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## ORIGINAL RESEARCH

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**OPTIMIZING LIFESTYLE IMPROVES GLYCEMIC PROFILE IN PATIENTS AT RISK FOR DIABETES MELLITUS**

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**Abstract**

There is a pandemic of type 2 diabetes mellitus due to urban and sedentary lifestyle, ageing and obesity. The most important means to prevent this disease is to optimize the lifestyle.

Our study aimed to follow-up the effect of moderate caloric restriction and increase of physical activity on clinical and metabolic parameters in persons at risk to develop type 2 diabetes.

Twenty-three overweight or obese patients with either altered fasting glucose or altered glucose tolerance were included in this study. They were followed up for 2 years for clinical progress and metabolic profile, while on lifestyle counseling.

The dietary and physical recommendations to improve lifestyle were followed by a small reduction in the BMI, total cholesterol, systolic and diastolic blood pressure, together with an increase of HDL at 1 and 2 years of dietary counseling. However there was a significant reduction in abdominal circumference, fasting glycemia and glycemia at 2 hours during oral glucose tolerance test.

The small reduction in BMI indicates the need of a more intensive lifestyle counseling.

**Keywords:** type 2 diabetes, prevention, lifestyle

**Rezumat**

Se vorbește despre existența unei pandemii de diabet zaharat tip 2 datorat stilului de viață sedentar, vârstei înaintate și obezității. Cea mai importantă măsură în prevenirea acestei afecțiuni este optimizarea stilului de viață.

Studiul nostru și-a propus să urmărească efectul unui program de restricție calorică moderată combinată cu creșterea activității fizice asupra parametrilor clinici și metabolici la persoane cu risc de a dezvolta diabet zaharat tip 2.

23 de persoane supraponderale sau obeze cu modificări ale glicemiei a jeun sau ale testului de toleranță la glucoză au fost incluse în studiu. Ele au fost urmărite pentru progresul clinic și al profilului metabolic pe un interval de doi ani în care au fost consiliate asupra stilului de viață.

Dieta și recomandările fizice pentru îmbunătățirea stilului de viață au fost urmate de o ușoară reducere a BMI, colesterolului total, presiunii sistolice și diastolice, precum și de o creștere a HDL la un an și la doi ani de la îmbunătățirea dietei. Am înregistrat o scădere semnificativă a circumferinței abdominale, a glicemiei a jeun și la două ore la testul de toleranță la glucoză.

Mică îmbunătățire a BMI indică necesitatea intensificării consilierii privind stilul de viață.

**Cuvinte cheie:** diabet tip 2, prevenție, stil de viață.

### Introduction

Diabetes mellitus is a metabolic disease defined by a threshold value of the glycaemia, though it has a plurifactorial etiopathogeny and implications involving alterations of glucose, lipids and protein metabolism that result from insulin deficiency, insulin resistance or both (9).

The disease develops through stages:

1. Normoglycemic stage is recognized in persons with evidence of the ongoing pathogenic process. Normal glucose tolerance is defined as fasting glycemia <110 mg/dL and <140 mg/dL at 2 hours during oral glucose tolerance test (OGTT) with 75 g glucose.

2. Alteration in glycemic regulation – impaired fasting glucose or impaired glucose tolerance test – is an intermediate stage in developing diabetes mellitus. Fasting glycemia over 110mg/dL, but lower than 126 mg/dL defines impaired fasting glucose; fasting glycemia < 126 mg/dL together with a level of blood glucose of 140-199 mg/dL at 2 hours during OGTT defines impaired glucose tolerance.

3. Diabetes mellitus is defined either by fasting glycemia over 126 mg/dL, or by glycemia over 200 mg/dL at 2 hours during OGTT. Clinical classification of this stage includes: insulin dependent diabetes mellitus, insulin necessity for a good clinical control of the disease, or insulin independent diabetes mellitus (9).

There is a pandemic of type 2 diabetes mellitus due to urban and sedentary lifestyle changes, ageing and obesity. The most important means to prevent this disease is to optimize the lifestyle.

The impact of diabetes on general population is threatening, mainly due to cardiovascular complications. These chronic complications impair quality of life, patients' autonomy, increasing hospitalization, medical and treatment costs. In the same time the diabetic patient becomes uninterested in profession or family life. It is possible to reduce these consequences using diabetes prevention programs, early diagnosis of diabetes by screening population at risk, evidence based treatment meant to reduce complications. Diabetes care needs a collaborative work of endocrinologists, cardiologists, nephrologists, neurologists, ophthalmologists, psychologists and social assistance.

Etiopathogeny of type 2 diabetes involves several factors:

Genetic factors. It is well known that type 2 diabetes has a strong hereditary link. It is estimated that 40% of patients relatives could develop the disease when a life expectancy of 80 years old is accepted. Other studies indicate a penetration of type 2 diabetes mellitus of 90%. Location of specific genes has not been established yet. This is going to be an important discovery in identifying people at risk.

Environmental factors. The most significant risk factors for diabetes are obesity, sedentary lifestyle, age, sex, stress and the so-called modern lifestyle.

Obesity and dietary errors are well known to increase diabetes risk. 75-80% of newly diagnosed type 2 diabetic patients are or have been obese. Some of these may not have an increased BMI, but have an increased percent of adipose tissue, distributed as abdominal adiposity. Several studies suggest that weight influences insulin secretion, while abdominal obesity is correlated with insulin resistance. There is an increased lipolysis in abdominal fat, which generates a high level of free fatty acids to cause muscle and liver insulin resistance.

Fat rich diets that are poor in fibers and carbohydrates predispose to obesity and are associated to diabetes mellitus.

Reduced physical activity is another important role involved in insulin resistance and type 2 diabetes.

The prevalence of impaired glucose tolerance and type 2 diabetes increases with age. Impaired fasting glucose is age-correlated and is initially shown by high postprandial glycemia. In early stages fasting glycemia is not yet risen. The involvement of age in impairing glucose tolerance is not completely known, but it seems to be related with increased insulin resistance. Smoking was involved in developing insulin resistance, which is reversible once stopping smoking. The link between insulin resistance and smoking seems to be due to alteration in the activity of sympathetic nervous system and reduction of physical activity secondary to cardiovascular and respiratory system. Social stress is also debated to induce type 2 diabetes

At present the key factor in prevention of type 2 diabetes is considered lifestyle changes

### Methods

Our study included 23 overweight or obese patients (11 women and 12 men) with impaired fasting glucose or impaired glucose tolerance. They have been followed-up for 2 years with personal and family history, clinical examination, metabolic profile.

Family history has been focused on diabetes mellitus, obesity, hyperlipemia, cardiovascular disorders. Personal medical history included former diagnosis of gestational diabetes, hyperlipidemia, hypertension, cardiovascular disorders.

Clinical examination highlights:

*Body mass index (BMI)* that is a ratio between weight and square height.

- BMI normal values: 18.5-24.9 kg/m<sup>2</sup>; overweight: BMI: 25-29.9 kg/m<sup>2</sup>, obese BMI >30 kg/m<sup>2</sup>.

- Abdominal circumference has been measured halfway between ribs and iliac crest

- Systolic and diastolic blood pressure has been assessed with a mercury sphygmomanometer in sitting position, after at least 5 min of rest. Medium value of 3 measurements was taken.

*Metabolic profile:*

1. Fasting glycemia (min 8 h fasting) and 2h OGTT (oral glucose tolerance test: ingestion of 75g glucose dissolved in 250-300ml water). Serum was immediately separated and analyzed in 20 min. Glycemia has been measured by glucose-oxidase method. Glycemia levels have been classified as recommended by WHO:

a) normal: fasting glycemia <110 mg/dl; 2h OGTT glycemia <140mg/dl

b.) impaired fasting glucose: glycemia 110-125mg/dl;

c.) impaired glucose tolerance: fasting glucose <126 mg/dl and 2h OGTT între 140-200 mg/dl;

d.) diabetes mellitus: fasting glucose >126 and 2h OGTT >200 mg.

2. Lipid profile (total cholesterol, HDL, LDL, triglycerides) have been assessed while fasting, by enzymatic methods.

The recommendations to all patients were to improve lifestyle by reducing caloric intake and increase of exercise. Diet choice was guided by patient adherence and associated disorders. As a general direction a diet with 500 kcalories/day less than the previous one was recommended. As a principle for hypocaloric diets, small, fractionated meals were recommended, avoiding high calorogenic foods, alcohol. Patients have exercised regularly: walking or running for 30 min 2-4 times a week.

### Results

Mean age of the studied patients was 51 with extremes between 42 and 61 years.

Diabetes mellitus as part of family history was present in 16 patients (69.56%), obesity in 12 patients (52.17%), hyperlipidemia in 6 patients (26.08%), hypertension and cardiac disorders in 19 patients (82.60%).

Personal medical history: one woman had had gestational diabetes (9.09%), 10 patients (43.47%) had previous hyperlipidemia, actually on hypolipemiant drugs and 11 patients (47.82%) had high blood pressure.

Metabolic parameters have been assessed at the beginning and annually after and are presented in the table 1.

**Table 1. Metabolic and anthropometric parameters at baseline, 1 year, 2yrs**

	Baseline (0)	1 year	2 yrs	p:0-1	p: 0-2
BMI (kg/m <sup>2</sup> )	30.01±1.25	29.47±1.41	29.15±1.63	0.2124	0.101251
AC (cm)	92.57±1.41	90.83±1.41	88.91±1.20	0.082	0.043
Fastig glycemia (mg/dl)	115.17±1.41	104.91±1.41	103.30±5.66	3.22 E-11	5.32462E-09
2h fasting TTGO (mg/dl)	146.43±2.83	139.35±2.83	137.30±2.83	0.022	0.005
Total cholesterol (mg/dl)	209.2±7.78	206.48±7.07	204.30±7.78	0.374	0.277
Tryglicerides (mg/dl)	192.91±4.01	172.50±4.24	164.04±4.14	0.094	0.049
HDL cholesterol (mg/dl)	42.17±1.41	43.26±0.71	44.70±1.41	0.279	0.085
Systolic blood pressure (mmHg)	144.35±7.07	138.70±7.07	137.39±7.07	0.114	0.066
Diastolic blood pressure (mmHg)	84.35±7.07	80.87±7.07	80.00±7.07	0.149	0.090

### Discussion

The patients included in the study developed a small reduction in BMI, total cholesterol, systolic and diastolic blood pressure and a small rise in HDL at 1 and 2 years of counseling towards weight loss and increase in physical activity. The program lead to a significant waist reduction, a reduction in plasma triglycerides, fasting glycemia and 2h glycemia (OGTT) at 2 years from initiation of lifestyle changes. Though the reduction in BMI was modest, caloric restriction and increase in physical activity improved glycemic profile in patients at risk for diabetes. The results on weight loss and improvement in glycemic profile are similar to those of Diabetes

Prevention Study in Finland (4). The insignificant reduction of BMI in the studied patients results in a more intensive method of counseling.

In 2007 International Federation of Diabetes (IDF) has published a consensus of type 2 diabetes prevention. IDF strategy focuses on risk factors control in general population and in persons at risk of diabetes. IDF prevention program comprises of 3 stages: identifying persons at risk for developing diabetes, risk assessment and preventive measures. The strategy of identifying the persons at risk for diabetes made use of a questionnaire including family history of diabetes, age (>45 in Europe), diagnosis of gestational diabetes or cardiovascular disease, long standing smoking, chronic glucocorticoid use, thyroid hormones, beta-adrenergic antagonists, antipsychotic medication, alpha interferon.

In patients with high risk for diabetes it is recommended fasting glycemia (or OGTT if fasting glycemia is between 110-125 mg/dl), triglycerides, HDL, LDL, blood pressure. Preventive means recommended are lifestyle improvement by caloric intake decrease, intensify of physical effort and medical therapy. If lifestyle changes do not lead to weight loss or improvement of glycemia, metformin is associated in patients with BMI>30 kg/m<sup>2</sup> and glycemia > 110 mg/dl in the absence of contraindications (1).

Diabetes Prevention Program (DPP) proved that metformin inpatients with pre-diabetes could prevent or delay the onset of diabetes, while other studies suggest that thiazolidindiones, acarbose or orlistat delay type 2 diabetes in patients with glucose intolerance (5, 2, 4, 3, 8).

In 2007 a group of experts of American Association of Diabetes (ADA) analyzed the clinical studies and the known risk for diabetes mellitus and concluded that persons with impaired glucose tolerance or impaired fasting glucose need counselling for lifestyle changes, with the objective of a weight loss of 5-10% and moderate physical activity. With respect to pharmacological intervention in preventing diabetes mellitus, same expert group emphasized that metformin only could be used as prophylactic antidiabetic drug. Other agents have cost efficiency and safety issues and an unsustainable prevention effect in some studies that made this expert group to recommend against their use in prevention of diabetes (9).

### Conclusions

Recommendation on lifestyle optimization lead to a small improvement on BMI, total cholesterol, systolic and diastolic blood pressure, HDL at 1 year and 2 years of the counseling onset. The program led to a significant reduction in abdominal circumference, triglycerides and basal glycemia at 2h OGTT. The insignificant reduction in BMI in the studied patients indicates the need for a more intensified counseling methods.

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