# Effect of different types of intermittent fasting on weight loss and improvement of blood glucose level in people suffering from type 2 diabetic

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## Abstract

Background: Type 2 Diabetes is a metabolic disorder characterized by hyperglycemia that causes numerous complications with significant long-term morbidity and mortality. The disorder is due to insulin resistance particularly in liver, skeletal muscle, and adipose tissue. Recent studies have suggested that intermittent fasting is depended on calorie restriction and is effective for weight loss by lifestyle modification is the basic of nonalcoholic fatty liver disease therapy, diabetic and cardioprotection. This review provides an overview of intermittent fasting and its effect on human anthropometric such as overweigh and high blood glucose, and nonalcoholic fatty liver disease, which are risk factors for diabetes. There are various studies which pointing to the intrmittent fasting benefits for glucose and insulin homeostasis. Methods: It was searched PubMed, Ovid MEDLINE, and Google Scholar databases for review articles and clinical trials related to type 2 diabetes, insulin resistance and intermittent fasting, there are studies in overweight and obese adult people that included changes in weight, body composition, and diabetic parameters (fasting glucose, fasting insulin, glycosylated hemoglobin concentration, and HOMA-IR index) were published between 2013 and 2022. Results: The researchs were demonstrated that intermittent fasting is effective at reducing bodyweight, decreasing fasting glucose, decreasing fasting insulin, also, reducing insulin resistance, decreasing levels of leptin, increasing levels of adiponectin, a significant improvement in the HOMA-IR index and a decrease in glycosylated hemoglobin, thus, Some studies found that patients were able to therapy by insulin during intermittent fasting protocols with supervision by their physician.Conclusion: Different types of intermittent fasting are an effective for weight loss and reduce diabetes parameters as fasting glucose, fasting insulin, HOMA-IR index, glycated hemoglobin and nonalcoholic fatty liver disease therapy.Evidence suggests that intermittent fasting is an effective non-medicinal treatment option for type 2 diabetes. Diabetic patients should consult the physician prior to followe an intermittent fasting regimen to allow for oversight and titration of the medication during periods of fasting regimen.



**KeyWords:**Intermittent fasting, Obesity, blood glucose level, nutrition, liver and kidney disease.
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## Introduction

Diabetes is a responsible for the development of multiple long term complications, which contribute to the disease's morbidity and mortality. For instance, renal failure, new onset blindness, and lower extremity amputation. Type 2 Diabetes Mellitus is a common metabolic disorder characterized by hyperglycemia, impaired insulin secretion, insulin resistance, decreased glucose utilization, excessive hepatic glucose production and systemic inflammation [1-2]. Medical nutritional therapy is an essential component of the management of patients with diabetes, hypertension, cardiovascular disease and metabolic disorders [3]. The increasing prevalence rates of diabetes and metabolic disorders are linked to overweight and obesity due to dietary factors and physical inactivity. consequently, interventions

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calorie restriction and increased physical activity have been promoted as adjuncts to the management of chronic metabolic disorders [4], which was about the association between changes in cardiovascular risk factors and weight loss in people suffering from type 2 diabetes, it showed that participants who lost 5–10% of their body weight showed improvements in systolic blood pressure, diastolic blood pressure, HDL cholesterol, and triglycerides, and that weight loss is the key component of treatment and reducing cardiovascular risk in patients with type 2 diabetes. Obesity is a responsible for the development of insulin resistance and diabetes, it is necessary to introduce physical activity and calorie restriction of weight loss and improvement body composition as fat, muscle, and water contents, a weight loss of 1 kg reduces the risk of diabetes by as much as 16% [5]. Due to the strong association between overweight or obesity and type 2 diabetes, so lifestyle such as calorie reduced healthy eating patterns and increased physical activity has become nesessary to induce weight loss of diabetes prevention and management [6-7]. The intermittent fasting connotes reduced caloric intake from several hours to 24 hours/day for religious reasons such as during Ramadan or for health reasons, including weight loss,diabeticdisesse and improving body composition and metabolic health [8-9] such as fsting a full day once or twice a week [10] or four day per week [11]. There are some protocols depend on protein intake without carbohydrates according to study [12] and anther protocols depend on just carbohydrates or macro and micronutrients, in all instances, non-caloric fluid intake is permitted and therefore reduces of dehydration and hypotensionthe risk [13], the glucose level monitoring in patients with diabetes mellitus is nessesary for safely the clinical management of intermittent fasting [14]. Intermittent fasting is the one of alternative methods of reducing kilocalories intake, it depend on refraining from eating for a period of time for example 16 hours, and then eating meals in feeding window, which lasts 8 hours and it can be modified by engthened or shortened periods of fasting or eating window [15], An example, alternating eating one day and then fasting the next day. On the day of fasting, one meal often consumed at lunch, which does not exceed 25% of the daily caloric [16], or the introduction of one, two, three, four or five days fasting per week. this way, one can reduce calories to a minimum [17]. It is aprogram that manipulate meal time, using short-term fast to improve body composition and overall health [18]. According to [19] studied the intermittent fastingand its role in the treatment of diabetes, and current evidence suggests that intermittent fasting is an effective non-medicinal treatment option for type 2 diabetes, but diabetic patients should consult their physician prior to beginning an intermittent fasting regimen for oversight and titration during periods of fasting. Intermittent fasting is an emerging practice in dietary modification. The purpose of this article is to present a balanced of the practice of intermittent fasting and its impact on blood glucose level in people with type 2 diabetes.



**Table 1: Different protocols of intermittent fasting [20]**

| Fast types | The definitions |
|---|---|
| Complete alternate day fasting | Alternating fasting days is depended on non consuming high energy food and drinks with eating days |
| Alternate day fasting | It allows consumption 20 - 25% of energy of baseline energy intake in a lunch (between 12 and 2 pm) on fast days or eating 500 calorie meal on fasting days. Also it is known with the popular 5:2 diet which is associated with consumption of one 500–600 calorie meal on the fasting day for 2 uninterrupted days a week and eating for the remaining 5 days of week. (Trepanowskiet al., 2017). |
| Time-restricted feeding | Eating meals with a energy value in food window, which lasts several hours. Current, The common modification is eating for 8 hours, followed by fasting for 16 hours daily, the hours of fasting and eating can be shortened and extended as eating for 6 hours, followed by fasting for 18 hours. |

| | |
|---|---|
| Religious fasting as an example for Ramadan fasting | Ramadan fasting is the one of intermittent fasting types for religious or spiritual purposes |
| Weekly one day fasting | It is Fasting regimen Once per week for 24 hours and depended on a water only |
| Fast mimicking diet | A low-calorie diet Once per month for 120 hours and allowe a small maximum amounts of macronutrients. |
| Ten-day juice fast | Fruit juices or soups are consumed during the fasting period for 240 hours without consumption the solid food |

* The meal may be optional , depending on the fasting regimen that is being followed

Glucose and lipid homeostasis can be improved by a weight loss, through continuous energy reduction daily, also, metabolic regulation of glucose and lipids can also be affected by dietary manipulations and changes in meal time [21] and fasting [22]. Most studies recommended the intermittent fasting as it offer impressive health benefits [18], including, lose weight and improve diabetic parameters in human [23]. On other hand the different types of intermittent fasting reduce body weight and diabetes parameters such as fasting glucose, fasting insulin and glycated hemoglobin in human [24].

## Intermittent fasting action mechanism

Most studies of intermittent fasting have focused on weight loss as primary goal [22, 25], which concluded that weight loss is the one of health benefit of intermittent fasting, [8] used the metabolic to shift glucose from glycogenolysis to fatty acids and fatty acid-derived ketones, and ketones are the preferred fuel for the brain and body during periods of fasting. The metabolic switch occurs when glycogen stores in the liver are depleted, after the cessation of food intake by 12 h, and adipose tissue lipolysis increases to produce fatty acids and glycerol, then the free fatty acids are transported to the liver where they are oxidized to β-hydroxybutyrate and acetoacetate, then they are converted to energy through beta-oxidation during water-only fasting [26]. Action mechanism is decreased caloric intake, potential mechanisms of health benefits from fasting including the intermittent fasting effectivness for inflammation, reactive oxygen species, blood pressure, and cholesterol levels, also the impact on the human microbiome due to weight loss, itochondriogenesis, immune system efficiency and autophagy [27], also the human growth hormone insulin-like and due to higher erythrocyte count and hemoglobin levels during water-only fasting may improve metabolic functioning or decrease insulin resistance [28].

## Intermittent fasting benefits



Insulin resistance improve with caloric restriction of type 2 diabetes. After a period of fasting, insulin sensitivity rises and insulin levels fall [29], glucose levels improved in fasting and postprandial. In addition, less propensity to weight gain and potentially weight loss, so fasting can be one option for healthy weight loss [30]. Intermittent fasting and calorie restriction can influence weight loss, especially when it is conducted frequently, also it have been shown to improve various metabolic and inflammatory pathways such as increased heat shock protein, promoting cellular autophagy, reducing advanced glycation end products, increased adiponectin, and decreased inflammation cytokines, all theses effects result in decreased vascular dysfunction and improvecardiovascular risk and mortality [31-32], reduce leptin levels and an increase adiponectin, improvements of insulin resistance, leading to improved appetite control and lower levels of chronic inflammation thus improving several risk factors for type 2 diabetes [8]. Insulin resistance is associated with an increased inflammatory state including elevated C-reactive protein, decreased adiponectin and lower low-density lipoprotein (LDL), that are associated with atherosclerosis and coronary artery disease [33], Furthermore, insulin is cause atherogenic and increase the risk of fluid retention and congestive heart failure, Thus, reducing insulin levels through intermittent fasting reduce cardiovascular risk and metabolic [34-35] and a lower risk of coronary artery disease and lower risk of diabetes [36].

## Intermittent fasting risks

The most risk with intermittent fasting is the potential for hypoglycemia in patients who are on

antidiabetic medications that , specifically insulin and sulfonylureas [37].

The patients are not cognizant to maintain adequate protein intake with long-term intermittent fasting, occur vitamin and mineral malnutrition and might necessitate taking supplements such as vitamin and mineral.

Insufficient energy intake due to dehydration, dizziness, nausea, insomnia, syncope, falls, migraine headache, weakness that limits daily activities, and excessive hunger pangs.

The presence of a chronic disease such as diabetes increase the risk of coronary artery disease, unstable angina, heart failure, atrial fibrillation, prior myocardial infarction, prior stroke or transient ischemic attack, most cancers, chronic obstructive pulmonary disease, pulmonary embolism, asthma, peripheral vascular thromboembolism, chronic kidney disease, people with these chronic diseases, they should not engage in fasting, because it exposing them to new myocardial infarction, stroke, or death [38], so drinking water and fluids is recommended during intermittent fasting regimen, is an important consideration for people of all ages who are participating in intermittent fasting.

Some peoples have unique risks and should be dissuaded from intermittent fasting, especially patienteswith diabetes, pregnant and lactating women, young children, adults of advanced age, and older adults frail, Individuals with

immunodeficiencies, patients who have a history of traumatic brain injury or post-concussive syndrome.

## Methods

A literature review was performed for articles related to the impact of intermittent fasting on type 2 diabetes mellitus. We used PubMed, Google Scholar, Ovid MEDLINE, American Diabetes Association and European Association to search for published articles, including randomized controlled trials, clinical trials and case reports, between the years of 1998 and 2021, for diabetes study for guidelines and recommendations. The following keywords were used: Intermittent fasting, Obesity, blood glucose level, nutrition, liver and kidney disease. The study design involved one of the three most commonly intermittent fasting regimens: alternate day fasting, periodic fasting, or time-restricted feeding. Finally, a total of 10 articles were chosen to explaine the effectiveness the intermittent fasting in patients with or without type 2 diabetes in Tables (2-3).



**Table 2: Study the effect of fasting regimens in patients without diabetes**

| Intermittent Fasting Protocol | Description | Effects of Intermittent Fasting vs. Baseline | Reference |
|---|---|---|---|
| Alternate Day Fasting | One day of fasting/One day of ad libitum feeding. | Average Baseline Values: Weight (96 kg ), fasting glucose (90 mg/dL), fasting insulin (18 uIU/mL) and HOMA-IR (4.1).<br>Results: Decrease body weight, fasting glucose, fasting insulin and HOMA-IR<br>( 6.8%, 6.3%, 7.5%. and 2.49%) respectively. | [xx] |
| | | Average Baseline Values:Body weight ( 95 kg), fasting glucose (99 mg/dL) and fasting insulin (23 uIU/mL)<br>Results: Decrease body weight, fasting insulin and fasting glucose ( 8% , 52% and 3%) | [39] |
| 5/2 method | Complete fasting on 2 non-consecutive days/5 days of ad libitum feeding | Average Baseline Values: HbA1C (7.2%) and Body weight (99 kg).<br>Results: Decrease HbA1C and body weight<br>( 0.7% and 8 kg) respectively. | [40] |
| | Complete fasting on 2 non- | Average baseline values:HbA1C(7.2%) and Body Weight (100 kg). | [40] |

| | | | |
|---|---|---|---|
| 5/2 method | consecutive days/5 days of ad libitum feeding | Results: Decreased body weight and HbA1C ( 6.8 kg and 0.3%) respectively. | |
| | | Average baseline values (Consecutive / Nonconsecutive 2 day fast) Weight(108.7/109.8 kg), BMI (36.6/36.8 kg/m2) and HbA1C(8.4/8.2%). Results : Decrease weight, BMI and HbA1C (3.1/3.6 kg, 0.5/0.8 kg/m2 and 0.6/0.7%) respectively. | [10] |
| Time Restricted Feeding | Daily 12–20 hour fast/4–12 hour feeding window | Average baseline values: Weight (105.7 kg), BMI (33.9 kg/m2) and fasting Glucose(5.8 mmol/L). Results:Decrease glycemic response to test meal by 36% and No significant weight reduction. | [41] |
| | | Average baseline values: Body weight (101 kg), fasting glucose (88 mg/dL), fasting insulin(12 uIU/mL), HOMA-IR (2.7) and HbA1C(5.9%) Results: decrease body weight, fasting glucose, fasting insulin, HOMA-IR and HbA1C (3.2% , 5.0 mg/dL, 2.3 uIU/mL , 29% and 0.2%) respectively. | [42] |

**Table 3: Reports investigating intermittent fasting in patients with type 2 diabetes**

| Intermittent fasting protocol | Description | Effects of intermittent fasting vs. Baseline | Reference |
|---|---|---|---|
| Alternate Day Fasting | One day of fasting/One day of ad libitum feeding | Average baseline values: HbA1C (11%, 96.7 mmol/mol) and body weight (83.8 kg) Results: Decreased HbA1C and body weight (4%, 10kg) respectively. | [15] |
| | | Average baseline values: HbA1C (7.2%, 55.2 mmol/mol) and body weight(61 kg ) Results: Decrease HbA1C and body weight (0.8% and 9 kg) respectively. | [15] |
| | | Average baseline values HbA1C(9.3%) and body weight (55.3 kg). Results: Decrease HbA1C and body weight (3.5% and 1.8 kg) respectively. | [43] |



## Conclusion

diabetes is characterized as a disorder of insulin resistance, the pharmaceutical treatments promote increases in insulin levels to achieve better glycemic control, which lead to weight gain, worsened insulin resistance, increased levels of leptin, and decreased levels of adiponectin. Intermittent fasting has become an increasingly popular dietary for the improvement of body composition and metabolic health. there are various of studies has been shown that intermittent fasting for patients with type 1 and 2 diabetic induce weight loss and reduce insulin requirements. Intermittent fasting have Long-term benefits such as including cardiovascular risk reduction, but may take months to years to be realized. Good evidences from studies indicate that the intermittent fasting benefits outweigh the potential harms, people with diabetes, their personal needs require more careful at beginning and during the intermittent fasting diet . With proper medication and self-monitoring of blood glucose levels , therefor, intermittent fasting can be encouraged and safely mplemented among people with diabetes.

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