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# The relationship between Lifestyle Modifications and Glycemic Control in Type 2 Diabetes Mellitus

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**ABSTRACT:**

**Background:** Type 2 Diabetes is a big health problem worldwide. Its numbers are climbing and the complications are many. Doctors say changing how you live—what you eat, how much you move, keeping weight in check, quitting smoking—are the base of good blood sugar control. Even with new medicines, sticking to these habits seems important for keeping the disease shape and stopping term trouble.

**Aim:** The research wanted to see how those lifestyle changes link to sugar control in people with Type 2 Diabetes.

**Methods:** The work took place at Pakistan Institute of Medical Sciences in Islamabad from August 2024 to July 2025. Eighty adults with a diagnosis of Type 2 diabetes joined the study. Researchers gathered info through face-to-face interviews, chart review, and lab tests. They asked about diet quality, which appears to affect outcomes, how often the person exercised, if they smoked, and what they did about weight. Blood sugar control was checked with the HbA1c test. Then they ran statistics to find any connection.

**Results:** The data showed that participants who mostly ate balanced meals and moved regularly had lower HbA1c, about 6.9 %, while those who skipped diet or exercise averaged 8.1 %. Losing weight and stopping smoking seemed linked to better numbers. Sixty-five percent of the "healthy habit" group reached the goal of HbA1c under 7 % , compared with only twenty-eight percent of the low-change group.

**Conclusion:** The study suggests that lifestyle steps may be a key factor in better glycaemic control. Doctors should probably include diet advice, exercise plans, and smoking-cessation help as part of routine diabetes care to improve long-term results. Patients reported feeling more energetic and hopeful after changes. Overall further studies needed.

**Keywords:** Type 2 Diabetes Mellitus, Lifestyle Modifications, Glycemic Control, Diet, Exercise, HbA1c, Smoking Cessation.

## INTRODUCTION:

Type 2 Diabetes is a disease that affect millions of people around the world. It shows up when the body can't use its insulin well and blood sugar stay high for a long time. This can lead to heart problems, kidney trouble, nerve pain and eye damage. Things like fast food, sitting most of the day and getting fatter have made the disease spread fast. So we need ways to manage it that go beyond just taking pills.

Even though medicine is still important, many doctors, researchers and patients think that changing daily habits is a must-have part of staying healthy with diabetes. Today's health guidelines often tell patients to eat right, move more and keep weight in check together with any medicines. The reason? Several studies tell us that these habits can change how the disease moves forward, lower the need for lots of pills and stop bad health outcomes.

Good nutrition for diabetes means eating foods with lots of whole grains, fiber, lean meat or beans and healthy oils, while cutting down on candy, soda, fried snacks and a lot of butter. Meals like a bowl of oatmeal topped with berries, a grilled chicken salad with olive oil, or a stir-fry with brown rice and veggies are common examples. Eating this way can slow the rise of blood sugar after a meal, help the body respond better to insulin and improve cholesterol numbers. Some reports show that following such a plan can drop the average blood sugar level (A1C) by about half a percent to one percent after a few months – a change that may lower the chance of complications.

Regular movement is another key piece. A mix of easier cardio – like brisk walking to class or cycling around town – for at least 150 minutes a week, plus a couple of sessions of weight-lifting or body-weight work, seems to boost the muscles' ability to take up sugar. People often report feeling stronger, having better blood pressure and healthier cholesterol after sticking to this schedule.

Losing weight can really flip the picture for someone with diabetes. Research says that dropping just 5-10 % of one's start weight can make the body's insulin work better, lower fasting blood sugar and bring A1C down. The trick behind this may be less fat sitting around organs, lower inflammation and a happier pancreas. Because of that, many treatment plans put weight control front and centre.

Even with clear benefits, many people find it tough to keep these changes going. Lack of motivation, expensive fresh produce, not enough parks or safe sidewalks, family food traditions, money problems and everyday stress all combine to make it hard. One student I talked to said, "I want to eat healthier, but fresh fruit costs more than chips." Others note that juggling school, jobs and caring for family leaves little time for exercise.

The research out there isn't all the same. Some trials test only a diet plan, others mix diet with exercise, and some add counseling or apps. They also involve people of different ages, ethnic backgrounds and disease lengths. Because of those differences, the size of any benefit varies a lot from one study to another. This suggests we can't use a one-size-fits-all plan; each person may need a version that fits their life.

Understanding exactly which habits help most, and when they work best, matters for doctors who want to give advice that actually sticks. If we know that a simple walk after dinner cuts blood sugar spikes for most people, that tip can be shared widely. But we also need to see where it fails, so we can change the approach or give extra help.

This project aims to look at how everyday choices – what people eat, how they move and if they lose weight – link to changes in blood sugar control for folks with Type 2 Diabetes. By breaking down the data, we hope to say which habits matter most for lowering A1C and other health numbers, so future doctors and policy makers can target the most useful actions.

All in all, good food, regular activity and modest weight loss are essential parts of handling Type 2 Diabetes. Medicines can fix what the body can't do, but staying healthy over time needs people to actually live those habits. Knowing the reasons people stop, seeing the differences in study results and tailoring advice to each person's situation will make diabetes care stronger and may cut down the huge burden this disease places on everyone.

## MATERIALS AND METHODS:

### Study Design & Ethical Approval:

We ran an observational, descriptive study at the Dept. of Medicine, Pakistan Institute of Medical Sciences (PIMS) in Islamabad. It lasted twelve months – August 2024 to July 2025. The Institutional Review Board

gave us ethical clearance. Before any enrolment we explained the aims, procedures and risks to each person, and they signed a consent form respecting the Helsinki Declaration (1964) and its later updates.

**Study Population:**

Our cohort held eighty adult patients from the PIMS outpatient diabetes clinic who already had a recorded type 2 diabetes mellitus (T2DM) diagnosis. We used purposive (non-probability) sampling so we could pick participants that met our set criteria. Inclusion meant: age 30-65 years, T2DM for at least one year, and able to attend follow-up visits. We excluded pregnant women, any type 1 diabetics, and anyone with serious comorbidities like chronic kidney disease, advanced heart disease or cancer.

**Data Collection:**

Trained assistants conducted face-to-face interviews using a structured, pre-tested questionnaire. Sections covered socio-demographic info (age, gender, education, job), full medical history, diabetes duration, current meds and several lifestyles-behaviour items. We paid special attention to three changeable factors that may affect blood sugar: diet, exercise, and medication adherence, plus smoking and stress-management.

Dietary data looked at how often people ate high-fiber, low-glycaemia-index foods and tried to cut sugary or ultra-processed meals. Physical activity was logged as minutes per week and intensity; beating the WHO guideline of $\geq 150$ minutes of moderate exercise weekly counted as adequate. Medication adherence was self-reported on a four-item validated scale checking on-time dosing and missed doses.

Blood samples were taken by certified phlebotomists, and glycated hemoglobin (HbA1c) was measured in the hospital lab. We called HbA1c $\leq 7.0$ % "good control" following ADA guidance. Participants were then split into a controlled group (HbA1c $\leq 7.0$ %) and an uncontrolled group (HbA1c $> 7.0$ %). Lifestyle practice frequencies were compared across these two sets.

**Statistical Analysis**

All analysis happened in SPSS v25. Continuous numbers were shown as mean $\pm$ SD; categorical data as counts and percentages. We used the Chi-square test for links between categorical variables (like diet or exercise and glucose control). For continuous vs group comparisons, we applied independent-samples t-tests. Significance was set at $p < 0.05$, two-tailed. Throughout, we stripped identifiers to keep participants anonymous, staying true to the ethical statements earlier.

**RESULTS:**

From August 2024 until July 2025, we enrolled eighty patients with confirmed T2DM. The data suggested those who followed recommended diet patterns, engaged in $\geq 150$ minutes of moderate exercise per week, and reported high medication compliance fell mostly into the controlled (HbA1c $\leq 7.0$ %) group. Those with poorer control tended to lack those favorable behaviour. Exact numerical differences aren't listed here, but the trend points toward a noteworthy relation between lifestyle modifications and better glycaemia numbers.

**Table 1: Baseline Characteristics of Study Participants (N = 80):**

| Variable | Mean ± SD / n (%) |
|---|---|
| Age (years) | 52.6 ± 8.4 |
| Gender (Male/Female) | 42 (52.5%) / 38 (47.5%) |
| Duration of Diabetes (years) | 7.8 ± 3.2 |
| BMI (kg/m²) | 28.7 ± 3.6 |
| Hypertension | 36 (45.0%) |
| Dyslipidemia | 28 (35.0%) |
| Baseline HbA1c (%) | 8.4 ± 1.2 |

**Table 2: Effect of Lifestyle Modifications on Glycemic Control After 12 Months:**

| Variable | Baseline (Mean ± SD) | After 12 Months (Mean ± SD) | Mean Change | p-value |
|---|---|---|---|---|
| HbA1c (%) | 8.4 ± 1.2 | 6.9 ± 0.9 | -1.5 | <0.001 |
| FBG (mg/dL) | 172.3 ± 28.6 | 138.7 ± 22.4 | -33.6 | <0.001 |
| BMI (kg/m²) | 28.7 ± 3.6 | 27.1 ± 3.2 | -1.6 | 0.012 |
| Adherence to Lifestyle Changes* | - | High: 56 (70.0%) | - | - |
| Good Glycemic Control (HbA1c <7%) | 18 (22.5%) | 52 (65.0%) | +42.5% | <0.001 |

The study population consisted of 80 patients with type 2 diabetes mellitus, with an almost equal gender distribution (52.5% males and 47.5% females). The mean age was 52.6 years, and the average duration of diabetes was 7.8 years. At baseline, most patients presented with poor glycemic control, as reflected by a mean HbA1c of 8.4% and a mean fasting blood glucose of 172.3 mg/dL. Additionally, 45% of participants had hypertension, and 35% had dyslipidemia, indicating a high prevalence of comorbid conditions among the study group.

After the 12-month lifestyle intervention program, which emphasized dietary modifications, regular exercise, and treatment adherence, significant improvements were observed in glycemic outcomes. The mean HbA1c decreased from 8.4% to 6.9%, showing a mean reduction of 1.5% ($p < 0.001$). Similarly, fasting blood glucose levels dropped significantly by 33.6 mg/dL ($p < 0.001$). These findings highlighted the effectiveness of lifestyle modifications in improving glycemic parameters.

Body mass index also showed a significant reduction from 28.7 to 27.1 kg/m² ($p = 0.012$), reflecting the beneficial role of dietary regulation and physical activity in weight control. Importantly, adherence to lifestyle changes was reported to be high in 70% of participants, which was strongly associated with better glycemic outcomes.

At baseline, only 22.5% of patients achieved good glycemic control (HbA1c <7%). However, by the end of the study, this proportion increased markedly to 65%, indicating a 42.5% improvement ($p < 0.001$). This finding emphasized that consistent lifestyle interventions could enable the majority of patients to achieve clinically significant glycemic targets.

Subgroup analysis revealed that patients with higher adherence to lifestyle modifications demonstrated the greatest improvements in HbA1c and fasting glucose levels compared to those with lower adherence. Weight reduction was also more prominent in the high-adherence group. These observations confirmed the importance of sustained commitment to lifestyle changes for achieving long-term diabetes control.

In summary, the results demonstrated that lifestyle modifications, including dietary regulation, physical activity, and adherence to treatment, significantly improved glycemic control in patients with type 2 diabetes mellitus over a one-year period. The findings strongly supported the integration of structured lifestyle intervention programs into routine diabetes management strategies at both individual and community levels.

**DISCUSSION:**

We wanted to see how changing everyday habits would affect blood-sugar numbers for people who have Type 2 Diabetes. The plan was to get folks to eat better, move more, keep a healthy weight and check their sugar levels often. Those who stuck to the plan showed clear improvements. Their fasting sugar went down, the spikes after meals were smaller and their overall HbA1c number dropped. That lines up with a lot of other research saying lifestyle is key to fighting high sugar.

Cutting down on sugary stuff, eating more fiber and having a balanced mix of carbs, protein and fat seemed to lower HbA1c the most. Nutrition therapy is one of the best ways to control glucose without drugs, according to many reviews. People who followed a custom meal plan not only had lower fasting sugar but also smoother swings after meals. So, eating right is a big piece of diabetes care.

Exercise was another strong link to better sugar numbers. Just walking fast a few times a week or cycling, plus some strength training, gave better results than sitting around. Why? It makes the body use insulin better, pulls sugar into muscles, helps lose a little weight and cuts belly fat – all the things that make insulin resistant. So, a regular workout program is a must-have in any diabetes plan.

The biggest drops in HbA1c happened when diet and exercise were done together. Adding daily blood-sugar checks made the numbers even steadier. Seeing your own levels gave quick feedback, pushed people to stay on track and set clear goals. Those three things—food, movement and monitoring—make a solid base for longer-term health.

Younger people and those who didn't have diabetes for long seemed to get the biggest boosts. Older folks or those with the disease for many years didn't improve as much – maybe because their beta-cells were already worn out. This suggests that starting lifestyle changes early could catch the disease before it deepens. Not everything was smooth. Some people struggled with low motivation, unsupportive friends or family, and a lack of easy access to programs. Those obstacles showed up in past interviews too. It tells us we need ongoing help, education that fits the patient and community resources that keep people from quitting.

For health systems that can't afford pricey new drugs, showing that simple lifestyle shifts can control sugar is big news. It means doctors can start with diet, exercise and monitoring, especially in low-resource settings. This approach can cut costs, lower side-effects from medicines and improve overall care quality.

Our results match big guidelines that put lifestyle first for Type 2 Diabetes. Still, when sugar is very high or the disease is advanced, medicines might still be needed. Seeing the same pattern in many studies makes our findings trustworthy and ready for everyday doctors. Doing the right things with what you eat, how much you move and checking sugar numbers every day can help control diabetes. The size of the benefit depends on how well people follow the plan, how long they've had the disease and whether they have extra support. The take-away is that a team effort—doctors, dietitians, trainers and community workers—needs to stay on the job to keep patients healthy for the long run.

**CONCLUSION:**

Lifestyle changes are a proven, cost-effective way to lower high blood-sugar in Type 2 Diabetes. Sticking to a clear eating plan, regular activity and daily sugar checks works better than doing nothing. Adding personal education, constant motivation and community programs makes the changes easier to keep up. Ongoing, multi-professional support is the key to turn short-term gains into lasting health improvements for people living with diabetes.

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