

Diet and life style modification in type 2 diabetes: A systematic review

Anjana Surendran, Amrita Prasad, Arunachalam SV* and SambathKumar R.

Department of pharmacy practice, J.K.K. Nattraja College of Pharmacy, Komarapalayam, Tamilnadu, India.

*Corresponding Author: E-Mail: sathyaarun86@gmail.com

Received: 19 Dec 2014, Revised and Accepted: 24 Dec 2014

ABSTRACT

Type 2 diabetes is a global public health problem that threatens the economies of all nations, particularly developing countries. The epidemic has grown in parallel with the worldwide rise in obesity, it is fuelled by rapid urbanization, nutrition transition, and increasingly sedentary lifestyles. The ideal diet for diabetic patients remains to be determined. Recommendations are for low-fat high-carbohydrate diets. The main purpose of this recommendation is to reduce the risk for coronary heart disease, a major killer of diabetic patients. Some investigators also suggest that even in patients with non-insulin-dependent diabetes mellitus (NIDDM), high-carbohydrate diets play an important role in improving glucose tolerance. Another advantage of a low-fat diet is that it may promote weight reduction. High-fat diets are thought to stimulate weight gain by many investigators. There are seven essential self-care behaviors in people with diabetes which predict good outcomes namely compliant with medications, being physically active, monitoring of blood sugar, healthy eating, good problem-solving skills, risk-reduction behaviors and healthy coping skills. This paper had identified that the increasing rate of diabetes mellitus can be prevented. The majority of cases of type 2 diabetes could be prevented by the adoption of a healthier lifestyle.

Keywords: Type 2 diabetes, Diet and life style modification.

1. INTRODUCTION

Diabetes mellitus (DM) is a chronic progressive metabolic disorder characterized by hyperglycemias mainly due to absolute (Type 1 DM) or relative (Type 2 DM) deficiency of insulin hormone. World Health Organization estimates that more than 346 million people worldwide have DM. This number is likely to more than double by 2030 without any intervention. The needs of diabetic patients are not only limited to adequate glycaemia control but also correspond with preventing complications; disability limitation and rehabilitation. There are seven essential self-care behaviours in people with diabetes which predict good outcomes namely healthy eating, being physically active, monitoring of blood sugar, compliant with medications, good problem-solving skills, healthy coping skills and risk-reduction behaviours. All these seven behaviours have been found to be positively correlated with good glycaemia control, reduction of complications and improvement in quality of life. [1-3]

Several lifestyle factors affect the incidence of type 2 diabetes. Obesity and weight gain dramatically increase the risk, and physical inactivity further elevates the risk, independently of obesity. Cigarette smoking is associated with a small increase and moderate alcohol consumption with a decrease in the risk of diabetes. In addition, a low fiber diet with a high glycemic index has been associated with an increased risk of diabetes and specific dietary fatty acids may differentially affect insulin resistance and the risk of diabetes. [1]

Diabetic diet refers to the diet that is recommended for people with diabetes mellitus. There is much controversy regarding what that diet should consist of. The diet most often recommended is high in dietary fibre, especially soluble fibre, but low in fat (especially saturated fat) and low in sugar. Recommendations of the fraction of total calories to be obtained from carbohydrate are generally in the range of 40 to 65%, but recommendations can vary as widely as from 16 to 75% [4]. People with diabetes may be encouraged to reduce their intake of

carbohydrates that have a high glycaemia index (GI), although this is also controversial. [5] (In cases of hypoglycaemia, they are advised to have food or drink that can raise blood glucose quickly, such as lucozade, followed by a long-acting carbohydrate (such as rye bread) to prevent risk of further hypoglycemia.) However, others question the usefulness of the glycaemia index and recommend high-GI foods like potatoes and rice. It has been claimed that oleic acid has a slight advantage over linoleic acid in reducing plasma glucose. [6]

An approach that has been popular with some people with type one diabetes mellitus since 2000 is known as DAFNE (Dose Adjustment for Normal Eating). This approach involves estimating how many carbohydrates there will be in a meal and modifying the amount of insulin one injects before meal accordingly. An equivalent approach has for people with type two diabetes mellitus is known as DESMOND, which stands for Diabetes Education and Self-Management for On-Going and Newly Diagnosed (diabetes). DAFNE has its own newsletter and has received recommendation. [7]

The American Diabetes Association in 1994 recommended that 60–70% of caloric intake should be in the form of carbohydrates. As mentioned above, this is controversial, with some researchers claiming that 40% [8] or even less is better, while others claim benefits for a high-fiber, 75% carbohydrate diet. [9]

An article summarizing the view of the American Diabetes Association [10] contains the statement: "Sucrose-containing foods can be substituted for other carbohydrates in the meal plan or, if added to the meal plan, covered with insulin or other glucose-lowering medications. Care should be taken to avoid excess energy intake." Sucrose does not increase glycaemia more than the same number of calories taken as starch. It is not recommended to use fructose as a sweetener. Benefits may be obtained by consumption of dietary fibre in conjunction with carbohydrate; as Francis (1987) points out, evidence suggests that carbohydrate consumed with dietary fiber will have a less major impact on glycaemia rise than the same amount of carbohydrate consumed alone.

1.1. Lifestyle changes for type 2 diabetes

Lifestyle changes are often advised for people at higher risk of diabetes and those who are newly diagnosed with type 2, to help manage their diabetes.

The recommended lifestyle interventions include:

- Taking two and a half hours each week of moderate intensity physical activity or

one hour and 15 minutes of high intensity exercise.

- Losing weight gradually to achieve a healthy body
- Replacing refined carbohydrates with wholegrain and increase intake of vegetables and other foods high in dietary fibre
- Reducing the amount of saturated fat in the diet. [2]

1.3. Dietary considerations

1.3.1. Carbohydrate

People with type 1 diabetes, because they experience absolute insulin deficiency, must use insulin to control glucose excursions after meals. Since 1994, the American Diabetes Association (ADA) has recommended that, for patients with type 1 diabetes, 60–70% of total calories come from carbohydrate and monounsaturated fat. Although some studies have considered whether a preponderance of calories from unsaturated fat or carbohydrate may be more beneficial, there is no consensus on the relative amount of each. There are demonstrated improvements, however, from adjusting the doses of prandial rapid- or short-acting insulin based on the carbohydrate content of meals for patients using basal-bolus insulin regimens involving multiple daily injections or continuous subcutaneous insulin infusion. Similarly, patients on fixed doses of rapid- or short-acting insulin should attempt to keep the amount of carbohydrate relatively constant from meal to meal. [7,8]

Recommendations for carbohydrate consumption for people with type 2 diabetes are similar to those for patients with type 1 diabetes. Carbohydrate and monounsaturated fat should comprise 60–70% of total calories. However, there is some concern that increased unsaturated fat consumption may promote weight gain in obese patients with type 2 diabetes and thereby decrease insulin sensitivity. [9] Glycemic excursions appear to be similar between starches and sucrose ("table sugar"); therefore, sucrose does not need to be eliminated from the diet. [10] The "glycemic index" is an attempt to compare the glycemic effects of various foods to a standard, such as white bread. Although several authors have proposed its clinical usefulness in controlling postprandial hyperglycemia, prospective studies have not demonstrated a clear improvement in hemoglobin A1c (A1C) in patients using low-glycemic-index diets. [9] One cross-sectional study suggested a relationship between low-glycemic-index diets and low A1C levels in patients with type 1 diabetes, but it is important to note that

this study did not control for patients using once-daily, twice-daily, or more intensive insulin therapy regimens to control their glucose excursions.^[10]

Another more recent meta-analysis of low-glycemic-index diets^[11] did suggest a mild but significant improvement in A1C levels. Therefore, there may exist a small benefit in pursuing a low-glycemic-index diet in patients with diabetes. This benefit, however, appears to be less than the benefit of either matching insulin doses to carbohydrate consumed or controlling carbohydrate consumed when using fixed insulin doses. Many sweeteners are available to the general public; perhaps the most common is sucrose. Studies comparing the impact of sucrose versus the impact of the same amount of starch on glycemic control have shown that their impact is essentially identical. As described above, sucrose should be adequately covered by rapid- or short-acting prandial insulin but does not need to be eliminated from the diet. Fructose may cause less postprandial hyperglycemia, but there is some evidence suggesting that it may also lead to or worsen hyperlipidemia. Therefore, the addition of fructose to the diet as a sweetening agent is not recommended by the ADA; foods that contain naturally occurring fructose, such as fruits, do not need to be avoided.

1.3.2. Protein

Although the majority of clinical focus on the management of diabetes is on carbohydrate metabolism, protein metabolism in the state of diabetes is also abnormal. Patients with type 2 diabetes exhibit a more negative nitrogen balance than individuals without diabetes. Protein degradation appears to be exacerbated by hyperglycemia and improved by controlling glucose levels with insulin therapy. These studies suggest that the protein requirements for people with type 2 diabetes may be slightly greater than those for nondiabetic individuals, but as pointed out by Franz et al.,^[9] most individuals in the United States consume considerably more protein than the recommended daily allowance. Patients with type 1 diabetes can and do convert amino acids into glucose depending on the level of insulinization; therefore, protein consumption may cause hyperglycemia.^[9] Studies of patients with type 2 diabetes, however, have demonstrated that protein consumption does not increase plasma glucose concentrations and that endogenous insulin release is, in fact, stimulated by protein consumption.^[12] There may also be an association between high-protein diets and the risk of developing diabetic nephropathy. In a cross-sectional study of patients with type 1 diabetes,^[13] patients with macro albuminuria

were more likely than those with microalbuminuria or normal albumin excretion to report consuming > 20% of their calories in the form of protein. High-protein diets are not recommended.

1.3.3. Dietary Fat

Recommendations regarding fat in the diet of people with diabetes are similar to those for patients with coronary artery disease. This is primarily because studies have shown that the risk of myocardial infarction in diabetic patients is similar to that of non-diabetic patients who have already suffered a myocardial infarction.^[14] Because saturated fats are the major dietary determinants of serum LDL cholesterol levels, people with diabetes should strive to keep saturated fat consumption to < 7% of total daily calories and to minimize consumption of trans-fatty acids. Cholesterol consumption should be < 200 mg/day. When incorporated into a controlled calorie diet in which individuals are not losing weight, programs that emphasize either carbohydrate or monounsaturated fats both lower cholesterol, but the higher-carbohydrate diets may exacerbate hyperglycemia. In diets in which total calories were reduced to facilitate weight loss, however, the hyperglycaemic effect of the high-carbohydrate diet appeared mitigated. Diets, which are high in polyunsaturated fats, have been associated with lower mortality in elderly Europeans, but this study was not specific to people with diabetes.^[15] Diets high in fish oil may decrease the risk of cardiovascular disease and all-cause mortality.^[16]

Plant sterols are plant esters that decrease intestinal absorption of both dietary and hepatobiliary cholesterol. They have been shown in prospective studies of diabetic patients to decrease LDL cholesterol. To avoid unnecessary weight gain, the ADA recommends that, if they are used in the diet to decrease cholesterol, they should replace cholesterol sources rather than simply be added.

A recent study suggested that a diet low in carbohydrate and high in fat and protein may yield greater weight loss than other diets in nondiabetic patients.^[17] Similar diets studied in diabetic patients have also suggested that a low carbohydrate diet may produce similar or superior weight loss than balanced diets. Changes in triglycerides may be more favourable in low-carbohydrate diets, and A1C levels may be lower in low-carbohydrate diets.^[18,19] Meta-analysis of several studies, however, suggested that low-carbohydrate diets may raise LDL levels.^[20] It is important to note that the existing studies of low carbohydrate diets are short-term studies and

that the long term effects of such diets is unknown.

1.3.4. Dietary recommendations

- Eat three meals a day. Avoid skipping meals and space breakfast, lunch and evening meal out over the day.
- At each meal include starchy carbohydrate foods, e.g. bread, pasta, chapatis, potatoes, yam, noodles, rice and cereals. Eat more slowly absorbed (low glycaemic index) foods, e.g. pasta, basmati or easy cook rice, grainy breads such as granary, pumpernickel and rye, new potatoes, sweet potato and yam, porridge oats, All-Bran® and natural muesli.
- Reduce the fat in the diet, especially saturated fats. Use unsaturated fats or oils, especially monounsaturated fats, e.g. olive oil and rapeseed oil.
- Eat more fruit and vegetables. Aim for at least five portions a day.
- Eat more beans and lentils, e.g. kidney beans, butter beans, chickpeas or red and green lentils.
- Eat at least two portions of oily fish a week, e.g. mackerel, sardines, salmon and pilchards. Limit sugar and sugary foods.
- Reduce salt in the diet to 6 g or less per day.
- Drink alcohol only in moderation.
- Don't use diabetic foods or drinks (they are expensive and of no benefit).
- A low glycaemic index diet can improve glycaemic control in diabetes without compromising hypoglycaemic events.
- Although the studies are not extensive, one meta-analysis has shown that, for people with type 2 diabetes, a large fall in blood pressure similar to that of single drug therapy can be achieved with salt restriction.
- Dietary advice should be personalised and take on board the individual's needs, cultural and belief, and willingness to make changes. Advice should be ongoing and available educational programmes should be offered - e.g. DESMOND (= Diabetes Education and Self-management for Ongoing and Newly Diagnosed).
- Emphasis should be on eating a healthy balanced diet applicable to the general population.

- Control of obesity is also important. For people who are overweight, the target should be an initial bodyweight loss of 5-10%. Lesser degrees of weight loss may still be of benefit and larger degrees may provide additional metabolic advantages.
- Diet should be assessed with a view to reducing hypoglycaemia in patients using insulin secretagogues.
- Limited substitution of sucrose-containing foods for other carbohydrates is allowable but excess energy intake should be avoided.
- Patients admitted to hospital or other institutions should have their meals and snacks planned with a view to providing consistency in carbohydrate content.

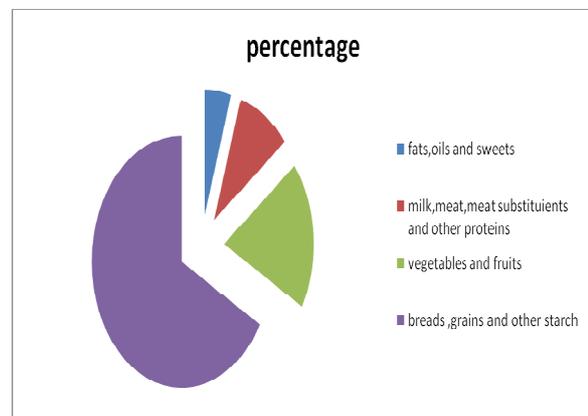


Figure 1: Diet pattern for diabetes patients.

1.3.5. EXERCISE

Patients with type 1 or type 2 diabetes have an increased risk of coronary artery disease. The ADA recommends that patients who plan to begin a moderate-to high-intensity exercise program undergo screening for cardiovascular disease if they are > 35 years of age. Patients who are > 25 years of age should also be screened if they have had type 2 diabetes for > 10 years or type 1 diabetes for > 15 years, have an additional risk factor for coronary disease, or have microvascular disease, peripheral vascular disease, or autonomic neuropathy. Decisions regarding screening of patients who plan low levels of physical activity, such as walking, are left to the discretion of the treating physician. Because some activities can lead to retinal haemorrhage or detached retina in the setting of proliferative retinopathy, patients with this condition should consult their ophthalmologist before beginning an exercise regimen. [21]

People with type 1 diabetes who begin an exercise regimen should tailor their exercise regimen to their specific condition. For instance, a

patient with peripheral neuropathy must take precautions to avoid blisters and abrasions and check closely for such conditions after exercising. Patients should consider delaying exercise if their blood glucose is > 250 mg/dl and ketones are present or if their blood glucose level is > 300mg/dl. They should monitor blood glucose before and after physical activity and be cautious about hypoglycemia, which can develop during or even several hours after exercise. They should have carbohydrate sources available and consume them as necessary to avoid hypoglycemia. Although studies have not demonstrated a clear benefit of aerobic exercise on A1C levels in type 1 diabetes, aerobic exercise is clearly beneficial in controlling other risk factors for cardiovascular disease. [21]

Physical exercise is a key component of lifestyle modification that can help individuals prevent or control type 2 diabetes. Although diet is probably more important in the initial phases of weight loss, incorporating exercise as part of a weight-loss regimen helps maintain weight loss and prevent weight regain. [22] Mild to moderate activity levels have been associated with a lower risk of developing diabetes or pre-diabetes. Men with low degrees of cardio respiratory fitness may have up to a 1.9-fold increased risk of developing impaired fasting glucose compared to men with high degrees of fitness. [22] Patients should understand that the amount of exercise that produces a beneficial effect on health is not large; as little as 30 minutes of moderate physical activity daily may offer protection from diabetes.

1.3.6. Exercise consideration

- The recommended minimum amount of activity for:
 - Adults - 30 minutes on at least five days of each week.
 - Children - one hour each day.
- It is essential to find activities that are enjoyable, achievable and sustainable, e.g. walks, dancing, swimming, bowling, cycling, golf, playing with the children, DIY.

1.3.7. Special considerations when advising diabetics about exercise

- Always consider insulin/oral hypoglycaemic therapy and meal schedule: test blood glucose before exercise, postpone exercise until after a snack if blood glucose is low, and always keep glucose at hand.
- Autonomic neuropathy is common and can be associated with silent ischaemia,

postural hypotension and a blunted heart rate response to exercise.

- Peripheral neuropathy is common and may lead to numbness, paraesthesiae, reduced balance, Charcot's joints.
- Peripheral vascular disease: there may be intermittent claudication, leg ulcers, etc.
- Avoid high-impact exercise, as this may traumatise the feet (emphasise foot care, proper shoes and cotton socks).
- Hypoglycaemia may occur up to several hours after exercise.
- Exercise is contra-indicated if there is active retinal haemorrhage or recent retinal photocoagulation.

1.3.8. Manage physical exercise using

- Formal recording of levels of physical activity
- Identification of new exercise opportunities and encouragement to develop these.
- Appropriate self-monitoring, additional carbohydrate, and dose adjustment of glucose-lowering therapy for those using insulin secretagogues.

Table - 1: Exercise chart

Intensity	Time (min)	Activity
Mild	30	Slow walking, shopping, house cleaning.
Moderate	20	Fast walking, cycling, heavy laundry.
Strenuous	10	Slow running, climbing stairs, table tennis, volley ball.
Very strenuous	5	Jumping rope, basket ball, swimming.

1.3.9. Stress

Stress has been recognised a risk factor for type 2 diabetes. When an individual is stressed their body responds with the threat response. The human body undergoes a number of changes; stress hormones are released that increase blood pressure, a surge in blood glucose levels and activates the immune system.

Non-crucial bodily functions such as digestion, growth and repair are slowed to ensure energy is used to fight or flee the threat that is instigating the threat response. [23]

1.3.10. Smoking and diabetes

Smoking is now proven to be an independent risk factor for diabetes, and amongst diabetics it increases the risk of complications.

Diabetes complications already include heart disease, stroke and circulation problems. Smoking adds to the risk of developing all of these things.

In some cases, smokings can double the likelihood of these conditions, as well as doubling the chances of suffering from kidney problems and erectile dysfunction.

2. CONCLUSION

This paper had identified that the increasing rate of diabetes mellitus can be prevented. The majority of cases of type 2 diabetes could be prevented by the adoption of a healthier lifestyle. Lifestyle alteration is required, which can prevent and reduce the risk of developing diabetes and its complications. It is essential that information about maintaining and controlling weight, dietary modification and regular exercise is provided through health education programs as well as promoting healthy behaviour in local health organizations, such as general practitioners, clinics and hospital waiting areas.

3. REFERENCES

1. Frank BH, Joann EM and Meir JS. Diet, lifestyle, and the risk of type 2 diabetes mellitus in women. **The New England Journal of Medicine**, 345(11): 2001; 345: 790-797.
2. Diabetes.co.uk. Lifestyle Changes for Type 2 Diabetes. (<http://www.diabetes.co.uk/lifestyle-changes-for-type2-diabetes.html>. accessed on:18 December2014).
3. Michael JF. Diabetes Treatment, Part 1: Diet and Exercise. **Clinical Diabetes**. 2007; 25: 105-109.
4. Harris MI, Flegal KM, Cowie CC, Eberhardt MS, Goldstein DE and Little RR. Prevalence of diabetes, impaired fasting glucose, and impaired glucose tolerance in U.S. adults: the Third National Health and Nutrition Examination Survey, 1988-1994. **Diabetes Care**,1998; 21: 518-524
5. Mokdad AH, Ford ES and Bowman BA.. Prevalence of obesity, diabetes, and obesity-related health risk factors. **JAMA**, 2003; 289: 76-79.
6. Field AE, Coakley EH and Must A. Impact of overweight on the risk of developing common chronic diseases during a 10-year period. **Arch Intern Med.**, 2001; 161: 1581-1586.
7. Lhoret R, Garon J, Langelier H, Poisson D and Chiasson JL. Effects of meal carbohydrate content on insulin requirements in type 1 diabetic patients treated intensively with the basal-bolus (ultralente-regular) insulin regimen. **Diabetes Care**, 1999; 22: 667-673.
8. Hamet P, Abarca G and Lopez D. Patient self-management of continuous subcutaneous insulin infusion. **Diabetes Care**, 1982; 5: 485-491.
9. Franz MJ, Bantle JP and Beebe CA. Nutrition principles and recommendations in diabetes. **Diabetes Care**, 2004; 27: 36-S46.
10. Bantle JP, Swanson JE, Thomas W and Laine DC. Metabolic effects of dietary sucrose in type II diabetic subjects. **Diabetes Care**, 1993; 16: 1301-1305.
11. Brand-Miller JC, Petocz P, Colagiuri S. Meta analysis of low-glycemic index diets in the management of diabetes: response to Franz. **Diabetes Care**, 2003; 26: 3363-3364.
12. Gannon MC, Nuttall JA, Damberg G, Gupta V and Nuttall FQ. Effect of protein ingestion on the glucose appearance rate in people with type 2 diabetes. **J Clin Endocrinol Metab.**, 2001; 86: 1040-1047.
13. Toeller M, Buyken A and Heitkamp G. Protein intake and urinary albumin excretion rates in the EURODIAB IDDM Complications Study. **Diabetologia**,1997; 40: 1219-1226.
14. Haffner SM, Lehto S, Ronnema T, Pyorala K and Laakso M. Mortality from coronary heart disease in subjects with type 2 diabetes and in nondiabetic subjects with and without prior myocardial infarction. **N Engl J Med.**, 1998; 339: 229-234.
15. Trichopoulos A, Psaltopoulou T, Orfanos P, Hsieh CC and Trichopoulos D. Low-carbohydrate high-protein diet and long-term survival in a general population cohort. **Eur J Clin Nutr.**, 2007; 61: 575- 581.
16. Wang C, Harris WS and Chung M. n-3 Fatty acids from fish or fish-oil supplements, but not alpha-linolenic acid, benefits cardiovascular disease outcomes in primary- and secondary-prevention studies: a systematic review. **Am J Clin Nutr.**, 2006; 84: 5-17.
17. Gardner CD, Kiazand A and Alhassan S. Comparison of the Atkins, Zone, Ornish, and Learn diets for change in weight and related risk factors among overweight premenopausal women: the A TO Z Weight Loss Study: a randomized trial. **JAMA**, 2007; 297: 969-977.

18. Foster GD, Wyatt HR and Hill JO. A randomized trial of a low-carbohydrate diet for obesity. **N Engl J Med.**, 2003; 348: 2082–2090.
19. Stern L, Iqbal N and Seshadri P. The effects of low-carbohydrate versus conventional weight loss diets in severely obese adults: one-year follow-up of a randomized trial. **Ann Intern Med.** 2004; 140: 778–785.
20. Nordmann AJ, Nordmann A and Briel M. Effects of low-carbohydrate vs low-fat diets on weight loss and cardiovascular risk factors: a meta-analysis of randomized controlled trials. **Arch Intern Med.**, 2006; 166: 285–293.
21. Zinman B, Ruderman N, Campaigne BN, Devlin JT and Schneider SH. Physical activity/exercise and diabetes. **Diabetes Care.** 2004; 27: 58–62.
22. Klein S, Sheard NF and Pi-Sunyer X. Weight management through lifestyle modification for the prevention and management of type 2 diabetes: rationale and strategies: a statement of the American Diabetes Association, the North American Association for the Study of Obesity, and the American Society for Clinical Nutrition. **Diabetes Care.** 2004; 27: 2067–2073.
23. Wei M, Gibbons LW, Mitchell TL, Kampert JB, Lee CD, Blair SN. The association between cardio respiratory fitness and impaired fasting glucose and type 2 diabetes mellitus in men. **Ann Intern Med.**, 1999; 130: 89–96.