

Intermittent Fasting and its Effects on Type 2 Diabetes Mellitus Management

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## **Introduction**

Diabetes affects millions of people and contributes significantly to increased morbidity and mortality rates (Mahan & Raymond, 2017). Categories of diabetes include prediabetes, Type 1 diabetes, Type 2 diabetes, and gestational diabetes. Type 2 diabetes (T2DM) accounts for 90-95% percent of diagnosed diabetes cases. Type 2 diabetes will be the focus of this research and discussion. With proper interventions, including medical nutrition therapy, T2DM is manageable. Effective medical nutrition therapy for diabetes includes improving glucose control, lipid and lipoprotein profiles, blood pressure, and achieving body weight goal. The majority of persons with T2DM are overweight or obese, with obesity contributing to some degree of insulin resistance (Mahan & Raymond, 2017). Therapeutic fasting is investigated for its potential effect on T2DM management by offering caloric restriction, weight loss, glycemic control, and hormonal benefits (Furmler, 2018; Carter et al., 2018).

## **Diabetes Statistics**

Approximately 10% of the United States and Canada population have been diagnosed with T2DM, with high associated morbidity and mortality rates. The economic burden of T2DM in the USA is \$245 billion (Furmler, 2018). The prevalence of T2DM continues to increase, and there are over 86 million people in the United States with prediabetes who are at high risk for developing T2DM without intervention. Two popular studies in which weight loss of 5%-10% was a factor, in addition to physical activity and counseling, reported a 58% reduction in the incidence of T2DM (Mahan & Raymond, 2017).

## **Objective**

This research aims to define and understand the effects of intermittent fasting on glycemic control and weight management in those with T2DM and determine whether it may be a beneficial option as part of medical nutrition therapy for the condition.

## **Type 2 Diabetes**

Type 2 Diabetes Mellitus is a progressive disease characterized by a combination of insulin resistance, low insulin production, and beta-cell failure, resulting in hyperglycemia (Mahan & Raymond, 2017). Factors that may predispose a person to type 2 diabetes are genetics, older age, physical inactivity, race, ethnicity, prior history of prediabetes, gestational diabetes, hypertension, or dyslipidemia (Mahan & Raymond, 2017). Many complications related to T2DM result from the combination of insulin resistance, inadequate insulin secretion, and inappropriate glucagon secretion (Furmli, 2018).

## **Diagnostic Criteria**

Hemoglobin A1C greater or equal to 6.5% or FPG greater or equal to 126 mg/dL, or 2-h PG greater than or equal to 200 mg/dL or in patients with classic symptoms of hyperglycemia or hyperglycemic crisis, a random PG greater than or equal to 200mg/dL (Mahan & Raymond, 2017).

## **Intermittent Fasting**

Intermittent fasting (IF) is an eating pattern that involves cycling between fasting and eating on a specific schedule. In recent years, IF has become a popular “dieting” trend that focuses on time-restricted eating cycles. Intermittent fasting is a specific eating pattern involving various protocols of frequent and regular fasting cycles of 48 hours or less. There are several

different IF protocols, all of which split the day or week into eating periods and fasting periods (Crupi, 2020). Types of popular intermittent fasting regimens include Time-Restricted, Alternate-Day Fasting, “5:2 Diet”, Weekly One-Day Fasting, Fast-Mimicking Diet, Ten-day Juice Fast, and Other Regimens (Grawjower, 2019). Therapeutic fasting is defined as the controlled and voluntary abstinence from all calorie-containing food and drinks from a specified time (Furmler, 2018). Mainstream ideas of “intermittent fasting” are often referencing “Time Restricted Eating” (TRE). TRE involves fasting periods that are longer than the average overnight period of fasting. A study highlighting the benefits of a time-restricted eating window of 12 hours (8 am - 8 pm) improved glycemic control by decreasing postprandial glucose levels with increased insulin sensitivity.

A drop in calories consumed was noted when restricted to a six or 12-hour eating window (Crupi, 2020). In a small study consisting of three people, the three individuals completed 24-hour fasts three times per week. Two patients (one and three) followed alternating-day 24-hour fasts. Patient two participated in triweekly 24-hour fasts. On the fasting days, all patients had one meal at dinner; on non-fasting days, they partook in lunch and dinner. At the end of the study, all patients showed a reduction in waist circumference, Hemoglobin A1C, and reversal of medications (Furmler, 2018). In a more prominent study, 137 participants were divided into two groups, with one group instructed to follow a diet of 500-600 kcals/day on two days of the week. The other five days, their usual eating pattern was resumed, with the majority of the intermittent fasting days being nonconsecutive. Group two was on a continuous energy restriction diet of 1200-1500 kcal/day. There was a 75% energy restriction two days followed by five regular eating days per week. A 500 kcal deficit per week and a 30% daily energy restriction is roughly a 300 kcal deficit per week. In both groups, the dietary energy restrictions were similar. The

primary outcomes of this study were an improvement in Hemoglobin A1C and a reduction of weight (Carter, 2018).

### **Relationship Between Intermittent Fasting and Type 2 Diabetes**

Obesity (particularly central adiposity) is associated with insulin resistance, and most of those diagnosed with T2DM are obese (Mahan & Raymond, 2017). To help patients improve their glycemic control, weight loss is a fundamental goal of their medical nutrition therapy (Mahan & Raymond, 2017). If glycemic control is not achieved, the potential complications include ketoacidosis, macrovascular disease, microvascular disease, and neuropathy, so the stakes associated with meeting this goal are high (Mahan & Raymond, 2017). The benefits of weight loss among patients with T2DM are irrefutable (Muñoz-Hernández, 2021). In light of the importance of weight loss in these cases, intermittent fasting can help those interested in this approach.

### **Impacts of Intermittent Fasting in Patients with Type 2 Diabetes**

#### **Glycemic Control**

As mentioned above, weight loss, one goal of intermittent fasting, plays a vital role in improving glycemic control (Mahan & Raymond, 2017). According to a published study, intermittent fasting resulted in lower Hemoglobin A1C levels and achieved weight loss in participants with type 2 diabetes (Carter et al., 2018). These results are consistent with studies on other calorie restriction diets (Horne et al., 2020). The use of strictly supervised intermittent energy restriction in persons with T2DM helps glycemic control and may reduce the need for

insulin and oral hypoglycemic medications (Muñoz-Hernández, 2021). However, there is concern that intermittent fasting might increase glycemic variability more than an approach such as calorie restriction (Horne et al., 2020).

### **Mechanism of Action**

Most studies on intermittent fasting were conducted under the concept that the main benefit of the practice for those with T2DM results from weight loss, with the mechanism of action being decreased calorie intake. Insulin resistance is well known to improve with caloric restriction. After fasting, insulin sensitivity increases and insulin levels decrease, which results in improved glycemic control. Some fasting plans may achieve ketosis, in which the body shifts from using glucose for energy to the use of fatty acids and ketones. However, the time it takes for ketosis to occur increases due to insulin resistance in those with T2DM (Grajowler & Horne 2019).

One study reported that intermittent fasting lowered insulin levels and increased a specific regulator of antioxidant response. The increased antioxidant suggested this antioxidant responsible for insulin levels (Crupi et al. 2020). Another study conducted on mice suggests that intermittent fasting does not improve insulin resistance but improves glucose tolerance by affecting pancreatic islet beta-cell health, independent of insulin resistance (Liu et al. 2017). However, studies involving humans suggest the primary mechanism in humans is an improvement in peripheral insulin action (Muñoz-Hernández, 2021).

## **Drawbacks**

Drawbacks relating to T2DM and intermittent fasting include anxiety, muscle loss and effects on the female menstrual cycles (Muñoz-Hernández, 2021). Although studies do not show hypoglycemia to be a significant drawback, consuming pharmaceutical prescriptions can cause an increase in hypoglycemia.

There is concern that intermittent fasting might increase glycemic variability more than an approach such as calorie restriction. More research is needed with close glucose monitoring during intermittent fasting to determine the level of glycemic variation. If intermittent fasting leads to episodes of hypoglycemia during fasting and hyperglycemia with the reintroduction of food, its safety would be called into question, even in light of an overall lowering of Hemoglobin A1C levels (Horne et al., 2020)

Munoz-Hernandez does mention that although meals are eaten every day, hunger seems to be a barrier keeping patients from adhering to the medical nutrition therapy of IRE (intermittent restrictive eating).

## **Additional Considerations**

For people using sulfonylureas and insulin, intermittent energy restriction requires adjusting medications and frequent monitoring (Carter, 2018). Sulfonylureas work by increasing the amount of insulin released from beta cells. When on a calorie-restricted diet such as IF, hypoglycemia can be a cause for concern. IF has shown an improvement in insulin sensitivity; thus, hypoglycemic episodes are more likely to occur without the proper supervision and adjustments. Hyperglycemia is also a concern when medications are not taken due to low calorie and carbohydrate consumption. Although carbohydrate consumption may be minimal,

sulfonylureas and insulin should still be taken to avoid hyperglycemic episodes. Adjusting medication schedules should, in theory, reduce the risk of hypoglycemia in intermittent fasting, but research regarding medication protocols is limited (Horne, Grajower, & Anderson, 2020). There are proposed medication adjustments based on known mechanisms; however, sufficient research to incorporate these changes into clinical practice guidelines is limited. (Horne, Grajower, & Anderson, 2020)

## **Summary**

There is limited information on the benefits of intermittent fasting and type 1 and gestational diabetes. The majority of studies found are focused on patients with type 2 diabetes. Weight loss resulting in increased insulin sensitivity has been highlighted as a significant benefit of intermittent fasting for people with type 2 diabetes. Proper supervision and medication control are of great importance to avoid any complications associated with intermittent fasting. Hypoglycemia is a concern when medication dosages are not appropriately adjusted. Patients should consult a team of doctors and dietitians before and during periods of intermittent fasting to monitor for possible side effects.

Type 2 diabetes patients can benefit from intermittent fasting by improved glycemic control and weight loss. Most research highlights benefits for T2DM with limitations in study size; more research is needed before making a definitive decision on the safety and efficacy of IF. Beta-cell reconstruction was highlighted in an article for mice but hasn't been tested in humans yet.



## Conclusion

The available research regarding intermittent fasting shows that it is as effective as calorie restriction for reducing Hemoglobin A1C in patients with type 2 diabetes (Carter, 2017). More research is needed to verify the safety of intermittent fasting in patients with T2DM and to create clinical guidelines for altering medication protocols (Horne et al., 2020). If closely monitored by the patient's medical team, intermittent fasting can decrease the need for medications related to type 2 diabetes (Muñoz-Hernández, 2021). For those unwilling or unable to be monitored closely, caution should be used when recommending or encouraging this approach until further research is conducted regarding its safety, particularly in the long term (Horne et al., 2020).

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