

Impact of Physical Activity on Metabolic Change in Type 2 Diabetes Mellitus Patients

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Abstract. Exercise is an important part of the diabetes management and prevention. This cross-sectional investigate from Jan. to Dec 2011, how many patients with type 2 diabetes mellitus (DM) in our DM education program have adequate exercise and to exam the relationship between exercise and other lifestyle habits and metabolic effects. Results: in 3369 type 2 DM patients only 37.6% had adequate physical activity. Those who had adequate physical activity had lower BMI, waist circumference, longer DM duration, higher prevalence of Coronary artery disease (CAD), less smoking, betel-nut chewing and alcohol drinking. Glycemic control did not differ among groups, but diastolic blood pressure, triglyceride, GPT lowered, HDL-C elevated significantly in adequate group. Conclusion: Advice alone is not sufficient to push patient to reach adequate physical activity. Adequate PA patients had better life habits like less smoking and more self-monitoring of blood glucose. Adequate exercise improved dyslipidemia, diastolic pressure and liver profile but not glycemic control in this cross sectional study.

Keywords: Physical activity, Type 2 diabetes mellitus patients, Exercise

1. Introduction

The incidence of type 2 diabetes mellitus is increasing dramatically in the world. Though there is a genetic predisposition, it occurred is linking to obesity and inactivity [1, 2]. Exercise is an important part of the diabetes management plan and for prevention of diabetes mellitus [3, 4]. Regular exercise has been shown to improve blood glucose control, reduce inflammation, reduce cardiovascular risk factors, and improve quality of life etc [3, 5]. The US department of Health and Human services' "physical activity guidelines for Americans suggests that adults over age 18 years perform 150 min per week of moderate-intensity or 75 min per week of vigorous aerobic physical activity or an equivalent combination of the two[6]. In Taiwan diabetes treatment guideline follows this principle too. We also apply this principle in our daily practice to advise patients to perform exercise. However we did not know if our patients had adequate exercise or not. So this cross-sectional studies investigate how may patients with type 2 diabetes mellitus have adequate exercise and to exam the relationship between exercise and other lifestyle habits and metabolic effects.

2. Methods

Data were compiled from our diabetes education program in Chia-Yi Christian Hospital in Taiwan. 3432 diabetes mellitus patients who completed at least one year of follow up from Jan 2011 to the end of 2011 were included in this survey. 63 patients are type 1 diabetes mellitus were excluded. Finally, 3369 type 2 diabetes mellitus were included. All patients are asked about their physical activity in the past 7 days, including type of activity, frequency and duration. Basic data including smoking, alcohol drinking habits were collected by diabetic educator. Measurements of anthropometrics, foot examination were done by

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trained educator too. Venous blood samples were collected after overnight fasting. Morning spot urine was collected for proteinuria or microalbuminuria test. According to American diabetes association suggestion, moderate intensity activity more than 150 min per week is suggested. So if patient had fulfill the above suggest ion we named it as adequate physical activity. If patients have less than 150 min moderate intensity activity per week, we divided it to less physical activity group. For those no exercise habits is no physical activity group.

3. Statistics and Data Analysis

The clinical and biochemical features of the patients were presented as mean \pm SD or percentages. A one-way analysis of variance (ANOVA) was used to compare baseline characteristics between three groups of continuous variables. Bonferroni correction was applied to locate differences between PA groups. A chi-squared test

(χ^2) was used to compare baseline characteristics between categorical variables. Statistical comparisons were considered significant when p value were < 0.05 . All statistical analyses were performed using the SPSS statistical package, version 19.0 (SPSS, Chicago, IL).

4. Results

There were about 37.6% of type 2 diabetes mellitus had adequate exercise after our suggestions. The basic data for type 2 diabetes mellitus with different physical activity was shown in table 1. Those who had adequate activity had lower BMI, waist circumference but longer diabetes duration. Besides, they often had less percentage of smoking, betal-nut chewing and alcohol drinking. They had more percentage to perform self-blood glucose monitoring (SMBG). There were no differences for diabetes nephropathy or neuropathy, stroke among exercise groups. But in adequate exercise group, cardiovascular disease history subjects had significantly increased.

Table 2 showed metabolic parameters for different physical activity groups. Glycemic control did not differ significantly. Blood pressure found diastolic pressure significantly lowered in adequate physical activity group. Triglyceride significantly lowered and HDL-C significantly elevated and liver profile (GPT) significantly lowered in adequate activity group.

Table 1: basic data for type 2 DM according to physical activity

	adequate PA (n=1268)	less PA (n=552)	No PA (n=1549)	<i>P</i> value
Age (y/o)	63.4 \pm 11.1 ^{a,b}	60.2 \pm 11.6	58.5 \pm 12.4	0.000
Sex (M,%)	47.3	47.6	50.5	0.190
BMI (kg/m ²)	25.6 \pm 4.3 ^{a,b}	26.3 \pm 4.1	26.6 \pm 4.3	0.000
Waist (cm)	89.8 \pm 9.5 ^{a,b}	91.3 \pm 9.6	92.5 \pm 10.5	0.000
DM duration (years)	10.6 \pm 7.4 ^{a,b}	9.2 \pm 6.4	8.6 \pm 6.7	0.000
Current smoker (%)	12	14.1	21.1	0.000
Betal nut (%)	2.8	3.4	7.0	0.000
Alcohol drinking (%)	6.0	5.5	8.1	0.000
SMBG (%)	50.6	46.7	42.2	0.000
DM neuropathy (%)	5.5	5.8	6	0.819
Overt proteinuria/microalbuminuria (%)	11.4/21.5	11,4/22.6	13.6/22.2	0.346
Stroke Hx (%)	4.1	2.6	3.8	0.250
CAD Hx (%)	6.6 ^a	4.5	4.6	0.037

a =>150min PA vs no PA, $p < 0.05$,
b =>150min PA vs <150 min PA $p < 0.05$

Table 2: metabolic parameters in physical activity (PA) groups

	adequate PA n=1268	less PA n=552	No PA N=1549	<i>P</i> value
AC (mg/dl)	137.7 ± 44.7	137.7 ± 43.9	140.1 ± 52.4	0.337
A1C(%)	7.54 ± 1.31	7.60 ± 1.49	7.67 ± 1.49	0.059
sBP (mmHg)	138.1 ± 17.5	137.7 ± 17.2	137.3 ± 18.2	0.434
dBP (mmHg)	79.8 ± 10.9 ^a	81.6 ± 11.6	82.3 ± 26.6	0.003
T.C (mg/dl)	176.9 ± 33.5	177.7 ± 33.2	178.5 ± 35.7	0.481
TG (mg/dl)	133.8 ± 84.7 ^a	135.2 ± 76.4 ^c	151.6 ± 124.7	0.000
HDL-C (mg/dl)	54.8 ± 14.5 ^{a,b}	53.3 ± 13.3	52.7 ± 13.3	0.000
LDL-C (mg/dl)	104.7 ± 29.9	106.4 ± 29.4	105.7 ± 30.8	0.480
Creatinine (mg/dl)	1.15 ± 0.81	1.15 ± 0.82	1.15 ± 0.92	0.981
GPT (mg/dl)	32.1 ± 24.8 ^a	35.6 ± 33.9	37.2 ± 40.1	0.000

a =>150min PA vs no PA, *p*<0.05,
b=>150min PA vs <150 min, PA *p*<0.05, c=< 150 min PA vs no PA, *p*<0.05

5. Discussion

The result of our study could not demonstrate a beneficial effect of physical exercise on the sugar control in diabetes patient (*p* value only 0.059). Several intervention studies of small number and variable duration in the past showed at least moderate intensity exercise may be more effective for improving glycemic control [7, 8]. In contrast to our study, their patients have confounding factors well controlled before the exercise intervention. Because type 2 diabetes mellitus is a progressive β -cell failure disease in that glycemic control often gets worse as times goes by. In adequate activity groups, they had longer diabetes duration but had lower A1C though not significant statistically, it is quite probable that exercise could have very positive effect on sugar control. Adequate physical activity group also had lower BMI and waist circumference, which is consistent with the results of previous studies [9], except one previous meta-analysis [7] did not show structured exercise program had significant BMI change. Lowered TG and elevated HDL-C were seen more frequently in adequate physical activity group. This might be explained by the following reasons. First, exercise per se improves insulin sensitivity [6], which is instrumental in ameliorating the unfavorable lipid profiles including low HDL-C and high triglyceride. Second, the adequate physical activity group had lower waist level and BMI, which were known to be associated with lower TG level and HDL-C elevation. Third, their smoking and alcohol drinking percentage were significantly lowered, which were expected to contribute to HDL-C elevation and TG lowering. This relation between blood lipids and physical activity is known from previous observational study [10] and was confirmed by smaller trials [11, 12]. The effect on LDL-C is less impressive than that on triglycerides and the HDL-C. There were no consistent results in this regard from previous studies. In look ahead study, exercise combined with strict diet control, which can reduce 10% body weight in the first year, had benefits in TG and HDL-C but not LDL-C reduction [3]. In other studies not confined to diabetes mellitus, exercise alone might not be sufficient to lower LDL-C [13, 14]. Diet control with exercise together had better effect on LDL-C [13, 15]. Our patients received dietitian education, but we did not further investigate if their diet control is achieved or not. Patients in adequate physical activity group have significantly lower GPT. Though we did not further evaluate if patients had virus hepatitis or nonsteatohepatitis, there are revelation of the benefit of exercise for liver fat reduction [16].

Although exercise had metabolic benefits in type 2 diabetes mellitus. It is really a hard work to push patients to perform regular exercise. Our data showed that only less than forty percent of diabetes mellitus had exercise even we advised them to do so. From previous meta-analysis on the exercise effect on fitness in type 1 and type 2 diabetes mellitus also showed that behavior target or recommending a specific form of exercise only are often not enough to improve fitness too[8]. Recent meta-analysis compared structured exercise training and advise only found that in 47 RCTs (8538 patients), structured exercise training especially >150min/week had better glycemic effect. Exercise advice alone is not associated with HbA1c reduction but can do so only combined with diet advice [17]. Another study found in a 15 month intervention period with motivational interviewing combined with exercise prescription had significantly increased leisure exercise time and improved health-related variables in hypertensive patients [18]. So other strategies such exercise prescription or supervised exercise might be needed [8, 19]. In this study, we did not know the

barrier or the difficulty about patients to perform adequate exercise. However we know if patients had adequate exercise, they also had better behavior like less smoking, less alcohol drinking and more self monitoring of glucose. These factors all contribute to better metabolic outcomes. It is also interesting to find longer diabetes duration and more percentage of cardiovascular disease in adequate exercise group. It might mean people often need some external motivation or awareness to embark on exercising.

Our study has some limitations. First this is a cross-sectional survey, not a prospective study, which carries its intrinsic limitation, i.e. it is hard to infer cause-effect relationship. Second, our physical activity was asked by questionnaire which included leisure-time physical activity. Underestimation of physical activity might be present, especially in no activity group who are much younger and are expected to more physically active during work. However even underestimate, there still showed adequate leisure-time physical activity group have better metabolic profile.

6. Conclusions

Our data showed that through diabetes education alone had only 37.6% patients with type 2 diabetes mellitus have adequate physical activity. Those who had adequate physical activity also had better behavior like less smoking, alcohol drinking and more SMBG. Elder, longer DM duration, more CAD patients had adequate physical activity. Adequate physical activity groups had lower BMI, waist level, better diastolic pressure, lower triglyceride, higher HDL-C and lower GPT level.

7. References

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