-term goals and are very hard to follow as long-term goals.

Conclusion

Medical Nutrition Therapy [MNT], is an evidence-based medical approach to treating certain chronic diseases through the use of individually-tailored nutrition plan. The success stories such as that of Professor Roy Taylor and associates at the Newcastle University, UK, have tempted the National Health Services of England, to fund one of the largest clinical studies, to explore whether the limited success of the reversal of diabetes by low calorie diet by this group, could be effectively applied for use at Primary Care Centers, for the management or reversal, of type-2 diabetes. Many insurance plans cover these kind of nutrition services. Medicare part B covers MNT for diabetes and kidney disease. We also have mentioned in this

overview about the need for nutritional interventions during pregnancy and growth of the children. Harvard study has demonstrated the beneficial effect of malnutritional supplements for the prevention of pregnancy related intrauterine growth alterations. There is a growing need of such nutritional intervention in developing countries to prevent the ill effect of malnutrition and development of excess metabolic diseases. It is noteworthy, that AHA Scientific Statement [Circulation: May 24, 2018], "Appreciating CVD risk in South Asians: The Time is Now", illustrated the need for ethnic-specific guidelines. They note, that the diets of South Asians are high in refined carbohydrates and saturated fat, and low in fruits, vegetables, and physical activity. Similar observations led the researchers at the University of Texas, Southwestern Medical Center to conclude, that micronutrient deficiency in the diet, is the key to excess incidence of diabetes in South Asians living in the USA. There are several windows of opportunity for interventions, starting from pre-conception, neonatal, postnatal, childhood, adolescent, and prediabetics, to prevent development of metabolic diseases such as obesity and diabetes. In this article, we have barely touched on this complex subject, however, the future nutrition and food science experts, can compete with the Pharma industry, and develop robust nutritional supplements as complimentary therapies, for better management of metabolic diseases.

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