

Determining Whether Diet And Exercise Is More Advantageous Than Insulin Pumps In Managing Type 2 Diabetes

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ABSTRACT:

Type 2 Diabetes (T2DM), caused by the body's inability to respond properly to insulin produced by the pancreas affects 35 million Americans. The purpose of this study is to determine how beneficial diet and exercise is compared to insulin pumps in diabetics. I searched Google Scholar using terms such as type 2 diabetes, insulin pumps, diet, and exercise. During high intensity exercise irisin levels increased 88.4%, betatrophin levels rose to 667.3%, and insulin levels rose to 100.2%. Those who adapted an intermittent fasting diet achieved a mean weight reduction of 5.93 kg and 47.2% of the individuals achieved remission. Insulin pumps are used in type 2 diabetics if the patient needs higher doses of insulin, but it has been proven to lower A1C levels by using less insulin than other devices. Further research should be done to test if insulin pumps are as effective in those who don't need a high dose of insulin.

INTRODUCTION:

Type 2 diabetes (T2DM) affects nearly 35 million Americans [1]. It can be found in adults, but it is also becoming increasingly prevalent in children and teens. It is caused by the body's inability to respond properly to insulin produced by the pancreas, or the body does not produce enough insulin. Insulin is a hormone produced by beta cells in the pancreas that acts as a signal for cells to take in glucose, a lack of response leads to high blood sugar in those affected by diabetes. For type two diabetics, managing their condition to remission, or when diabetes is not present anymore, is ideal [2]. Diabetes affects many organs in our body: the heart, blood vessels, the eyes, and the kidney. Recently, diabetes has been linked to various cardiovascular diseases, such as congestive heart failure or a stroke. Cardiac problems cause 80% of deaths in diabetic patients. Recent studies have shown a need to control glucose management and cardiovascular disease risk factors in diabetic patients [3].

There is no cure for diabetes; patients often focus on lifestyle changes instead. Although patients can achieve remission, in which A1C levels are very low there is no guarantee remission will be permanent. The Diabetes Prevention Program detailed that changes in lifestyle can prevent type 2 diabetes by 58% over 3 years [3]. Additionally, there are medical devices commonly used to manage glucose levels and insulin administration. There are many devices

available. Some include insulin pumps, multiple daily injections (MDI), insulin pens, and implantable glucose monitors. Insulin pumps offer results over a long period of time and are often more affordable than other devices available. Furthermore, devices must manage nocturnal hypoglycemia, when blood sugar levels become low while a person is sleeping [4]. Devices are able to do this by constantly monitoring glucose levels and releasing small amounts of insulin when necessary.

The usual diet advised to patients is a balanced diet with calorie restriction [2]. Furthermore, research has been conducted on the various dietary options available, including low fat/low carbohydrate diets, mediterranean diets, and Chinese medicine dietary therapy (TCMDT). Consisting of whole grains and traditional Chinese medicines, TCMDT is often used to battle hyperglycemia and reduce obesity in patients [5]. Nonetheless, currently there is not enough data on which diet is most effective after four years. In a study comparing a diet or fitness change to a group that made no change, 46% of patients achieved remission in the tested group compared to the 4% that made no change to their normal routine [6]. Not many reviews have shown the true effect of either a medical device and diet on managing diabetes.

The purpose of this study is to determine how beneficial diet and exercise is compared to insulin pumps in diabetics. In these trials, patients were used to study the effect of insulin pumps and diet or exercise. By analyzing the data already gathered we can understand which factor is better at controlling diabetes. Positive results are indicated by a decrease in A1C levels or weight loss over a given amount of time.

METHODS:

I used Google Scholar to find relevant sources by using the search terms: Type-2 diabetes, insulin pumps, diet, and exercise. Other inclusion criteria were articles written in English in the last five years. Exclusion criteria included papers about Type-1 diabetes, other diabetic devices, like insulin injections or glucose monitors, and any studies on pregnant individuals or children.

RESULTS:

In a trial that determined the effect of intermittent fasting on Type-2 diabetes remission, those who practiced intermittent fasting for three months, 47.2% achieved remission and achieved a mean weight reduction of 5.93 kilograms. In the control group, 2.8% achieved remission and had a mean weight reduction of 0.27 kilograms [6]. Yang L, Lin H et al. demonstrated that exercise helps insulin resistance in Type-2 diabetics. Exercise also leads to a decrease in blood sugar and an increase in glucose uptake, by increasing glucose oxidation. Additionally, a decline in branched amino acids was observed, which promotes glucose and lipid metabolism [6]. It was concluded that a high fat diet leads to an increase in firmicutes which break down carbohydrates. Daly and Hovorka detail the various types of technology available to those with Type-2 diabetes (see figure 1); they concluded that there is no significant benefit of

self monitoring glucose levels longer than a year, since there was no difference compared to the control which used normal basal insulin once a day [7].

Enteshary et al. conducted studies on the levels of irisin, betatrophin, and insulin during exercise. They concluded combined aerobic training led to increased irisin levels by 88.4% in the high intensity group and 36.7% in the moderate group. Betatrophin levels rose 667.3% in the high intensity group. In the moderate group it rose by 1.6%. Insulin levels rose to 100.2% in the high intensity group. In the moderate group it rose 56.7%. Participating in high intensity training increases insulin levels in diabetic patients by 100.2% [8]. Since the various hormones released during exercise facilitate the release of insulin, blood sugar reduces in the body [8]. A narrative review describes the various dietary strategies beneficial for type 2 diabetics, concluding that low carbohydrate diets were effective in reducing weight to achieve remission. But patients were unable to continue the diet due to the low requirement of carb needed [9].

Brown et al. 14.7% of the participants achieved remission by taking part in the Mediterranean diet [9]. In Grunberger et al. they compared the benefits of Insulin pumps against MDI. The study observed that the mean difference in A1C in CSII was -1.27% as opposed to the 0.85% from MDI. Fasting plasma glucose in Continuous subcutaneous insulin infusion (CSII) was -33.9mg/dL. In MDI the difference was -35.6 mg/dL. It was concluded that both treatments are effective in reducing A1C. But, the CSII group achieved a greater reduction with much less insulin compared to the MDI group [4]. A clinical overview of insulin pumps detailed that many studies have shown that A1C has decreased by 1% or more when individuals use insulin pumps [10]. Ruiyu, Wu et al. used the TCMDT diet and studied how it affected gut bacteria, concluding that it increased diabetes-improving bacteria (Coriobacteriaceae, Bacteroidaceae, and Peptostreptococcaceae) by 7-26 times [5].

The difference in fasting blood glucose between those dieting and using an insulin pump is also significant. Those who adopted an intermittent fasting diet achieved a reduction in blood glucose of 1.82 mmol/L [2], while those who utilized an insulin pump for another study achieved a reduction of 1.9 mmol/L [4]. Furthermore, a reduction in mean A1C was observed in the diet group of 1.75% [2], while in the CSII group there was a 1.27% difference in mean A1C [4].

Table 1: Reviewed Studies

Article	Purpose	Independent Variable	Dependent Variable
Effect of an Intermittent Calorie-restricted Diet on Type 2 Diabetes Remission: A Randomized Controlled Trial	Determine the effect of an intermittent fasting diet on type 2 diabetes remission.	Intermittent Fasting Control	Percent of those who achieve remission A1C levels Fasting blood glucose level

<p>Exercise Ameliorates Insulin Resistance of Type 2 Diabetes through Motivating Short-Chain Fatty Acid-Mediated Skeletal Muscle Cell Autophagy</p>	<p>To understand how exercise aids in insulin resistance in type 2 diabetics.</p>	<p>High fat diet Control</p>	<p>Fasting blood glucose levels Intestinal flora levels Glucose uptake capacity</p>
<p>Comparison of the Effects of Two Different Intensities of Combined Training on Irisin, Betatrophin, and Insulin Levels in Women with Type 2 Diabetes.</p>	<p>Understand how different intensities of exercise can affect hormone levels beneficial in diabetics.</p>	<p>High-intensity training Moderate-intensity training Control</p>	<p>Irisin levels Betatrophin levels Insulin levels</p>
<p>Human regular U-500 insulin via continuous subcutaneous insulin infusion versus multiple daily injections in adults with type 2 diabetes: The VIVID study</p>	<p>To determine if CSII is more beneficial than MDI.</p>	<p>Continuous subcutaneous insulin infusion (CSII) MDI</p>	<p>A1C levels Fasting plasma glucose Weight change Hypoglycemia</p>
<p>Effect of a Chinese medical nutrition therapy diet on gut microbiota and short chain fatty acids in the simulator of the human intestinal microbial ecosystem (SHIME)</p>	<p>To study the effect of the TCMDT diet on gut microbiota.</p>	<p>TCMDT diet Control</p>	<p>Composition of gut micro bacteria Microbiota activity</p>

DISCUSSION:

Type-2 diabetes stems from insulin resistance in the body which is when the body does not react to insulin produced by the pancreas [1]. Studies have shown that exercise helps with blood sugar levels. As exercise is performed, hormones are produced such as irisin and betatrophin. Irisin increases the expression of betatrophin, which increases beta cell growth [8]. This increases insulin production, as its source in the body increases. Additionally, insulin levels also increase with exercise [1]. The higher the intensity of exercise the higher the hormone levels are. Exercise promotes the decrease of blood branched-chain amino acids, which are substrates that produce energy. Therefore, promoting lipid and glucose metabolism in patients [6]. Exercise regulates the concentration of short fatty acid chains (SCFA) in diabetic individuals. When the whole body vibrates it increases the amount of SCFA producing bacteria [6]. Bacteria found in the gut (intestinal flora) can regulate the secretion of hormones of endocrine cells, which regulates appetite and the release of insulin. Exercise can change the composition of intestinal flora, the barrier of the gut, and can lead to an increase in Bacteroides which can battle obesity and help insulin resistance [6].

A decrease in A1C was observed as well as an increase in remission rate when diabetic individuals adopted an intermittent fasting diet. [2]. To clarify, remission only occurred in those who had lower A1C levels and were on fewer antidiabetic medications. But it was found that many did achieve remission despite having the disease for a minimum of 6 years [2]. Intermittent fasting promotes the production of beta cells which helps control the body's metabolism and the production of insulin [5]. With the introduction of intermittent fasting in their diets, patients greatly decreased their medicine costs by using less antidiabetic drugs. Furthermore, research has found that a high fiber diet is found to promote a group of SCFA's that focus on easing the effects of diabetes [2].

Insulin pumps have been a trusted mode of insulin delivery for many years by efficiently administering insulin. Specifically, in Type-2 diabetes it is only used in those who need higher doses of insulin. In a study comparing insulin pumps to MDI, both devices lead to a lower A1C [4]. However, the group tested with insulin pumps achieved this lower level by using less insulin. The insulin pumps vastly increased insulin release in the morning to modify the amount of insulin released at night. Additionally, both groups experienced similar amounts of weight gain [4]. Moreover, the occurrence of nocturnal hypoglycemia actively decreased as the study continued in the insulin pump group. Therefore, as the device discovered the trend it adapted the amount of insulin released during the night to avoid hypoglycemia. In many occurrences insulin pumps have been proven to be the best device for managing diabetes, since they are much more practical, easy to use, and cheaper than other devices [7].

After reviewing my findings, I have found that daily aerobic exercise aids in reducing insulin resistance and intermittent fasting reduces A1C levels in order to achieve remission in Type-2 diabetics. As opposed to using an insulin pump to control blood sugar, changes in

exercise and diet have shown a great amount of promise to control type 2 diabetes leading to weight loss and a decrease in A1C levels. Insulin pump therapy did show great promise with decreasing total A1C and managing nocturnal hypoglycemia, but it was not as beneficial as diet and exercise. Often, insulin therapy is used in type 2 diabetics with those who require high amounts of insulin. This has become a novel approach as there are no other practices [6].

This research can be utilized to modify insulin pump technology in the future. As my research has shown that lifestyle changes are more beneficial. After analyzing the positive effects of lifestyle changes, insulin pumps do not seem to be the best choice for those with type 2 diabetes. Furthermore, these results highlight how vital diet and exercise is to treating diabetes. Future research on the use of insulin pumps in individuals that do not need high doses of insulin is vital to see if insulin pumps can be advantageous to everyone with Type-2 diabetes.

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