

## Lifestyle Modification for Management and Prevention of Type 2 Diabetes: Review Article

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### ABSTRACT

**Background:** A serious non-communicable illness with emerging incidence international is type-2 diabetes. Type-2 diabetes arises when human body cannot utilize the insulin it generates and produces insufficient amounts. The main factor contributing to early mortality is type-2 diabetes. If not treated appropriately, it can cause a variety of morbidities, such as neural disorders, stroke, heart disease, blindness, kidney illness, amputations of extremities, and even death.

**Objective:** This review article aimed to throw the light on the effect of lifestyle modification for management and prevention of type 2 diabetes mellitus.

**Methods:** We searched PubMed, Google Scholar, and Science Direct for relevant articles on Lifestyle modification, type 2 diabetes mellitus, management and prevention. However, only the most recent or thorough study was taken into account between January 2004 and January 2023. The authors also evaluated the value of resources culled from other works in the same genre. Therefore, documents written in languages other than English have been ignored due to a lack of translation funds. Unpublished works, oral presentations, conference abstracts, and dissertations were generally agreed upon not to qualify as scientific research.

**Conclusion:** successful lifestyle variations, involving weight loss counselling and physical exercise, are the cornerstones of type 2 diabetes prevention. We discovered that dietary changes, regular exercise, and weight loss are effective long-term methods for reducing the risk of heart disease, renal issues, visual abnormalities, nerve damage, and other issues. All diabetics should get recommendations and prescriptions for physical activity and exercise as a component of managing their glucose control and general health. Depending on the type of diabetes, age, the activity being done, and the existence of diabetes-related health issues, different advice and precautions will be made. Each person's unique demands should be considered when formulating recommendations.

**Keywords:** Type 2 diabetes mellitus, Lifestyle, Modifications, Prevention, Diet, Exercise.

### INTRODUCTION

Diabetes mellitus (DM) is defined as a group of metabolic disorders characterized by hyperglycemia caused by defects in insulin secretion, action, or both. Type 1 diabetes mellitus (T1D) and type 2 diabetes mellitus (T2D) are the two kinds of diabetes mellitus. Diabetes is a complicated, chronic condition that needs ongoing medical attention and risk-reduction measures that go beyond glucose control. For the purpose of avoiding acute problems and lowering the likelihood of long-term consequences, ongoing patient self-management education and assistance are essential <sup>1</sup>.

95% of instances of diabetes are type 2 diabetes mellitus. It is a serious health issue that causes significant morbidity and death and affects 5% of adults globally <sup>2</sup>. It is a costly and challenging condition to manage. The estimated 190 million individuals who currently suffer from diabetes are expected to treble to 325 million people in the next 25 years <sup>3</sup>.

Several disabling magnitudes, involving cardiovascular events, nephropathy, vascular disorders, alterations to the retina, and blindness may trigger disability and immediate mortality in people with type-2 diabetes. Prevention and management of type 2 diabetes mellitus has become more crucial due to these consequences as well as the rising prevalence and

incidence of the condition. Modifying one's way of life by losing weight, getting more exercise, and changing one's diet are just a few strategies that have been shown to be effective in preventing type 2 diabetes mellitus <sup>4</sup>. The most essential elements for the development of this illness appear to be genetic vulnerability and environmental effects. However, a significant increase in physically inactive patients, obesity, and type 2 diabetes were documented <sup>5</sup>.

The cornerstone of care in the prevention of diabetes complications is good glycemic control. However, patients may find it challenging to maintain a conventional healthy lifestyle, which can have a negative impact on the effectiveness of diabetes treatment by increasing insulin resistance, lowering glucose control, and causing diabetic complications <sup>6</sup>.

Preventing or delaying the progression of diabetes in high-risk people, including individuals with reduced tolerance for glucose, may be possible with lifestyle intervention programs that emphasise nutritious diets, exercise, and small weight reductions <sup>7</sup>. Intent to prevent the disease through modifications to lifestyle became noticeable in the 1980s, and the 2004 suggestions of the European Association for the Study of Diabetes (EASD). Diabetes and Nutrition Study Group (DNSG) emphasised the prospect of T2D prevention throughout lifestyle

changes. Since then, several randomised controlled trials (RCTs) have demonstrated that increasing physical activity, decreasing weight, and altering one's diet can stop or considerably delay the development of T2D<sup>8</sup>.

In this review, we give a summary of the research on the beneficial possessions of lifestyle modifications for the prevention and management of diabetes, clarify diabetes briefly, talk about the international burden, and explain the roles that exercises, obesity, and diabetes participate in the development and progression of the disease.

### **Glucose Intolerance:**

Worldwide, hyperglycaemia is a significant factor in circulatory death, and it appears as pre-diabetes or diabetes. Pre-diabetes is a kind of hyperglycaemia that encompasses both lessened fasting glucose (IFG) and prejudiced glucose tolerance (IGT), when the levels of glucose in the blood are distinguished than normal but less than the diabetes cutoffs. Fasting plasma glucose (FPG) readings ranging from 100 to 125 mg/dL are indicative of IFG, while plasma glucose levels of 140 to 199 mg/dL following an OGTT (oral glucose tolerance test) are indicative of IGT<sup>9</sup>.

Raised blood glucose levels are a result of problems with insulin production, insulin action, or both, with IGT and IFG both reflecting problems with cell function. Chronic hyperglycemia is indicated by glycated hemoglobin (HbA1c), and clinically, levels between 5.7% and 6.4% are used to identify pre-diabetes<sup>10</sup>.

If no lifestyle changes are done, many persons with pre-diabetes will acquire diabetes over the following 10 years since hyperglycemia is a significant risk factor for the disease<sup>8</sup>. At FPG 126 mg/dL, plasma glucose levels 200 mg/dL following an OGTT, or a HbA1c value of 6.5, those with IFG/IGT advance to diabetes. A random plasma glucose level of less than 200 mg/dL can sometimes be used to identify diabetes (for example, in individuals with symptoms of hyperglycemia). Despite being more costly and unavailable in some circumstances, HbA1c is generally viewed as a more practical and reliable approach than IFG and OGTT<sup>11</sup>.

### **The Diabetes Burden:**

Diabetes is a significant worldwide public health burden since it is risk factor for early disability and death, mostly due to cardiovascular disease (CVD), although it can also cause nephropathy, retinopathy, and neuropathy. The International Diabetes Federation (IDF) reports that 8.3% of people aged 20 to 79 had diabetes in 2014, with low- and middle-income countries for 77% of all cases worldwide. While, the prevalence of diabetes appears to be comparable across men and women, it is greater in urban than rural populations. The nations reported the most instances of diabetes worldwide are China, India,

and USA, with 92, 62, and 24 million individuals afflicted, respectively. Around 46% of diabetes cases worldwide go misdiagnosed since it can be asymptomatic and go unnoticed for a long time, suggesting that those who have it are not getting the proper care to prevent complications. With 46823 disability-adjusted life years lost in 2010 and 4.9 million deaths globally in 2014, diabetes has emerged as a major global cause of disability and mortality<sup>12,13</sup>. The incidence of diabetes worldwide is predicted to rise and reach 55% by 2035 due to trends in global population growth and ageing<sup>7</sup>.

Diabetes afflicted 9.3% of persons over the age of 20 in the US in 2012, with predictable 28% of diabetes cases going undiagnosed. Diabetes affects 12.3% of American adults, with men having a greater incidence than women and persons over the age of 65 having the greatest prevalence (25.6%). Asian Americans (9%), Hispanics (13%), non-Hispanic blacks (13%), and American Indians and Alaska Natives (16%) all have higher prevalence of diabetes than other racial and ethnic groups. On the other hand, non-Hispanic whites have the lowest prevalence of diabetes in the nation (7.6%)<sup>14</sup>.

### **A Lifestyle Recommendation to Prevent T2D:**

An overwhelming body of research demonstrates that dietary and lifestyle modifications that lead to a drop in body weight and surge in physical activity significantly reduce the risk of diabetes. There is proof that altering one's lifestyle can lessen the impact of genes on the chance of developing diabetes. For example, in the US Diabetes Prevention Program (DPP), those receiving a lifestyle intervention showed a reduced correlation between genotypes associated with susceptibility and development of diabetes<sup>7</sup>. Similar to this, research among Swedish individuals revealed that leading an active lifestyle may counteract a hereditary propensity to diabetes<sup>15</sup>.

Since obesity is partially a result of having a positive energy balance, it is imperative that weight loss-driven diabetes preventive strategies target physical activity and food. Physical activity is any skeletal muscle-driven motion that occurs during free time, occupational activity (i.e., employment), transportation (such as walking or cycling), home duties, play, games, sports, or organized exercise. Particularly among high-risk persons, a variety of exercise and strengths are linked to a 20% to 30% decrease in the chance of developing diabetes<sup>7</sup>.

The extent of  $\beta$ -cell malfunction and hyperglycemic characteristics determines how much lifestyle adjustments can avert or postpone the onset of diabetes. For instance, altering one's lifestyle can increase insulin sensitivity and eventually re-establish normoglycemia in people with trivial  $\beta$ -cell dysfunction who develop impaired glycemic tolerance (IGT) because of peripheral insulin resistance. Contrarily, lifestyle modifications may

not rebuild normoglycemia in individuals with mild  $\beta$ -cell dysfunction with isolated IFG but may assist manage glucose levels. Whereas lifestyle modifications may not have much of an impact on the advancement of diabetes in people with isolated IFG concentrations, it is quite helpful for people with IGT. Independent of socio-demographic characteristics, physical activity, and obesity, other lifestyle choices and mental health problems have also been related to an increased risk of diabetes, including sedentary behavior, smoking, stress, and sleep patterns. Smoking considerably raises the risk of diabetes, with active smokers having a 44% higher risk, according to meta-analyses. Sleep disruptions have also been related to improper glucose metabolism, with sleeping disorder being proven to greatly raise risk for diabetes. Similarly, psychological stress predicts the occurrence of diabetes in men and impaired glucose metabolism in women <sup>7</sup>.

### **Management Of T2D:**

Each individual need tailored care. Type 2 diabetics may need insulin or oral hypoglycemic medications if diet and exercise are ineffective at lowering blood glucose levels. A medical team, including a doctor, dietitian, and nurse or health educator, should be working with diabetic patient. Balancing the levels of glucose and insulin in the blood is the key to effective treatment of diabetes, regardless of the kind of diabetes. This calls for modifying the exercise routine, food, and occasionally, medicine <sup>16</sup>.

### **Diet and T2D:**

A notable decrease in the likelihood of acquiring type-2 diabetes was linked to the favorable effects of the traditional food pattern and dietary habits on diabetes mellitus and glucose metabolism generally. The diet places an emphasis on consuming fat, particularly unsaturated fatty acids from meals. Furthermore, it encourages a daily consumption of fruits, vegetables, low-fat dairy products, whole grains, as well as very little red animal products, poultry, fish, tree nuts, and legumes <sup>14</sup>. One of the most well-known nutritional habits for its beneficial effects on human health is the content of the diet. This diet may help to prevent the onset of type-2 diabetes by reducing insulin resistance and oxidative stress. A high proportion of monounsaturated to saturated fatty acids, little consumption of trans fatty acids, and a substantial amount of dietary fibre, antioxidants, and polyphenols are all associated with eating a lot of fruits and vegetables, beans, nuts, fish, grains, and oil. Overall, the diets have a low-calorie density, which prevents weight gain and has a preventive impact against the onset of type 2 diabetes, a disease that is largely mediated by weight management. After adjusting for multiple characteristics, higher diet adherence and modest physical

activity were linked to decreased probabilities of getting diabetes <sup>5</sup>.

A Paleolithic diet, on the other hand, whereas control subjects who were given dietary advice did not notice a significant improvement in their glucose tolerance despite losing weight and having a smaller waist circumference, this diet, which consists of lean fish, meat, shellfish, vegetables, fruits, roots, eggs, and nuts, was linked to a noticeable improvement in glucose tolerance. The risk factors for developing diabetes are: being overweight, having upper-body obesity, being older than 40, having a family history of the disease, and being a woman 50% more frequently than a man <sup>17</sup>.

### **Objectives of dietary treatment of T2D:**

Objectives of nutritional management for diabetes include achieving ideal blood glucose and blood lipid levels, providing adequate calories for healthy weight maintenance, normal growth, and development, especially during pregnancy and breastfeeding, to avert, postpone, and treat problems associated with diabetes, to enhance health through a well-balanced diet. <sup>3</sup> The attempts to follow the traditional meal measures to follow the guidelines of the so-called "diabetic diet" sometimes lead to unwarranted limitations, overindulgence, or repetitious use of some food items, such as unripe plantains or beans <sup>2</sup>. This is a result of cultural misunderstandings regarding the function of nutrition in the treatment of diabetes as well as illiteracy, poverty, and other factors. This is typically the part of diabetic care that causes the greatest issues. For non-obese diabetic patients, 1500–2500 calories per day are often suggested, with 2000 calories per day being the average allotment. Between 800 and 1500 kcal should be consumed daily by an overweight diabetes patient, and at least 2500 kcal should be consumed daily by an underweight diabetic patient, including growing children and adolescents <sup>17</sup>.

### **Physical activity or exercise and T2D:**

Regular exercise increases glucose uptake by body cells, lowering blood glucose levels. Along with aiding in weight loss, regular exercise also lowers cholesterol and blood pressure. The doctor and nutritionist must be informed of the benevolent of physical activity the patient routinely engages in. The patient may balance the physical activity with the medicine and food plan for diabetics with the assistance of the doctor and nutritionist. Doctor could advise patient to do more exercise if he/she isn't doing it already <sup>15</sup>. Reducing the need for insulin, lowering the chance of becoming obese, and lowering the risk of heart disease are all significant advantages of a consistent aerobic exercise performance in the controlling of diabetes. Exercise lowers blood triglycerides and total cholesterol while increasing the proportion of (LDL) to

(HDL). Additionally, it could lessen stress levels and blood pressure. One of the simplest and healthiest forms of exercise is walking. Without specific equipment and with little danger of damage, this is one sport that anybody may engage in for the rest of their lives. Consulting the physician about exercising. Due to the possibility of an insulin imbalance, supervised exercise is recommended<sup>18</sup>.

### **T2D and smoking:**

Individuals who smoke have a bigger chance of acquiring type 2 diabetes, and smoking impairs glycemic control (smokers with type 2 diabetes require higher insulin doses to achieve control comparable to that of non-smokers).

Smokers who have diabetes run a greater risk of utilizing peripheral vascular disease, CVD, and neuropathy. Additionally raising the risks of surgery is smoking<sup>19</sup>.

### **Consuming Alcohol and T2D:**

Alcohol interferes with the actions of insulin, insulin secretagogues, and glucagon, increasing the risk of hypoglycemia in people with type 2 diabetes who take these medications. Alcohol can lower BGLs and reduce awareness of hypoglycemia. These effects on diet and control of BGLs have an impression on controlling type 2 diabetes<sup>7</sup>.

Alcohol and hypoglycemia both negatively affect cognitive performance, although they do so in separate ways. People who are overweight or obese may benefit from reduced calorie intake, which should include considering alcohol consumption, as part of diabetes care<sup>20</sup>.

### **Preventive interventions:**

The progression of pre-diabetes to diabetes can be avoided or hesitated with the use of metformin and lifestyle interpolations that emphasize food, exercise, or both. However, the US FAD has not yet given metformin approval for this particular condition<sup>21</sup>. When discussing preventative measures for pre-diabetes, doctors and patients may wish to take a few additional things into account. Metformin was found to be not as effective as lifestyle modifications in the Diabetes Prevention Program (DPP) research. Lifestyle changes also help with weight, blood pressure, and lipid levels (by raising levels of HDL cholesterol and reducing levels of triglycerides) in addition to delaying the development of diabetes<sup>22</sup>. Metformin helps people lose weight, but it doesn't seem to have any effect on blood pressure or consistently lower cholesterol levels. Metformin may be helpful for those under 60, with a BMI of 35 or higher, FPG of 110 mg/dL (6.11 mmol/L) or higher, or with gestational diabetes history, according to the DPP Outcomes Study (DPPOS)

and similar analyses. All DPP subgroups benefited from lifestyle interventions<sup>23</sup>.

### **CONCLUSION**

In conclusion, successful lifestyle variations, involving weight loss counselling and physical exercise, are the cornerstones of type 2 diabetes prevention. We discovered that dietary changes, regular exercise, and weight loss are effective long-term methods for reducing the risk of heart disease, renal issues, visual abnormalities, nerve damage, and other issues. Exercise and diet are crucial components of managing a diabetic condition. All diabetics should get recommendations and prescriptions for physical activity and exercise as a component of managing their glucose control and general health. Depending on the type of diabetes, age, the activity being done, and the existence of diabetes-related health issues, different advice and precautions will be made. Each person's unique demands should be considered when formulating recommendations.

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