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Active screening for diabetes mellitus: data from 88 oral glucose tolerance tests with 75 g of glucose performed in patients in general practice in urban area based on previous 250 fasting plasma glucose determinations

Aktywne badania przesiewowe w celu wykrycia cukrzycy: dane z 88 OGTT 75 g wykonanych u pacjentów w miejskiej praktyce lekarza rodzinnego na podstawie wcześniejszych 250 oznaczeń poziomu glukozy na czczo

ABSTRACT

Background: Diabetes mellitus (DM) and other glucose metabolism abnormalities are one of biggest challenges for the public health in the 21st century.

Objectives: In general practice efforts should be made to early detect glucose metabolism abnormalities, which allows for fast diagnosis of medical problem in individual patients and implementation of lifestyle modification and/or pharmacological treatment.

Material and methods: The present study is based on cross-sectional data from 250 patients, a sample from the general practice "Ogrody" located in industrial area of Bydgoszcz, where biochemical analyses were conducted in second half of 2014. Each patient with fasting plasma glucose ≥ 100 mg/dl who hasn't been previously diagnosed with type 2 diabetes mellitus was referred for "gold standard" 75 g oral glucose tolerance test (OGTT).

Results: According to study design, 75 g OGTT was performed in 88 patients with elevated fasting plasma glucose after excluding individuals with previously diagnosed diabetes mellitus.

Conclusions: 1) Among 250 primary care patients, 176 (70,40%) had fasting plasma glu-

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cose ≥ 100 mg/dl. 2) On the basis of a gold standard test, 75 g OGTT, following glucose metabolism disturbances were diagnosed (in order of frequency; number and %): IFG 39 (37,50%); IFG+IGT 22 (25,00%); T2DM 16 (18,18%); normal result of OGTT 11 (12,50%) and IGT 6 (6,82%). 3) In general practice, emphasis on detection of glucose metabolism abnormalities allow for early diagnosis of medical problem in individual patients and implementation of lifestyle modification and/or pharmacological treatment.

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Key words: diabetes mellitus, IFG, IGT, oral glucose tolerance test, mass screening, family medicine, primary care, public health

STRESZCZENIE

Wstęp: Cukrzyca typu 2 i inne zaburzania gospodarki węglowodanowej są jednym z głównych wyzwań dla zdrowia publicznego na przełomie XX–XXI wieku.
Cel badania: W praktyce lekarza ogólnego położenie szczególnego nacisku na szybką diagnostykę nieprawidłowości gospodarki węglowodanowej, która pozwala na postawienie rozpoznania u pacjenta, modyfikację stylu życia i wdrożenie leczenia farmakologicznego.
Materiał i metody: W 2014 roku u 250 osób z praktyki lekarza rodzinnego (NZOZ "Ogrody" w mieście przemysłowym) wykonano przekrojowe oznaczenia laboratoryjne. Każdej osobie z glikemią na czczo ≥ 100 mg/dl i bez wcześniej rozpoznanej cukrzycy wykonano następnie OGTT 75 g jako „złoty standard" w rozpoznawaniu zaburzeń gospodarki węglowodanowej.
Wyniki: Łączne wykonano 88 OGTT u osób z nieprawidłową glikemią na czczo w badaniu przesiewowym, które nie miały uprzednio postawionego rozpoznania cukrzycy.
Wnioski: 1) W praktyce lekarza rodzinnego176 (70,40%) osób z 250 miało poziom glukozy na czczo ≥ 100 mg/dl. 2) Zgodnie ze „złoty standardem" OGTT postawiono następujące rozpoznania (w porządku według częstości; liczba i %): IFG 39 (37,50%); IFG+IGT 22 (25,00%); DM t2 16 (18,18%); normoglikemia wg OGTT 11 (12,50%) i IGT 6 (6,82%). 3) W praktyce lekarza ogólnego położenie nacisku na rozpoznawanie zaburzeń gospodarki węglowodanowej pozwala na szybkie postawienie rozpoznania medycznego problemu u pacjenta, modyfikację jego stylu życia oraz wdrożenie adekwatnego leczenia farmakologicznego.

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Słowa kluczowe: cukrzyca, IFG, IGT, OGTT, badanie przesiewowe, medycyna rodzinna, podstawowa opieka zdrowotna, zdrowie publiczne

BACKGROUND

Nowadays one of biggest challenges for family medicine is improving the quality and length of life. One of ways to do this is to actively influence the so-called civilization diseases through early diagnosis of medical problem in individual patients, modification of lifestyle and implementation of appropriate pharmacological treatment. As the human life span increases, its quality is gradually reduced and the morbidity and mortality related to cardiovascular diseases rapidly increases. One of the main causes is the increase in the number of different carbohydrate metabolism disorders which, if not monitored, quickly lead to the development of diabetes mellitus (DM) and cardiovascular diseases (CVD) [1–4]. Nowadays, many investigators observe a rapid increase in various abnormalities of glucose metabolism among general practice patients [5–7]. It is very important for the medical professionals to focus a special effort on

prevention in patients who have not developed DM and/or CVD yet — this is the best way to reduce high socioeconomic cost [8–10].

OBJECTIVES

In general practice efforts should be made to early detect glucose metabolism abnormalities, which allows for fast diagnosis of medical problem in individual patients and implementation of lifestyle modification and/or pharmacological treatment.

The primary objective of this study is to answer the following questions:

1) How often do patients in my GP practice have abnormal fasting plasma glucose levels?
2) What types of carbohydrate disorder occur in these patients (excluding patients with previously diagnosed DM)?
3) Are there other abnormalities (in blood morphology and/or biochemical parameters) in patients who underwent a gold standard test, i.e. 75 g OGTT?

MATERIAL AND METHODS

Study design

The present study is based on cross-sectional data from 250 patients — a sample from the general practice "Ogrody" located in the industrial area of Bydgoszcz, where biochemical analyses were conducted in the second half of 2014. The methodology of anthropometric measurements (including height, weight, waist [WC] and hip circumferences [HC]) was similar to the one described previously [11].

Patients

Each patient with plasma glucose ≥ 100 mg/dl who hasn't been previously diagnosed with type 2 diabetes mellitus was referred for "gold standard" 75 g oral glucose tolerance test.

Biochemical variables

Samples of venous blood were taken following a 12 h overnight fast from the antecubital vein with suitable vacutainers according to norm ISO 6710 and underwent standard biochemical analysis (venous blood morphology; ESR/Westergren ESR; ALAT; concentrations of total cholesterol, HDL and LDL cholesterol, triglycerides and glucose; potassium and creatinine levels) in certificated laboratory "Vitalabo" in Bydgoszcz [12].

Classification of OGTT results

According to diagnostic criteria for DM [13], the patients who underwent screening for glucose metabolism disturbances were divided into 5 subgroups on the basis of the results of 75 g OGTT:

0 — normal OGTT,
1 — impaired fasting glucose (IFG),
2 — impaired glucose tolerance (IGT),
3 — IFG + IGT ,
4 — DM (*de novo* type 2 diabetes mellitus).

Statistical analyses

Based on primary measurement, BMI, WHR and estimated glomerular filtration rate (GFR) values were calculated using MDRD, Cockcroft-Gault or CKD-EPI formulas. Significance was accepted at $p < 0,05$. The results are shown in 2 figures and 4 tables. Statistical analysis was carried out using Statistica software StatSoft [14] under license from the Department of Biophysics, Faculty of Pharmacy CM UMK in Bydgoszcz.

RESULTS

In 250 adult patients (130 females and 120 males) from general practice, fasting plasma glucose was measured. Figure 1 shows their age (mean 71,42 x ± 10,01 years, max. 92 and min. 38). The most numerous age group were people from 70 to 80 years.

One hundred and seventy-six out of 250 patients had fasting plasma glucose ≥ 100 mg/dl. Among them, 63 patients (35,80%) had previous diagnosed type 2 diabetes mellitus. One hundred and fourteen patients were referred for oral 75 g oral glucose tolerance test. In

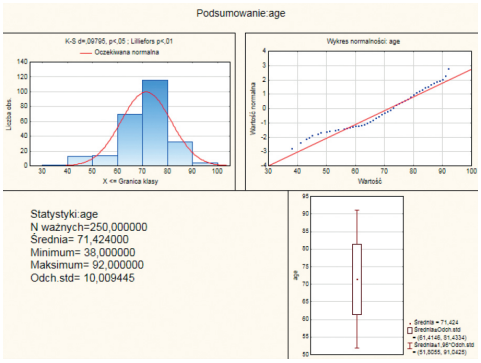

Figure 1. Age (mean, SD, min., max.) of the patients included in the study and graphic presentation of age ditribution

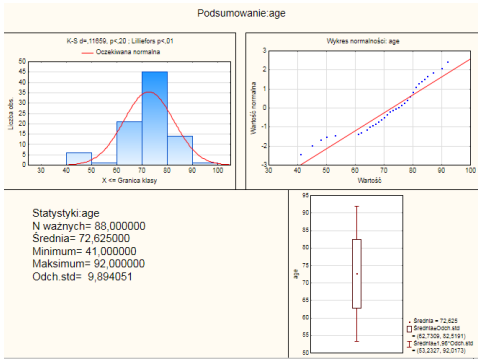

Figure 2. Age (mean, SD, min., max.) of patients included in the final analysis and graphic presentation of age distribution

88 patients (77,19%), 75 g OGTT was performed by the end of 2014, but in 26 (22,81%) the test hadn't been performed (unknown reason). The final analysis included only those patients (Figure 2) who underwent 75 g OGTT.

Eighty-eight adult patients (39 women and 49 men) from general practice underwent OGTT. Figure 1 shows their age (mean 72,62 ± 9,89 years; max. 92; min. 41). The most numerous age group were people from 70 to 80 years, similarly as in the previously pre-screened group (250 patients).

On the basis of 75 g OGTT results the patients were divided into 5 subgroups: 0 – normal OGTT; 1 — IFG; 2 — IGT; 3 — IFG+IGT and 4 — DM (de novo type 2 diabetes mellitus).

In the practice of family physician, most patients (39 [37,50%]; 75,18 ± 7,51 years; 17 women vs 16 men) had IFG followed by IFG+IGT (22 [25,00%]; 69,73 ± 12,73; 10 vs 12). Diabetes mellitus was diagnosed in about 1 in 5 patients (subgroup 4: 16 patients [18,18%]; 72,75 ± 10,31 years; 4 women vs 12 men). Less common were normal result of OGTT (11 [12,50%]; 70,45 ± 10,52; 5 vs 6) and IGT (6 [6,82%]; 72,83 ± 5,64; 3 vs 3).

Table 2 shows fasting plasma glucose (mg/dl; mean and SD) and glucose values at 0 and 120 minutes of 75 g OGTT. This test enables identification of patients with normoglicaemia and those with IFG, IGT or DM.

Table 3 shows that patients with DM (subgroup 4) are characterized by higher body

Table 1

Age and gender of patients according to the results of OGTT

	∑ — sum	0 — normal	1 — IFG	2 — IGT	3 — IFG+IGT	4 — DM
Number n (%)	88 (100%)	11 (12,50%)	33 (37,50%)	6 (6,82%)	22 (25,00%)	16 (18,18%)
Age (mean±SD)	72,62±9,89	70,45±10,52	75,18±7,51	72,83±5,64	69,73±12,73	72,75±10,31
0 – women	39	5	17	3	10	4
1 – men	49	6	16	3	12	12

Table 2

Fasting plasma glucose (mean and SD) and glucose values at 0 and 120 minutes of OGTT

	∑ — sum	0 — normal	1 — IFG	2 — IGT	3 — IFG+IGT	4 — DM
Glucose	112,62±9,91	104,94±4,22	111,75±10,52	105,88±4,65	113,60±8,94	120,90±8,08
0 OGTT	110,46±13,27	92,67±7,14	111,15±9,23	93,03±5,55	115,65±9,70	120,67±12,55
2h OGTT	154,97±57,45	102,30±25,68	116,60±22,01	168±11,50	163,84±14,93	252,93±40,20

weight (84,19 ± 12,97 kg) then other subgroups. They (subgroup 4) were also slightly higher (170,37 ± 8,55 cm then other subgroups, but had higher BMI (29,09 ± 4,08). However, small number of patients in the subgroups didn't allow for the general conclusion, that DM patients have statistically significantly higher body weight than remaining subgroups. Therefore, Table 2 presents only BMI values in each 5 subgroups. Similarly, subgroup 4 (with DM) and subgroup 3 (IFG + IGT), seem to be more obese based on WC and WHR, but due to additional stratification by gender, the subgroups were too small to provide statistical significance.

Table 4 contains detailed laboratory test results in patients with normal and elevated fasting plasma glucose. All blood morphology parameters (WBC, RBC, HGB, HCT, PLT) were similar in all 5 subgroups according to OGTT results (normal glucose metabolism vs IFG vs IGT vs IFG + IGT vs DM). Erythrocyte sedimentation rate (ESR) was slightly higher (18,00 ± 12,21) in normoglicaemic pa-

Table 3

Anthropometric data of patients who underwent OGTT

	∑ — sum	0 — normal	1 — IFG	2 — IGT	3 — IFG+IGT	4 — DM
Weight	78,56±14,31	78,64±15,84	77,97±16,05	74,00±7,48	76,55±12,94	84,19±12,97
Height	167,68±14,31	167,64±9,07	166,48±10,06	169,33±7,00	167,09±10,83	170,37±8,55
BMI	27,84±4,55	27,85±4,31	27,96±5,07	25,94±3,80	27,26±4,44	29,09±4,08
BMI <=20.00	3	1	2	0	0	0
BMI 20<x<=25	19	1	7	2	6	3
BMI 25<x<=30	39	6	13	3	10	7
BMI >30.00	27	3	11	1	6	6
WC	100,71±11,44	97,33±12,73	96,67±13,25	96,50±8,23	106,50±8,33	106,22±8,21
HC	106,33±7,24	104,67±8,83	105,67±7,33	105,00±8,08	107,75±7,96	108,22±5,14
WHR	0,95±0,08	0,93±0,07	0,91±0,10	0,92±0,06	0,99±0,05	0,98±0,06

Table 4

Detailed laboratory test results (mean ± SD) blood morphology, ESR, ALAT, K+, lipid profile and creatinine in subgroups divided based on OGTT results

	∑ — sum	0 — normal	1 — IFG	2 — IGT	3 — IFG+IGT	4 — DM
WBC	6,59±1,52	6,15±1,28	6,64±1,40	5,69±1,16	6,65±1,44	7,04±2,01
RBC	4,62±0,40	4,49±0,38	4,62±0,47	4,23±0,37	4,68±0,34	4,66±0,37
HGB	14,19±1,17	13,55±1,04	14,14±1,28	14,10±1,00	14,31±0,98	14,60±1,25
HCT	42,04±4,48	40,64±2,49	42,28±3,92	41,67±2,81	42,76±2,74	41,69±7,99
PLT	241,6857,85	226,18±49,63	247±44,32	191,17±41,03	253,69±61,50	242,75±78,97
ESR	12,86±8,63	18,00±12,21	13,73±9,56	10,83±4,50	11,59±6,99	10,06±5,42
ALAT	21,53±8,52	21,05±8,07	19,42±6,57	21,83±6,56	23,10±9,24	23,98±11,46
Total cholesterol	204,34±42,37	221,62±31,49	207,41±47,72	202,23±37,41	195,69±40,97	198,83±41,15
HDL	54,14±12,51	58,19±14,70	56,93±13,28	48,17±15,34	52,25±8,86	51,93±12,08
LDL	123,26±37,21	133,25±28,03	125,91±42,38	125,05±26,59	117,10±36,69	118,77±37,27
TG	153,82±95,40	185,90±194,18	131,13±54,52	142,18±110,78	164,69±79,11	167,98±78,27
Creatinine	0,93±0,22	0,86±0,17	0,94±0,24	0,88±0,20	0,96±0,24	0,95±0,22
MDRD	79,30±20,05	85,66±20,20	76,28±18,39	80,60±13,01	77,76±21,51	82,75±23,84
Cockr	77,88±27,32	84,17±40,33	73,21±21,86	74,40±13,69	78,85±32,26	83,18±24,34
CKD_EPI	73,96±16,84	79,90±16,27	70,99±15,02	73,48±11,67	74,36±20,85	74,49±16,85
K+	4,45±0,50	4,40±0,30	4,37±0,53	4,19±0,35	4,53±0,53	4,63±0,55

tients than in other subgroups. It can explain two facts: increased sugar level simultaneous exceed viscousity solutio so them sedimentation rate of blood cells go down. Co-reason is that the more age of each people, the faster is falling erythrocytes what was find in large cohort healthy Norwegian adults [15]. In my study normoglicemic people were a little older then people with each type of glycemic abnormalities. All the other (mean and SD) laboratory test results (ALAT, total cholesterol, HDL, LDL, triglycerides, potassium and creatinine) and estimated glomerular filtration rate (GFR) calculated using MDRD, Cockcroft-Gault or CKD-EPI formulas were in normal range.

CONCLUSIONS

1. Among 250 primary care patients, 176 (70,40%) had fasting plasma glucose ≥ 100 mg/dl.
2. On the basis of a gold standard test, 75 g OGTT, following glucose metabolism disturbances were diagnosed (in order of frequency; number and %): IFG 39 (37,50%); IFG + IGT 22 (25,00%); T2DM 16 (18.18%); normal result of OGTT 11 (12,50%) and IGT 6 (6,82%).
3. In general practice, emphasis on detection of glucose metabolism abnormalities allows early diagnosis of medical problem in individual patients and implementation of lifestyle modification and/or pharmacological treatment.

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