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The Effects of Intermittent Fasting and Fasting-Mimicking Diet on Diabetes and Cardiovascular Diseases

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ABSTRACT

Purpose: *Pre-diabetes, diabetes, and Cardiovascular Disease (CVD) are among the top comorbidities with numerous complications resulting in high morbidity and mortality globally. Diet is one of the aspects that greatly influence the development of diabetes and cardiovascular disease. The purpose of this study is to conduct interventional research to assess the impact of Intermittent Fasting (IF) and Fast-Mimicking Diet (FMD) on Body Mass Index (BMI), Fasting Blood Sugar (FBS), and Total Cholesterol (TC) as factors of diabetes and cardiovascular disease.* ***Method:*** *This interventional study involved 35 participants who were subjected to the interventions of IF and FMD for four weeks. Thirty-one (31) subjects completed the study and were assessed.* ***Results:*** *Twenty participants demonstrated a reduction in their BMI (64.5%) and 6 participants did not show any change accounting for 19.3% (p=0.05). For FBS, 20 participants had reduced fasting blood sugar (64.5%), no change for 8 participants (25.8%) and increased FBS for 5 participants (16.1%) (p=0.05). As regards total cholesterol levels, there was a significant reduction in 54.8% of the participants (n=17) with no change in 25.8% (n=8). Moreover, the total cholesterol increased in six participants (19.4%) after the four weeks (p=0.05).* ***Conclusion:*** *Intermittent fasting and fast-mimicking diet have a significant positive effect on body mass index; fasting blood sugar and total cholesterol thereby improving diabetes and cardiovascular disease.*

Keywords: Intermittent fasting, Fasting-mimicking diet, Time-restricted feeding, Obesity, Cardiovascular disease

INTRODUCTION

Cardiovascular diseases and diabetes are serious health problems globally because of the high morbidity associated with them. The World Health Organization statistics on these conditions show that there are approximately 17.9 million and 1.5 million deaths annually as a result of cardiovascular diseases and diabetes respectively [1,2]. Both diabetes and cardiovascular diseases mostly affect people who are 40 years and above [3]. As age increases, the risk of developing and dying from complications of cardiovascular diseases and diabetes increases [4]. The development of cardiovascular diseases is strongly influenced by certain modifiable and non-modifiable risk factors. Those factors that cannot be altered are age, gender, and the genetic composition of an individual [5]. Modifiable risk factors on the other hand include diabetes, hypertension, hyperlipidemia, alcohol intake, smoking, sedentary lifestyle, and obesity [6]. Treatment of cardiovascular is often started with lifestyle modification as it is shown to significantly improve

outcomes [7]. Other treatments that may be needed depending on the progress and severity are pharmacotherapy and invasive approaches.

The prevalence of diabetes and cardiovascular diseases can drastically be reduced by addressing the risk factors [8]. They include cessation of smoking, exercising, reducing salt intake, eating healthy foods, limiting alcohol intake, and ensuring appropriate body weight [9]. Meals that compromise red meat and sweetened beverages should best be avoided [10]. It should be borne in mind that hypertension accelerates the onset of cardiovascular diseases [11]. A BMI of more than 25 is a significant risk factor for prediabetes as well as overt type II diabetes mellitus [12]. A high BMI translates to a high free fatty acid circulation in the body that eventually increases the resistance of the tissues to the insulin that is produced by the pancreas [13]. Alcohol also causes pancreatitis that significantly affects the function of the pancreas by releasing insulin that aids in glucose control through intracellular transport [14].

There is currently a rise in the incidence and prevalence of overweight and obesity globally [15]. Such an occurrence results in a rise in the burden of prediabetes and CVD. Efforts to address weight gain can therefore be considered as primary prevention of CVD and diabetes in the community. Intermittent fasting is one of the measures that has been initiated to aid in weight control and reduce excess caloric intake. It entails a strict intake of foods within a day or a week [16]. Intermittent fasting diets are of two types: time-restricted feeding and alternate-day fasting [16]. Time-restricted feeding is the one that is more popular with people and can be used in three approaches which include 16/8, 20/4, and 18/6. The 16/8 variant entails 16 hours of fast with an 8-hour feeding window. The alternate-day fasting on the other hand entails fasting for 24 hours and followed by a normal diet for 24 hours. Such a trend is to be followed either twice or thrice a week [17]. There are two commonly used ways of following the alternate-day fasting approach: 4:3 or 5:2 [17]. The 4:3 system means 4 days of caloric restriction with 3 days of regular diet every week. The fasting period in this regard is defined as the consumption of (400-600) kcal per day [18].

A study that compared the fasting and non-fasting approaches observed that the former resulted in cardioprotection by reducing fat tissues and the harmful Low-Density Lipoproteins (LDL) [19]. Studies have also shown that alternate day fasting led to consumption difficulties as a result of increased hunger during the day after a period of fasting. Consumption difficulties eventually affect adherence to the lifestyle of intermittent fasting as a way of controlling weight gain. However, there are more benefits of intermittent fasting than risks. It is therefore worth implementing to prevent overweight and obesity in the community.

The protocol for Time-Restricted Feeding (TRF) varies from one individual or lifestyle to another based on personal preferences. However, the fundamental principle of TRF is limiting intake for at least (6-12) hours [20]. TRF is preferred among those who are physically active because of its benefit of weight reduction with subsequent maintenance of muscle mass. It is thus the recommended approach for sportspeople such as athletes who desire to have a specific body mass for a certain type of sporting activity [20]. Moro, et al. experimented on 34 individuals who were well trained in resistance. They were randomly placed in either the TRF or normal diet groups. The group under investigation was subjected to the intake of 100% energy needs during an 8-hour eating window that was divided into three-time schedules-1300 h, 1600 h, and 2000 h. The control group that was subjected to normal diets had their intakes of 100% energy needs at 0800 h, 1300 h, and 2000 h. The results of the two groups were compared after two months and showed that the interventional group demonstrated decreased fat mass with no change for the same parameter in the control group. Moreover, the muscle area of the arm and thing remained the same for those who were subjected to TRF as well as those on a normal diet [20].

Compared to the traditional intermittent fasting approach, time-restricted feeding is often practiced daily and it does not require prescribed restrictions. Moreover, periods of fasting can be planned at any time hence can help to avoid eating at night which can eventually enable them to follow a circadian rhythm. The current time-restricted feeding can be seen as a flexible method that falls under the control of the user. Such flexibility may encourage modification as long as the principle of the fasting method is kept at all times with a focus on the objective of applying the time-restricted feeding to one's lifestyle. Whenever possible, it is paramount to maintain consistency of time-restricted feeding to realize good results as discussed in this paper above.

Fasting Mimicking Diet (FMD) was pioneered by Dr Longo to promote compliance with intermittent fasting [21]. The FMD, therefore, replaced simple fasting and encouraged people to adopt it in their lifestyles due to its simplicity and effectiveness. An experimental study on the effect of FMD administration for mice four days bimonthly revealed a

reduction in visceral fat and extended longevity [22]. Inflammatory biomarkers that play a part in the onset of diabetes mellitus are also significantly reduced with the adoption of FMD. A study has further affirmed that FMD which is characterized by low sugars, calories, and proteins but high in unsaturated fat had a significant positive impact on fasting blood sugar, blood pressure, and weight [23]. Cheng, et al., made an interesting observation in their study that showed that FMD promotes the generation of pancreatic B-cells with subsequent restoration of insulin secretion [24]. Such a finding forms the basis of using FMD to prevent type II diabetes as well as for effective glucose control in diabetic individuals.

Objectives

In this study, the research team conducted interventional research to assess the effects of IF and FMD on diabetes and CVD. The parameters that have been taken into consideration are body mass index, fasting blood sugar, and total cholesterol as they are key factors in diabetes and CVD.

MATERIALS AND METHODS

A total of 35-prediabetic participants with at least one CVD risk factor (high BP, high cholesterol, or obesity) were given a VLCD balanced regimen and instructed to practice Intermittent Fasting (IF) for 14 hours daily for four weeks. During IF, a participant can drink water, coffee, and tea. While during the feeding window (10 hours), he/she can consume VLCD of 800-kilo calories. Very Low-Calorie Diet VLCD; is a healthy meal replacement that has been proven clinically in numerous medical studies. Thirty (30) packages of VLCD were given to participants once they agreed and meet inclusion criteria.

Inclusion and Exclusion Criteria

Diabetic adults (aged 20 to 65) who have at least one risk factor of CVD factors (high BP, high cholesterol, or obesity) were eligible to participate in this study.

Participants older than 65 or under 20 years or who have medical conditions, such as the presence of ischemic heart disease or heart failure, chronic inflammatory disorders, moderate to severe renal disease, or uncontrolled hypertension, were excluded from participation.

Blood sugar for each participant (fasting blood sugar) was measured once weekly. Moreover, CVD risk factors (Total Cholesterol) were measured before and after participation to find any differences or effectiveness of the interventions.

RESULTS

The table below provides the findings after four weeks of using the intervention of intermittent fasting and a fast-mimicking diet (Table 1). The parameters that were measured were Body Mass Index (BMI), Fasting Blood Sugar (FBS), and Total Cholesterol (TC) levels. Initially, 35 participants were recruited for the study but only 31 managed to adopt the intervention up to the end of the study.

Table 1 Showing parameters of BMI, total cholesterol, and fasting blood sugar measured during intermittent fasting and fasting-mimicking

NO.	BEFORE			AFTER		
	BMI	Fasting blood sugar	Total cholesterol	BMI	Fasting blood sugar	Total cholesterol
1	35	7	250	30	6.7	239
2	37	7.2	290	35	7	250
3	42	6.4	270	41	6.7	270
4	30	7	260	30	7	260
5	40	8.1	290	35	7	250
6	37	7.5	249	35	7.1	240
7	45	9.1	265	40	7	245
8	41	8.5	300	35	7.6	280
9	39	8.6	305	37	8	300
10	42	8.9	310	42	8.9	315

11	40	7.5	300	40	7.6	310
12	37	6.9	270	36	6.7	265
13	42	8.9	310	42	8.9	315
14	40	7.5	300	40	7.6	310
15	42	6.4	270	41	6.7	270
16	30	6.4	253	30	6.4	250
17	32	7	290	32	6.7	300
18	35	8.1	250	30	6.7	239
19	41	8.5	300	36	7.6	280
20	44	7.5	300	40	7.6	310
21	30	7	260	30	7	260
22	33	7.2	270	33	7	270
23	39	8.6	305	37	8	300
24	45	9.1	265	40	7	245
25	37	7.5	249	35	7.1	240
26	33	7.3	256	33	6.9	250
27	42	6.9	270	41	6.7	270
28	45	11	310	44	9	310
29	37	6.9	270	36	6.7	265
30	30	7	260	30	7	260
31	36	8	290	35	7.8	300

Twenty participants demonstrated a reduction in their BMI accounting for 64.5%. Six (6) of them did not show any change in BMI which translates to 19.3% (p=0.05). For the case of fasting blood sugar, three outcomes were noted, 20 participants had reduced fasting blood sugar (64.5%) whereas it did not change for 8 of the participants (25.8%). However, it was noted that the fasting blood sugar of 5 participants (16.1%) increased after four weeks of the intervention (p=0.05). As regards total cholesterol levels, there was a significant reduction in 54.8% of the participants (n=17) with no change in 25.8% (n=8). Moreover, the total cholesterol increased in six participants (19.4%) after the four weeks (p=0.05).

DISCUSSION

Intermittent fasting and fast-mimicking diet aid in lipolysis that eventually results in loss of excess fats with subsequent reduction in the body mass index [16]. Several other factors may affect the effect of IF and FMD on body fat such as an individual's specific diet. The use of the interventions above with unhealthy foods may not produce the expected results [25]. It should be noted that in the above results, there is a lack of close and strict monitoring of the participants' diet components. Therefore, the observation of no change in the BMI for some participants should be interpreted with this information in the back of the mind.

Changes in the fasting blood sugar levels are influenced by the timing of feeding, amount of the feeds, and insulin levels [26]. For this reason, accurate comparison requires monitoring such parameters for all the participants. IF and FMD results in controlled caloric intake hence lowering the blood sugar levels. In uncontrolled diabetes, the best outcome is realized with the use of both anti-diabetic agents and the interventions being investigated herein [26]. Intermittent fasting and a fast-mimicking diet do not result in a significantly good outcome for individuals with existing poorly controlled sugars [27].

Total cholesterol includes triglycerides, High-Density Lipoprotein (HDL), and Low-Density Lipoprotein (LDL). An individual's diet is the main source of total body cholesterol. Intake of too much-saturated fat or transfats is the major cause of high total cholesterol in the body. Intermittent fasting and a fast-mimicking diet enable the body to utilize the excess fats to release the required energy, resulting in a reduction in the total cholesterol levels in the body [28]. The positive effect of IF and FMD on blood pressure is the consequence of reduced body cholesterol hence lowering peripheral vascular resistance.

CONCLUSION

IF and IFD helps to prevent numerous risk factors that are implicated in diabetes and cardiovascular diseases as well as preventing hypertension. Fasting affects the biochemical changes of lipids thereby decreasing body mass index and body fats. Bad cholesterol such as LDL and triglycerides are eventually lowered. The IF diet acts by increasing the BDNF factor that eventually lowers both the systolic and diastolic blood pressures via the activation of the inhibitory autonomic system. However, the impact of IF and FMD lies in their effectiveness in weight reduction. Both IF and FMD are currently becoming increasingly popular and regarded as effective non-pharmacological treatments for lifestyle diseases.

DECLARATIONS

Conflict of Interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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