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(REVIEW ARTICLE)



Lifestyle modifications: A key to manage diabetes

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Abstract

Diabetes is one of the leading challenges to the health care organization across world. Worldwide, 422 million peoples suffering from diabetes 1. Diabetes mellitus is a metabolic disorder which is characterized by abnormal metabolism of carbohydrates, fats, protein. The main etiological factors contributes in the development of diabetes are sedentary lifestyle, obesity, intake of junk foods. It is mandatory to manage increased blood sugar level (BSL) to prevent microvascular as well as macrovascular complications.

To manage diabetes, metformin and insulin play a key role hence these two medications added in the diabetes pharmacotherapy. Diabetes is not a treatable disease hence we have to maintain weight by doing regular exercise and implementation of dietary modifications.

It is important to maintain the balance of daily calories intake and their utilization by practicing physical activity remain the primary and most effective prevention strategy for diabetes management. A management strategy basically involves promotion of effective weight loss and physical exercise, but it is compulsory to do exercise and follow dietary modifications regularly.

This is a comprehensive review which focuses on lifestyle modifications in diabetes. How lifestyle modification play a key role in the management of both type of diabetes along with pharmacotherapy.

Keywords: Diabetes; Lifestyle modifications; Blood sugar level; Exercise

1. Introduction

Diabetes is one of the leading challenges to the health care organization across world. Worldwide, 422 million peoples suffering from diabetes 1. Diabetes mellitus is a metabolic disorder which is characterized by abnormal metabolism of carbohydrates, fats, protein. The main etiological factors contributes in the development of diabetes are sedentary lifestyle, obesity, intake of junk foods. It is mandatory to manage increased blood sugar level (BSL) to prevent microvascular as well as macrovascular complications 2.

Diabetic patients may having symptoms such as Increased thirst (Polydipsia), excessive eating or appetite (polyphagia), Frequent urination (polyuria) and also patient may having symptoms of microvascular and macrovascular complications.

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Diagnosis of DM is majorly based on three criteria viz.: fasting plasma glucose ≥ 126 mg/dL, a 2-hour value from a 75-g oral glucose tolerance test ≥ 200 mg/dL, or BSL level of ≥ 200 mg/dL and patient having symptoms of diabetes viz. polydipsia, polyphagia and polyuria. Diagnosis confirmed by any of the three criteria on a separate day 1.

Management of DM mainly directed towards attaining normoglycemia, reducing the onset and progression of microvascular and macrovascular complications, intensive therapy for associated cardiovascular risk factors, and improving quality and quantity of life. According to the United Kingdom Prospective Diabetes Study (UKPDS), metformin is only oral hypoglycemic agent which can reduce the risk of total mortality and this drug widely used by doctor to manage BSL. It is mandatory to manage glycemic control to reduce the progression of microvascular and macrovascular complication 2.

It is important to maintain the balance of daily calories intake and their utilization by practicing physical activity remain the primary and most effective prevention strategy for diabetes management.

A management strategy basically involves promotion of effective weight loss and physical exercise, but it is compulsory to do exercise and follow dietary modifications regularly 3.

Compliance to daily physical activities and dietary changes will reduce the risk of disease progression and duration of long term therapy. Metabolic improvements rapidly vanish with weight regain 4. To prevent risk of increased BSL, long term lifestyle modifications are necessary. It may include daily exercise, balanced diet (Especially fat restriction) and mental health is also one of the main aspects in the management of diabetes and other disease conditions 5. These things will help to prevent or slow down the complications of type 2 diabetes mellitus. However, the knowledge and practice of healthy lifestyles in many diabetic patients have been inadequate 2.

This is a review aimed to study the management of diabetes by practice of lifestyle modifications. Also study focuses on positive impact of health education on knowledge attitude, and practices with effectively improved patient glycemic control in diabetes.

2. Major Lifestyle risk factors to develop disease

The major lifestyle risk factors that will contribute to develop pathogenesis of metabolic abnormalities are obesity, physical activity, tobacco smoking, alcohol consumption and mental stress. We are actually living in the digital world where we are virtually connected to each other. But we have implemented sedentary lifestyle 1.

Family history, environmental factors (Circumstances such as exposure to a viral illness likely play some role in type 1 DM), autoantibodies formation inside the body, geographical factors are the contributing risk factors to develop type 1 diabetes mellitus among susceptible population. However age (more than 45 years), obesity, race or ethnicity, abnormal cholesterol and triglyceride levels, other disease conditions such as hypertension, polycystic ovarian disease are contributes to develop symptoms of type 2 diabetes mellitus 2.

If disease will remains undiagnosed that time patient may having various problems such as,

2.1. Neuropathy

Increased blood sugar level can damage to nerve or it may not help to nourish the neurons especially in lower limbs. So it will effect on lower limbs and shows variety of symptoms such as tingling, numbness, burning or pain at the tips of the toes or fingers and gradually spreads upward 6.

2.2. Nephropathy

Increased BSL may have effect on nephrons; diabetes can damage the units of excretory system. It leads to disturbance in urine formation

Retinopathy: Increased BSL can damage the capillaries of the retina. It may leads to develop various problems such as blindness, conjunctivitis.

2.3. Cardiovascular disease

If diabetes is undiagnosed that time patient may suffer from cardiovascular problems including myocardial infraction, Ischemic heart disease and stroke.

2.4. Diabetic foot

Decreased blood flow to the lower limbs and it may causes blisters and cuts. Blisters and cuts converted to serious infection and ultimately require toe, foot or leg amputation.

2.5. Skin conditions

Diabetes may causes skin problems which includes bacterial and fungal infection

2.6. Hearing impairment

Hearing problems are more common in people with diabetes.

2.7. Alzheimer's disease

Increased BSL causes damage to neuron especially brain cell connections. It may leads to develop several neurological problems 2

Depression: Diabetes may have bad impact on psychological status of human being. Hence it can increase severity of depression 5.

3. Contribution of lifestyle modifications in the management of DM

The fundamental aspect of diabetic care is to follow lifestyle modifications viz. diabetes self-management education (DSME) system, regular exercise, smoking cessation counseling, and psychosocial care. It is necessary to focus on glycemic control by mean of medical intervention. Patient and health care providers should create a strategy in the management of diabetes from comprehensive diagnosis to discharge of patient from hospital. Post discharge medications and lifestyle modification should provide to the patient. Along with these complications assessment should be considered 7 8.

Various studies shown that lifestyle modifications has significant effect in glycemic control, lower HbA1C, lower self-reported weight, improved quality of life and reduced cost of therapy 9 10.

An Intensity and duration of physical activity to improve glycemic control is not well defined. However an exercise dose response was reported as physical activities having major role in glycemic control as well as decrease cardiovascular risk. Several cross-sectional and prospective studies show that long duration and high intensity with proper protocol, physical activities are associated with lower prevalence and incidence of obesity and DM 11 12.

According to National Health and Nutrition examination survey, implementation of active lifestyle by doing daily exercise at least 60 min/day and intake of balanced diet can reduce the risk of cardiovascular diseases and diabetes mellitus 13.

In summary, lifestyle modification programs are necessary to maintain metabolic changes in the long period, and such programs should always address both nutritional treatment and physical activity 4.

4. Main strategies for living with DM

4.1. To educate about risk and complications of DM along with role of lifestyle modifications in the glycemic control

Diabetes Self-Management Education and Support (DSMES) system is important in the management of diabetes mellitus because patient who have the knowledge about glycemic control strategies are healthier than who do not have. It will save patient's money as well as time and reduces the chances of emergency hospital admission. Also it helps patients to avoid diabetic complication 7.

DSMES System provides following:

- It make better decision about diabetes
- It work with health care professionals along with patient to manage diabetes
- It gives basic idea about following parameters
- Glycemic range monitoring
- Be active.
- Eat Healthy
- Take your medicine as directed by physician
- Balance mental health with diabetes
- Reduces other health complications 7 14 15.

4.2. Good Eats

It is the best key to manage blood sugar level. Good eats means balanced diet that contains proteins, carbohydrates, vitamins and other nutrition in certain amount.

It helps to patient to maintain blood sugar level.

Calorie consumption and utilization should be balanced viz. 1000–1200 kcal/day for overweight women, and 1200–1600 kcal/day for overweight men and heavier for more active women.

For obeys patient diets are designed to create a calorie deficit of 500–1000 kcal/day to promote a weight loss of 0.5–1.0 kg/week. Several studies show that low carbohydrates diet has direct link to weight reduction 16 17.

Dietary recommendations

Table 1 Dietary recommendations as per daily energy consumption and utilization ratio 2 6

Sr. No.	Type of meal	Energy (Kcal)
1	Breakfast	
	Whole-wheat bread, 1 med. Slice (1 Bread/Starch)	70
	Jelly, regular, 2 tsp. ($\frac{1}{2}$ Fruit)	30
	Cereal, shredded wheat, $\frac{1}{2}$ C (1 Bread/Starch)	104
	Milk, 1%, 1 C (1 Milk)	102
	Orange juice, $\frac{3}{4}$ C ($1\frac{1}{2}$ Fruit)	78
	Coffee, regular, 1 C (Sugar Free)	5
	Breakfast total	389
2	Lunch	
	Whole-wheat bread, 2 med. Slices (2 Bread/Starch)	139
	Lean roast beef, unseasoned, 2oz (2 Lean Protein)	60
	Lettuce, 1 leaf (1 Vegetable)	1
	Tomato, 3 med. Slices ($\frac{1}{3}$ Fat)	10
	Mayonnaise, low-calorie, 1 tsp. (1 Fruit)	15
	Apple, 1 med	80
	Water, 1 C	0
Lunch Total	305	
3	Dinner	
	Salmon, 2 oz. edible (2 Lean Protein)	103
	Vegetable oil, $1\frac{1}{2}$ tsp.	60
	Baked potato, $\frac{3}{4}$ med. (1 Bread/Starch)	100
	Margarine, 1 tsp.	34
	Green beans, seasoned, $\frac{1}{2}$ C (1 Vegetable)	52
	Carrots, seasoned (1 Vegetable)	35
	White dinner roll, 1 small (1 Bread/Starch)	70
	Iced tea, unsweetened, 1 C & Water, 2 C	0
Dinner Total	454	
4	Snack	
	Popcorn, $2\frac{1}{2}$ C (1 Bread/Starch)	69
	Margarine, $\frac{3}{4}$ tsp.	30

	Snack Total	99
5	Grand Total	1247

4.3. Get active- Be energetic

Being more active is an essential tool for diabetes. It increases sensitivity of insulin indirectly. It also has a vital role in the prevention of diabetic complications viz. retinopathy, neuropathy, nephropathy and cardiovascular comorbidities. Daily Exercise is necessary for at least 60 min 18 6. It should increase slowly day by day starting from easy exercise to avoid chances of hypoglycemia; if heavy exercise performed by patient. If patient choose brisk walking as the preferred activity then patient should be instructed by counselor to add 500 steps at 3-day intervals to a target value of 10,000–12,000 steps/day 19. While some patients may prefer aerobic exercise, resistance exercises. (Strength Training is contraindicated in the presence of comorbidities viz. hypertension, cardiovascular diseases). Moderate-intensity physical activities may include walking briskly, doing housework, mowing the lawn, dancing, and swimming, bicycling and playing sports. These activities may increase your muscle strength as well as you became mentally fit.

Exercise Recommendations

Table 2 Exercise Recommendations as per age groups. It explains type of exercise allowed to do in respective age group 19 9

Sr. No	Age Group	Type of Diabetes	Exercise pattern	Duration
1	Children (2-12 years) and adolescents(12-16 years)	T1DM, T2DM, prediabetes	moderate- or vigorous intensity aerobic activity, with vigorous muscle-strengthening and bone-strengthening activities	At least 60 min/day (3 days/week)
2	Adult(18-35 years)	T1DM, T2DM, prediabetes	Moderate to vigorous intensity physical activity Prolonged sitting should be interrupted every 30 min for maintaining BSL	At least 150 min/week (with no more than 2 consecutive days without activity)
3	Adult(18-35 years)	T1DM, T2DM	resistance exercise/ Strengthening exercise	2-3 sessions/week
4	Middle aged Person (36-55 years), Elder Person (≥55 years)	T1DM, T2DM	Flexibility training, balance Training, Yoga-	At least 30 min/day (2/3 times/week)

(T1DM: Type 1 Diabetes Mellitus; T2DM: Type 2 Diabetes Mellitus)

4.4. Healthy weight

We already know that obesity is related to development of cardiac comorbidities as well as diabetes. So weight assessment is necessary to avoid such complications. If increase in weight simultaneously in diabetic patient, may develop cardiac comorbidities 20.

A parameter which describes proportion of weight to height is called as body mass index (BMI). BMI can be an indicator of high fatness.

BMI range should always in between 18.5 – 24.9 for healthy life. Following table describes BMI range as per weight status

Table 3 Body mass index (BMI) as per weight status 20

Sr. No	Type	BMI range
1	Underweight	≤18.5
2	Normal/Healthy weight	18.5-24.9

3	overweight	25-29.9
4	obesity	≥30

Healthy food and daily physical activities are essential tools for management of weight and thereby it decreases risk of diabetic complications 21

4.5. Glycemic control

Diabetic management must include blood sugar level assessment. It is important to keep BSL in normal range as much as possible to prevent complications. Normal BSL can improve quality of life of a patient. Continuous glucose monitoring will help to stay BSL in normal range. BSL assessment can be done by using glucometer. To check BSL, take small sample of blood from fingertip and drop it on glucometer strip. For more concise information patient should follow directions which is available in leaflet of glucometer.

Along with daily monitoring of BSL, HbA1C is also taken every 6 months for accurate monitoring of glycemic range. Normal ranges are as fasting BSL should be in between 80-130 mg/dl (4.0 to 5.4 mmol/L); postprandial BSL up to 200 mg/dl (up to 7.8 mmol/L).

Diabetic patient who take daily insulin and oral hypoglycemic agents having high risk of hypoglycemia hence whenever brisk walking started at morning, it is necessary to keep sugary chocolates in a pocket 22.

4.6. Managing sick days & emergency preparedness

Every diabetic patient trying to keep BSL in normal ranges as much as possible but they can get sick. It is essential to be ready before getting sick with all aspects. Patient should keep all the necessary medicines. Make sure patient have insulin, other diabetic medications along with enough food for several weeks especially in this pandemic era.

Follow these steps whenever patient getting sick

- Monitor BSL range every 4 hours and check glycemic status
- Take insulin and other diabetic medications as usual
- Drink plenty of water and other fluids.
- Monitor BMI regularly
- Check your temperature every morning and evening. A fever may be a sign of infection.
- If patient having trouble in breathing and BSL \leq 60 mg/dl then immediately visit to the nearest hospital 23.

4.7. Diabetes and mental Health

Diabetic patient is always in depression state because of fluctuation in BSL at certain time. Fluctuation in BSL can create mental problems such as fatigue, stress and especially causes diabetes distress. Diabetes distress means stress, depression and anxiety due to diabetes 24 5.

To maintain good mental state in diabetes, we have to manage our stress by listening music and doing meditation regularly, Along with this, Cognitive-behavioral therapy (CBT), Family therapy, & Dialectical-behavioral therapy (DBT) are the basic tools to manage diabetic distress. CBT means we have to develop belief about our healthy life. Family therapy includes helps to family member to solve their issues and discussion is a part of family therapy. And DBT mainly focuses on teaching skills.

In addition to the therapies, some antianxiety and antidepressant drug helps to relieve symptom. When patient has high level of mental symptoms then visit to psychiatry clinic as soon as possible 25.

5. Lifestyle modifications with pharmacotherapy

Doing lifestyle modifications along with pharmacotherapy surely manage the disease well. Several studies compare the effect of lifestyle modification and pharmacotherapy on disease management. These data show that lifestyle modification and pharmacotherapy are equivalent when used separately, but additive when used in combination 26 27.

6. Future scope of diabetic management strategies

Nowadays, diabetic management is focuses on medication therapy viz. insulin and other oral hypoglycemic agents. But it has less potential so we have to go with lifestyle modification along with pharmacotherapy. Understanding of the biochemical and molecular basis of diabetes mellitus will be one of the future aspects to learn more about diabetes. Surely it will helps in the management of diabetes mellitus. Diabetes mellitus is managed by doing regular exercise and implementing dietary modifications will be helpful in future prospective 21. This type of thinking will reduces the deaths due to diabetic complications.

The immunological concerns underlying gene therapy can also be addressed by the current advances in molecular biology. However, irrespective of all these concerns, it is imperative to always that the merits of gene therapy of diabetes exceed the demerits and present advantages as compared with conventional treatment before this approach could gain widespread acceptance in general medical practice.

7. Conclusion

A lifestyle change is a main aspect in the management of diabetes. Various health care providers follow various guidelines that mainly depend on lifestyle modifications. Several data show that doing daily exercise (at least 60 min/day) and follow dietary modifications can prevent the complications of diabetes. It also helps to keep mental health along with physical health. Meal replacement, combining lifestyle modifications with pharmacotherapy, setting daily exercise goal improves health status.

More research is needed to create impact of lifestyle modification on diabetic treatment. One day will came when a patient manage their BSL by using lifestyle modification tools that day became a marvel in the world of diabetes.

Compliance with ethical standards

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All Authors contributed equally and declared that they have no conflict of interest.

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