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Screening for dysglycaemia in patients with coronary artery disease as reflected by fasting glucose, oral glucose tolerance test, and HbA1c: a report from EUROASPIRE IV—a survey from the European Society of Cardiology

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Aims Three methods are used to identify dysglycaemia: fasting plasma glucose (FPG), 2-h post-load plasma glucose (2hPG) from the oral glucose tolerance test (OGTT), and glycated haemoglobin A1c (HbA1c). The aim was to describe the yield and concordance of FPG, HbA1c, and 2hPG alone, or in combination, to identify dysglycaemia in patients with coronary artery disease.

Methods and results In EUROASPIRE IV, a cross-sectional survey of patients aged 18–80 years with coronary artery disease in 24 European countries, 4004 patients with no reported history of diabetes had FPG, 2hPG, and HbA1c measured. All participants were divided into different glycaemic categories according to the ADA and WHO criteria for dysglycaemia. Using all screening tests together, 1158 (29%) had undetected diabetes. Out of them, the proportion identified by FPG was 75%, by 2hPG 40%, by HbA1c 17%, by FPG + HbA1c 81%, and by OGTT (=FPG + 2hPG) 96%. Only 7% were detected by all three methods FPG, 2hPG, and HbA1c. The ADA criteria (FPG + HbA1c) identified 90% of the population as having dysglycaemia compared with 73% with the WHO criteria (OGTT = FPG + 2hPG). Screening according to the ADA criteria for FPG + HbA1c identified 2643 (66%) as having a 'high risk for diabetes', while the WHO criteria for FPG + 2hPG identified 1829 patients (46%).

Conclusion In patients with established coronary artery disease, the OGTT identifies the largest number of patients with previously undiagnosed diabetes and should be the preferred test when assessing the glycaemic state of such patients.

Keywords Coronary artery disease • Diabetes • Impaired fasting glucose • Impaired glucose tolerance • HbA1c • Oral glucose tolerance test

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Introduction

The majority of patients with coronary artery disease have an abnormal glucose metabolism that is frequently unrecognized.[1,2] Dysglycaemia, defined as impaired fasting glucose, impaired glucose tolerance, high-risk HbA1c, and diabetes mellitus, is characterized by an elevated glucose concentration in the circulating blood. Today three methods are used to identify dysglycaemia: fasting plasma glucose (FPG), 2-h post-load plasma glucose (2hPG) from the oral glucose tolerance test (OGTT), and glycated haemoglobin A1c (HbA1c).[3–5] The diagnostic threshold is based on detecting glycaemia associated with diabetes-induced retinopathy.[6] Originally, HbA1c was intended to monitor glycaemic control, but in 2010, it was introduced as a diagnostic measure of diabetes by the American Diabetes Association (ADA).[3] Current guidelines endorse the use of all three tests for diagnosis,[3–5,7,8] but there is controversy about which one is preferable for screening for diabetes and other forms of dysglycaemia.[9] The debate is centred on the long duration (2 h) needed to perform an OGTT, the reproducibility of post-load 2hPG vs. the lower sensitivity of FPG and HbA1c to predict macrovascular events and to detect diabetes compared with 2hPG.[10]

It has been reported there is limited overlap between the three available tests and that a non-diagnostic value using one test does not exclude diabetes with another one.[3,5] In 2010, the ADA stated that 'Further research is needed to better characterize those patients whose glycaemic status might be categorized differently by two different tests (e.g. FPG and HbA1c) obtained in close temporal approximation'.[3]

The European Action on Secondary Prevention through Intervention to Reduce Events (EUROASPIRE) are large cross-sectional surveys across Europe of patients with coronary artery disease to evaluate the adherence to Joint European Societies prevention guidelines.[11] In the current survey, EUROASPIRE IV, the scope was widened to include all tests for dysglycaemia in those without prevalent diabetes using the protocol from the EuroHeart Survey of Diabetes and the Heart.[12] This created a unique opportunity to compare different screening tests for dysglycaemia in a large, well-characterized patient cohort with coronary artery disease.

The present objective is to describe the yield of and concordance between FPG, HbA1c, and 2hPG to identify diabetes mellitus and other forms of dysglycaemia in patients with established coronary artery disease.

Methods

Study population

EUROASPIRE IV was conducted at 79 centres in 24 European countries during May 2012 to April 2013. Men and women aged ≥18–<80 years were identified by a first or recurrent clinical evidence of coronary artery disease at a time 6–36 months before recruitment: (i) coronary artery bypass grafting (CABG); (ii) percutaneous coronary intervention (PCI); (iii) acute myocardial infarction (ICD-10 121); and (iv) acute myocardial ischaemia (ICD-10 120). For the present study patients without known diabetes and full information on FPG, OGTT, and HbA1c were included (*Figure 1*).

Methods

Information on personal and demographic details, self-reported lifestyle and medication were obtained during an outpatient visit at the participating centres. Data collectors were trained to use standardized methodologies for physical measurements and all equipment were calibrated according to the manufacturer's recommendations. The following measurements were performed according to a written protocol:

Height (kg) and weight (cm) in light indoor clothes without shoes (scales 701 and measuring stick model 220; SECA Medical Measuring Systems and Scales, Birmingham, UK).

Waist circumference (cm) was measured using a metal tape with the patient standing.

Blood pressure (mmHg) was measured twice on the right upper arm in the sitting position using an automatic sphygmomanometer (Omron M6; OMRON Corporation, Kyoto, Japan) and the mean was used for the analyses.

Physical activity was assessed by means of the International Physical Activity Questionnaire (IPAQ; IPAQ core group, Karolinska Institutet, Stockholm, Sweden).

Laboratory investigations

Before cholesterol and HbA1c measurements, serum and blood samples were transported frozen to the central laboratory (Disease Risk Unit, National Institute for Health and Welfare, Helsinki, Finland) and stored at −70°C. The laboratory has been accredited by Finnish Accreditation Service and fulfils the requirements of the standard SFS-EN ISO/IEC 17025:2005.

HbA1c [mmol/mol (% = Diabetes Control and Complications Trial [DCCT])] was measured at the central laboratory (Disease Risk Unit, National Institute for Health and Welfare, Helsinki, Finland) with an immunoturbidimetric IFCC aligned method (Abbot Architect analyser; Abbott Laboratories, Abbott Park, IL, USA) in fasting venous whole blood sampled in an EDTA-tube.

Blood lipids [mmol/L (mg/dL)] were measured in the fasting state and analysed at the central laboratory on a clinical chemistry analyzer (Abbot Architect analyzer; Abbott Laboratories, Abbott Park, Illinois, USA) using enzymatic method for measuring total cholesterol.

An OGTT [mmol/L (mg/dL)] was performed using 75 g of glucose in 200 mL of water in the morning after at least 10 h of fasting. Blood for FPG was drawn before intake of the glucose with a dip safe from the EDTA-tube in which the HbA1c was collected. Samples for 2hPG were drawn from whole venous blood using an EDTA-tube. Plasma glucose was analysed locally with a photometric point-of-care technique (Glucose 201+, HemoCue®, Ängelholm, Sweden). Regression analysis between the HemoCue® instrument and standard isotope dilution gas chromatography–mass spectrometry (IDGC-MS) showed a slope of 1.051 (95% confidence interval: 1.031–1.071) an intercept of −0.222 (95% CI −0.016 to −0.428; $r = 0.994$). The mean deviation was 0.24 mmol/L (2.0%). Values obtained with the HemoCue® instrument were in 69% within 5%, in 91% within 10%, and always within 14.3% of the ID GC-MS method.[13] The HemoCue® method is cholesterol sensitive due to the measurement in very small volumes with higher levels of glucose with lower cholesterol. Therefore, the glucose values were corrected according to the formula: HemoCue® glucose + 0.22 × (total cholesterol −5 mmol/L). The values were converted from whole venous blood to plasma applying the formula by Carstensen *et al.*:[14] plasma glucose = 0.558 + 0.119 × whole blood glucose, as used by the Euro Heart Survey on Diabetes and the Heart.[12] The standardized use of the equipment was assured through the central training of the data collectors, and retrieval of HemoCue®-cuvette storage information and validation sheets from a selection of the participating centres.

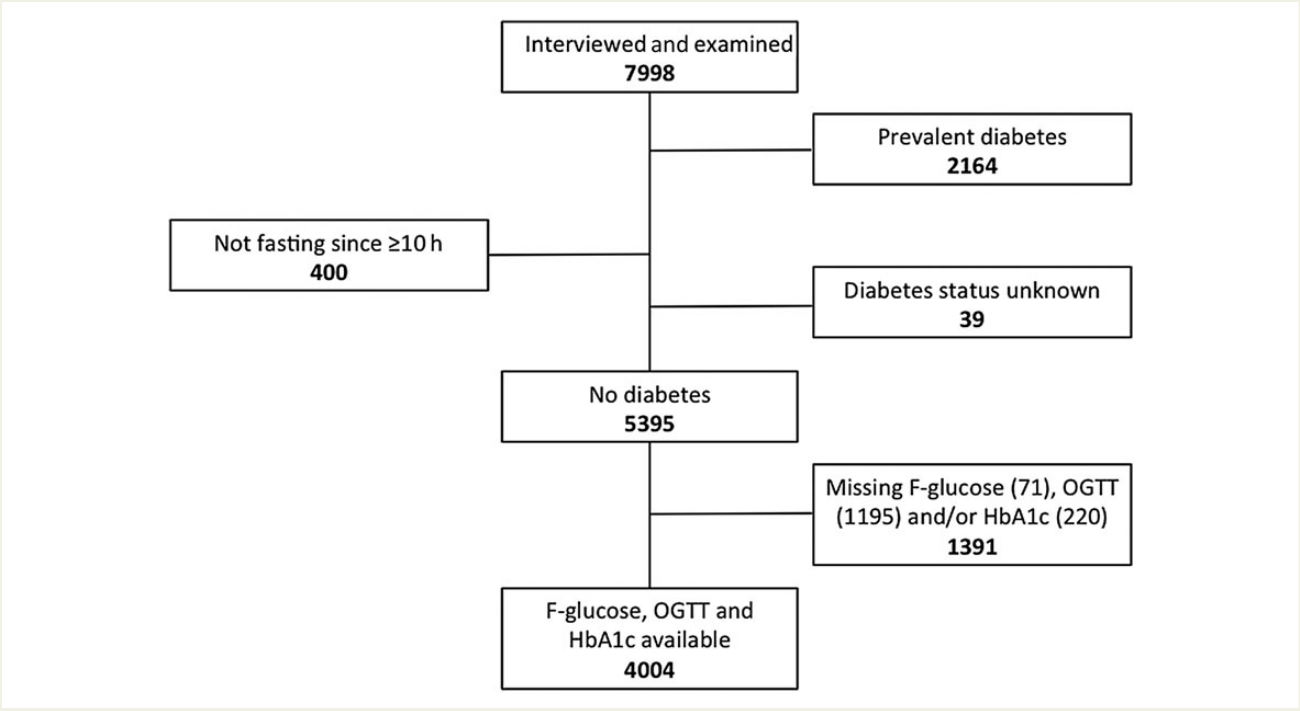

Figure 1 Patient flow chart.

Definitions

Dysglycaemia,[3–5] comprise any of the following conditions:

- Diabetes – ADA + WHO, was defined as a FPG ≥7.0 mmol/L (126 mg/dL), 2hPG value ≥11.1 mmol/L (200 mg/dL) or HbA1c ≥48 mmol/mol (≥6.5%).
- Impaired F-glucose (IFG) – ADA, was defined as a FPG 5.6–6.9 mmol/L (101–125 mg/dL), and HbA1c <48 mmol/mol (<6.5%).
- Impaired F-glucose (IFG) – WHO, was defined as a FPG 6.1–6.9 mmol/L (110–125 mg/dL) and 2hPG less than 7.8 mmol/L (140 mg/dL), and HbA1c <48 mmol/mol (<6.5%).
- Impaired glucose tolerance (IGT) – WHO, was defined as a 2hPG in the OGTT 7.8–11.0 mmol/mol (140–198 mg/dL), and FPG <7.0 mmol/L (126 mg/dL), and HbA1c <48 mmol/mol (<6.5%)
- High-risk HbA1c – ADA, was defined as 39–47 mmol/mol (5.7–6.4%) according to ADA.
- When the term 'high risk for diabetes' is used it includes IFG and IGT (WHO) or IFG and high-risk HbA1c (ADA).

Overweight: was defined as a body mass index (BMI) 25.0–29.9 kg/m^2 and obesity as a BMI ≥30 kg/m^2. Central obesity was defined as a waist circumference of ≥88 cm for women and ≥102 cm for men.

High blood pressure: was defined as elevated if systolic blood pressure (SBP) was ≥140 mmHg and/or diastolic blood pressure (DBP) ≥90 mmHg.

Smoking: at the time of interview was defined as self-reported smoking, and/or a breath carbon monoxide exceeding 10 ppm.

Physical activity: was assessed by the international activity questionnaire (IPAQ). Low or moderate physical activity was defined as proposed in http://www.ipaq.ki.se/scoring.pdf.

Low educational level: was defined as primary school completed or less.

Data management

Data were submitted online to the data management centre (EuroObservational Research Program for EUROASPIRE IV, European Heart House, Sophia Antipolis, France). Data were checked for completeness, internal consistency, and accuracy. All data were stored under the provisions of the National Data Protection Regulations.

Statistical analyses

Descriptive statistics (means, standard deviation, and proportions) were used to present information on patient characteristics. Included and excluded patients (*Table 1*) were compared according to Fisher's exact test and the Mann–Whitney *U* test. *P*-values for the comparison between the three separate exclusive groups in *Table 1* were obtained by means of logistic regression analysis adjusting for gender and age at the time of interview. A two-sided $P < 0.05$ was considered statistically significant. All statistical analyses were undertaken using SAS statistical software release 9.3 (SAS Institute Inc., Cary, NC, USA).

Ethics

The study complies with the Declaration of Helsinki and local Ethics Committees of all participating centres approved EUROASPIRE IV. Written, informed consent was obtained from each participant.

Results

Patient population and characteristics

A total of 7998 patients were interviewed and 5395 (67%) of them reported no history of diabetes (*Figure 1*). Complete information on FPG, OGTT, and HbA1c was available for 4004 (74%) patients, who were included in this analysis. Clinical characteristics at

Table 1 Pertinent characteristics in patients with screen-detected diabetes by means of Fasting Plasma Glucose alone (FPG), 2 h post-load Glucose alone (2hPG) and HbA1c alone

	FPG ≥7 mmol/L (*n* = 606)	HbA1c ≥6.5% (*n* = 49)	2hPG ≥11.1 mmol/L (*n* = 218)	*P*-value[a]
Age (years; mean ± SD)	65 (9.4)	61 (11.2)	67 (8.8)	0.03
Female gender	22 (135/606)	12 (6/49)	28 (60/218)	0.18
Low educational level	18 (107/603)	29 (14/49)	16 (35/216)	0.06
Current smoking	15 (91/606)	20 (10/49)	11 (23/218)	0.35
BMI (kg/m^2; mean ± SD)	29 (4.1)	30 (4.4)	30 (4.8)	0.006
BMI ≥25	84 (507/606)	86 (42/49)	85 (186/218)	0.78
BMI ≥30 kg/m^2	35 (209/606)	53 (26/49)	42 (91/218)	0.01
Central obesity	58 (349/601)	66 (31/47)	62 (133/213)	0.31
Blood pressure ≥140/90 mmHg	39 (237/606)	31 (15/49)	41 (89/216)	0.52
Total cholesterol ≥4.5 mmol/L	43 (262/605)	37 (18/49)	37 (81/218)	0.24
Triglycerides ≥ 1.7 mmol/L	27 (163/603)	41 (20/49)	31 (66/216)	0.12
ASA/antiplatelets	91 (551/603)	98 (48/49)	96 (209/218)	0.03
Beta-blockers	82 (497/603)	92 (45/49)	83 (180/218)	0.26
ACE-inhibitors	59 (357/603)	63 (31/49)	67 (146/218)	0.07
AT-II Receptor antagonists	16 (96/603)	10 (5/49)	16 (34/218)	0.67
Diuretics	31 (185/603)	25 (12/49)	31 (68/218)	0.83
Statins	84 (506/603)	90 (44/49)	89 (193/218)	0.16
Low or moderate physical activity	48 (229/476)	63 (20/32)	58 (102/177)	0.06

Data presented are % (*n*) if not stated otherwise.
[a]Significance of the difference between groups, adjusted for age and gender.

interview of participants who were included and excluded are presented in a Supplementary material online, *Table*. Patients included had a lower FPG, HbA1c, and lower proportions of smoking and blood pressure ≥140/90 mmHg but a higher proportion of central obesity than those with incomplete data. In total, 1158/4004 had previously undetected diabetes (29%; men 29%/women 28%) according to the criteria of ADA and WHO using FPG, 2hPG, or HbA1c.

There were no major differences in the characteristics of patients with diabetes identified by only one of the three tests (*Table 1*), although the 49 patients detected by HbA1c alone had a lower education level, higher prevalence of obesity, and were less physically active. Moreover, HbA1c was only slightly elevated (6.5–6.9%) in a majority of these patients (82%) while it was 7.0–7.4% in six, 7.5–7.9% in two, and ≥8.0% in one patient, respectively. The nine patients with HbA1c ≥7.0% were not different from all other patients except that all of them were men (n.s).

Detection of diabetes

The proportions screened as having diabetes using different tests and the overlaps between them are presented in *Figure 2A*. Of the 1158 screened with diabetes, the proportions identified were by FPG: 75%, 2hPG: 40%, HbA1c 17%, OGTT = FPG + 2hPG: 96% and by HbA1c + FPG: 81%. There was some overlap in individuals detected by different methods and the proportion having diabetes by all three methods was 7.2% (women 7.5%; men 7.1%). Of the 466 patients with diabetes based on an elevated 2hPG, a total of 218 (47%) would not have been detected with diabetes without the glucose load.

Patients at high-risk for diabetes

Applying the WHO criteria, based on the OGTT = FPG + 2hPG, a total of 1065 (27%) had normal glucose metabolism while the corresponding proportion was 420 (11%) according to the ADA criteria, based on FPG + HbA1c (*Figure 3*). Screening according to the ADA criteria for FPG + HbA1c identified 2643 (66%) of patients as having a 'high risk for diabetes' where IFG contributed 91% and high-risk HbA1c 53%. The overlap, i.e. patients identified as having high risk by both tests, was 44%. The WHO criteria identified 1829 patients (46%) as having a 'high risk for diabetes' where 76% was identified by IFG and 53% by IGT with an overlap of 29%.

Discussion

This is the largest study comparing three currently recommended screening tests for dysglycaemia in patients with coronary artery disease. The most important finding was that screening by means of an OGTT identified the largest number of patients with undetected diabetes. The difference between FPG and/or HbA1c and FPG and/or 2hPG for detecting diabetes was 15%. The overlap in case detection between FPG, 2hPG, and HbA1c was very small. Moreover, screening with HbA1c alone would have left 83% of those with diabetes undetected. In addition, the total proportion of patients identified with diabetes and other forms of dysglycaemia varied from 90% using the ADA criteria for FPG + HbA1c to 73% using the WHO criteria for OGTT = FPG + 2hPG.

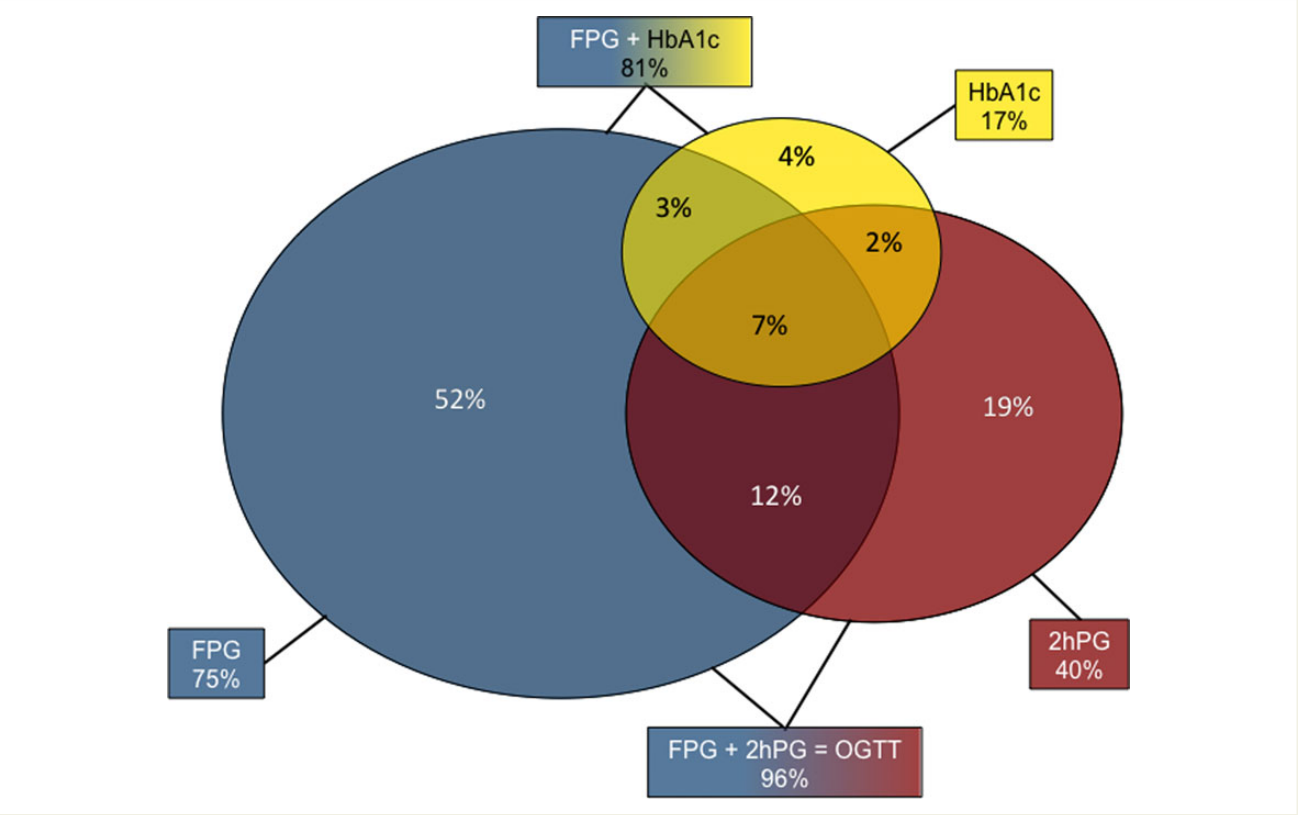

Figure 2 Proportions and their overlap between screening with fasting plasma glucose ≥7 mmol/L ($n = 867$), plasma glucose 2 h after a glucose load ≥11.1 mmol/L (2hPG, $n = 466$), glycated haemoglobin A1c ≥ 6.5%/48 mmol/mol (HbA1c, $n = 193$) and combinations commonly used in clinical practice (fasting plasma glucose + HbA1c and fasting plasma glucose + 2hPG) for the 1158 patients with newly detected diabetes.

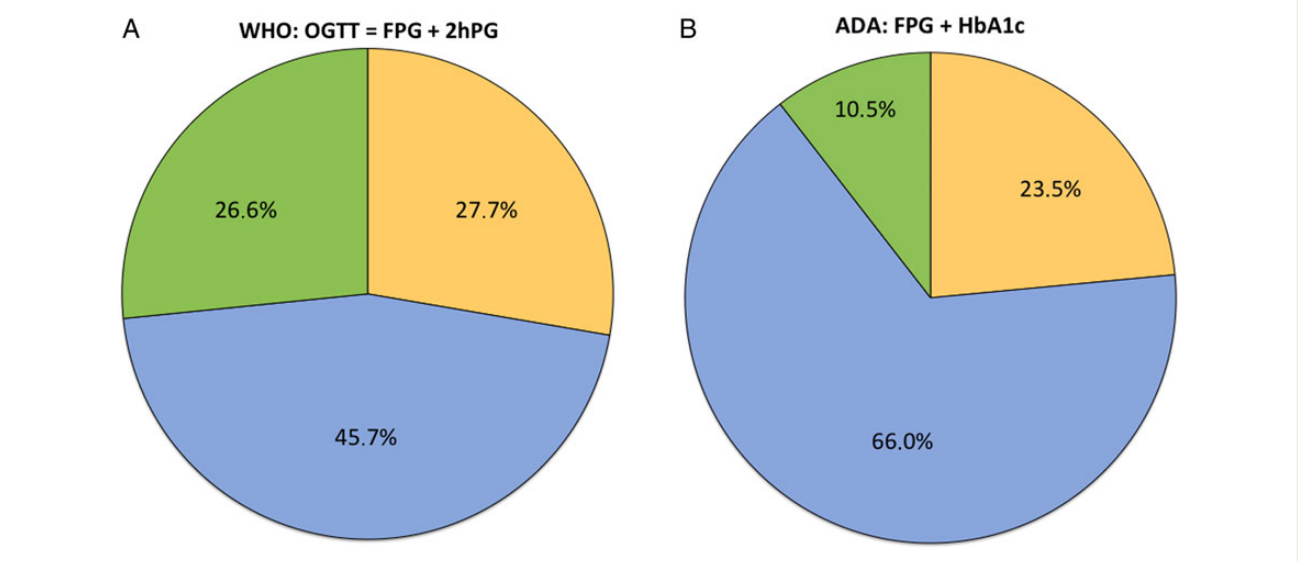

Figure 3 Proportion of patients with varying risk for dysglycaemia by different tests and criteria. Yellow = newly detected diabetes; Blue = high risk to develop diabetes; and Green = normoglycaemia. (*A*) According to WHO, i.e. diabetes = fasting plasma glucose ≥7.0 mmol/L (126 mg/dL) and/or 2hPG ≥11.1 mmol/L (200 mg/dL); impaired F-glucose = fasting plasma glucose 6.1–6.9 mmol/L (110–125 mg/dL); and IGT = 2hPG 7.8–11.0 mmol/mol (140–198 mg/dL). (*B*) According to ADA, i.e. diabetes = fasting plasma glucose ≥7.0 mmol/L (126 mg/dL) and/or HbA1c ≥48 mmol/mol (≥6.5%); impaired F-glucose = fasting plasma glucose 5.6–6–9 mmol/L (101–125 mg/dL); and high risk HbA1c = HbA1c 39–47 mmol/mol (5.7–6.4%).

Recent reports based on smaller patient populations with acute coronary syndromes,[15] stable coronary artery disease,[16] or referral for coronary angiography[17] reveal that a HbA1c ≥48 mmol/mol (≥6.5%) detects only a small number of patients with unknown diabetes compared with screening based on OGTT.[18] The present study confirms and extends these findings to a broader and larger population of coronary patients. In the Euro Heart Survey of Diabetes and the Heart the proportion of newly detected diabetes and IFG + IGT in patients with stable coronary artery disease detected by an OGTT according to the WHO criteria was 14 and 37%, respectively.[19] This is lower than the 28 and 46% observed in the present study. The reason may be differences in the patient populations, but it is also possible that the proportion of European coronary patients with undetected diabetes and IGT has increased since 2003–04 considering the global increase in dysglycaemic conditions.[20] This highlights the importance of investigating the glycaemic state of people with coronary artery disease.[4] The present findings indicate that such screening is poorly practiced. One reason may be that an OGTT is considered time consuming and that it is easier to use HbA1c alone or combined with FPG. There was a limited overlap in the detection of dysglycaemia between the three screening methods and their combinations as already reported.[16] Individuals identified to have diabetes by one method only did not differ largely from each other.

Population based screening with HbA1c >48 mmol/mol (≥6.5%) alone diagnosed less diabetes than disclosed by the OGTT in some studies[21,22] while other studies reported that more diabetes was detected by HbA1c than the OGTT.[21,22] Some of these differences may relate to ethnicity.[23,24] The combination of HbA1c and FPG increased the yield of patients with diabetes coming closer to the proportion identified by the OGTT although not identifying exactly the same patient population. A concern about using HbA1c and FPG together, as proposed by the ADA, is that it labels far more individuals (90%) as dysglycaemic than an OGTT using the WHO criteria (73%) due to lower cut points for FPG and HbA1c. Furthermore, WHO and others acknowledge that an HbA1c between 39 and 47 mmol/mol (5.7–6.4%) is less effective than FPG and 2hPG for predicting individuals at risk of developing diabetes.[5,25] The comparison of the proportions identified by means of the OGTT indicates that the ADA criteria of HbA1c + FPG may overestimate the prevalence of individuals at high risk for diabetes and underestimate the prevalence of previously undiagnosed diabetes. While there is solid evidence for people with IGT, as detected by an OGTT, that lifestyle and pharmacological interventions can reduce progression to diabetes by about 50%,[4] such evidence is not available for people with IFG and high-risk HbA1c.

Under-diagnosing dysglycaemia would be less important if this state had little or no impact on the future prognosis in patients with coronary artery disease.[12,26–29] There is a stronger association between the 2hPG and the level of carotid intima–media thickness, the extent of coronary artery disease as well as cardiovascular risk according to the Framingham score compared with the FPG and HbA1c.[27,30,31] The relationship between FPG or HbA1c and mortality, when corrected for post-load glycaemia and other cardiovascular risk factors, has not been confirmed while this relationship is established for 2hPG.[17,29] Additionally, people with IGT are more likely to develop cardiovascular disease progression than those with IFG, while such prognostic information is limited regarding HbA1c.[28,32] Moreover, HbA1c between 39 and 47 mmol/mol (5.7–6.4%) is less sensitive than IFG and IGT to detect individuals with β-cell dysfunction and insulin resistance.[25]

On the other hand over-diagnosing dysglycaemia with the low thresholds of FPG and HbA1c may also have negative implications causing concern for patients and lead to the unnecessary use of health care resources. This makes it important to evaluate potential differences in prognostic information gained by the three tests used to detect previously unknown dysglycaemia in patients with coronary artery disease. By analogy with the current diagnostic thresholds for diabetes, which are related to retinopathy, research is required to find a similar glucose threshold for the cardiovascular prognosis in patients with coronary artery disease. When dysglycaemia is discovered in a patient with coronary artery disease, a clinician should be alerted to the even greater risk for recurrent coronary events and mortality. High cardiovascular risk in patients with diabetes can be lowered to almost that of normoglycaemic patients through multifactorial management, including lifestyle, pharmacotherapy, and revascularization, as recommended by the current guidelines.[12,33] Given the low yield of an isolated HbA1c, it is perhaps better to abstain from this test on patients with coronary artery disease if resources are scarce, at least until more data supporting its prognostic value is available or algorithms intended to limit the use of OGTT are properly validated.[18,34]

Discrepancies also exist in recommendations expressed in different guidelines and by expert groups regarding the levels of FPG and HbA1c that should define a person to be at high risk of developing diabetes.[4,5,35,36] The OGTT is the only method on which there is an agreement on the definition of 'high risk', i.e. IGT.[5] There is a need for further research on the clinical value of the high-risk classification by FPG and HbA1c, before it is integrated into clinical practice as an evidence-based recommendation for patients with coronary artery disease.

Study strengths and limitations

EUROASPIRE IV is a large cross-sectional European study, which enabled the investigation of 4004 well-characterized individuals with coronary artery disease, without previously known diabetes. The size of the study population allowed a statistically robust comparison of the three main methods recommended for the screening for dysglycaemia. Standardized central training was given to the staff performing the blood sampling and glucose measurements. All centres used HemoCue® 201 + equipment for glucose determination with appropriate quality control, and the cuvettes and glucose sachets were all centrally supplied. All other measurements were standardized using the same equipment in every centre providing high-quality data collected at a single study visit, rather than from medical records, and limiting potential errors due to transportation. HbA1c was determined in one central laboratory. For logistical reasons, only one blood sample for FPG, 2hPG, and HbA1c each was collected. According to present recommendations, one positive test is not sufficient to diagnose diabetes, it should instead be confirmed by a repeat measurement. Nevertheless, one test is sufficient for the purpose of the screening yield comparison using different methods. The OGTT has been criticized for high variability. This may relate to a dichotomization of a continuous variable, namely plasma glucose. Wallander *et al.*[37] performed an OGTT at 5

days, 3 months, and 12 months after an acute myocardial infarction in 122 patients. Of those who were identified to have diabetes at discharge from hospital, 93% were still classified as dysglycaemic (diabetes 64%; IGT 29%) after 12 months indicating that an OGTT is a reliable test of dysglycaemia over time.

Conclusion

The overlap between the three methods, FPG, 2hPG, and HbA1c, is very small. An OGTT identifies the largest number of coronary patients with previously undiagnosed diabetes. It should therefore be the standard when assessing the glycaemic state of coronary patients. The WHO and ADA criteria result in different yields of patients with other forms of dysglycaemia. It may be that screening according to ADA compared with WHO overestimates the prevalence of other forms of dysglycaemia, a finding that needs further evaluation.

Supplementary material

Supplementary material is available at *European Heart Journal* online.

Authors' contributions

Study concept and design: V.G., L.R., J.T., O.S. Acquisition, analysis, interpretation of data, and approval for submission: all authors. Drafting of the manuscript: V.G., L.R., J.T., O.S., and D.D.B. Critical revision of the manuscript: all authors. Statistical analysis: D.D.B. Further information: See appendix.

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Conflict of interest: All authors completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. V.G. reports lecture honorarium from MSD Sweden. D.D.B., G.D.B., J.S., and O.S. have nothing to declare. K.K. reports grants from European Society of Cardiology and grants from Hoffman-La Roche and Boehringer Ingelheim outside the submitted work. J.T. reports grants and fees from AstraZeneca, grants and fees from Bayer Pharma, grants from Boehringer Ingelheim, fees from Eli Lilly, fees from Impeto Medical, grants and fees from Merck Serono, grants and fees from MSD, fees from Novo Nordisk, grants and fees from Novartis, grants and fees from Sanofi-Aventis, grants from Servier and Orion pharma outside the submitted work. D.W. reports grants from AstraZeneca, Bristol-Myers Squibb/Emea Sarl, GlaxoSmithKline, F. Hoffman-La Roche, and Merck, Sharp & Dohme and fees from AstraZeneca, Merck Sharp, and Dohme, Kowa Pharmaceuticals, Menarini, Zentiva, fees from Merck Sharp and Dohme outside the submitted work. L.R. reports grants from The Swedish Heart-Lung Foundation and The European Society of Cardiology; fees from Roche, BMS and Sanofi-Aventis, grants from Bayer, outside the submitted work.

Appendix

EUROASPIRE was originally an initiative of the ESC Working Group on Epidemiology and Prevention and the first EUROASPIRE survey was undertaken as part of work of the Joint ESC/EAS/ESH Implementation Group on Coronary Prevention. The structure of the administrative organisation is described subsequently followed by a list of participating study centres and organisations, and investigators, and other research personnel.

Scientific steering/Expert committees

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