



Role of Dietary Patterns on Type 2 Diabetes Mellitus Population - A Systematic Review

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ABSTRACT

Diabetes mellitus is the outcome of interaction between genetic, environmental and behavioral risk factors. Diabetes is believed as unitary of the causes of blindness, kidney failure, heart attacks, stroke and lower limb amputation. It is anticipated that the prevalence of Diabetes mellitus in adults of which type 2 Diabetes mellitus is becoming prominent will increase in the next two decades and much of the growth will happen in developing nations. Systematic searches were conducted in Science Direct, Web of Science, PubMed and Google Scholar to identify all article descriptions, methods and topics involving the patients suffering from Diabetes mellitus 2 from 2009 to 2019. The following inclusion criteria were used such as the effect of diet on patients with diabetes mellitus 2 and diet patterns and study of nutritional changes in patients residing in different countries was included. As the conclusion nutritional motivational campaign may be useful in enhancing dietary habits and wellness condition of patients with Type 2 Diabetes Mellitus. The accessibility of rich, nutritious food in developing countries still needs to be ameliorated by increasing access and control prices by using appropriate government policies.

Keywords: Diabetes mellitus, Systematic searches, diet, nourishing food.

INTRODUCTION

Diabetes mellitus is seen as unitary of the oldest disease known to mankind. It was firstly published in Egyptian manuscript before 3000 years ago. In 1936, the differentiation between type 1 and type 2 Diabetes mellitus was understood¹. Type 2 Diabetes mellitus was first reported as a component part of metabolic syndrome in 1988. Type 2 Diabetes mellitus (earlier known as non-insulin dependent Diabetes mellitus) is the most general form of Diabetes mellitus characterized by hyperglycemia, insulin resistance, and relative insulin deficiency². Type 2 Diabetes mellitus is the outcome of interaction between genetic, environmental and behavioral risk factors.

People living with type 2 Diabetes mellitus are more prone to various forms of both acute and chronic complications, which many a times leads to their death before time³. The trend of increased morbidity and mortality is seen in patients with type 2 Diabetes mellitus because of the generalized pattern, of this type of Diabetes mellitus, its abrupt onset and late diagnosis, especially in developing countries like Africa who are economically poor⁴.

The number of people with diabetes has increased from 108 million in 1980 to 422 million in 2014⁵. The onset of diabetes worldwide among adults over 18 years of age has risen from 4.7% in 1980 to 8.5% in 2014. Prevalence of diabetes had alarmingly increased more rapidly in middle and low-income countries. Diabetes is considered as one of the reasons of blindness, kidney failure, heart attacks, stroke and lower limb amputation. In 2016, around 1.6 million deaths were directly caused by

diabetes³. Another 2.2 million deaths were known to occur due to high blood glucose in 2012. Almost half of all deaths were due to high blood glucose before the age of 70 years. According to WHO reports diabetes was the seventh leading cause of deaths in 2016⁶. Healthy diet, regular physical activity, maintaining a normal body weight and avoiding drug use are some of the ways to prevent the onset of type 2 diabetes. Diabetes is curable and its consequences can be avoided or delayed with diet, physical activity, medication and regular checkups and treatment for complications⁷.

It is recorded that 366 million people had Type 2 Diabetes mellitus in 2011; by 2030 this number may rise to 552 million⁸. It is estimated that 439 million people would be suffering from type 2 Diabetes mellitus by the year 2030(9). The occurrence of type 2 Diabetes mellitus varies consequently from one geographical region to the other as a result of environmental and lifestyle risk factors⁹.

Literature review had shown that in Africa less data is available on the prevalence of type 2 Diabetes mellitus. Studies examining data trends within Africa reveals the evidence of a dramatic increase in occurrence in both rural and urban areas, and affecting both genders equally¹⁰. The majority of the Diabetes mellitus occurring in Africa appears to be type 2 Diabetes mellitus, with less than 10% of Diabetes mellitus cases being type 1 Diabetes mellitus. Diabetes mellitus affects about 25.8 million people in the US (7.8% of the population) in 2010 with 90% to 95% of them being type 2 Diabetes mellitus¹¹.

It is predicted that the prevalence of Diabetes mellitus in adults of which type 2 Diabetes mellitus is becoming prominent will increase in the next two decades and



much of the increase will occur in developing countries where the majority of patients are in age between 45 and 64 years¹². It is estimated that the patients may even exceed in developing nations, thus culminating in a double burden as a result of the current trend of transition from communicable to non-communicable diseases¹³.

Relation between Diet and Type 2 Diabetes Mellitus

The role of diet in the etiology of Type 2 Diabetes mellitus was proposed by Indian Scientists as mentioned earlier, who observed that the disease was almost confined to rich people who consumed oil, flour, and sugar in excessive amounts. During the First and Second World War, decline in the diabetes mortality rates were documented due to food shortage and famines in the involved countries like Germany and other European countries¹⁴. In Berlin also, diabetes mortality rate declined from 23.1/100,000 in 1914 to 10.9/100,000 in 1919. In contrast, there was no change in diabetes mortality rate in other countries with no shortage of food in the same time period such as Japan and North American countries. Whereas few studies have found a strong association of Type 2 Diabetes mellitus with high intake of carbohydrates and fats. Many studies have reported a positive association between high intake of sugars and development of Type 2 Diabetes mellitus¹⁵. In a written report, researchers investigated more than 500 ethnically diverse school children for 19 months. It was found in the study that for each extra serving of carbonated beverages consumed, frequency of obesity increased, after correcting for different parameters such as dietary, demographic, anthropometric, and life style. A study was conducted which included the diabetic patients with differing degrees of glycemic control. There were no differences in the mean daily plasma glucose levels or diurnal glucose profiles. As with carbohydrates, the association between dietary fats and Type 2 Diabetes mellitus was also inconsistent. Many of prospective studies have found relations between fat intake and subsequent risk of developing Type 2 Diabetes mellitus. In a diabetes study, conducted in the San Louis Valley, more than a thousand subjects without a prior diagnosis of diabetes were prospectively investigated for 4 years. In that study, the researchers found an association between fat intake, Type 2 Diabetes mellitus and impaired glucose tolerance. Another study observed the relationship of the various diet components among two groups of women, including fat, fiber plus sucrose, and the risk of Type 2 Diabetes mellitus¹⁶. After adjustment, no associations were found between intake of fat, sucrose, carbohydrate or fiber and risk of diabetes in both groups. Recently, evidence suggested a link between the intake of soft drinks with obesity and diabetes, resulting from large amounts of high fructose corn syrup used in the manufacturing of soft drinks, which raises blood glucose levels and BMI to the dangerous levels. It was also stated by Assay that diet soft drinks contain glycated chemicals that markedly augment insulin resistance. Food intake is

strongly linked with obesity, not only related to the volume of food but also in terms of the composition and quality of diet. High intake of red meat, sweets and fried foods, contribute to the increased the risk of insulin resistance and Type 2 Diabetes mellitus. In contrast, an inverse correlation was observed between intake of vegetables and Type 2 Diabetes mellitus. Consumption of fruits and vegetables may protect the development of Type 2 Diabetes mellitus, as they are rich in nutrients, fiber and antioxidants which are considered as protective barrier against the diseases. Lately, in Japanese women, a report revealed that the elevated intake of white rice was associated with an increased risk of Type 2 Diabetes mellitus. This demands an urgent need for changing lifestyle among general population and further increases the awareness of healthy diet patterns in all groups¹⁷.

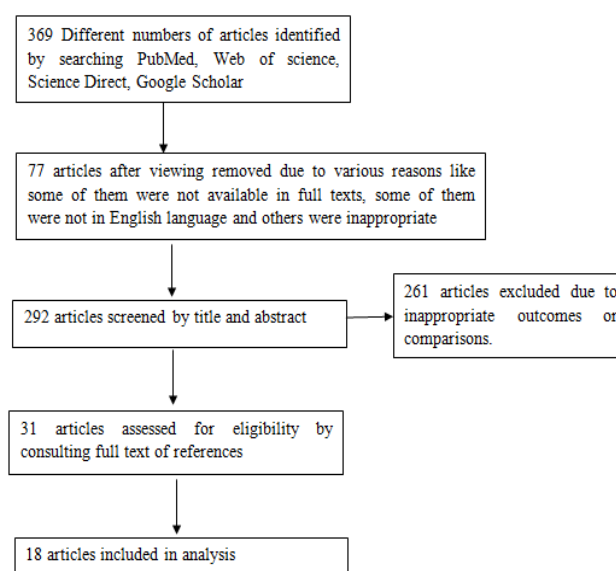


Table 1: Prisma Diagram of Retrieved Studies.

METHODS

Systematic searches were conducted in Science Direct, Web of Science, Pub Med and Google Scholar to identify all article descriptions, methods and matters affecting the patients suffering from Diabetes mellitus 2 from 2009 to 2019. The aim was to identify all articles related to the diet patterns and their effect on patients to make a comparison of these studies together. The search method consists of search terms for systematic review, were (A) Diabetes mellitus 2 effects, (B) Effect of nutrition and diet on patients suffering from diabetes mellitus 2. These description filters were included. Boolean (AND, OR) words, field specifications (Title, Abstract, All fields), duplication checks, a comparison between articles and criteria are also used as a technique for making progress. The complete syntax used in this study is “Effect of diet on patients suffering from diabetes mellitus 2” AND “Key pattern sand Factors Influencing* [Title / Abstract]”. The following inclusion criteria were used such as effect of diet on patients with diabetes mellitus 2 and diet patterns and study of nutritional changes in patients residing in

different countries was included. On the other hand, exclusion criteria were used: (1) the studies related to gestational diabetes (2) studies in which diet patterns were excluded; (3) publications published in non-English journals were also excluded; (4) publications that prejudice incomplete discussions (5) articles are not listed completely (abstract only). Six results from this study were compared together, using health technology assessments as the same method. Search progress based on article selection is provided in Figure 1.

RESULTS

Search Results

A diagram depicts the steps of searching followed PRISMA diagram is introduced in Figure 1. As proven in the figure, electronic databases produced a complete of 369 articles (Science direct (59), Google Scholar (113), PubMed (19), Web of Science (178)). Title and abstracts of the 292 identified articles were independently assessed by the two authors, of which, 261 were excluded. 31 articles assessed for eligibility by consulting the full text of references. Finally, 18 articles are included in the review.

Table 1: Summary of the Results of Articles

Sr. No	Authors	Year	Target Population	Region	Overview	Methods used	Reference
1	Valeria Di Onofrio, Francesca Galle, Mirella Di Dio, Patrizia Belfiore, Giorgio Liguori	2018	69	Naples, South Italy	A nutritional motivational intervention may be useful in improving dietary habits and health status of patients with Type 2 Diabetes Mellitus. The conclusion was drawn that a similar intervention will be applied in Campania and in other Italian regions.	A questionnaire was designed and group of 69 patients was selected thereafter statistical analysis was done onto them	2
2	Steyn, NP Mann, J Bennett, PH Temple, N Zimmet, P Tuomilehto, J Lindström, J, Louheranta, A	2004	NA	Finnish, US, Da Qing; Pima Indian Study	There was convincing evidence for a decreased risk of diabetes in adults who are physically active and maintain a normal body mass index (BMI) throughout adulthood, and in overweight adults with impaired glucose tolerance who lose weight voluntarily. It was probable that a high intake of saturated fats and intrauterine growth retardation also contribute to an increased risk, while non-starch polysaccharides are likely to be associated with a decreased risk. From existing evidence it is also possible that omega-3 fatty acids, low glycaemic index foods and exclusive breastfeeding may play a protective role, and that total fat intake and trans fatty acids may contribute to the risk.	Epidemiological and experimental studies, focusing on nutritional intervention in the prevention of type 2 diabetes are used to make disease-specific recommendations. Long-term cohort studies are given the most weight as to strength of evidence available.	18
3	Cradock, Kevin A. ÓLaighin, Gearóid Finucane, Francis M. McKay, Rhyann Quinlan, Leo R. Martin Ginis, Kathleen A. Gainforth, Heather L.	2017	42	NA	This study provides evidence that changing the dietary environment may have more of an effect on HbA1c in adults with type 2 diabetes than changing dietary behavior. Dietary interventions achieved clinically significant reductions in HbA1c, although initial reductions in body weight diminished over time. If appropriate BCTs and theory are applied, dietary interventions may result in better glucose control.	The Cochrane Library, CINAHL, Embase, PubMed, PsycINFO, and Scopus databases were searched. Reports of randomized controlled trials published during 1975-2017 that focused on changing dietary behavior were selected, and methodological	19



						rigor, use of BCTs, and fidelity and intervention features were evaluated	
4	Archana Shrestha	2017	17	NA	Workplace dietary interventions can improve Hba1c. The effects were larger for the interventions with greater number of female participants and with individual-level interventions.	Random effect models for meta-analysis in 2016	20
5	Prabha Shrestha, Laxmi Ghimire	2012	NA	Broadly throughout world	Healthy life style may best be achieved through public private partnerships involving government, partner organizations, health service providers, community and people living with diabetes. Effective strategies to reduce the incidence of diabetes globally and assist in managing the disease are urgently required.	Based on diabetes prevention programs	21
6	Grith Moller, Henning Keinke Andersen, Ole Snorgaard	2019	912	Broadly throughout world	Advice that is provided by a dietitian compared with dietary advice that is provided by other health professionals leads to a greater effect on HbA1c, weight, and LDL cholesterol.	Risk of bias and the quality of evidence were assessed according to the Grading of Recommendations Assessment, Development and Evaluation guidelines	22
7	Yamada, Satoru Kabeya, Yusuke, Noto, Hiroshi	2018	Population of Type 2 Diabetes mellitus	Japan	All the randomized controlled trials showed better glucose management with the carbohydrate restricted diet. The study revealed that there is very little evidence on diets, particularly in Japanese patients with diabetes, and that the energy restricted diet, which has been recommended by the Japan Diabetes Society in the sole dietary management approach, is not supported by any scientific evidence	Randomized controlled trials on an energy restricted diet were also included in the three studies for a carbohydrate restricted diet	23
8	Zhu, Huan Gao Jiang, Zhao Shun Gong, Pi Yun Zhang, Dong Mei Zou, Zhi Wei Zhang, Qian Ma, Hui Mei Guo, Zhen Gang Zhao, Jun Yu Dong, Jian Jun, Lin-Liao	2018	NA	NA	Research showed that Low Protein diet was not significantly associated with improvement of renal function in patients with either type 1 or 2 diabetic nephropathy. Although these results do not completely eliminate the possibility that Low Protein diet is beneficial for patients with diabetic nephropathy, it does not seem to be significant benefit to renal function.	Random-effects models were used to calculate the standardized mean difference (SMD) and the corresponding 95% confidence intervals (CI). Subgroup analyses were also performed.	24
9	Carla K. Miller	2012	Patients with 35-65 yearsage	Random	Training in mindful eating and diabetes self-management facilitate improvement in dietary intake, modest weight loss, and glycemic control. The availability of effective treatments gives patients	A prospective randomized controlled trial with two parallel interventions was used	26



					with diabetes choices in meeting their self-care needs		
10	Assessment, Swedish Council on Health Technology	2010	Random	Random	In type 2 diabetes, low-fat and moderate low-carbohydrate diets (30–40% of the energy from carbohydrates) have similar, favorable effects on HbA1c (long-term blood glucose) and bodyweight. The absence of sufficient-quality studies in people with diabetes prevents evaluation of the long-term effects of more extreme diets involving low-carbohydrate and high-fat intake, e.g., so-called “low-carb, high-fat” (LCHF) diets	The review includes randomized clinical trials (RCTs) and observational studies. Observational studies had to be prospective, i.e., a group of patients, after an initial survey, was followed forward in time.	27

Table 2: Influence of Diet on Diabetes Mellitus Type 2 In South Asia

Sr. No	Authors	Year	Target Population	Region	Overview	Methods used	Reference
1	Garduno-Diaz, S. D., & Khokhar, S.	2011	2900	South Asia, India	Genetic predisposition, central adiposity and unfavorable lifestyle, including physical inactivity and an unhealthy diet, were found connected with the prevalence of Diabetes Mellitus Type 2 in migrant South Asians. ‘Westernization’, acculturation, socioeconomic factors and lack of knowledge about the disease have also been identified as contributors to the development of Diabetes Mellitus Type 2 in this population This article describes the prevalence rate, risk factors and complications associated with Diabetes Mellitus Type 2 in migrant South Asians living in different countries	Population based study and cross sectional survey	29
2	Waqas Sami, Tahir Ansari, Nadeem Shafique Butt, Mohd Rashid Ab Hamid	2017	500	Pima Indians	Dietary habits and sedentary lifestyle are the major components for rapidly increasing incidence of DM among developing countries. In type 2 diabetics, recently, elevated HbA1c level has also been regarded as one of the leading risk factors for developing microvascular and macrovascular complications. Advancement in the elevated HbA1c level can be attainment through diet management; thus, the patients could be prevented from developing the diabetes complications.	NA	30
3	Ramachandran, A., Snehalatha, C., Satyavani, K., Sivasankari, S., & Vijay, V.	2003	475	Indian	Metabolic Syndrome is common in Asian Indians. Its prevalence is age-related, and is more common in adult females. HOMA/IR or fasting plasma insulin was not a core component of the Metabolic Syndrome.	ATP-III Criteria	31
4	Mitra, A., Bhattacharya, D., & Roy, S	2007	NA	Southeast asia	Coronary risk in Indians is associated with an increased prevalence of Type 2 diabetes mellitus, a rise in plasma or tissue levels of triglycerides and low-density lipoprotein (HDL) cholesterol. A review on available literature points out that proper diets and life-style patterns	Population based survey	32

					as advised reduce the incidence of diabetes and also hold back relentless progress of the disease.		
5	Colles, S., Singh, S., Kohli, C., & Mithal, A	2013		Urban north India	This study aimed to characterize the eating patterns, knowledge, beliefs, and determinants of food choice, and assess associations with the metabolic health among urban Asian Indians with type 2 diabetes, Strategies to enhance diabetes control among Asian Indians are required and should encourage fruit/vegetable intake, personal accountability, and consider individual beliefs and preferences. Greater emphasis and resources directed to regular dietary and behavioral counseling may assist.	A cross-sectional study of 258 individuals (mean age 55.7 ± 10 years; body mass index 27.1 ± 4.8 kg/m ² ; diabetes duration 10.1 ± 6.5 years) attending two outpatient clinics in New Delhi, India. Food-related information was collected during a semi-structured interview. Clinical, anthropometric, and biochemical data were recorded	33
6	Joshi, S. R., Bhansali, A., Bajaj, S., Banzal, S. S., Dharmalingam, M., Gupta, S	2014	796	India	The primary outcome was to notice out the percentage of total energy intake as simple and complex CHO from total CHO. Secondary outcomes were to find the differences in percentage of total energy intake as simple CHO, complex CHO, proteins and fats between Type 2 Diabetes Mellitus and non- Type 2 Diabetes Mellitus groups. The percentage of Type 2 Diabetes Mellitus participants adhering to diet plan and showing glycaemic controls were also examined	Cross sectional, single-visit, multicentre, two-arm, single-country survey. Participants were enrolled from 10 specialty endocrinology/dialectology centres from five regions of India.	34
7	Misra, A., Singhal, N., & Khurana, L.	2010	NA	South east asia	Data show imbalanced consumption of fats and oils in developing countries, which may have potentially deleterious metabolic and glycemic consequences, although more research is required. In view of the rapid rise of Type 2 Diabetes Mellitus in developing countries, more aggressive public health awareness programs coupled with governmental action and clear country-specific guidelines are required, so as to promote widespread use of healthy oils, thus curbing intake of SFAs and TFAs, and increasing intake of n-3 PUFAs and MUFAs. Such actions would contribute to decelerating further escalation of “epidemics” of obesity, the metabolic syndrome, and Type 2 Diabetes Mellitus in developing countries	NA	35
8	Salas-Salvado, J., Martinez-Gonzalez, M. Á., Bullo, M., & Ros, E	2011	NA	Developing countries	There is no universal dietary strategy to prevent diabetes or delay its onset. Together with the maintenance of ideal body weight, the promotion of the so-called prudent diet (characterized by a higher intake of food groups that are generally recommended for health promotion, particularly plant-based foods, and a lower intake of red meat,	NA	36

					meat products, sweets, high-fat dairy and refined grains) or a Mediterranean dietary pattern rich in olive oil, fruits and vegetables, including whole grains, pulses and nuts, low-fat dairy, and moderate alcohol consumption (mainly red wine) appears as the best strategy to decrease diabetes risk, especially if dietary recommendations take into account individual preferences, thus enabling long-time adherence		
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DISCUSSION

A nutritional motivational campaign may be useful in enhancing dietary habits and wellness condition of patients with Type 2 Diabetes Mellitus. There is strong grounds for the diminished risk of diabetes in adults who are physically active and maintain a normal body mass index (BMI) throughout their life and in case of obese patients with impaired glucose tolerance who lose weight voluntarily. It is possible that an if a patient takes high saturated fats then intrauterine growth retardation also contribute to an increased risk, while non-starch polysaccharides are likely to be associated with a decreased risk. There is a possibility that omega-3 fatty acids, low glycemic index foods and exclusive breastfeeding may play a protective role, and that total fat intake and trans fatty acids may contribute to the risk. This study provides evidence that altering the diet patterns may cause more of an effect on HbA1c in adults with type 2 diabetes than changing dietary behavior. Diet campaigns achieved clinically significant reductions in HbA1c, although initial reductions in body weight. Workplace dietary motivational programs can improve Hba1c. The effects were larger for the campaigns with greater number of female participants and with individual-level interventions. Healthy life style may be accomplished through public private partnerships involving government, partner organizations, health service providers, community and people living with diabetes. Effective strategies to bring down the incidence of diabetes globally and assist in managing the disease are urgently demanded. Advice that is provided by a dietitian compared with dietary advice that is offered by physicians leads to a greater effect on HbA1c, weight, and LDL cholesterol. The study revealed that there is very slight evidence on diets, in case of Japanese patients with diabetes, and that the energy restricted diet, which has been commended by the Japan Diabetes Society in the sole dietary management approach, is not supported by any scientific evidence. Training in eating and diabetes self-management increases the improvement in dietary intake, modest weight loss, and glycemic control. The accessibility of effective treatments gives patients with diabetes choices in meeting their self-care needs. In type 2 diabetes, low-fat and moderate low-carbohydrate diets (30–40% of the energy from carbohydrates) have similar,

favorable effects on HbA1c (long-term blood glucose) and bodyweight.

CONCLUSION

There is the high impact of dietary patterns on the living standards of the diabetes mellitus patients. The availability of rich, nutritious food in developing countries still needs to be improved by increasing access and control prices by using appropriate government policies. The randomized controlled trial method is effectively used to measure the diet patterns of different populations.

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