In what ways does intermittent fasting benefit type 2 diabetics and increase fat loss with exercise?

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Abstract: Intermittent fasting has been growing in the health industry as a method for weight loss. Individuals can integrate intermittent fasting into their lifestyle in a variety of ways. Some forms are more suitable for beginners while others are more restrictive. The different kinds of intermittent fasting include a 12 hour fast, 16 hour fast, fasting for 2 days per week, alternate day fasting, the weekly 24-hour fast, and the warrior diet. With weight loss being the main promise, there has been a higher interest in the effects of fasted cardio. Research studies have shown that fasted cardio can increase the percentage of fat burned during a workout. Along with this, intermittent fasting may improve the way that the body regulates blood sugar after consuming a meal. Intermittent fasting has shown to be able to decrease the amount of insulin individuals with type 2 diabetes take. While people incorporate intermittent fasting as a way to achieve health benefits, cultures such as Ramadan use it as a way to grow spiritually. In Islam, people fast from sunrise to sunset for a month. During this time, they are able to gain inner peace and tranquility. Intermittent fasting has gained popularity in recent years as a strategy to enhance one's wellness. Although there are many health benefits that can be achieved through intermittent fasting, it is important to talk to a medical professional and know the pros and cons prior to starting. The purpose of this paper is to discuss how intermittent fasting may impact one's psychological and physiological health so that readers may enhance their knowledge of the topic and integrate intermittent fasting into their own life.

Fasting, abstinence from food or drink, has become an increasingly popular weight loss strategy in mainstream media. With "approximately 35% of US adults being obese in 2011-2012" (Imes & Burke, 2014), many are searching for effective ways to reduce their risks of health complications in the future. However, despite weight loss being one of the reasons individuals choose intermittent fasting, others choose fasting as a benefit for certain health conditions, or for religious or cultural beliefs. There are many different intermittent fasting methods that vary in eating windows, fasted days, and amount of calories consumed. Typically, when someone is intermittent fasting, the majority of the fasting hours come from being asleep. Thus, people will occasionally work out while remaining in this fasted state in order to maximize fat loss. Through studies, fasted cardio has shown to increase the amount of fat burned by up to 70% in comparison to cardiovascular exercising in a non-fasted state. Blood glucose spikes can be regulated in the meal following fasted cardio, in those who regularly participate in fasted cardio, and intermittent fasting.

There are a variety of methods to do intermittent fasting depending on the preference of the individual. These may include the 12 hour fast, 16 hour fast, fasting for 2 days per week, alternate day fasting, the weekly 24-hour fast, and the warrior diet. The 12-hour fasting window is typically considered to be a good option for beginners due to its relatively simple rules. For this type of intermittent fasting, a person must select 12 hours out of their day in which they will refrain from any food or drink. This 12 hour fasting window generally occurs during sleep and allows the person to consume their typical amount of calories every day. Research shows that "fasting for 10-16 hours can cause the body to turn its fat stores into energy, which releases ketones into the bloodstream" (Leonard, 2023) and ultimately encourages weight loss. The 16 hour fast, referred to as the 16:8 method or Leangains diet, requires an individual to be in a

fasted state for 16, leaving 8 hours for eating. The Leangain diet is commonly used after seeing minimal benefits from the 12 hour fasting method. A study performed on mice with a high fat diet "found that limiting the feeding window to 8 hours protected them from obesity, inflammation, diabetes, and liver disease, even when they ate the same total number of calories as mice that ate whenever they wished" (Leonard, 2023). The 16 hour fast is a stronger form of the 12 hour diet and is typically done if no results are seen from the 12 hour fast. While these two methods may provide results to some, others may not prefer to fast every day. The 5:2 diet accomates for such people and allows them to consume a standard quantity of food for 5 days and reduce their calorie consumption for the others. Although there is limited research regarding this diet, the results of a study including 107 overweight or obese women found that restriction of calories twice a week and continuous restriction of calories both contributed to weight loss. Moreover, the study additionally found that this diet reduced participant's insulin levels and improved insulin sensitivity. Another variation of fasting is the alternate day fast, meaning a person fasts every other day. The restrictions of alternate day fasting vary in preference from person to person. While some allow themselves a maximum of 500 calories, others avoid solid food completely. Due to its extremity, this method is not recommended for beginners or people with medical conditions. Other individuals prefer a weekly 24-hour fast, which involves consuming no food for 24 hours 1 to 2 times a week. Individuals following this plan are able to consume water, tea, and other zero calorie fluids on days they are fasting, but should return to their normal structure during non-fasting days. Initially, a 24-hour fast can potentially cause fatigue, headaches, or irritability. However many find these side effects to fade after their body adapts to their new eating schedule. Another type of fasting is called the Warrior diet. The Warrior diet is a relatively restrictive form of intermittent fasting with only a 4 hour eating window. During the other 20 hours in the day, those participating in this style of fasting will typically consume small portions of raw fruits and vegetables, along with a large meal at night. On this diet, there is the risk of individuals not consuming crucial nutrients such as fiber, thus increasing the probability of developing cancer or negative effects to their digestive and immune health.

Many cultures incorporate fasting throughout the year, one of the most popular being Ramadan. In Islam, Ramadan is the ninth month on the Muslim calendar but varies in timing from year to year. As one of the five "pillars of Islam", Ramadan is a time for spiritual growth, self-improvement, and kindness. Muslims believe that fasting is more than abstaining from food and drinks, "falsehood in speech and action, abstaining from any ignorant and indecent speech, and from arguing, fighting, and having lustful thoughts" (Ahmad et al., 2012) are also prohibited. All able-bodied Muslims are expected to fast for a month with an exception of those physically limited or traveling. The law in Islam exempts fasting for the "children below the age of 12 years, sick, traveling, elderly, the women who are menstruating, breastfeeding and pregnant, and those unable to understand the purpose of fasting during Ramadan" (Ahmad et al., 2012). Additionally, those who are unable to fast for reasons other than the ones listed, if financially able, are expected to provide meals to those in need. As expected, Ramadan has shown to decrease weight, however the majority of studies have found that most individuals return to their starting weights in the following months. In athletes, research has found that total cholesterol, low-density lipoprotein, high-density lipoprotein, and blood glucose improve after Ramadan in comparison to before beginning the month-long fast. According to the Cleveland Clinic Abu Dhabi, people participating in Ramadan can greatly improve their health by having a healthy Iftar (the meal eaten after sunset during Ramadan), staying hydrated, exercising moderately, and picking up healthy habits. Staying hydrated can be difficult during the month as some

completely abstain from all drinks, including water throughout the day time. Although water is avoided, it is recommended for participants, particularly athletes, to drink ample fluids at night to compensate for the dehydration that occurs during the day. There are a variety of positive impacts that Ramadan can have on a person's physical and mental health including a curbed appetite, boosted mood and mental clarity, stronger control of impulses, and inner peace and tranquility. Ramadan is one of the many cultural occasions that use intermittent fasting as a way to grow spiritually. Although this is a holiday for spiritual growth, this holiday also has proven to be beneficial for the health of a person as a whole, as we now know that benefits of intermittent fasting can improve the health of an individual.

The pros and cons of fasting are highly dependent on the overall health of the person. For people in good health, intermittent fasting can result in weight loss, lower cholesterol, lower blood pressure, improved blood sugar, less inflammation, better brain health, fewer age-related diseases, and an overall longer and healthier life. The reduction of inflammation that can be achieved through intermittent fasting, can additionally lower the rates of biomarkers associated with the resistance of insulin. A study conducted by the American Heart Association's Scientific Sessions discovered that "people who followed a regime in which they fast for a 24 hour period at least once a week for 26 weeks had high levels of galectin-3 (a cell-repair protein associated with easing inflammation) compared to a control group of people who did not fast" (Keppler, 2021). Despite these benefits, fasting is not meant for everyone. Researchers recommend those who are over the age of 65, are still growing, have diabetes, have heart, kidney, or liver disease, have a history of disordered eating, are pregnant or breastfeeding, have low blood pressure, or take medications should consult medical personnel about their interest in fasting prior to trying it out.

Intermittent fasting is most popularly done for its promise of weight loss, creating a higher interest in fasted cardio. To workout in a fasted state, a person must have had their last meal 10-12 hours prior. A study performed by researchers at the University of Bath in England used 30 overweight men to see if fasted cardio had any effect on their bodies. The men were split into 3 groups, a control group and two groups who rode a stationary bike. The two exercise groups were given a drink 2 hours before their ride, one being a vanilla flavored protein shake and the other being a placebo drink containing water, flavoring, and zero calories. The study found that "the riders who had pedaled on an empty stomach, however, had incinerated about twice as much fat during each ride as the men who consumed the shake first" (Blechman, 2022). Regardless of burning close to double the amount of fat, fasted cardio may not be preferred by everyone. Another study conducted by sports scientists at Nottingham Trent University concluded that "The amount of fat burned during the 30-minute cycle increased by about 70% from 4.5g to 7.7g" (Nottingham Trent University, 2022). However, regardless of these results, the scientists found that the fasted participants had reduced exercise performance, motivation, and overall enjoyment. Thus, individuals who choose to do fasted cardio may struggle to stick with it in the long run. Moreover, according to Tommy Slater, a sports science researcher in Nottingham Trent University's School of Science and Technology, if people regularly do fasted cardio "it may improve the way the body deals with spikes in blood sugar after eating" (Nottingham Trent University, 2022). Particularly in individuals with diabetes, fasted cardio may aid them in regulating their blood sugar levels.

Diabetes has been growing as a significant public health and economic concern across the US with "an estimated 37.3 million"(Diabetes Statistics, 2023) cases reported in 2022. Diabetes is a disease in which a person has a heightened blood sugar, or glucose. It can be

broken up into “subclassifications, including type 1, type 2, maturity-onset diabetes of the young (MODY), gestational diabetes, neonatal diabetes, and steroid-induced diabetes” (Sapra & Bhandari, 2023). Type 1 and type 2 diabetes are the most common, but the management and pathophysiology differ. With type 1 diabetes, the autoimmune-mediated destruction of the pancreatic beta cell causes the body to have low levels of insulin. Along with this, alterations in lipid metabolism, enhanced hyperglycemia-mediated oxidative stress, endothelial cell dysfunction, and apoptosis is typically seen. Likewise, with type 2 diabetes, the elevated levels of glucotoxicity, lipotoxicity, endoplasmic reticulum induced-stress, and apoptosis result in the loss of beta cells. The difference between the two is that “while type 1 diabetes is characterized by the presence of beta cell autoantibodies, a combination of peripheral insulin resistance and dysfunctional insulin secretion by pancreatic beta cells is implicated in the pathogenesis of type 2 diabetes” (Ndisang et al., 2017). Diabetes can additionally cause a number of complications that can be classified as either microvascular or macrovascular. With microvascular complications, there can be “nervous system damage (neuropathy), renal system damage (nephropathy) and eye damage (retinopathy)” (Deshpande et al., 2008). Whereas macrovascular complications include “cardiovascular disease, stroke, and peripheral vascular disease. Peripheral vascular disease may lead to bruises or injuries that do not heal, gangrene, and, ultimately, amputation” (Deshpande et al., 2008). Particularly with type 2 diabetes, intermittent fasting may eliminate a person’s need for medication. A study published in the Endocrine Society’s *Journal of Endocrinology and Metabolism*, “patients achieved complete diabetes remission, defined as an HbA1c (average blood sugar) level of less than 6.5% at least one year after stopping diabetes medication” (Intermittent fasting may reverse type 2 diabetes, 2022) after going through an intermittent fasting intervention. The researchers in this study performed a 3-month intermittent fasting diet intervention with 36 diabetic individuals, finding that nearly 90% of the participants lowered their medication intake after intermittent fasting. Of these participants, 55% of them went through diabetes remission and stopped taking their medication for a minimum of one year. Moreover, 65% of these participants that experienced diabetes remission had a diabetes duration over 6 years. This conclusion allowed the researchers to challenge the belief that diabetes remission could only be achieved in individuals with a 0-6 year diabetes duration. Through intermittent fasting, people with diabetes may “reduce body fat and insulin resistance not only by limiting overall calorie intake but also through “metabolic reprogramming”” (Kingsland, 2021). “Metabolic reprogramming” causes the body to burn fatty acids and ketones from fat stores instead of utilizing glucose for fuel. Along with this reprogramming of the body, intermittent fasting reduces body fat which in turn can improve a person’s sensitivity to leptin and adiponectin. As a result, an individual may gain more control of their appetite and can reduce chronic inflammation. While there are a variety of benefits that can stem from intermittent fasting in those with type 2 diabetes, it is recommended that healthcare professions monitor their blood sugar levels during fasting in order to prevent dangerously low blood sugar or episodes of hypoglycemia.

The popularity of intermittent fasting has grown greatly in recent years due to its many benefits. Some of the benefits include decrease in inflammation, increase in brain health, and an overall decrease in age related conditions. Individuals who suffer from hypertension, diabetes, and high cholesterol may also be able to normalize their blood pressure, cholesterol, and blood glucoses. While some individuals choose to fast because of the promise of weight loss and a healthier lifestyle, religions and cultures, such as Ramadan, when the Islamic culture and Muslim religion incorporate fasting into their lives as a way to grow spiritually. It can be

challenging for individuals to find the time to exercise while having a busy schedule, which can commonly lead them to intermittent fasting as a way of healthy weight loss. Through intermittent fasting, many individuals may be able to begin to form healthier habits, which can lead to a healthier lifestyle with an overall better quality of life.

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