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Research Article

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Effect of physical activity on the balance of type 2 diabetes in the west of Algeria

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ABSTRACT

The aim of the present study was to improve evaluate the effect of a physical activity program for a period of 7 months, on glycemic control and its relationship with cardiovascular risk factors (blood pressure, BMI, blood lipids), in Algerian diabetic type 2 patients. Fifty T2D (22 men/28 women), aged of 52±10 years, were maintained between 08h and 16h in a day hospital of Mascara city, and submitted to a program of physical activity for seven months. Clinical parameters and metabolic disorders were determined. Results showed significant reduction in body mass index (5%), systolic and diastolic blood pressure (1%) and (8%) respectively, fasting blood glucose (27%), post-effort and post-prandial glycemia (35% and 38%), and HbA1c (9%). Moreover, a decrease in cholesterolemia (9%), triglyceridemia (12%), LDLc (12%) and a significant increase of HDLc (2%) were observed. This study shows that a regular exercise, combined with a balanced diet constitute the main management of the type 2 diabetes.

Keywords: Type 2 diabetes, Physical activity, HbA1c, Glycemia, BMI.

INTRODUCTION

Type 2 diabetes (T2DM) results from inability of β cells of the Langerhans islets to secrete enough insulin, and at the right time (early in the course of the meal) to offset appearance of insulin -resistance [1]. Deficit of insulin secretion and that of insulin action coexist in the T2DM, and these two anomalies arise from interaction between genetic and environmental factors [2].

One of the major determinants of insulin sensitivity of an individual is the muscle mass, itself determined by the level of physical activity. Furthermore, accumulation of abdominal fat (abdominal obesity), major abnormalities of metabolic syndrome, commonly associated with T2DM, is inversely correlated with insulin sensitivity. Data suggest the crucial role of physical inactivity in the development of T2DM. Moreover the High Authority of Health (HAS), as international consensus, recommends, at diagnosis of diabetes, lifestyle changes with two objectives: an increase in physical activity 30 min / day and weight reduction of around 5%. [3]

Many studies have shown that by intervening on the lifestyle, eating habits and physical activity, it is possible to exert a true prevention of T2DM, education plays a fundamental role in the results [4]. Indeed, the demographic transition, which affects Algeria, for about half a century has resulted in increased incidence of chronic diseases such as cancer [5]. From 10 to 20 years, the phenomenon of "globalization" contributes, moreover, to standardize lifestyles on a model that favors the increase of obesity and sedentary lifestyles [6]. In recent years, our laboratory focuses several on understanding and treating such diseases [7-10].

Thus, the present study aims to evaluate effect of a physical activity program for a period of 7 months, on glycemic control and its relationship with cardiovascular risk factors (blood pressure, BMI, blood lipids), in Algerian diabetic type 2 patients.

EXPERIMENTAL SECTION

1.1. Patients

Fifty diabetic type 2 patients (female / male, 28/22), mean age of 52 ± 10 years, were recruited by the attending physician, from medical records, and all belong to the network of "House of diabetics' of the Wilaya of Mascara – Algeria". The objective of the study was presented to patients who gave informed consent. T2D patients included in the study had less than 74-year of age, free of complications, and living in the wilaya of Mascara. Were excluded from the study, patients with uncontrolled ischemic heart disease, poorly controlled diabetes (blood glucose> 15mmol / L), proliferative retinopathy laser- untreated, foot lesions, polyneuropathy of the lower limbs, with anatomical deformations and macroproteinuria.

Table 1. Anthropometric and clinical characteristics of type 2 diabetic patients

	Male (n=22)	**Female (n=28)**
Body weight (kg)	76,95±2,22	75,39±2,50
height (cm)	76,95±2,22	1,61±0,01
BMI[a] (kg/m^2)	26,51±0,77	28,65±0,98
Age (years)	52±2	52±10
Disease duration (years)	10±1	7±1
Family history	+	+
Associated pathologies	HBP, dyslipidemia	HBP, dyslipidemia
Treatement	OAD[b]	OAD[b]
SBP[c] (mm Hg)	133±2	138±4
DBP[d] (mm Hg)	63±2	63 ±2
HR[e] (batt/min)	77±1	86±1
VO_2max (%)	53± 3	57±3

Each value represents the mean ±SE. a: body mass index (weight/height^2, kg/m^2); b: oral antidiabetic; c: systolic blood pressure, d: diastolic blood pressure; e: heart rate

1.2. Questionnaire

By using a detailed questionnaire, we recorded socio-demographic data, management of the disease, lifestyle and clinical aspects of each patient.

1.3. Anthropometric measurements

Weight (kg) is determined using a balance (SECA®-Germany) with a graduated vertical column, which measures the size of the subject.

1.4. Physical activity program

The program consisted of practicing a brisk walk on a 2km circuit, for duration of 30 min, 3-times a week for seven months. The assessment was made, before the first session of physical exercise. For this, we carried out an electrocardiogram and an effort test to avoid potential problems that could occur during physical activity sessions.
Physical activity was assessed using two different methods: a subjective method, in questionnaire form, includes all the activities practiced during the week. Apart from the intensity alone are considered, the type, duration and frequency of physical activity. An objective method allows the measurement of heart rate using a heart rate monitor (Polar) [11-12]

The maximum oxygen consumption is appreciated, from the patient's VO_2max, it is determined indirectly from the measurement of the heart rate and the theoretical maximum frequency (FMT = 220-age). The systolic and diastolic blood pressures and heart rates are necessarily measured in all patients before and after each exercise test, which consists of a course of 2 km. [13]

1.5. Samples

Blood samples of patients fasting were collected in heparin tubes, between 08h and 09h in the morning, after the effort test (post-exercise) and postprandial (2 hours after breakfast). L-glycosylated hemoglobin (HbA1c) was measured on whole blood, collected in tubes with EDTA, every 3 months during the exercise program. HbA1c was determined by a chromatographic separation technique (cation exchange resin). Glucose was determined by an enzymatic method (GOD-PAP), total cholesterol (TC) and triglycerides (TG) by a colorimetric enzymatic method (test-kits Human liquicolor Germany). HDL cholesterol (HDL) was assayed, after precipitation of VLDL and LDL (Human HDL Cholesterol test-liquicolor Germany), and LDL-cholesterol (LDLc) is calculated using the formula of Friedwald: LDLc = TC-HDLc- (TG / 5 (g / L), provided that the triglycerides does not exceed 3 g / L.

RESULTS

1.6. Anthropometric and socio-demographic data

Table2. shows the anthropometric characteristics of the study population.

Table2. Weight and BMI during the exercise program

	Male (n=22)		Female (n=28)	
	Before (1st month)	**After (7th month)**	**Before (1st month)**	**After (7th month)**
Weight (kg)	81±2	77±3**	80±2	75±4**
BMI (kg/m^2)	27,83±0,77	26,51±0,23**	30,31±0,98	28,66±0,07**

** p<0,01 ; ** p<0,001*

Our results showed that at the beginning of the program, men with diabetes had an excess weight with an average BMI of 27.83 kg/m^2 and women were obese resulting in a mean BMI of 30.31 kg/m^2. These values were significantly improved at the end of the program, showing a highly significant loss in mean body weight of 5.32 kg ($p < 0.001$), leading to a significant decrease in BMI sample average (5.06%).

98% of diabetic patients are married. The intellectual level reveals that 32% are illiterate, 62% of patients had a primary or average, 4% are of secondary level and 2% of all has a higher level. 28% are active, 14% unemployment, 10% retirees, 24% have no activity and the remaining 24% are housewives.

1.7. Etiology of the disease

80% of patients have a family history (father and the mother), 15% father and / or mother, and the remaining 5% do not. Obesity, affecting 56% of the patients, is the most common complication. We noticed that women are the most affected. Hypertension comes in second position (28%), followed by cataract (22%), dyslipidemia (18%), tobacco (2%) and podiatric problems (2%).

3.3. Therapy

57.54% of the patients are treated in monotherapy with biguanide, 3.70% with sulfonamides. In the other hand, 37.90% of them follow combination therapy and 1.4% in diet alone. 60% of patients are under antihypertensive treatment against 40% in the half-salt diet. Majority of the patients (80%) practice continuous measurement of body weight and blood pressure.

3.4. Total physical and weekly activities

According to our results, 48% of patients are practicing leisure activities, 28% have a professional activity, and 24% focus their activities on domestic work. Sexual activity has also been the subject of a questionnaire in which 8% have very frequent sexual activity, 66% have frequent activity and 26% with no activity.

Duration of weekly physical activity, quantified hour per week, showed that 8% of patients practice less than 20h / week., 56% between 20 and 40 hours / week., and 36% higher than 40h / week.

According to their weekly activity, patients were stratified as following, 18% have frequency of intense physical activity, both in men than women, 46% of men and 10% of women have moderate frequency, and finally 8% (women) with low frequency. We noticed that the patients do the course in 19.25 ± 1.25 mins, ranking this type of effort as moderate, and thus to advocate for obtaining a permanent glycemic control in diabetic patients.

Table 4. Blood pressure (mm Hg) variations

Male (n=22)			Female (n=28)				
Before effort		After effort	Before effort		After effort		
1st month							
Systolic	Diastolic	Systolic	Diastolic	Systolic	Diastolic	Systolic	Diastolic
130.9±1.1	55,9±0,9	133,2±0,1	63,2±0,1	137,4±0,3	68,7±0,1	137,4±0,6	62,9±0,1
7th month							
133,2±0,2	63,2±0,1	120,9±0,1*	56,8±0,1*	137,4±0,1	62,9±0,1	121,6±0,6*	57,8±0,1*

3.5. Evolution of heart rate of patients with diabetes during the program

In men and women with diabetes, heart rate, high at the start of the program tends to significantly decrease at the end of the program, with an average decrease of 2.5% over the entire population. This decrease is more pronounced among women (3.2%) compared to men (1.4%) (Table 5).

Table 5. Changes in heart rate (beats/min) during the physical activity program

Male (n=22)		Female (n=28)	
Before effort	After effort	Before effort	After effort
77,45±0,50	86,32±0,55	86,45±0,48	95,32±0,40
75,59±0,02	85,05±0,01*	83,81±0,02	92,26±0,01*

**p<0,05*

3.6. Evolution of the VO_2max of diabetic patients during physical activity program

VO_2max diabetic women was significantly higher compared to that of men, at the beginning of the program ($p < 0.01$). Our results showed a decrease of 2.3% in men and 3.26% among women after 7 months of physical activity (Table 6).

Table 6. VO_2max during the physical activity program

Male (n=22)		Female(n=28)	
Before effort	After effort	Before effort	After effort
52,72±0,01	51,49±0,01*	56,38±0,01	54,54±0,01*

. **p<0,05*

3.7. Evolution of blood glucose in diabetic patients during physical activity program:

According to our data, all patients had significantly elevated rates of blood glucose at the beginning of the program, and for both fasting blood glucose and postprandial stress that post, each with average values of 2.2 ± 0.6, 2.26 ± 0.82 and 2.38 ± 0.82 g / L (Fig. 1). A significant decrease was recorded in the first three months of the program, for fasting glucose, followed by a slight increase in the 4th and 5th months and a significant decrease of 28% to end of the 7th month, a decrease of 29% for men and 27% for women.

The values of the post-exercise blood glucose show a significant decrease from the 3rd month reaching 35% and 38% for men and women, respectively. Postprandial blood glucose were also decreased significantly by 35% in women and 37% in men.

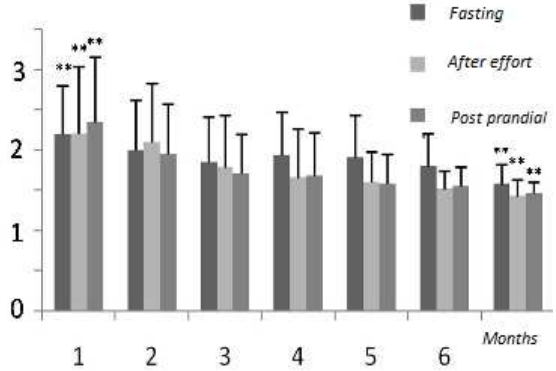

Fig.1. Changes in blood glucose levels in diabetic patients during physical activity program

*** (P<0,001)*

3.8. Evolution of HbA1c levels in diabetic patients during physical activity program

We noticed a significant decrease of HbA1c rates by 0.97% in women and 1% among men at the end of the program. (Fig.2).

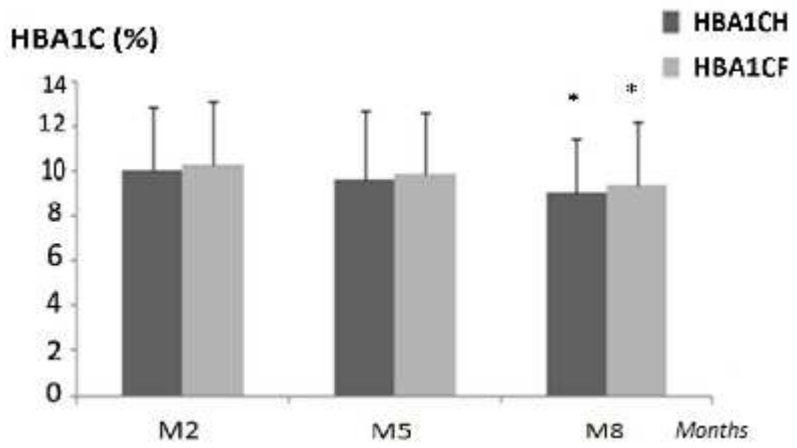

Fig.2. Changes of glycosylated hemoglobin (HbA1c) in diabetic patients
**(P<0,05)*

3.9. Lipid profile in diabetic patients during physical activity program

Compared to baseline, our results demonstrate a significative reduction in triglycerides by 24% in men and 12% in women. Similarly, physical activity program resulted in a significative decrease of serum cholesterol by 11.7% for men against 8.8% in women, and LDL by 14% and 12.5% for men and women, respectively. The exercise program also had a positive effect on improving the value of HDL-C which increased by 2% in women.

DISCUSSION

Diabetes remains one of major public health problems in Algeria. Recently, Moumen *et al*. (2015) studied infectious complications in Algerian diabetics living in Mascara [14]. Physical activity is an integral part of the therapeutic management of type 2 diabetes its beneficial effects on metabolic control and quality of life of T2DM patients are widely recognized.

Our study is based on two complementary aspects aiming to promote physical exercise and / or fighting against physical inactivity. Evaluation of the patient's motivation to change his behavior, was an essential element of the success of the exercise program. Physical activity program assessed in the present study resulted in an improved glycemic control, resulting in a highly significant reduction in post-exercise blood glucose and postprandial ($p < 0.01$), and therefore HbA1c. Our results are in line with those previously published suggesting that cardiovascular-based physical activity appears to improve glycaemic control. One of the mechanisms by which the exercise improves insulin sensitivity, involves increasing the expression of the glucose transporter GLUT4, allowing better penetration of glucose in myocytes, and a better storage as glycogen by increasing the activity of glycogen synthase [15, 16].

Following this physical activity program over a period of 7 months, demonstrated the beneficial effects of muscular exercise on blood pressure, favoring a slight decrease in blood pressure. Indeed, Padilla *et al*. (2005) found that Physical Activity Reduces Blood Pressure [17]. Several studies reported similar effect [18]. Reduction in blood pressure may be attributed to the decrease we observed in BMI. In fact, fitness levels are inversely associated with blood pressure (BP). On the other hand, some studies suggested that the changes in BP are independent of changes in body weight, body composition and dietary influences [19].

Our results showed also a positive effect of the physical activity program practiced over seven months on the lipid profile of the patients. In addition to its direct effects on energy balance and improved diabetes control, physical activity, regularly practiced, promotes the use of lipid substrates. The highest level of lipid oxidation reported in literature [20-21] is observed in moderate physical activity corresponding to 50-60% of VO_2max. In our study, this intensity was achieved by 56% of our patients.

CONCLUSION

The present study showed the benefic results of regular physical activity practice, combined with nutritional education, among type 2 diabetics. We give evidence that seven months of physical activity result in an improved glycemic control and dyslipidemia, as well as blood pressure with a reduction of degenerative complications and associated pathologies. This strategy of comprehensive care has contributed to the improvement of the metabolic

status of our patients. These results justify the interest of development of regular physical activity, combined with a balanced diet, accompanying the therapy of type 2 diabetic patients.

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