

## Review Article

## Lifestyles and Diabetes Mellitus

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**Abstract:** Diabetes mellitus is a common disease with an increasing prevalence in low- and middle-income countries. It causes significant macrovascular and microvascular complications which result in a considerable amount of human suffering. Further, it also increases premature mortality. Emerging scientific data confirms the mitigating effects of healthy lifestyles on diabetes mellitus. The five major healthy lifestyles with the most impact are non-smoking, alcohol intake in moderation, maintaining normal body weight, exercising regularly, and eating a prudent diet. Following these five lifestyle behaviors are not only beneficial for diabetes mellitus prevention and management but also help in prolonging life expectancy at age 50 years. This has been estimated to be 14.0 years in females and 12.2 years in males when compared with individuals with zero low-risk lifestyles. This manuscript briefly reviews the impact of these five factors on diabetes mellitus.

**Keywords:** Diabetes, smoking, obesity, alcohol, diet, exercise.

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## INTRODUCTION

Type 2 Diabetes Mellitus (DM) is one of the most common metabolic disorders worldwide [1]. Its global prevalence, especially in the low- and middle-income countries continues to increase [2]. The two major types of diabetes are type I and type 2 [2]. Type I diabetes is an autoimmune disorder, with several genetic, epigenetic, and environmental factors playing a role in its genesis [3]. Type 2 diabetes is characterized by insulin resistance and accounts for 90-95% of all diabetes cases [2]. This manuscript will deal primarily with type 2 diabetes (DM). In 2017, it affected 425 million people globally, and these numbers are expected to increase to 629 million by 2045 [4]. It results from a combination of defective insulin secretion by pancreatic  $\beta$ -cells and/or the inability of insulin-sensitive tissues to respond to insulin [5]. According to the American Diabetes Association [6], Type II DM is diagnosed if there is: A fasting plasma glucose level of 126 mg/dL (7.0 mmol/L) or higher; 2-hour plasma glucose level of 200 mg/dL (11.1 mmol/L) or higher during a 75-g oral glucose tolerance test; or a random plasma glucose of 200 mg/dL (11.1 mmol/L) or higher in a patient with classic symptoms of hyperglycemia or hyperglycemic crisis; or a hemoglobin A1c (HbA1c) level of 6.5% (48 mmol/mol) or higher. Prediabetes, according to the American Diabetes Association [7] is characterized by: impaired fasting glucose (IFG) level of 100 mg/dl to 125 mg/dl (5.6–6.9 mmol L); impaired glucose

tolerance (IGT) levels of 140 mg/dl to 199 mg/dl (7.8–11.0 mmol L); HbA1c 5.7% - 6.4% (39–46 mmol L). Prediabetes is associated with an increased risk of developing DM [8]. DM is associated with considerable morbidity and mortality [9]. It is not a benign disease and causes significant microvascular (retinopathy, nephropathy, and neuropathy) and macrovascular (coronary artery disease, stroke, peripheral artery disease) complications [10]. This leads to considerable suffering, increased disability, and considerable premature deaths [11]. Diabetes-related mortality is increasing all over the world [12]. Deaths from DM have increased by more than 60% since 2000 and now rank in the top 10 causes of death [13]. It is estimated that DM causes 1.5 million deaths worldwide and contributes to an additional 17.5 million deaths each year [14]. This premature mortality results in a reduction in the life expectancy of the affected individual by approximately six years [15]. Cardiovascular diseases (CVDs) are extremely common in diabetics and account for more than 50% of diabetes-related deaths [16]. Diabetes is recognized as an independent major risk factor for the development of CVDs [17]. Prediabetes is also associated with a higher risk of atherosclerotic disease and all-cause mortality [18]. Following these five lifestyle behaviors help prevent and reduce the impact of DM morbidity and mortality [19]. They also help in prolonging life expectancy at age 50 years [20]. This has been estimated to be 14.0 years in females and 12.2 years in

males when compared with individuals with zero low-risk lifestyles [21]. DM is an expensive disease and is responsible for approximately 12% of global health expenditure.

## DISCUSSION

Healthy lifestyles include non-smoking, regular exercise, low to moderate alcohol intake, a normal body mass index, and a prudent quality of diet [21]. Tobacco smoke has several thousand chemicals, and many of them are toxic [22]. Smokers inhale the first hand or mainstream smoke from the cigarette [23], while passive smokers inhale environmental smoke – consisting of a combination of side-stream smoke (emanating from the burning end) and exhaled mainstream smoke [24]. Third-hand smoke is inhaled by both the smoker and the passive smokers. Third-hand smoke occurs when the residue from smoked cigarettes clings to surfaces such as skin, hair, clothing, and furniture, and becomes airborne and results in inhalation [25]. Engaging in regular exercise is a healthy lifestyle and should include an aerobic workout at least 150 min per week of moderate-intensity or 75 min per week of vigorous-intensity along with at least 2 days of muscle-strengthening activity [26]. Exercise and not living a sedentary life have innumerable health benefits [27]. Maintaining a normal body weight - a body mass index or BMI of 18.5–24.9 kg/m is also extremely important [28]. There should be no central or visceral obesity (waist circumference <102 cm in males and <88 cm in females; waist-hip ratio 0.9 or less in males and 0.85 or less in females; weight height ratio < 0.5 [29, 30]. Obesity is associated with an increased number of adipocytes, both white and brown, and the former has several endocrine functions which can be harmful [31]. Besides maintaining a healthy weight by exercise and calorie restriction, the quality of diet is important [32]. A healthy diet is well balanced, mostly plant-based, rich in fruits and vegetables, whole grains, fish, low in sugar and salt, and with the occasional intake of lean meats [33]. It limits or eliminates trans-fats, saturated fats, fried foods, sodium, red meat, refined carbohydrates, and sugar-sweetened beverages [33]. The benefits of a plant-based diet have been confirmed in several studies [34]. Alcohol drinking should be done in moderation – not to exceed two standard drinks a day for men and one standard drink a day for women [35]. In the United States, a standard drink contains 12–15 g of pure ethanol [36]. Alcohol in moderation may be beneficial in certain ailments [37], but in general, alcohol intake is harmful, even in small amounts as noted in its relationship with cancer [38]. Deviations from these low-risk lifestyle behaviors are unhealthy and deleteriously impacts the development and progression of diabetes mellitus [39].

### Smoking

Several studies have found that smokers have an increased risk of developing DM [40-43]. This increased risk ranges from 11.7% in male smokers and

2.4% in female smokers [44]. Smoking in patients with diabetes increases both microvascular and macrovascular complications [45-55]. In a meta-analysis of prospective studies on diabetes, Qin *et al.*, reported that smoking increased the risk of death by 48%, coronary heart disease by 54%, stroke by 44%, and myocardial infarction by 52% [48]. Smoking is also associated with the premature development of neuropathy, nephropathy, and retinopathy [56]. Smoking also impairs the renal excretory function in diabetics [57]. Non-diabetic smokers exhibit higher blood glucose levels [40]. Passive smokers show a 22% increased risk of incident DM compared to those not exposed to passive smoke [44]. Smoking during pregnancy increases the risk of DM in the offspring [58]. Smoking cessation gradually decreases the risk of developing DM [59], and its vascular complications in those with established disease [60]. Smokers often gain weight after smoking cessation [61] and this weight gain increases the risk of DM during the first 3 years following cessation [62]. Smoking impacts DM by impairing beta-cell function, increasing insulin resistance, and raising inflammatory markers [63].

### Alcohol

Some studies have estimated that moderate alcohol consumption may reduce the incidence of type 2 diabetes, and this reduction could be by 30%-40% [64-67]. In a large study involving 22,778 twins and 580 incident cases of type 2 diabetes during 20 years of follow-up, Carlsson *et al.*, had reported that low to moderate intake of alcohol was beneficial for DM [68]. Low to moderate alcohol intake reduces inflammation [69] increases insulin sensitivity [70] and may also stimulate the synthesis of HDL [71]. Heavy alcohol intake, on the other hand, has been associated with a higher risk for DM in many studies [68, 72] and worsening of some complications [73]. In a study of 2366 Koreans monitored over 10 years, consumption of more than 2 units of alcohol per day was associated with an increase in the risk of DM [74]. Further, heavy drinkers may show poor judgment and may eat unhealthily [75] and smoke [76] and are less likely to follow other healthy lifestyle behaviors such as regular exercise [77]. A reduction in alcohol intake in heavy drinkers reduces the risk of DM development and improves survival [78, 79].

### Obesity

Obesity is strongly linked with DM - >85% of DMs are overweight or obese [80]. Obesity increases the risk for DM, in adults [81-83], adolescents, and children [84]. Weight loss is beneficial in reducing this risk [85, 86]. Prediabetes conversion into DM is reduced by 58% by weight loss of 5.5% [87]. In the DIRECT trial, the weight loss resulted in sustained remissions of DM in more than a third of people at 24 months [88]. Bariatric surgery often induces DM remission in 23-60% of patients if they lose 20-30% of their body weight [89]. Weight loss in diabetics also

helps decrease medication requirements, hospitalizations, and health care costs [90, 91]. These patients have reduced symptoms [92] and they improve their quality of life [93]. They also experience an increased survival [92]. They have less cardiovascular comorbidity [94]. Obesity is associated with chronic inflammation, biotoxicity, and adipocyte-induced loss of insulin sensitivity, and these factors contribute to the development of DM [95].

### Exercise

Exercise can help prevent or delay type 2 diabetes [96, 97]. In people with impaired glucose tolerance, physical activity at least 150–175 min/week and dietary energy restriction results in reductions of 40%–70% in the risk of developing type 2 diabetes [98]. Other studies have shown similar protective effects of exercise [99, 100]. In DM, aerobic exercise reduces blood glucose, A1C, triglycerides, blood pressure, and insulin resistance [101]. There is a reduction in body weight and a decrease in cardiovascular risk [102–104]. Diabetics become metabolically healthier, and function better [105]. Resistance exercises are also helpful in these patients [106, 107]. Other exercises such as stretching, improve joint mobility [108] while balance training decreases the risk of falls, especially if there is peripheral neuropathy [109, 110]. Both Yoga and Tai Chi are also helpful [111, 112]. There is a decrease in mortality in these patients with exercise [113]. Since diabetics may suffer from cardiovascular autonomic neuropathy, exercise stress testing should be done before starting an exercise program [114].

### Diet

A calorie restriction-induced weight loss of about 15 kg, can lead to remission of DM in about 80% of obese diabetics [115]. Dietary quality also impacts DM [116–121]. Schwingshackl *et al.*, estimated that risk-decreasing foods are associated with a 42% reduction, while consumption of risk-increasing foods results in a threefold increase in DM risk, compared to non-consumption [118]. Risk decreasing foods are primarily plant based [116, 117] and rich in fruits and vegetables [119], whole grains [120], and low-fat dairy products [121]. Intake of virgin olive oil, chocolate, and coffee also lowers the risk of DM [122]. In contrast, risk-increasing foods are high in unprocessed and processed meat and sugar-sweetened beverages [119, 123, 124]. Moderate egg consumption does not appear to be a risk factor for DM [125]. Both the DASH diet [126] and the Mediterranean diet [127] show an inverse association with DM.

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