



Review Article

Role of Lifestyle Modification in Glycemic Control and Prevention of Complications among Patients with Type-2 Diabetes Mellitus: A Narrative Review

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Abstract

Background: Type-2 diabetes mellitus (T2DM) is a major chronic metabolic disorder characterized by hyperglycemia resulting from insulin resistance, progressive impairment of pancreatic β -cell function, or a combination of both. The increasing prevalence of T2DM is closely associated with modifiable lifestyle factors including unhealthy dietary patterns, physical inactivity, sedentary behavior, overweight and obesity. Persistent hyperglycemia can result in microvascular and macrovascular complications affecting the eyes, kidneys, nerves, cardiovascular system and lower limbs. Lifestyle modification is therefore an important component of comprehensive diabetes management and prevention of disease-related complications.

Keywords: Type-2 diabetes mellitus; Lifestyle modification; Glycemic control; Physical activity; Healthy diet; Weight management; Diabetes complications; Self-care; Health education; Nursing.

INTRODUCTION

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Type-2 diabetes mellitus is one of the most important noncommunicable diseases worldwide and represents a substantial public health challenge. The number of people living with diabetes has increased considerably over recent decades, particularly in low- and middle-income countries. Diabetes is associated with significant morbidity and mortality and can lead to cardiovascular disease, stroke, kidney failure, vision loss, neuropathy and lower-limb complications.^{1,2}

T2DM is influenced by both non-modifiable and modifiable factors. Age, genetic predisposition and family history contribute to disease susceptibility, whereas excess body weight, unhealthy dietary patterns, physical inactivity and sedentary behavior are important modifiable factors.^{3,4}

DIABETES MELLITUS AND LIFESTYLE-RELATED RISK FACTORS

T2DM develops through a complex interaction between insulin resistance, progressive β -cell dysfunction and environmental factors. Excess adiposity, especially central adiposity, is strongly associated with insulin resistance. Physical inactivity and unhealthy dietary patterns may further contribute to metabolic dysfunction and progression of disease.⁶

Dietary patterns characterized by high intake of refined carbohydrates, sugar-sweetened foods and beverages, highly processed foods and unhealthy fats may contribute to excessive energy intake and metabolic risk. In contrast, diets emphasizing vegetables, whole grains, legumes, nuts, fruits in appropriate portions and minimally processed foods are generally

associated with better health outcomes.⁵

Physical inactivity is another important modifiable risk factor. Regular physical activity increases glucose uptake by skeletal muscle and improves insulin sensitivity. Conversely, prolonged sedentary behavior is associated with poorer metabolic health and may make glycemic management more difficult.⁷

CONCEPT OF LIFESTYLE MODIFICATION

The major components include:

- Healthy and individualized dietary practices
 - Regular aerobic and resistance physical activity
 - Reduction of prolonged sedentary behavior
 - Weight management
 - Adequate sleep
 - Stress management
 - Smoking cessation
 - Appropriate alcohol-related counseling
 - Diabetes self-management
 - Medication adherence
 - Regular monitoring and preventive care
- Current recommendations emphasize individualized nutrition, physical

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activity and behavioral interventions, particularly for people with T2DM and overweight or obesity.⁴ The ADA 2026 recommendations specifically support nutrition, physical activity and behavioral therapy as components of weight and health management.⁸

DIETARY MODIFICATION AND GLYCEMIC CONTROL

Dietary management is a central component of lifestyle modification in T2DM. The primary objectives of dietary intervention are to support appropriate energy intake, maintain or achieve a healthy body weight, improve glycemic control and reduce cardiovascular risk.⁹

There is no single dietary pattern that is appropriate for every person with T2DM. Current evidence supports several healthy dietary patterns, including Mediterranean-style, plant-based, DASH-style and appropriately individualized lower-carbohydrate approaches.¹⁰

Healthy dietary practices generally emphasize vegetables, legumes, whole grains, nuts, seeds and other nutrient-dense foods while limiting excess refined carbohydrates, added sugars, highly processed foods and unhealthy fats. The WHO similarly recommends a diversified diet based on a variety of foods, with appropriate consideration of individual and cultural dietary practices.¹¹

Medical nutrition therapy provided by qualified professionals can support improvement in glycemic control and other cardiometabolic outcomes.¹²

PHYSICAL ACTIVITY AND EXERCISE

The WHO recommends physical activity as an important component of management for people living with T2DM and provides guidance on reducing sedentary behavior.^{13,14}

REDUCTION OF SEDENTARY BEHAVIOR

The ADA recognizes breaking up prolonged sedentary time as a potentially useful strategy, while WHO guidance specifically addresses both physical activity and sedentary behavior in people living with T2DM.^{5,14}

WEIGHT MANAGEMENT

The Diabetes Prevention Program demonstrated that intensive lifestyle intervention involving weight reduction and increased physical activity substantially reduced progression to diabetes among high-risk adults.¹⁷ Although prevention findings cannot automatically be equated with outcomes among people already diagnosed with T2DM, they provide strong evidence for the metabolic importance of lifestyle change.

BEHAVIORAL MODIFICATION AND HEALTH EDUCATION

Behavioral strategies such as goal setting, self-monitoring, action planning, problem solving, reinforcement and regular follow-up can facilitate lifestyle modification. Structured health education can provide patients with practical skills rather than simply delivering information.

A systematic review and meta-analysis of theory- and model-based lifestyle interventions found significant improvement in HbA1c among people with T2DM, suggesting that structured behavioral approaches can contribute to glycemic

improvement.⁹

STRESS MANAGEMENT AND PSYCHOLOGICAL WELL-BEING

Diabetes is a long-term condition requiring continuous attention to food, medication, physical activity, monitoring and healthcare appointments. These demands can contribute to diabetes-related emotional distress and may interfere with self-management.

SLEEP AND TYPE-2 DIABETES

Sleep is increasingly recognized as an important component of overall metabolic health. Inadequate or irregular sleep may affect appetite regulation, energy balance, insulin sensitivity and daytime physical activity.

SMOKING CESSATION AND ALCOHOL-RELATED COUNSELING

Tobacco use increases cardiovascular and other health risks and is particularly concerning in people with diabetes who already have elevated cardiovascular risk. Smoking cessation should therefore form part of comprehensive diabetes management.^{1,5}

DIABETES SELF-MANAGEMENT

Diabetes self-management involves the daily behaviors required to maintain health and reduce the risk of complications. These behaviors include appropriate nutrition, physical activity, medication adherence, glucose monitoring when indicated, foot care, healthcare attendance and recognition of symptoms requiring medical attention.

WHO identifies healthy eating, physical activity, blood glucose monitoring, medication, self-management education and psychosocial support as important components of diabetes management.³

LIFESTYLE MODIFICATION AND GLYCEMIC CONTROL

Glycemic control is an important goal of T2DM management because prolonged hyperglycemia contributes to vascular and neurological damage. HbA1c is commonly used to assess average glycemic exposure over the preceding approximately 2–3 months.³

Lifestyle interventions can influence glycemic control through several mechanisms, including increased glucose uptake by skeletal muscle, improved insulin sensitivity, reduced excessive energy intake and weight reduction.¹⁵

A systematic review and meta-analysis of theory- and model-based lifestyle interventions involving 18 studies and 2,384 participants reported a significant improvement in HbA1c.⁹ Another recent systematic review and meta-analysis involving South Asian adults with T2DM included 16 randomized controlled trials and 1,499 participants and reported reductions in HbA1c and fasting blood glucose following lifestyle interventions.¹¹

LIFESTYLE MODIFICATION AND CARDIOVASCULAR RISK

People with T2DM have an increased risk of cardiovascular disease. Therefore, diabetes management extends beyond glucose control to include management of blood pressure, lipids, body weight, smoking and physical activity.

Lifestyle interventions can positively influence several of these modifiable risk factors. Healthy dietary patterns can support

lipid and blood pressure management, while physical activity contributes to cardiovascular fitness and weight management.^{5,15}

LIFESTYLE MODIFICATION AND PREVENTION OF DIABETIC COMPLICATIONS

Diabetes-related complications include microvascular complications such as retinopathy, nephropathy and neuropathy and macrovascular complications such as coronary artery disease, cerebrovascular disease and peripheral arterial disease.^{1,3}

Persistent hyperglycemia, hypertension, dyslipidemia, obesity, smoking and physical inactivity can contribute to the overall risk profile for diabetes complications.

However, lifestyle modification should not be interpreted as a replacement for recommended complication screening. Regular assessment of eyes, kidneys, feet, cardiovascular risk factors and neurological status remains necessary. WHO emphasizes that appropriate screening and treatment of complications are essential components of diabetes care.^{2,3}

LIFESTYLE MODIFICATION AND DIABETIC NEPHROPATHY

Diabetic kidney disease is an important complication of diabetes and can progress to chronic kidney disease and kidney failure. Good glycemic and blood pressure control are important components of risk reduction.

Patients should also receive appropriate screening for kidney disease according to established diabetes care recommendations. Lifestyle counseling should be coordinated with medical management, particularly in patients who already have impaired kidney function.

LIFESTYLE MODIFICATION AND DIABETIC NEUROPATHY AND FOOT COMPLICATIONS

Diabetic neuropathy can impair sensation and increase the risk of unnoticed foot injuries, ulcers and infection. Diabetes-related foot complications can ultimately result in serious morbidity and lower-limb amputation.^{1,2}

Lifestyle modification alone cannot prevent all neuropathic complications; however, improved metabolic control and comprehensive diabetes self-care are important components of risk reduction.

LIFESTYLE MODIFICATION AND DIABETIC RETINOPATHY

Diabetic retinopathy is a major cause of visual impairment among people with diabetes. Prolonged hyperglycemia and other vascular risk factors contribute to its development and progression.

Lifestyle interventions that support glycemic and cardiovascular risk management may form part of a broader strategy to reduce complication risk. However, lifestyle modification does not eliminate the need for regular eye screening.

STRUCTURED LIFESTYLE INTERVENTIONS

A structured program may include:

1. Initial lifestyle assessment
2. Individualized goal setting
3. Dietary education
4. Physical activity planning

5. Weight-management counseling
 6. Self-monitoring
 7. Behavioral counseling
 8. Regular follow-up
 9. Reinforcement and feedback
 10. Referral to other professionals when required
- The evidence suggests that interventions combining multiple lifestyle components can produce clinically relevant improvements in glycemic and metabolic outcomes.⁸⁻¹¹

ROLE OF NURSES IN LIFESTYLE MODIFICATION

The nursing role may include:

- Assessing current dietary and physical activity patterns
 - Identifying lifestyle-related risk factors
 - Providing health education
 - Reinforcing medication adherence
 - Teaching appropriate glucose-monitoring practices
 - Encouraging physical activity
 - Supporting weight-management goals
 - Providing foot-care education
 - Identifying barriers to lifestyle modification
- Nurse-led education can be particularly relevant in community and primary healthcare settings where long-term follow-up is possible.

BARRIERS TO LIFESTYLE MODIFICATION

Socioeconomic conditions can influence access to nutritious food and opportunities for physical activity. Current recommendations therefore emphasize consideration of social, cultural and economic circumstances when developing lifestyle interventions.^{4,5}

should therefore be culturally sensitive and adapted to the patient's actual living environment.¹⁴

DIGITAL HEALTH AND LIFESTYLE MODIFICATION

Digital health technologies are increasingly being incorporated into diabetes self-management. Mobile applications, text messaging, wearable activity monitors, telehealth and online education can facilitate monitoring, reminders, communication and behavioral support.

IMPLICATIONS FOR NURSING PRACTICE

Lifestyle modification represents an important area of nursing practice in diabetes management. Nurses can contribute to prevention, early education, self-management support and long-term follow-up.

CONCLUSION

Lifestyle modification should not be viewed as an alternative to clinically indicated pharmacological therapy but as an integral component of comprehensive diabetes care. Regular screening for complications and appropriate medical treatment remain essential.¹⁵

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