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Research Article

Cardiovascular Risk in Correlation with Physical Activity Level and Body Mass Index among Adults with Type 2 Diabetes Mellitus in Ethiopia

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ABSTRACT

Background: Physical inactivity has major negative health consequences throughout the lifespan and physical exercise is an important component of a comprehensive approach to chronic disease prevention and health promotion. Yet, many patients with type two Diabetes Mellitus are often overweight or obese and do not achieve recommended levels of physical activity.

Objective: To assess cardiovascular risk in correlation with physical activity level and body mass index among type 2 diabetic patients in some selected hospitals in Ethiopia.

Methods: Institution based cross-sectional study was conducted in Six Diabetes Clinics in major hospitals in Ethiopia. Sample size was determined using single population proportion formula. Questionnaire was used for assessment of demographic information and medical record review was also done. Anthropometric, blood pressure, and blood sugar measurements were undertaken. SPSS version 20.0 was used for statistical analysis.

Results: A total of 415 (98.3%) of Type two Diabetes Mellitus patients responded to the questionnaire among whom 232 (55.9%) were men, while 183 (44.1%) were women. The age of the respondents ranged from 25 to 86 years with mean age and standard deviation of 48.88 + 11.29 year. The average estimate of total weekly physical activity was 25.39(SD=+0.117) MET. There were significant differences in the total Cholesterol F (3, 411)=6.956, P=.000, Triglycerides f (3)=67.353, P=.000, HDL F (3)=102.223, P=.000, LDL F (3)=89.081, P=.000, Systolic Blood Pressure F (3)=32.515, P=.000, and HbA1c F (3)=969, P=.000, between underweight, normal weight, overweight and obese participants.

Conclusion: Majority of the Type two Diabetes Mellitus patients did not engage in regular physical activity. Both risk factors (physical inactivity and dyslipidemia) were highly prevalent in Type two Diabetes Mellitus patients in Ethiopia. Therefore, their risk of developing CVDs is very high.

Key words:

Cardiovascular risk; Physical activity; BMI; DM; Ethiopia

Abbreviations:

ADA: American Diabetes Association; BMI: Body Mass Index; CAD: Coronary Arterial Disease; CVD: Cardiovascular Diseases; HbA1c: Hemoglobin A1C; HDL: High Density Lipoprotein; LDL: Low Density Lipoprotein; NHMS: National Health and Morbidity Survey; PA: Physical Activity; T2DM: Type 2 Diabetes Mellitus; TC: Total Cholesterol; TG: Triglyceride; WHO: World Health Organization

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Introduction

Over the past half-century scientific data have continued to accumulate indicating that physical inactivity has major negative health consequences throughout the lifespan and is an important component of a comprehensive approach to chronic disease prevention and health promotion [1]. The low prevalence of physical activity in the US population, the population attributable risk for major causes of death and disability, such as heart disease and diabetes, is quite high and appears comparable to other well-established risk predictors [2-4].

People with type 2 diabetes mellitus have a greater incidence of cardiovascular disease; hyperglycemia accounts for part but not all of the increased risk [5, 6]. Cardiovascular diseases (CVD) are the most prevalent complication of diabetes mellitus. It is estimated that 77% of hospitalizations in the United States for chronic complications of diabetes are attributable to CVD [7]. Cardiovascular complications cause the majority of diabetes-related deaths [8]. The risk of diabetics for cardiovascular events is equivalent to that of non-diabetic patients who have established cardiovascular disease [9].

Atherosclerotic coronary artery disease (CAD) and other forms of cardiovascular disease (CVD) are the major causes of mortality in type 2 diabetes mellitus (Type 2 DM), and are major contributors to morbidity and depreciation in quality of life. Risks of incidence from CAD or fatal CAD are two- to fourfold higher in people with DM than in those without [10-17]. The lifetime risk for CVD in people with diabetes is high, about 67% in men and 57% in women at age 50 years. In a meta-analysis of 37 prospective cohort studies of fatal coronary heart disease among a total of 447 064 people, the rate of fatal coronary heart disease was about 3.5-fold higher in patients with diabetes than in those without [18].

Many patients with Type 2 DM, often overweight or obese and with other comorbidities, do not achieve recommended levels of physical activity (PA), i.e., at least 30 minutes of moderate PA five times a week [19]. But American Diabetes Association (ADA) recommends that all adults, and particularly those with type 2 diabetes, should decrease the amount of time spent in daily sedentary behaviour [20]. Poor perception of patients and their physicians towards physical activity is one of the major barriers of diabetic management [21].

Therefore, the purpose of this study was to assess cardiovascular risk in correlation with physical activity level and body mass index (BMI) among Type 2 diabetic patients in some selected hospitals in Ethiopia.

Patients and Methods

Study Design, area, population and period

This is an institution based cross sectional study. Six diabetic Clinics in Major hospitals in Ethiopia were randomly selected. Type 2 DM patients that were enrolled in Adama specialized medical hospital, Felege Hiwot specialized hospital, Hawassa University hospital, Maychew specialized hospital, Tikur Anbessa specialized hospital and Yekatit 12 specialized hospital were recruited into the study. Data were collected from October 1, 2018 to March 30, 2019.

Inclusion and exclusion criteria

All adult patients with a diagnosis of Type 2 diabetes and no previous history of CVD were included in the study. However, Type 2 diabetic adult patients who had prior history of cardiovascular disease were excluded.

Sample size determination

The sample size was calculated using single population proportion formula as indicated by Daniel (1999) by assuming the knowledge level of 50%; 95% CI and 5% margin of error. Based on this we got 389 sample size. An additional 10% was added to the sample size as a contingency to increase power. Hence, the total sample became 422 [22].

Instrument and method of data collection

Physical Activity Level Assessment Questionnaire: This is a 2-item scale tool used to measure the participants' current physical activity level [23]. Participants were asked to estimate weekly participation in strenuous, moderate, and mild activity. Participants also rate the frequency of routine exercise behaviors (e.g. often, sometimes, and never/rarely). Weekly frequencies of strenuous, moderate, and mild activities were multiplied by nine, five, and three METS, respectively. Total weekly physical activity was calculated by summing the products of the separate components. The second questionnaire item was used to calculate the frequency of responses to the question regarding the frequency of weekly leisure-time activity "long enough to work up a sweat". Based on frequency of participation in a week, participants were classified in to regular exercise group and non- regular exercise group. Regular exerciser group–embrace those who participate in physical activity three or more times per week, at least for 20 minutes each session that makes them sweat or breathe hard (e.g. often and sometimes). Non- regular exerciser group–includes participants who reported physical activity two or less times per week, at least 20 minutes each session that makes them sweat or breathe hard (e.g. never/rarely).

Conversation on Health Related Factors of Cardiovascular Disease Assessment Questionnaire: Participants were asked to indicate if their physician discussed their risk of developing CVD, risk-reducing behavioral change, and exercise recommendations during the time of clinical visit [24].

Attitudes to Physical Exercise Assessment Questionnaire: Adapted from Rhodes and Courneya (2003), individual attitudes regarding regular exercise was measured using four 7-point bipolar adjective scales. Attitude scales were reversely scored, in such a way that higher scores indicate higher levels of positive attitudes regarding exercising regularly. Regular exercise was defined as activities performed at a moderate intensity three or more times per week for at least 30 minutes each time [25].

Medical Record Review Form: This form was used to assess information about patient diabetic conditions. Medical record data was collected from their secondary data during the patient interview date. Information gathered included: type of diabetes, date of diabetes onset, records of HbA1C, prescribed medications and complications.

Equipment and procedure of measurements

Blood Pressure Measurement: Resting blood pressure was measured using mercury sphygmomanometers. Following WHO recommendations, blood pressure was measured with the subject in a seating position after waiting in a quiet room for at least five minutes with legs uncrossed. Depending on the size of the subject's right upper arm, one of two mercury sphygmomanometers with different size cuffs were used to take three readings for blood pressure, measured to the

nearest 2mmHg, at intervals of one minute each. An average of three readings was later used for the analysis [26].

Lipid Profile Evaluation: After a twelve hour fasting, venous blood was withdrawn from the median cubital vein in the antecubital fossa for each participant, and used for lipid profile assay. Blood was stored in deep freezer at 4 degree centigrade until it is analyzed. Laboratory samples were analyzed using fully automated biochemistry analyzers by the direct end point enzymatic method [27, 28]. The blood lipid measurements r included High Density Lipoprotein Cholesterol (HDLC), Low Density Lipoprotein Cholesterol (HDL-C), Total Cholesterol (TC), and Triglycerides Cholesterol (TG-C).

Anthropometry measurements

Body Weight and Height Measurement: Height was measured using a wall-mounted stadiometer to the nearest 0.1 cm. Body weight was measured using a digital calibrated scale to the nearest 0.1 kg. Body weight and height were used to calculate body mass index (BMI). The equation BMI=weight (kg)/height (m^2) was used [26].

Data processing and analysis

Data was checked for consistency, cleaned and coded and entered in to Epi-Data version 3.1 and were exported to SPSS version 20. Continuous variables were expressed as mean and standard deviation while, categorical variables were expressed as frequencies and percentage. Independent sample t-test and one way ANOVA test were used to assess the statistical significance of the mean difference between two and more than two categories respectively. A significance level of $p<0.05$ was used in all tests

Ethical issues

Ethical clearance for the study was obtained from the Institutional Review Board of College of Health and Medical Sciences, Jimma University under reference no: FPU15-05635 and FPU16-04141. Written permissions were obtained from the directors of each hospital. Informed written consents were obtained from the participants and their physicians and data collection were done confidentially.

Results

Socio-Demography of the Type 2 DM patients

A total of 422 Type two Diabetes Mellitus patients were included into this study. Only 415 (98.3%) of Type 2 DM patients responded to the questionnaire among whom 232 (55.9%) were men while 183 (44.1%) were women. The age of the respondents ranged from 25 to 86 years with mean age and standard deviation of 48.88 + 11.29 year. Regarding to BMI of study subjects; 175 (42.2%) of the study participants were obese; 169 (40.7%) were overweight; 47(11.3%) had normal weight and the remaining 24 (5.8%) participants were underweight. Current cigarette smokers were 298 (71.8%).

Regarding distribution of diabetes treatment, 175(42.2%) participants had been taking combination treatment (Pills and insulin), 95(22.9%) participants on oral agent (Pills) treatment, 110(26.5%) of participants had been taking insulin treatment, and 35(8.4%) of participants had been taking diet alone (Table 1).

Current physical activity level and attitudes to regular physical activity

According to the findings of this study, about 263 (63.4%) of the patients were not involved in regular physical activity. Mean distributions of each physical activity level scores are shown in Table 2. As defined by Godin and Shepard (1985)23, total physical activity was measured using arbitrary units, such that an average total weekly activity score was derived by summing the reported weekly frequency of participation at each of three intensity levels multiplied by the corresponding anticipated MET value (9, 5, or 3 METS). The average estimate of total weekly physical activity was 25.39 (SD=0.117) MET.

Majority of the T2DM patient participants 263(63.4%) did not (never) engage in regular physical activity long enough to work up a sweat (i.e., heart beats rapidly) during a 7-day period, 89 (21.4%) of the diabetic patient participate in regular physical activity sometimes during a 7-day period and the remaining 63(15.2%) diabetic patient engaged always in regular physical activity long enough to work up a sweat (i.e., heart beats rapidly) during a 7-day period. The mean of attitudes to regular physical activity of T2DM patients was 3.97 (SD=.435) (Table 2).

CVD risk factors versus body mass index category

One-way ANOVA were conducted to examine the differences between BMI groups in relation to one another on CVD risk factors. As can be seen from the Table 3, there were significant differences in the total Cholesterol F(3) = 6.956, P=.000, Triglycerides F (3)=67.353, P =.000, HDL f (3)=102.223, P =.000, LDL f (3)=89.081, P=.000, Systolic Blood Pressure f (3)=32.515, P=.000, HbA1c f (3)=.969, P=.000, and Number of Complications f (3)=286.155, P=.000 between underweight, normal weight, overweight and obese participants.

To identify differences between groups, Turkey post-hoc tests revealed that overweight participants found significantly have high total Cholesterol level than underweight participants and significantly have low total Cholesterol level than obese participants. Obese T2DM patient participants have significantly high Triglycerides level than overweight and normal weight T2DM patient participants. Over weight T2DM patient participants significantly have low LDL level than Obese T2DM patient participants and significantly have low HDL and high LDL level than normal weight T2DM patient participants. Obese T2DM patient found significantly have high Systolic Blood Pressure, and Hemoglobin A1c than overweight, normal weight and underweight T2DM patient participants (Table 3).

CVD risk factors and exercise status

A series of t-tests were conducted to assess exercise differences on CVD risk factors. As Table 4 shows, there were significant differences on the total Cholesterol level (t (415)=-3.917, p=0.000), between regular exercisers (M=212.11,SD=18.443) and non-regular exerciser groups (M=220.65,SD=22.939); HDL level (t(415)=9.082, p=0.000 between regular exercisers (M=39.03,SD=8.421) and non-regular exerciser groups (M=29.44, SD=13.066); LDL level (t(415)=-14.917, p=0.000) between regular exercisers (M=100.32,SD=11.025) and non-regular exerciser groups (M=117.30,SD=11.420); and systolic blood pressure (t(415)=-10.086, p=0.000) between regular exercisers (M=124.64,SD=16.651) and non-regular exerciser groups (M=138.49, SD=3.947); However, no significant differences were found between regular exercisers and non-regular exercisers on the triglycerides level, HbA1c and diastolic blood pressure ($p > 0.05$) (Table 4).

Table 1: Socio-demographic characteristics of adult patients with T2DM attending some selected hospitals in Ethiopia from October 2018 to March 2019.

Variables (N=415)	Categories	Frequency	Percent
Age in years, Mean ± SD	48.88 ±11.29		
Gender	Male	232	55.9
	Female	183	44.1
Education Status	Illiterate	118	28.4
	Primary level	195	47
	Secondary level	85	20.5
	Tertiary level & above	17	4.1
Marital Status	Married	209	50.4
	Living with Partner	33	8
	Single	71	17.1
	Divorced	59	14.2
	Separated	27	6.5
	Widowed	16	3.9
Family Income	Less than 9515 birr/year	257	61.9
	9515-33,660 birr/ year	91	21.9
	Greater than 33,660 birr/year	67	16.1
Current employment status	Employed full time (≥30 hours/week)	38	9.2
	Employed part-time (<30 hours/week)	79	19
	Unemployed	215	51.8
	Disabled &Retired	83	20
Has had HbA1c Test	Yes	346	83.4
	No	69	16.6
Current Smoking Status	Current Smoker	298	71.8
	Non-Smoker	117	28.2
Smoking History	Has Smoked/Smokes	337	81.2
	Never Smoked	78	18.8
Frequency of discussion b/n patient and their physician on exercise	At Every Visit	23	5.5
	Occasionally	47	11.3
	Sometimes	71	17.1
	Rarely	113	27.2
	Never	161	38.8
Time recommended exercise to patient	Within the last 3 months	38	9.2
	Within the last 6 months	31	7.5
	Within the last year	55	13.3
	Longer than One Year Ago	136	32.8
	Never has recommended exercise	54	13
	The first day visit to this particular doctor	101	24.3
Body Mass Index Category	Underweight	24	5.8
	Normal Weight	47	11.3
	Overweight	169	40.7
	Obese	175	42.2
Treatment Regimen	Diet only	35	8.4
	Pills	95	22.9
	Insulin injections	110	26.5
	Pills and insulin inject	175	42.2
Reason for hospital visit	DM-related	184	44.3
	Cold/flu	55	13.3
	Other	86	20.7
	General check up	90	21.7
No. of cigarettes smoked per day (n=298) M=8.75, SD=3.368			

Table 2: Intensity levels, status, frequency and attitudes to physical activity of T2DM patients attending in some selected hospitals of Ethiopia, from October to March 2018.

		Mean	SD
Strenuous Physical Activity		1.11 (9.99 MET)	0.727
Moderate Physical Activity		1.84 (9.22 MET)	0.803
Mild Physical Activity		2.06 (6.18 MET)	0.573
Godin Leisure-Time (average total weekly) current physical activity Level		1.25 (25.39 MET)	0.117
Attitudes to regular physical activity[a]		3.97	0.435
		Frequency (n=415)	Percent (%)
Frequency of Physical Activity	Often	63	15.20%
	Sometimes	89	21.40%
	Rarely/Never	263	63.40%
Physical Activity Status	Regular physical activity	152	36.60%
	Non-regular physical activity	263	63.40%

[a]Low scores=1; High scores=7 ; METs=Weekly Metabolic equivalents

Table 3: Cardiovascular Disease risk factors by body mass index among patients with T2DM attending in some selected hospitals of Ethiopia, from October to March 2018.

	Under Weight		Normal Weight		Over Weight		Obese			
	M	SD	M	SD	M	SD	M	SD	f	Sig
Total Cholesterol (mg/dl)	212	17.654	213.7	19.639	213.76	24.011	223.27	19.139	6.956	0
Triglycerides (mg/dl)	140	0	156.81	19.377	158.03	11.089	171.89	12.582	67.353	0
HDL (mg/dl)	36.29	7.364	41.24	11.191	20	0	20	0	102.223	0
LDL (mg/dl)	100.24	13.283	105.14	10.289	125	0	125	0	89.081	0
Systolic Blood Pressure (mmHg)	122.6	16.504	132.75	12.943	140	0	140	0	32.515	0
Diastolic Blood Pressure (mmHg)	89.79	3.753	89.68	3.672	89.64	3.642	89.71	3.664	0.017	0.997
HbA1c in % (n=346)	6.4	0.966	6.4	0.879	6.2	1.125	6.9	1.328	0.969	0

Note: HDL= High Density Lipoprotein, LDL= Low Density Lipoprotein, HbA1c= Hemoglobin A1C, Obese = (BMI > 30) kg/m^2, Normal weight= (BMI 18.5–24.9) kg/m^2, Overweight = (BMI 25–29.9) kg/m^2, Underweight= (BMI <18) kg/m^2

Table 4: Cardiovascular Disease risk factors by exercise status among patients with T2DM attending in some selected hospitals of Ethiopia, from October to March 2018.

	Regular Exerciser†		Non-Regular Exerciser†				
	M	SD	M	SD	Mean Difference	t	Sig. (2-tailed)
Total Cholesterol (mg/dl)	212.11	18.443	220.65	22.939	-8.542	-3.917	.000*
Triglycerides (mg/dl)	161.68	18.16	162.97	13.449	-1.288	-0.824	0.41
HDL (mg/dl)	39.03	8.421	29.44	13.066	9.59	9.082	.000*
LDL (mg/dl)	100.32	11.025	117.3	11.42	-16.979	-14.917	.000*
Systolic Blood Pressure (mmHg)	124.64	16.651	138.49	3.947	-13.848	-10.086	.000*
Diastolic Blood Pressure (mmHg)	89.77	3.655	89.64	3.65	0.131	0.352	0.725
HbA1c in % (n=346)	6.39	0.884	6.71	1.371	-0.3229	0.2313	0.021
Number of Complications	1.74	0.81	2.76	0.655	-1.013	-13.899	.000*

Note: HDL= High Density Lipoprotein, LDL= Low Density Lipoprotein, HbA1c= Hemoglobin A1C

*Significant at 0.05 levels (2-tailed)

†Regular Exerciser - an individual that participates in physical activity 3 or more times per week, at least 20 minutes each session that makes you sweat or breathe hard.

†Non-regular Exerciser- an individual that participate in physical activity 2 or less times per week, at least 20 minutes each session that makes you sweat or breathe hard.

Discussion

In this study, we evaluated the correlation between physical activity level and BMI with CVD risk among diabetics in Ethiopia. The finding of the current study indicates that only 36.6% of the patients were involved in regular physical activity. A similar study conducted in Dundee, England indicated that physical activity was undertaken by 34% of their patients [29]. Another study conducted in Alberta, Canada, found that of those with type 1 and type 2 diabetes are 63.7 and 71.9% respectively, were not achieving recommended PA levels [30]. A study revealed that barriers to physical activity among DM patients were more related to patients'

medical conditions than environmental barriers especially in a low income setting [31]. But in another study it is reported that the main reasons for inactivity included perceived difficulty taking part in exercise, feelings of tiredness, and being distracted by something good on television. Lack of time and lack of local facilities also contributed [29]. The authors of this study indicated that few patients with diabetes participate in physical activity, and in those who do the level of intensity is low. There are many modifiable factors distracting patients from exercise. The benefits of regular exercise include improvement in myocardial contraction and its electrical stability, and an increase in stroke volume at rest and during exercise, leading to a higher maximal cardiac output. Heart rate is decreased at rest, and at any given level of submaximal cardiac output. Endothelial function is improved; leading to better flow–mediated dilatation.3 In addition, the diameter and dilatory capacity of coronary arteries are increased, as is collateral formation. Regular exercise also has effects on the tendency of blood to clot. Changes include reduced platelet aggregation and increased fibrinolytic activity, possibly resulting from lower levels of plasminogen activator inhibitor‐1. In addition, regular physical activity lowers inflammatory factors such as plasma fibrinogen concentrations, C‐reactive protein and white cell count [3, 4].

The results of the current study also indicate that there were strongly significant differences on the total Cholesterol level; HDL level; and LDL level between regular exercisers and non-regular exerciser groups. In a similar study conducted in Ghana, it was reported that triglycerides were significantly reduced even in mild exercise, whilst HDL was increased in subjects who did 3 h and over exercise per week [32]. This study discussed that the positive effects of exercises on lipid profile on type 2 diabetics engaged in routine exercise for at least 3-5 h per week over at least a three month period as a supplement to conventional ant diabetic drug therapy. In addition, some studies [33,34] have reported LDL cholesterol reductions after aerobic and resistance training. Besides to this another study demonstrated a trend toward triglyceride level reductions after resistance training only [35]. Whereas others did not find any change after aerobic, resistance, and combined training [36]. On the contrary, we found that systolic blood pressure and number of diabetic complications were significantly different between regular exercisers and non-regular exerciser groups. However, no significant differences were found between regular exercisers and non-regular exerciser groups on the triglycerides level, HbA1c and diastolic blood pressure ($p > 0.05$). A similar finding was reported in a National Health and Morbidity Survey (NHMS) conducted in Malaysia. NHMS indicated that Systolic blood pressure level was positively associated with PA level ($p = 0.02$) whilst no significant association was noted between PA level and diastolic blood pressure (DBP) [37].

In the present study strongly significant differences were observed in the total cholesterol, triglycerides, HDL, LDL, systolic blood pressure, HbA1c, and number of diabetic complications among underweight, normal weight, overweight and obese participants. A similar study done in Indonesia reported that triglyceride, LDL level increased with increasing BMI ($p = 0.044$; $p = 0.016$ respectively), but there was no significant correlation between TC versus BMI ($p = 0.255$) [39]. Despite this, a study conducted in Pakistan revealed that a significant negative correlation between BMI and HDL was observed, while the correlation between BMI and LDL was observed to be insignificant. HDL was found significantly higher in patients with normal BMI. These results are important to indicate that there is modest impact of BMI on lipid profile. Therefore, the researches of this study argued that, assessment and management for altered blood lipids should not be based on a patient's body weight or BMI [38]. Likewise, association between BMI and HDL (Pearson correlation coefficient=- 0.267, $p<0.001$) and TG (correlation coefficient=0.163, $p=0.006$) was observed in a study conducted by Shamai et al. But, Shamai et al revealed that there was no association between BMI and TC (correlation coefficient=0.002, $p=0.96$) or LDL (correlation coefficient=0.078, $p=0.06$) levels. Thus, further more epidemiological studies are required to find out whether or not BMI is correlated with all lipid profile parameters. Moreover, BMI is not a perfect measure of body fat mass and require additional investigation.

The results of the current study should impact clinical practice and research in Ethiopia. Healthcare professionals need to promote their patients the importance of physical exercise in reducing the risk of diabetes and its complications. Health policy makers in the country and insurance companies also need to allocate resources for programs that encourage patients to exercise regularly. Future studies, using a panel design, should establish causal association to control the complications in the analysis.

Strength and Limitations of the Study

Although multicentre nature of the study and good representation of diverse population by relatively large sample size could be considered strength of this study, it is not free of limitations. One such limitation is that utilization of BMI as a proxy measure of fat mass of the participants, for whom population specific standardized BMI and fat mass data are lacking yet. Self-reported nature of physical activity data and the associated recall bias could be another limitation.

Conclusion

Majority of the Type 2 DM patients did not engage in regular physical activity and in those who do the level of intensity is low. The overall perception on CVD risk among the patients was also minimal. Further, there were significant differences on the total Cholesterol, HDL, and LDL levels between regular exercisers and non-regular exerciser groups. Significant differences also exist among underweight, normal weight, overweight and obese participants with regard to the total cholesterol, triglycerides, HDL, LDL, systolic blood pressure, HbA1c, and number of diabetic complications.. Both risk factors (physical inactivity and dyslipidemia) were highly prevalent in Type 2 DM patients in Ethiopia, hence higher risk of developing CVDs.

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Competing Interests

The authors have declared that no competing interest exists.

Ethics Approval and Consent to Participate

The study was approved by the Institutional Review Board of Jimma University. The study respected freedom to participate and adhered to research principles pertaining to privacy and confidentiality and written consent was sought from all the study participants.

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Author's contribution

TG and YM designed and conducted the main research. BZ and TA involved in data interpretation, analysis, manuscript revision and write up. EM and NA involved in data analysis and interpretation, and write up. SHG and MW involved in preparing the study designed data analysis and manuscript drafting. All authors contributed to data analysis, drafting or revising the article, gave final approval of the version to be published, and agree to be accountable for all aspects of the work.

References

1. Haskell WL, Blair SN, Hill JO. Physical activity: health outcomes and importance for public health policy. Preventive medicine. 2009;49: 280-282.
2. Brownson RC, Housemann RA, Brown DR, Jackson-Thompson J, King AC, Malone BR, et al. Promoting physical activity in rural communities: walking trail access, use, and effects. Am J Prev Med. 2000;18: 235-241.
3. Press V, Freestone I, George CF. Physical activity: the evidence of benefit in the prevention of coronary heart disease. Qjm. 2003;96: 245-251.
4. Bouchard C. Physical Activity and Prevention of Cardiovascular Diseases: Potential mechanisms. In: Leon AS, ed. Physical Activity and Cardiovascular Health. Champaign IL, Human Kinetics, 1997:48–56.
5. Klein R. Hyperglycemia and microvascular and macrovascular disease in diabetes. Diab Care 1995;18: 258–268.
6. Lehto S, Ronnemaa T, Haffner SM, Pyörälä K, Kallio V, Laakso M. Dyslipidemia and hyperglycemia predict coronary heart disease events in middle-aged patients with NIDDM. Diabetes 1997;46: 1354–1359.
7. Mooradian AD. Cardiovascular disease in type 2 diabetes mellitus: current management guidelines. Arch Intern Med. 2003 Jan 13;163: 33-40.
8. Centers for Disease Control and Prevention. National diabetes fact sheet: general information and national estimates on diabetes in the United States, 2007. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention. 2008 Jul 15;1.
9. Miettinen HL, Salomaa S, Mähönen V, Niemelä M, Haffner M, Pyörälä M, et al. For the FINMONICA Myocardial Infarction Register Study Group: Impact of diabetes on mortality after the first myocardial infarction. Diab Care. 1998;21.
10. Williams G, Pickup JC. Handbook of Diabetes. Oxford: Blackwell Science Inc; 1998.
11. Morrish NJ, Wang SL, Stevens LK, Fuller JH, Keen H. Mortality and causes of death in the WHO Multinational Study of Vascular Disease in Diabetes. Diabetologia. 2001;44: S14–21.
12. Geiss LS, Herman WH, Smith PJ. National Diabetes Data Group, National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases; 1995. Mortality in non-insulin-dependent diabetes. 1995: 233–257.
13. Wingard DL, Barrett-Connor E. National Diabetes Data Group, National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases; 1995. Heart Disease and Diabetes 1995: 429–48.
14. Caro JJ, Ward AJ, O'Brien JA. Lifetime costs of complications resulting from type 2 diabetes in the U.S. Diabetes Care. 2002;25: 476–481.
15. de Vegt F, Dekker JM, Ruhe HG, Stehouwer CD, Nijpels G, Bouter LM, et al. Hyperglycaemia is associated with all-cause and cardiovascular mortality in the Hoorn population: The Hoorn Study. Diabetologia. 1999; 42: 926–931.
16. Pyorala K, Laakso M, Uusitupa M. Diabetes and atherosclerosis: An epidemiologic view. Diabetes Metab Rev. 1987;3: 463–524.
17. Kannel WB, McGee DL. Diabetes and cardiovascular risk factors: The Framingham study. Circulation. 1979;59: 8–13.
18. Lau DC, Shen GX. Cardiovascular complications of diabetes. Can J Diabetes. 2013;37: 279-281.
19. Duclos M, Oppert JM, Verges B, Coliche V, Gautier JF, Guezennec Y, et al. SFD Diabetes and Physical Activity Working Group Physical activity and type 2 diabetes. Recommendations of the SFD (Francophone Diabetes Society) diabetes and physical activity working group. Diabetes Metab. 2013;39: 205–216.
20. Colberg SR, Sigal RJ, Yardley JE, Riddell MC, Dunstan DW, Dempsey PC, et al. Physical activity/exercise and diabetes: a position statement of the American Diabetes Association. Diabetes care. 2016;39: 2065-2079.
21. Nam S, Chesla C, Stotts NA, Kroon L, Janson SL. Barriers to diabetes management: patient and provider factors. Diabetes Res Clin Pract. 2011;93: 1-9.
22. Daniel WW. Biostatistics: A Foundation for Analysis in the Health Sciences. 7th edition. New York: John Wiley & Sons. 1999.
23. Godin G, Shepard RJ. A simple method to access exercise behavior in the community. Can J Appl Sport Sci. 1985;10: 141-146.
24. Groot M, Klein W, Hockman E, Ignet B, Davis E. Patient-provider communication about cardiac risk reduction among type 2 diabetes expo attendees. Diabetes 2004;53: A442.
25. American College of Sports Medicine. Guidelines for exercise testing and prescription. Baltimore: Lippincott, Williams & Wilkins. 2000.
26. WHO. Surveillance of Noncommunicable Disease Risk Factors, The WHO Stepwise Approach. 2001;12: 51-79.
27. Mahan KL, Escott-Stump S. Krause's Food Nutrition and Diet Therapy. Philadelphia, PA: Elsevier 2004; 798.
28. American Diabetes Association. Standards of medical care in diabetes-2006. Diabetes Care 2006;29: S4-42.
29. Thomas N, Alder E, Leese GP. Barriers to physical activity in patients with diabetes. Postgrad Med J. 2004;80: 287-291.
30. Plotnikoff RC, Taylor LM, Wilson PM, Courneya KS, Sigal RJ, Birkett N, et al. Factors associated with physical activity in Canadian adults with diabetes. Med Sci Sports Exerc. 2006;38: 1526-1534.
31. Dutton GR, Johnson J, Whitehead D, Bodenlos JS, Brantley PJ. Barriers to physical activity among predominantly low-income African-American patients with type 2 diabetes. Diabetes care. 2005;28: 1209-1210.
32. Ngala RA, Sadique O, Gmagna PK. Effect of Exercise on Lipid Profile and Oxidative Stress in Patients with Type 2 Diabetes Mellitus. Am J Drug Discov Dev. 2013;3: 23-31.
33. Hansen D, Dendale P, Jonkers RA, Beelen M, Manders RJF, Corluy L, et al. Continuous low- to moderate-intensity exercise training is as effective as moderate- to high-intensity exercise training at lowering blood HbA(1c) in obese type 2 diabetes patients. Diabetologia. 2009;52: 1789-1797.
34. Gordon LA, Morrison EY, McGrowder DA, Young R, Fraser YTP, Zamora EM, et al. Effect of exercise therapy on lipid profile and oxidative stress indicators in patients with type 2 diabetes. BMC Complement Altern Med. 2008;8: 21.

35. Duncan GE, Perri MG, Theriaque DW, Hutson AD, Eckel RH, Stacpoole PW. Exercise training, without weight loss, increases insulin sensitivity and postheparin plasma lipase activity in previously sedentary adults. Diabetes Care. 2003;26: 557-562.

36. Boule NG, Haddad E, Kenny GP, Wells GA, Sigal RJ. Effects of exercise on glycemic control and body mass in type 2 diabetes mellitus: a meta-analysis of controlled clinical trials. JAMA. 2001;286: 1218-1227.

37. Teh CH, Chan YY, Lim KH, Kee CC, Lim KK, Yeo PS, et al. Association of physical activity with blood pressure and blood glucose among Malaysian adults: a population-based study. BMC public health. 2015;15: 1205.

38. Haskell WL, Blair SN, Hill JO. Physical activity: health outcomes and importance for public health policy. Prev Med. 2009;49: 280-282.

39. Brownson RC, Housemann RA, Brown DR, Jackson-Thompson J, King AC, Malone BR, et al. Promoting physical activity in rural communities: walking trail access, use, and effects. Am J Prev Med. 2000;18: 235-241.