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Impact of Dietary Modification Alone in Controlling Impaired Glucose Tolerance

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ABSTRACT

The purpose of the literature review is to determine the extent impaired glucose tolerance is controlled by dietary modification alone. The review analyzes the role dietary intervention contributes to preventing the progression of prediabetes to diabetes. Diabetes mellitus describes the diseases of abnormal carbohydrate metabolism that are characterized by hyperglycemia. It is associated with a relative or absolute impairment in insulin secretion, and varying degrees of peripheral resistance to the action of insulin. Clinical practice guidelines describe prediabetes as fasting plasma glucose of 6.1-6.9 mmol/L and HbA1C 6.0-6.4%. Impaired glucose intolerance is a serious health condition and increases the risk of type 2 diabetes mellitus. It is a rising threat in our society as the incidence and prevalence has been on the increase among different age population. Articles were identified by searching specified keywords such as prediabetes, dietary modification, and impaired glucose tolerance in three electronic databases (PubMed, GoogleScholar) from 2000 to 2022. About 7 articles fit the inclusion criteria carried out in USA, Serbia, Spain, Japan, Norway, New Zealand, and Germany. The result showed that subjects on low caloric diet and high protein diet experienced a reduction in body weight, waist circumference and BMI. Other studies showed an improvement in impaired glucose within a year, less so in subsequent years as well as remission of prediabetes. However, the findings are varied as the study covers various age groups ranging from 20 years to an average of 59 years for both male and female but does not take into consideration people with pre-existing medical condition like cardiovascular disease, chronic kidney disease and heart failure. The associated risks of complications is high so all efforts are being made to prevent further progression. More evidence is needed on this study as current evidence is limited.

Keywords: impaired glucose intolerance (IGT); type 2 diabetes mellitus (T2D); prediabetes; dietary interventions; glycemic control body mass index (BMI); obesity.

INTRODUCTION AND BACKGROUND

Impaired glucose tolerance is characterized by a fasting plasma glucose concentration of <7.0 mmol/L and a 2-h post-load plasma glucose concentration of ≥7.8 but <11.1 mmol/L following an oral glucose challenge. Since 2010, a glycated hemoglobin A1C (HbA1C) result between 5.7% and 6.4% has been included in the American Diabetes Association's (ADA) criteria for prediabetes [1]. Subjects with poor glucose tolerance have a higher chance of developing type 2 diabetes, making them an important target population for diabetes prevention therapies [2].

Although diabetes prevention is essential to avoid further complications, it is also important to reduce the financial burden on individuals and the nation's healthcare system. Diagnosed diabetics face both physical and psychological challenges, as well as side effects from medication. As a result, preventing prediabetes from developing into full-blown diabetes is of paramount importance [3].

Prediabetes affects 96 million individuals (38.0%) of the adult population of the United States. It affects nearly half of the population aged 65 and up (26.4 million) [4]. It is anticipated that 20% to 70% of patients with prediabetes who do not reduce weight, modify their dietary habits, or participate in moderate physical exercise are at risk of developing type 2 diabetes within three to six years [5].

Dietary interventions play a crucial role in preventing prediabetes from progressing to diabetes. Nutritional therapies contribute to weight loss by allowing calories to be derived from healthier sources, which appears to be the primary driver to reduce the risk of developing diabetes. Moreover, nutritional interventions for prediabetes are cost-effective techniques for reducing both private and public healthcare costs. In 2012, diabetes was projected to have cost around USD245 billion in the United States [3].

It is recommended that people with diabetes and those who are at risk of developing diabetes eat at least the recommended daily allowance of dietary fiber; this may help modestly lower HBA1C levels when supplemented with dietary fiber in the form of food (such as vegetables, pulses [beans, peas, and lentils], fruits, and whole intact grains) [6].

Our focus is to evaluate the effect of dietary modification alone in preventing type 2 diabetes mellitus in patients with impaired glucose intolerance.

We reviewed the literature on the effect of diet alone on prediabetes all over the world. Our search included common databases like PubMed and Google Scholar using keywords from the thrust of our paper with search terms such as prediabetes, IGT, dietary modifications. Articles were reviewed from Jan 2000 to May 2022 and presented in Table 1.

TABLE 1: Studies on Effect of Dietary Modifications on Impaired Glucose Intolerance

Author	Study site	Mean age/Sex	BMI	Sample size	Study question	Study Design	Study Outcome
Stentz et al 2016 [7]	USA	Male and female between 20-50 years	BMI≥30 to ≤55 kg/m2	24	To determine the effect of a high protein (HP) diet versus a high carbohydrate (HC) diet on the remission of pre-diabetes, as well as the effects on metabolic parameters, lean and fat body mass, in obese, pre-diabetic participants following a 6-month dietary intervention	A prospective randomized study comparing an HP diet (30 percent kcals from protein, 40 percent kcals from CHO, 30 percent kcals from fat) vs an HC diet (15 percent kcals from protein, 55 percent kcals from CHO, 30 percent kcals from fat) over a 6-month period.	100% of subjects on the HP diet experienced remission of pre-diabetes to normal glucose tolerance, but only 33.3% of subjects on the HC diet experienced remission of pre-diabetes.
Polovina et al 2010 [8]	Serbian	N/A	Obese ≥30 kg/m2	55	To investigate the influence of medical nutritive therapy in obese people with impaired glucose tolerance risk factor for Type 2 Diabetes mellitus and potential consecutive lowering of cardiometabolic risk	The 55 obese participants were separated into two groups: group A (n = 35) and group B (n = 20) for the study. Group A was on a diet for 12 weeks (1200-1500 kcal/day with 55-65% carbohydrates, 15-18% proteins, and 22-23 mostly unsaturated fats, and 20-40 g fibers/day).	Group A experienced a reduction in waist circumference (p = 0.001), systolic blood pressure (p = 0.001), diastolic blood pressure (p = 0.01), fasting blood glucose (p = 0.001), Index HOMA IR (p 0.001), triglycerides (p 0.001), and an increase in HDL cholesterol (p 0.05) after 12 weeks on a low-calorie diet.
Konig et al 2014 [9]	Germany	Sex: NA Mean Age = 54 ± 8 y	BMI =32.8 ± 2.89 kg/ m2	42	To determine the efficacy of a 6-week lifestyle intervention (increased physical activity and a low-calorie diet) versus a meal replacement regimen on glycemic control in prediabetic patients with impaired fasting glucose.	A randomized controlled clinical trial, the participants were randomly assigned to the lifestyle group (LS=14), which received nutritional counseling sessions (fat-restricted, low-calorie diet) and instructions on how to enhance physical activity. Patients in the meal replacement (MR) group (n = 28) were told to replace two daily meals with a low-calorie, high-soy-protein, low-glycemic index drink.	Both interventions led to a significant drop in body weight and BMI, while the reduction in the MR group was more pronounced (P <0.05). In both groups, glucose concentrations significantly dropped ((LS: -12 mg/dL, P < 0.01; MR: -11 mg/dL, P < 0.01), and mean glucose levels reverted to the normal range.
Rancero-Ramos et al 2020 [10]	Spain	Male= 389 Female = 73 Mean Age = 57.01+/ 0.8	Mean BMI = 29.8+/ 0.4 kg/m2	462	To evaluate the influence of two healthy diets on the development of type 2 diabetes (T2DM) in individuals with coronary heart disease linked with each of the prediabetes diagnosis criteria.	The participants were randomized to consume either a Mediterranean or a low-fat diet. T2DM risk was determined using a COX proportional hazards regression analysis following a median follow-up period of 60 months.	There was a decreased risk of developing type 2 diabetes in the long-term consumption of a low-fat diet (HR: 3.20; 95 percent CI 0.75–13.69, respectively) when compared to the Mediterranean diet (HR: 4.70; 95 percent CI 1.12–19.67, respectively).

Author	Study site	Mean age/Sex	BMI	Sample size	Study question	Study Design	Study Outcome
Swinburn et al 2001 [11]	New Zealand	Sex= NA Reduced fat mean age = 52.5 ± 0.8 Controlled diet mean age = 52.0 ± 0.8	BMI:(RF) = 29.08 ± 0. 55 kg/m2 BMI (CD)= 29.17 ± 0. 48 kg/m2	136 (RF) n=66 (CD) n=70	To determine whether reducing dietary fat may reduce body weight and improve long-term glycemia in those with glucose intolerance.	A five-year follow-up of a one-year randomized controlled experiment comparing a reduced-fat ad libitum diet to a typical diet.	In patients on the low-fat diet, glucose tolerance improved; a lower proportion developed type 2 diabetes or impaired glucose tolerance at 1 year (47 vs. 67%, P < 0.05), but in subsequent years, there were no changes between the groups. The more compliant half of the intervention group, however, maintained lower fasting (P = 0.041 and P = 0.026, respectively) compared to the control group.
Mansoor et al 2016 [12]	Norway	Female =963 Male= 408 Mean age=48.5	Mean BMI=33.1 kg/m2	1371	The purpose of this meta-analysis was to compare the impact of low-carbohydrate (LC) diets vs low-fat (LF) diets on weight loss and cardiovascular disease (CVD) risk factors.	Meta-analysis with database searches in MEDLINE via Ovid, EMBASE, and Cochrane Library in Trials (CENTRAL) for relevant RCT until May 28, 2015.	Participants on low carbohydrate diets showed a higher decrease in body weight (WMD −2·17 kg; 95 % CI −3·36, −0·99) and TAG (WMD −0·26 mmol/l; 95 % CI −0·37, −0·15), but a greater increase in HDL-cholesterol (WMD 0·14 mmol/l; 95 % CI 0·09, 0·19) and LDL-cholesterol (WMD 0·16 mmol/l; 95 % CI 0·003, 0·33).
Maekawa et al 2016 [13]	Japan	Male= 38 Female=34 Mean age= 59 years	<35 kg/m2	72	To evaluate the effectiveness of a low-carb diet (LCD) along with diabetes education and support at 3-month intervals for regulating blood sugar levels in IGT patients and delaying the progression of IGT to type 2 diabetes.	72 IGT patients (36 in the LCD group and 36 in the control group) were enrolled between April 2007 and March 2012 and followed for 12 months. The LCD group was compared retrospectively to the control group.	At 12 months, blood glucose was normalized in 69.4% of the LCD group, and the 2-hour oral glucose tolerance test (OGTT) plasma glucose level was lowered by 33 mg/dL. In addition, at 12 months, the incidence of diabetes was considerably lower in the LCD group than in the control group (0% versus 13.9%, P=0.02) At 12 months, plasma glucose, hemoglobin A1c, the homeostasis model of assessment of insulin resistance, body weight, and serum triglycerides (TGs) were significantly reduced in the LCD group.

CONCLUSION

Nutritional interventions play a crucial role in preventing the progression of prediabetes to diabetes. Individuals with prediabetes should receive an individualized medical nutrition therapy designed by a dietitian or nutritionist in order to achieve treatment goals.

A key strategy to achieve glycemic targets when counseling people with prediabetes should include an assessment of current dietary intake followed by individualized advice to ensure the recommendations given are available and cost effective to encourage compliance that will foster glycemic control. There are certain barriers which should be put into consideration when providing these recommendations which include their cultural backgrounds, personal preferences, co-occurring conditions (often called comorbidities), and socioeconomic settings should also be put into consideration when these changes are made.

Several studies done in the past has shown that plant-based foods, Mediterranean diet rich in olive oil, fruits and vegetables, including whole grains, pulses and nuts, low-fat dairy, and a lower intake of red meat, meat products, sweets, high-fat dairy are beneficial in people with impaired glucose intolerance are reduces their progression to full blown diabetes. It has been found that the traditional Mediterranean diet has numerous health benefits, such as reducing the risk of type 2 diabetes and improving insulin sensitivity.

Even though several other studies have found that other lifestyle modifications including regular exercise, smoking cessation and low alcohol intake forms an additive effect in the overall reduction of progression but dietary modification plays a greater role. However, more studies still need to be done to determine the diet that gives greatest outcome considering individual's cultural background, costs and availability.

AUTHOR'S CONTRIBUTIONS
All authors contributed to the conception, design of the manuscript, literature search, writing of the manuscript and final approval of manuscript.

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None.

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REFEENCES

[1] American Diabetes Association. (2019). Standards of medical care in diabetes-2019 abridged for primary care providers. Clinical Diabetes: A Publication of the American Diabetes Association, 37(1), 11–34. https://doi.org/10.2337/cd18-0105

[2] Tuomilehto, J., Lindström, J., Eriksson, J. G., Valle, T. T., Hämäläinen, H., Ilanne-Parikka, P., Keinänen-Kiukaanniemi, S., Laakso, M., Louheranta, A., Rastas, M., Salminen, V., Uusitupa, M., & Finnish Diabetes Prevention Study Group. (2001). Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. The New England Journal of Medicine, 344(18), 1343–1350. https://doi.org/10.1056/NEJM200105033441801

[3] Yau, J. W., Thor, S. M., & Ramadas, A. (2020). Nutritional strategies in prediabetes: A scoping review of recent evidence. Nutrients, 12(10), 2990. https://doi.org/10.3390/nu12102990

[4] National Diabetes Statistics Report. (2022, January 20). Cdc.gov. https://www.cdc.gov/diabetes/data/statistics-report/index.html

[5] Stull, A. J. (2016). Lifestyle approaches and glucose intolerance. American Journal of Lifestyle Medicine, 10(6), 406–416. https://doi.org/10.1177/1559827614554186

[6] Evert, A. B., Dennison, M., Gardner, C. D., Garvey, W. T., Lau, K. H. K., MacLeod, J., Mitri, J., Pereira, R. F., Rawlings, K., Robinson, S., Saslow, L., Uelmen, S., Urbanski, P. B., & Yancy, W. S., Jr. (2019). Nutrition therapy for adults with diabetes or prediabetes: A consensus report. Diabetes Care, 42(5), 731–754. https://doi.org/10.2337/dci19-0014

[7] Stentz, F. B., Brewer, A., Wan, J., Garber, C., Daniels, B., Sands, C., & Kitabchi, A. E. (2016). Remission of pre-diabetes to normal glucose tolerance in obese adults with high protein versus high carbohydrate diet: randomized control trial. BMJ Open Diabetes Research & Care, 4(1), e000258. https://doi.org/10.1136/bmjdrc-2016-000258

[8] Polovina, S., & Micić, D. (2010). The influence of diet with reduction in calorie intake on metabolic syndrome parameters in obese subjects with impaired glucose tolerance. Medicinski pregled, 63(7–8), 465–469. https://doi.org/10.2298/mpns1008465p

[9] König, D., Kookhan, S., Schaffner, D., Deibert, P., & Berg, A. (2014). A meal replacement regimen improves blood glucose levels in prediabetic healthy individuals with impaired fasting glucose. Nutrition (Burbank, Los Angeles County, Calif.), 30(11–12), 1306–1309. https://doi.org/10.1016/j.nut.2014.03.014

[10] Roncero-Ramos, I., Alcala-Diaz, J. F., Rangel-Zuñiga, O. A., Gomez-Delgado, F., Jimenez-Lucena, R., García-Rios, A., Vals-Delgado, C., Romero-Baldonado, C., Luque, R. M., Ordovas, J. M., Perez-Martinez, P., Camargo, A., & Lopez-Miranda, J. (2020). Prediabetes diagnosis criteria, type 2 diabetes risk and dietary modulation: The CORDIOPREV study. Clinical Nutrition (Edinburgh, Scotland), 39(2), 492–500. https://doi.org/10.1016/j.clnu.2019.02.027

[11] Swinburn, B. A., Metcalf, P. A., & Ley, S. J. (2001). Long-term (5-year) effects of a reduced-fat diet intervention in individuals with glucose intolerance. Diabetes Care, 24(4), 619–624. https://doi.org/10.2337/diacare.24.4.619

[12] Mansoor N, Vinknes KJ, Veierød MB, Retterstøl K. Effects of low-carbohydrate diets v. low-fat diets on body weight and cardiovascular risk factors: a meta-analysis of randomised controlled trials. Br J Nutr. 2016 Feb 14;115(3):466-79. doi:10.1017/S0007114515004699. PMID: 26768850.

[13] Maekawa, S., Kawahara, T., Nomura, R., Murase, T., Ann, Y., Oeholm, M., & Harada, M. (2014). Retrospective study on the efficacy of a low-carbohydrate diet for impaired glucose tolerance. Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy, 7, 195–201. https://doi.org/10.2147/DMSO.S62681