Effects of Moderate Intensity Continuous Training on Fasting Blood Sugar Level on Type II Diabetes Mellitus of Outpatient Individual In Case of Entoto Number Two Health Center in Addis Ababa Ethiopia

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The purpose of this study was to investigate the effects of moderate intensity continuous training on fasting blood sugar level on type II diabetes mellitus of outpatient individual in case of Entoto number two health center in Addis Ababa Ethiopia. The methodology of the study was employed experimental research design. Thirty (20 male and 10 female DM patients) middle age participants in the study were selected in Entoto No2 Health Center. The study subjects were randomly divided into two equal groups, such as the EG (n = 15) and CG (n = 15). The EG had taken MICT for 8 weeks with 3 sessions per week, each lasting 30 to 60 minutes. It consists basic Aerobic exercise of MICT (walking, machine exercise, aerobic dance). Pre-and-post medical examination were administered for all participants; the fasting blood sugar was measured by glucometer, The data collected from the study subjects was analyzed using SPSS version 26 software by descriptive statistics, paired t-test and independent t test at significant level of 0.05. Cohen-d>0.5 was employed to summarize health status. Result showed MICT significantly improved fasting blood sugar, p<0.05. Based on this finding, it can be concluded that MICT significantly affect blood sugar level, Therefore, MICT is suggested to middle age diabetic mellitus patients for improving health related status.

Background of the study

Diabetes defined as a group of chronic diseases characterized by hyperglycemia (Wake, 2020). It is a serious, chronic disease that occurs either when the pancreas does not generate enough insulin (a hormone that regulates blood glucose), or when the body cannot effectively use the insulin, it make.(World Health Organization, 2016). The prevalence of diabetes mellitus has reached dangerous pandemic proportions, raising worldwide health concerns. According to a report released in 2013 by the international diabetes federation (IDF), the prevalence of diabetes in adults (20-79 years old) around the world was 8.3% (382 million people), with 14 million more men than women (198 million men vs 184 million women), and the majority between the ages of 40 and 59 years (Kharroubi, 2015). Globally, approximately 50% of diabetes

cases are undiagnosed, with the majority of these occurring in low-income and middle-income countries.

In sub-Saharan Africa, Ethiopia is one of the top five nations with the highest prevalence of DM (diabetes mellitus) patients (Tadesse & Endazenew, 2020). While urgent interventions are required to optimize glycemic control should be taken account of lifestyle, clinical and treatment-related factors(Lubaki & Francis, 2022).Ethiopia is one of the low-income countries affected by the trend of sharp increase in the number of population with DM, where the prevalence of diabetes was reported to be 5.2%(Zeleke Negera & Charles Epiphanio, 2020)

More than 90% of cases of diabetes are T2DM (Diabetes Care (2014) 37:1 (S14-S80)),” 2014). leading a sedentary lifestyle is one of the factors that contribute to T2DM (IDF, 2017), physical activity is a method of life style modification that is also a sound pillar for managing the condition. It can lower blood sugar, prevent obesity by burning calories so that blood sugar will be used as the energy source, and decrease blood sugar (Damayanti, 2018).According to health recommendations, aerobic exercise training can lower the risk of developing chronic conditions like DM as well as early death (Ross et al., 2016). Exercise intensity is crucial for managing T2DM and may have a significant impact on glycemic control (Magkos et al., 2020). Currently, two popular forms of aerobic exercise are moderate intensity continuous training (MICT) and high intensity interval training (HIIT). intensity may produce different acute and chronic effects in reduction of blood glucose among T2DM patients (Ruslan et al., 2022)

According to recommendations, people with T2DM should engage in at least 150 minutes per week of moderate-intensity aerobic activity (Young-Hyman et al., 2016). therefore, the objective of the present study is to investigate the effect of moderate intensity continues training on fasting blood glucose level in type II diabetics mellitus of outpatient individual in case of Entoto number 2 health center in Addis Ababa Ethiopia.

Statement of the Problem

The Randomized controlled trials from all around the world have proven, in principle, that altering one's lifestyle and engaging in physical exercise can postpone or stop the onset of T2DM (IDF, 2017). There is a limitation of literature that can be used to conduct exercise-based research in order to prescribe intensity, in Ethiopian

context(Wake, 2020). The optimal exercise that will result in greater benefit in T2DM remains unclear(Ruslan et al., 2022). Moreover, the results of effects of MICT are inconsistent and inconclusive(Su et al., 2019) and Studies on moderate intensity continuous training alone still limited Based on those many contradictions and the inconsistency across the results training methods further supporting research are needed (A. M. Ahmad, 2019).Researches (Savikj & Zierath, 2020), (Wake, 2020) (Zeleke Negera & Charles Epiphanio, 2020) have recommended Studies should be conducted about type of physical activity, duration, intensity, and the interaction factors on type 2 diabetics. And also, other researcher should be studying some selected physical activities that can reduce blood sugar levels in people with DM, such as 30 minutes walking or cycling routine every day. Also, people with DM can increase their exercise time-spent more than 30 minutes and exercise 3-4 times a week(Faswita et al., 2021). There are different studies that have been conducted about MICT protocol in the world. But when it comes to Ethiopian context, when the researcher tries to dig out the repositories of universities in the country, there were lack of research conducted about MICT protocol. based on this, the research was designing a well-planned moderate intensity continuous training program for diabetic outpatient in order to investigate the effect of MICT protocol on fasting blood sugar, variable among in Entoto number 2 health center in Addis Ababa city to fulfill the recommended gaps

LITURATUR REVIEW

Type II Diabetes (T2DM)

Type 2 diabetes **is also called insulin resistance** it is impairment in the way the body regulates and uses sugar (glucose) as a fuel. This long-term (chronic) condition results in too much sugar circulating in the bloodstream. Ultimately, high blood sugar levels can lead to disorders of the circulatory, nervous and immune systems. over 90% of diabetes mellitus cases are T2DM, a condition marked by deficient insulin secretion by pancreatic islet β-cells, tissue insulin resistance (IR) and an inadequate compensatory insulin secretory response(Galicia-Garcia et al., 2020).

T2DM accounts for between 90% and 95% of diabetes, with highest proportions in low- and middle-income countries. It is a common and serious global health problem that has evolved in association with rapid cultural, economic and social changes, ageing

populations, increasing and unplanned urbanization, dietary changes such as increased feeding of highly processed foods and sugar sweetened beverages, obesity, reduced physical activity, unhealthy lifestyle and behavioral patterns, fetal malnutrition, and increasing fetal exposure to hyperglycemia during pregnancy(Kazi & Blonde, 2019). Patients with T2DM are mostly characterized by being obese or having a higher body fat percentage, distributed predominantly in the abdominal region. According to the International Diabetes Federation (IDF), in 2019, diabetes caused 4.2 million deaths; and 463 million adults aged between 20 and 79 years old were living with diabetes, a number that will likely rise up to 700 million by 2045. Diabetes was the underlying cause of at least 720 billion USD in health expenditure in 2019..

Physical Activity and Diabetes

Once a person has diabetes mellitus being active makes the body more sensitive **to** insulin (the hormone that allows cells in your body to use blood sugar for energy), which helps manage the diabetes. A sedentary lifestyle is well-known as one of the major reasons for the rising epidemic of type 2 diabetes mellitus besides the other reasons such as adopting energy-dense diets relative to the actual need for energy and population aging(Sigal et al., 2018).

Physical activity also helps control blood sugar levels and lowers the risk of heart disease and nerve damage. It is central to the management of T2DM to help achieve and maintain therapeutic goals and improve quality of life (Balducci, et al., 2014). Physical activity can help people with diabetes achieve a variety of goals, including increased cardiorespiratory fitness, improved glycemic control, decreased insulin resistance, improved lipid profile, blood pressure (BP) reduction and maintenance of weight loss(Sigal et al., 2018).

Moderate intensity continuous training (MICT)

Currently, moderate intensity continuous training (MICT) and high intensity interval training (HIIT) are a well-known method of aerobic exercise. Aerobic exercise intensity may produce different acute and chronic effects in reduction of blood glucose among Type 2 diabetes mellitus (T2DM) patients (Ruslan et al., 2022). Previously, the use of moderate-intensity continuous training (MICT) has generally been considered the most beneficial exercise treatment modality for the prevention/management of metabolic type disease. More recently, however, high-

intensity interval training (HIIT) has emerged into the clinical setting as a potential alternative to traditional MICT in the management of such diseases, but the comparative effects are not well understood(Pearson, 2015).

The optimal exercise that will result in greater benefit in T2DM remains unclear. Despite the several published studies about the benefits of HIIT in patients with T2DM, very few have analyzed its acute efficacy on glycemic control and cardiovascular responses in this population and in direct comparison with MICT. Different exercise intensity may have different acute effects on cardiovascular responses and glycemic control(Ruslan et al., 2022). Several recent meta-analysis studies have investigated the benefits of HIIT versus MICT in patients with type 2 diabetes (Jelleyman et al., 2015),(Fabiana Meijon Fadul, 2019) compared to HIIT conveys benefits to cardiometabolic health which in the cases of insulin resistance superior to the effect of traditional continuous training. Based on that inconsistency across the results subsequent trials and further supporting research are needed in this field in an attempt to resolve the controversy about the best type of aerobic exercises which delivers the greatest glycemic benefits(A. M. Ahmad, 2019).

High-intensity interval training (HIIT) compared to Moderate-intensity continuous training (MICT) reduced the fast blood glucose and insulin levels and increased the insulin sensitivity in patients with type 2 diabetes Nonetheless, it is still not clear whether high intensity interval exercise (HIIE) has an advantage over traditionally used moderate intensity continuous exercise (MICE) in controlling blood glucose of individuals with T2D(Terada, 2014). In general, there are many contradictions in the results of the training methods, and, on the one hand, the mechanism of the useful effects of these training methods on the subject of the present study is not well understood and also the result is inconsistency.

Fasting Blood glucose

Fasting blood sugar is a simple, common blood test to screen for diabetes, prediabetes, or gestational diabetes it is also called a fasting blood glucose test.

Fasting blood sugar test. A blood sample is taken after an overnight fast. Results are interpreted as follows:

- Less than 100 mg/dL (5.6 mmol/L) is normal.

- 100 to 125 mg/dL (5.6 to 6.9 mmol/L) is diagnosed as prediabetes.
- 126 mg/dL (7 mmol/L) or higher on two separate tests is diagnosed as diabetes.

In addition to its long-term positive effects on body mass and many cardiovascular risk factors, exercise benefits individuals with T2D by acutely lowering blood glucose concentration.

MATERIAL AND METHOD

Study population

The target population of this study was individuals who have T2DM out patients who were follow up medical care in Entoto number 2 health center. according to Entoto number 2 health center Data Base They were around 150 T2DM out patients in 2015 E.C. Therefor the Total population of the study was 150.

Sample size and sampling techniques

From 150 total populations 30 participants was selected as a sample based on inclusion criteria. Simple random sampling was used to assign experimental and control group by using lottery method. Therefore, among the selected patients, half of them (15) were experimental group and the remaining (15) were categorized in controlled group.

Test for fasting blood glucose

Glucometer

The objective of this test is to measure the sugar level in the blood stream from diabetic patient. Portable glucose analyzers or glucometers are recommended by the American Diabetes Association (ADA) for self-monitoring at home, in the field, or in clinical settings(Salacinski et al., 2014).

The level of glucose in the blood can be measured by applying a drop of blood to a chemically treated, disposable ‘test-strip’, which is then inserted into an electronic blood glucose meter. The reaction between the test strip and the blood is detected by the meter and displayed in units of mg/dL or mmol/L(Pickering & Marsden, 2014).

The objective of the glucometer is a blood sugar test can be used to determine the amount of glucose in the blood. It may be used to diagnose diabetes or to help those with diabetes check their blood sugar and insulin levels. To undertake this test will require; - Blood glucose monitor, Test strips (check that they are in date and have not been exposed to the air), Alcohol swab, Single-use safety lancets or lancing device, Gloves,

Cotton wool/gauze, Sharps box, Control solution for calibration.

Methods of Data analysis

The data that was collect through medical tests were analyzed and interpreted in to a meaningful idea using computer. To report the pre-test and post-test measurement results of the variable fasting blood sugar. descriptive statistics like means and standard deviation were used to describe the demographic characteristics of participants.

As well as, paired samples statistical t-test was used to compare the difference of pre-test and post-test for control and experimental groups and independent t test to compare the mean value of the experimental and control groups. All data analyses were performed with in computer system using statistical package for social science (SPSS), version 26. P-values for statistical significance was set at $p \leq 0.05$; while a Cohen-d>0.5 were consider of practical significance. Their changes were observed in their moderate intensity continuous training by calculating measures of central tendency like mean and calculating measures of dispersion like standard deviation.

Data Analysis on Fasting Blood Sugar

Table 1 Descriptive statistics for FBS

Variable	Group	Pretest (n=15)	Posttest(n=15)
		Mean ± SD	Mean ± SD
FBS	Experimental group	174.0000 ± 20.32240	158.6667± 19.415
	Control group	167.4000± 19.85591	174.0000± 18.999

To indicate the table 4.2 showed that the supplementary statistical information of the pretest and posttest of experimental group and control group of MICT on FBS. It indicated that, mean, standard deviation of fasting blood sugar of the pretest and posttest of the experimental and control group.

From the table 4.2 has been observed that the mean values and standard deviation of pre and post-test results of EG fasting blood sugar test were M =174.00, SD = 20.32240, M= 158.6667, and SD = 19.41526 respectively. It implies mean result of fasting blood sugar is lower for posttest compared to pretest. It implies that after MICT exposure, experimental group participants have significant reduction on their sugar level (pre-test m= 174.0 and post-test m = 158.67). However, the mean and standard deviation of

the pretest and posttest of CG were M=167.4000, SD=19.85591, M=174.4000 and SD=18.999 respectively. This implies that sugar levels of participants in CG are slightly increase on post-test FBS measures.

Table 2 paired t test for FBS

The hypothesis (H1) of the paired Samples t-test was:

H1; Moderate intensity continues training has a significant effect on fasting blood sugar.

Variable	Group	MD	SD	95% Confidence Interval of the Difference		T	p-value
				Lower	upper		
FBS	E. G	15.33	20.359	4.05842	26.6082	2.917	0.011
	C.G	7.000	16.36	16.06	2.06	.524	.120

P< 0.05

To indicate the table 4.3 showed that the supplementary statistical information of the pretest and posttest of experimental group and control group. It indicated that, the mean difference, standard deviation of FBS variable of the pretest and posttest of the experimental and control group. And also, it implies whether this change/ difference was statistically significant or not and the effect size or magnitude of the training.

According to the result presented in the table 4.3 the mean difference and standard deviation of FBS for E.G were MD=15.33 and SD=20.359 and C.G was MD=7.000 and SD=16.36. The significance values (P-value) of the experimental group were p=0.011. So, the independent variable (moderate intensity continuous training) has significant effect over the dependent variable (FBS) since, (p<0.05). Beside CG the p values were .120 this implies it shows has no significant different was observed since, p> 0.05.

	Levene's Test for Equality of Variances		t-test for Equality of Means			95% Confidence Interval of the Difference		Cohens'd
Variables	F	Sig.	T	Sig. (2-	MD	Lower	Upper	
FBS	.016	.902	2.243	.033	15.733	30.10067	1.3659	1.12

Table 3: Independent Samples t- test for FBS

The hypothesis (H1) of the Independent Samples t-test is:

H1: The variances of the two groups are significantly different in fasting blood sugar.

To indicate the table 4.4 showed that the levenve t test from the supplementary statistical information of the mean score of two independent groups the post result of (experimental group and control group). Levene‘s Test is used to check the assumption of equal variance between the two groups (EG and CG) after intervention and the effect size or magnitude of the treatment.

The results of Levine‘s Test for Equality of Variances from table 4.4 showed that there is unequal variance between EG and CG in FBS variables during the test. the p-value of Levine‘s assumption of equal variance is 0.033 during fasting blood sugar. since, ($p < 0.05$). Therefore, the variances of the two groups are significantly different in the total population. That means the mean score of the two groups have different value. hence the mean score of EG post test result during fasting blood sugar test it become lower this mean the participate was performed better sugar control after they taken MICT intervention when it compares to CG. So, the alternative hypothesis is accepted. The cohens’d showed that moderate intensity continuous training has a large effect size on fasting blood sugar. since $d> 0.8$.

Discussion

The purpose of this study is to investigate the effect of moderate intensity continues training on type II diabetic mellitus outpatients- individuals in case of Entoto No.2 Health Center, Addis Ababa. Based on the finding of the study, taking part in MICT regularly has significant effects on FBG, Therefore, in this section, the researcher discussed findings and results that were presented in the above portion in line with the pre described research hypotheses.

The major findings in this study are: (a) MICT has a significant effect on FBS ($p< 0.05$), These observations provided a significance effect of MICT on FBS,

The effect of MICT on FBS

The result on this study found that MICT has a significant effect on FBS ($p< 0.05$). With no improvement in the control group. The participated MICT trained DM patients show better control of sugar level has a large effect size during fasting blood sugar test.

Similarly, to these results, supported by Ahmad M. (2019) concluded that MICT showed statistically significant ($P<0.05$) reductions in FBS compared to baseline values (A. M. Ahmad, 2019). As well as, De Nardi and his collogues have concluded that

the MICT improved blood glucose (De Nardi et al., 2018). In addition, several studies reported that MICT have induced reductions in blood glucose in patients with type 2 diabetes (Hollekim-Strand et al., 2014; Karstoft et al., 2014) And also, this result supported by robinson and his friends (2023) have concluded that MICT did appear superior for reducing fasting plasma glucose(Robinson et al., 2023). This result also consistent with mitranum et al,(2014) concluded that Moderate intensity continuous training exercise groups reduced fasting blood glucose concentration and insulin resistance.(Mitranun et al., 2014).

This result also supported by Aggarwala and his friends(2016) concluded that duration of 4 weeks aerobic exercise on Type II diabetic subjects to improve their glycemic control and lipid profiles.(Aggarwala et al., 2016)

Contradictory to the findings of this study regarding to fasting blood sugar liubaoerjijin and his friends (2016) conclude that no difference in MICT showed statical significant on fasting glucose level and HbA1c in a group of patients with T2D(Liubaoerjijin et al., 2016). And also other study concluded that Fasting plasma glucagon levels did not differ between the intervention days (P > .05 for all(Karstoft et al., 2014).

CONCLUSION

Based on the result the following conclusions were enumerated: In the present study, there was significance difference between experimental and control group. The intervention of 8 weeks MICT has significant effect on the variables, of fasting blood Sugar (FBS), So, the researcher can conclude that MICT has significance effect over FBS MICT has large effect size during FBS. Therefore, MICT is suggested to T2DM middle age diabetes patients' individuals to improve the health status.

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