PREDICTIVE VALUE OF RISK FACTORS FOR THE PROGRESSION FROM PREDIABETES TO TYPE 2 DIABETES

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BACKGROUND AND AIMS

Diabetes and prediabetes have become major public health problems in recent decades, and are increasing in prevalence around the world. The aim of the present study was to evaluate the predictive value of different risk factors and their changes with time on the progression from prediabetes to type 2 diabetes.

MATERIAL AND METHODS

A total of 383 subjects (213 females and 170 males), at mean age 51.93±13.47 years and mean BMI 29.11±5.3 kg/m^2 were included in the study. According to glucose tolerance they were divided in three groups:

- 147 (84 females and 63 males) with normal glucose tolerance (NGT), of mean age 50.06±14.8 years, mean BMI 28.46±6.0 kg/m^2
- 122 (69 females and 53 males) with impaired fasting glucose (IFG), of mean age 52.48±12.9 years, mean BMI 29.39±5.1 kg/m^2
- 114 (60 females and 54 males) with impaired glucose tolerance (IGT), of mean age 53.75±13.1 years, mean BMI 29.64±5.5 kg/m^2

and were followed-up about a year (13.4±2.2 months) later.

Laboratory methods

- Glucose tolerance was studied during standard OGTT with 75g glucose applying 2006 WHO criteria.
- Plasma glucose was measured by a hexokinase method.
- Serum lipids – total cholesterol, HDL-cholesterol, triglycerides, were assessed by enzyme-colorimetric tests.
- hsCRP was measured turbidimetrically.
- HbA1c was measured in whole blood immuno-turbidimetrically.
- Serum insulin concentrations were determined using immuno-radio-metric assay (IRMA).
- Serum proinsulin levels were measured by enzyme-linked immunosorbent assay (ELISA).

Anthropometric measurements

- Weight and height were measured and BMI was calculated.
- Waist circumference was measured with a plastic tape in the horizontal plane midway between the lowest rib and the iliac crest.
- Body fat mass and visceral fat area were measured by bioimpedance analysis (InBody 720).

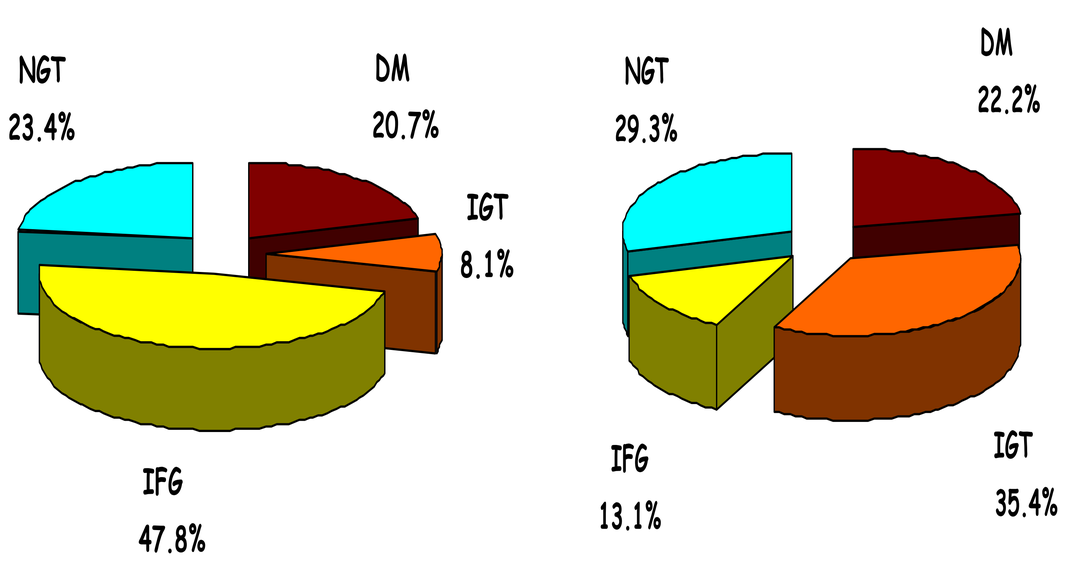
Blood pressure was measured twice in seated position after 5 minutes rest with a manual sphingomanometer.

Statistical methods

Statistical analysis - SPSS 17.0 for Windows (SPSS, Chicago, USA).

RESULTS

FOLLOW-UP OF GLUCOSE TOLERANCE IN THE GROUPS WITH IFG AND IGT AFTER ONE YEAR



Analysis of the predictive value of different baseline parameters for the progression from prediabetes (IFG and IGT) to diabetes (Baseline determinant model). Rate ratios (RR) with 95% CI are presented.

Parameter	Impaired Fasting Glucose (IFG)		Impaired Glucose Tolerance (IGT)	
	RR (95%CI)	p	RR (95%CI)	p
Sex (women vs men)	0.662 (0.346-1.267)	0.212	0.722 (0.387-1.346)	0.306
Family history of diabetes (yes vs no)	1.540 (0.797-2.974)	0.199	1.107 (0.583- 2.099)	0.756
Dyslipidaemia (yes vs no)	0.669 (0.350-1.280)	0.225	1.012 (0.552- 1.858)	0.968
Obesity (yes vs no)	2.435 (0.824-7.285)	0.111	6.691 (2.459- 18.208)	**0.0001**
History of abnormal glucose (yes vs no)	9.571 (3.917-23.387)	**0.0001**	2.771 (1.113- 3.227)	**0.028**
Physical activity (yes vs no)	0.437 (0.173-1.102)	0.079	0.549 (0.240- 1.256)	0.156
Known hypertension (yes vs no)	1.253 (0.648-2.425)	0.502	0.774 (0.402- 1.490)	0.444
Fruit and vegetable intake (yes vs no)	0.423 (0.216-0.826)	**0.012**	0.251 (0.126- 0.498)	**0.0001**
Smoking (yes vs no)	0.754 (0.398-1.427)	0.385	1.705 (0.900-3.227)	0.102
Age (per 5 years)	1.033 (1.001-1.060)	**0.046**	1.012 (0.988- 1.036)	0.320
Fasting blood glucose (per 0.5 mmol/l)	10.21(4.513-23.098)	**0.0001**	11.775 (5.286-26.23)	**0.0001**
2h blood glucose (per 0.5 mmol/l)	3.696 (2.063- 6.623)	**0.0001**	2.062 (1.539-2.763)	**0.0001**
HbA1c (per 0.5%)	8.830 (4.252-18.338)	**0.0001**	6.421 (3.451-11.946)	**0.0001**
Total cholesterol (per mmol/l)	1.034 (0.774-1.373)	0.817	1.101 (0.864-1.404)	0.437
HDL cholesterol (per mmol/l)	0.880 (0.343-2.260)	0.790	0.523 (0.239-1.145)	0.105
LDL cholesterol (per mmol/l)	1.008 (0.718-1.414)	0.964	1.125 (0.863-1.465)	0.385
Triglycerides (per mmol/l)	1.079 (0.827-1.406)	0.576	1.022 (0.849-1.231)	0.817
hsCRP (per mg/l)	1.136 (1.008-1.280)	**0.037**	1.035 (0.954-1.123)	0.410
BMI (per kg/m^2)	1.056 (0.988-1.128)	0.110	1.055 (1.004-1.112)	**0.048**
Waist circumference (per cm)	1.024 (0.094-1.014)	0.113	1.023 (1.000-1.046)	**0.049**
Body fat mass (per %)	1.003 (0.968-1.039)	0.876	1.003 (0.972-1.035)	0.860
Visceral fat (per cm^2)	1.010 (0.998-1.022)	0.107	1.003 (0.994-1.011)	0.541
Systolic blood pressure (per mmHg)	1.025 (1.004-1.046)	**0.018**	1.014 (0.998-1.030)	0.078
Diastolic blood pressure (per mmHg)	1.014 (0.982-1.047)	0.403	1.012 (0.995-1.050)	0.108
Insulin (per mIU/l)	1.048 (0.989-1.111)	0.115	1.027 (0.997-1.080)	0.288
Proinsulin (per pmol/l)	1.155 (1.036-1.288)	**0.009**	1.052 (1.003-1.103)	**0.036**
Proinsulin:insulin (per pmol.mIU^{-1})	10.474 (1.535-71.50)	**0.017**	2.794 (1.064-8.100)	**0.049**
HOMA-IR (per mmol/l.mIU/l)	1.341 (1.070-1.679)	**0.011**	1.299 (1.062-1.590)	**0.011**
HOMA-%B (per %)	0.995 (0.984-1.007)	0.421	0.985 (0.974-0.997)	**0.045**

Analysis of the predictive value of time-dependent changes in the studied parameters for the progression from prediabetes (IFG and IGT) to diabetes (Time-dependent change-determinant model). Rate ratios (RR) with 95% CI are presented.

Parameter	Impaired fasting glucose (IFG)			Impaired glucose tolerance (IGT)		
	Change (95% CI)	RR* (95% CI)	p	Change (95% CI)	RR* (95% CI)	p
HbA1c (RR: per increased 0.5%/year)	0.452 (0.292-0.612)	9.992 (2.941-33.945)	**0.0001**	0.105 (-0.124-0.334)	3.245 (1.215-8.668)	**0.009**
Total cholesterol (RR: per increased mmol.l^{-1}/year)	-0.690 (-1.00;-0.381)	2.947 (1.142-7.606)	**0.025**	-0.147 (-0.548-0.254)	0.637 (0.345-1.176)	0.150
HDL cholesterol (RR: per increased 0.1 mmol.l^{-1}/year)	-0.031 (-0.101-0.039)	0.221 (0.018-2.670)	0.235	-0.025 (-0.185-0.135)	0.774 0.179-3.343)	0.732
LDL cholesterol (RR: per increased mmol.l^{-1}/year)	-0.652 (-0.957;-0.346)	1.944 (0.802-4.715)	0.141	-0.370 (-0.788-0.049)	0.884 (0.437-1.787)	0.731
Triglycerides (RR: per increased mmol.l^{-1}/year)	-0.015 (-0.322-0.29)	7.516 (2.196-25.726)	**0.001**	0.082 (-0.254-0.418)	0.616 (0.245-1.782)	0.414
hsCRP (RR: per increased mg.l^{-1}/year)	-0.968 (-1.828;-0.105)	1.623 (0.822-3.203)	0.163	-0.978 (-2.899-0.944)	1.176 (0.952-1.453)	0.133
BMI (RR: per increased kg/m^2/year)	0.265 (-0.162-0.69)	1.889 (1.090-3.275)	**0.023**	-0.001 (-0.518-0.516)	1.277 (1.065-2.115)	**0.034**
Waist circumference (RR: per increased cm/year)	0.211 (-0.808-1.229)	1.402 (1.045-1.882)	**0.024**	-0.765 (-2.168-0.639	1.108 (0.927-1.323)	0.259
Body fat mass (RR: per increased %/year)	1.163 (0.471-1.855)	1.246 (0.891-1.743)	0.198	-0.747 (-1.804-0.310)	1.110 (1.027-1.201)	**0.009**
Systolic blood pressure (RR: per increased 5 mmHg/year)	-0.053 (-3.694-3.589)	1.082 (1.001-1.162)	**0.041**	-4.471 (-8.837;-0.104)	1.091 (1.004-1.184)	**0.039**
Diastolic blood pressure (RR: per increased 5 mmHg/year)	-1.842 (-4.368-0.684)	1.183 (1.041-1.343)	**0.010**	-3.765 (-6.707;-0.823)	1.010 (0.928-1.099)	0.812

* Rate ratios (RR) are adjusted for age, sex and baseline value of the covariates.

CONCLUSIONS

- Individuals with IFG and IGT identified through high-risk strategies in a Bulgarian population, have a rather high risk of developing diabetes within 1 year – progression rates from IFG and IGT to diabetes - 12.08 and 19.91 per 100 person-years.
- The changes in glucose measures, body weight, waist circumference, body fat mass, total cholesterol and triglycerides, systolic and diastolic blood pressure are significant determinants of progression to diabetes.
- Adequate measures for the control of risk factors is necessary for the prevention of the disease.

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