Prevalence of Undiagnosed Diabetes and Quality of Care in Diabetic Patients Followed at Primary and Tertiary Clinics in Abu Dhabi, United Arab Emirates

Hussein Saadi1, Jumaa Al-Kaabi1, Mahmoud Benbarka2, Ali Khalili3, Wael Almahmeed2, Nicolaas Nagelkerke1, Alessandro Salustri2, Laila Abdel-Wareth2, Awad Al Essa1, Javed Yasin1, Bayan Al-Dabbagh1, and Elsadig Kazam1

1Department of Internal Medicine, Faculty of Medicine and Health Sciences, UAE University, Al Ain, United Arab Emirates. 2Department of Internal Medicine, Sheikh Khalifa Medical City, Abu Dhabi, United Arab Emirates. 3Department of Family Medicine, Sheikh Khalifa Medical City, Abu Dhabi, United Arab Emirates. 4Department of Community Medicine, Faculty of Medicine and Health Sciences, UAE University, Al Ain, United Arab Emirates. 5Department of Laboratory Medicine, Sheikh Khalifa Medical City, Abu Dhabi, United Arab Emirates. Address correspondence to: Hussein Saadi, e-mail: saadih@uaeu.ac.ae

Abstract

AIMS: To investigate the prevalence of undiagnosed type 2 diabetes (T2D) at primary health care (PHC) clinics, and to assess the quality of care of diabetic patients followed at a tertiary hospital diabetes center in Abu Dhabi, United Arab Emirates (UAE).

METHODS: Between May 2009 and October 2010, adult patients attending two PHC clinics, and adult diabetic patients attending the diabetes center, were invited to participate in the study. After overnight fast, participants returned for interview and laboratory tests. Undiagnosed T2D was defined by FPG ≥ 7.0 mmol/l or HbA1c ≥ 6.5%. Quality of care was assessed by reported care practices and achievement of internationally recognized targets.

RESULTS: Out of 239 patients at PHC clinics without history of T2D, 14.6% had undiagnosed T2D, and 31% had increased diabetes risk (FPG 5.6-7.0 mmol/l or HbA1c 5.7-6.5%). The independent predictors of undiagnosed T2D were age (adjusted OR per year 1.07, 95% CI 1.04-1.11, p < 0.001) and BMI ≥ 25 (adjusted OR 4.2, 95% CI 0.91-19.7, p = 0.033). Amongst all 275 diagnosed T2D patients, including those attending PHC clinics and those followed at the diabetes center, it was found that 40.1% followed dietary recommendations, 12% reported visiting a diabetes educator, 28.2% walked for exercise, and 13.5% attained recognized targets of HbA1c < 7%, blood pressure < 130/80 mmHg, and LDL cholesterol < 2.6 mmol/l.

CONCLUSIONS: Almost half of the adult patients attending PHC clinics had undiagnosed T2D, or increased diabetes risk. Care practices, and achievement of treatment targets, were suboptimal.

Keywords: type 2 diabetes · diabetes screening · quality of care · diabetes diagnosis · obesity · hypertension · albuminuria · questionnaire · OGTT · fasting plasma glucose

Introduction

In the United Arab Emirates (UAE), there are growing concerns about diabetes-associated health problems. The UAE has the second-highest diabetes prevalence in the world, particularly type 2 diabetes (T2D) [1, 2]. In 2004, the total annual direct treatment costs of uncomplicated diabetes were estimated at US$ 1,605 per patient, which was more than three times the per capita expenditure for health care in the UAE [3]. Treatment costs increase with age, diabetes duration, complications, and use of insulin [3]. Screening for undiagnosed T2D would be cost-effective...
due to the greater opportunity to reduce cardio-
vacular disease complications, principally
through the use of statins [4, 5]. Also, intensive
multi-factorial intervention in people with screen-
detected T2D in primary care should result in
lower morbidity and mortality [6]. In view of the
high T2D prevalence rate, and the increasing
costs, in the UAE, national guidelines recommend
screening of all adults aged 30 years and above.

Subjects, materials, and methods
Study population
The target population of the survey was adult
Emirati patients residing in Abu Dhabi. We chose
two groups of patients. One group included pa-
tients being treated for general medical problems,
including diabetes, at the PHC clinics of Shaikh
Khalifa Medical City (SKMC). The other included
those who were being actively followed up for
regular diabetes care at the diabetes center of
SKMC. Health care provision in Abu Dhabi is al-
most equally divided between state-managed in-
stitutions and privately-owned facilities. SKMC is
the major state-managed hospital in Abu Dhabi.
The majority of patients attending SKMC are
Emirati citizens, and their health care is funded
by the government of Abu Dhabi. In addition to
being a tertiary hospital, SKMC manages six PHC
d Clinics.

Initially, recruitment was carried out at Al-
Bateen, and later at Al-Khaleej PHC clinics. These
two clinics were selected because they are desig-
nated by SKMC to serve Emirati citizens. These
two clinics employ 12 family medicine consultants,
14 specialists, 30 nurses, and 2 part-time dieti-
tians. They handle 9500 patient visits per month.
The diabetes center at SKMC employs 4 endocri-
nology consultants, 2 specialists, 3 full-time diabe-
tes educators, 1 podiatrist, 2 dietitians, 1 clinical
pharmacist, and 1 part-time clinical psychologist.
The diabetes center handles 1200-1400 patient
visits per month. More than 90% of diabetic pa-
tients who attend the diabetes center are Emirati
citizens. Diabetes patients are usually referred
from PHC clinics to the diabetes center for diabe-
tes education and specific treatment of diabetic
complications. Patients from both PHC clinics and
the diabetes center are referred to the ophthal-
mology department of SKMC for retinopathy
screening.

Subject recruitment
All patients, diabetic and non-diabetic, attend-
ing the two PHC clinics for any reason between
May 2009 and October 2010, were invited to par-
ticipate. Patients learned about the study from the
physicians they were visiting, and from other
health care professionals, such as nurses and
derks, and through posters placed in the clinics.
Eligibility criteria were UAE citizenship, age 18 years and over, and no known pregnancy. 394 (84.7%) of the 465 eligible patients seen at PHC clinics, agreed to participate. Subsequently, 30 (7.6%) of the 394 patients were excluded due to failure to engage in fasting blood measurements, or not completing the questionnaire. Patients who agreed to participate were asked to return after fasting on an agreed date, for interview, physical examination, body fat estimation, and laboratory tests. The latter included oral glucose tolerance test (OGTT) in patients as yet undiagnosed of T2D. OGTT was performed in 121 patients. Most other patients refused OGTT after learning that their fasting blood glucose was normal.

During the study period, all adult diabetic patients attending the diabetes center were invited to participate. 161 (76.3%) of the 211 eligible diabetic patients seen at the diabetes center agreed to participate. Subsequently, 4 of the 161 patients were excluded due to failure to engage in fasting blood measurements, or not completing the questionnaire. One patient reported type 1 diabetes. Patients who agreed to participate were asked to return to the SKMC cardiac laboratory for further study, after fasting on an agreed date. The study was approved by SKMC Research Committee and the Al Ain Medical District Human Research and Ethics Committee.

Questionnaire
Following informed consent, each participant was interviewed in Arabic language by a trained nurse using an English questionnaire on demographic data, tobacco use, diet, physical activity, reproductive history, co-morbidities, medications use, and personal and family history of T2D in first-degree relatives. Information on disease onset, duration, and management were obtained from patients with known T2D diagnosis.

For self-reported diabetic complications, retinopathy was considered to be present if the patient reported diabetic changes in the eye, laser treatment to the retina, or acquired blindness. Peripheral neuropathy was considered, if the diabetic neuropathy symptom (DNS) score was ≥1 [12]. Peripheral vascular disease (PVD) was considered, if circulatory problems or intermittent claudications were reported. Diabetic foot was considered, if patients had foot ulcers, gangrene, or non-traumatic amputation of lower extremities. Cardiac disease was considered, if patients reported angina, myocardial infarction, angioplasty, coronary bypass surgery, or heart failure. Cerebrovascular disease was considered in cases of stroke, or transient ischemic attacks.

Physical examination and anthropometric measurements
Physical examination and measurements were performed by the same trained nurses who carried out questionnaire interviews. Weight and height were measured by portable digital scales, and a portable stadiometer. Waist and hip circumference were measured using a flexible tape over loose clothing. Blood pressure (systolic and phase-V diastolic) recordings were made using a validated electronic sphygmomanometer (Omron Hem 907), after the participants had rested in sitting position for ten minutes. Two separate determinations were made. The mean of the two recorded values was taken as the blood pressure value.

Peripheral neuropathy was ascertained by DNS score and diabetic neuropathy examination (DNE) score [12, 13]. Body fat percent was estimated by bioelectric impedance using the Tanita Body Composition Analyzer, Model TBF-410 (Tanita Corporation, Tokyo, Japan).

Laboratory measurements
In patients with hitherto undiagnosed T2D, fasting blood glucose was determined by glucose meter using Roche Accuchek Inform meter, and OGTT was conducted if blood glucose was <7 mmol/l. Participants were requested to drink 75 g anhydrous glucose dissolved in 250 ml water within the space of five minutes, for the purpose of carrying out OGTT. Fasting venous blood samples were collected from all participants for determination of fasting plasma glucose (FPG), HbA1c, and lipid profile. Spot urine was collected for measurement of albumin and creatinine. All samples were processed within 30 minutes of collection, and the above laboratory tests were measured on a Beckman Coulter DxC800 (Beckman Instruments, Inc., Fullerton, California, USA) autoanalyzer at the central laboratory of SKMC.

Initially, HbA1c was measured by high-performance liquid chromatography (HPLC, BioRad Variant II), and after February 1, 2010, by immunoassay (Cobas Roche Integra 400 plus). Large artery stiffness index (SI) derived from the digital volume pulse (DVP) was measured at the right index finger by a photoplethysmography (PulseTrace PCA2, Micro Medical Ltd., Rochester, UK). SI (m/s) was formulated automatically by computer as body height (m) divided by transition
Table 1. Baseline characteristics and risk factors of study participants by diabetes status and follow-up facility

<table>
<thead>
<tr>
<th>Variable</th>
<th>Low risk (n = 130)</th>
<th>Increased risk (n = 74)</th>
<th>Undiagnosed T2D (n = 35)</th>
<th>Diagnosed T2D (n = 118)</th>
<th>p</th>
<th>Diabetes center (n = 157)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women (%)</td>
<td>86.9</td>
<td>78.4</td>
<td>80.0</td>
<td>76.3</td>
<td>N S</td>
<td>52.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Age (yr)</td>
<td>38.0 ± 12.0</td>
<td>46.7 ± 12.2</td>
<td>52.8 ± 12.0</td>
<td>51.9 ± 11.9</td>
<td>&lt;0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>29.6 ± 6.8</td>
<td>32.4 ± 6.0</td>
<td>31.9 ± 5.9</td>
<td>32.8 ± 6.5</td>
<td>&lt;0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body fat (%)</td>
<td>32.5 ± 11.7</td>
<td>36.0 ± 7.0</td>
<td>34.7 ± 8.8</td>
<td>37.5 ± 10.0</td>
<td>N S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waist (cm)</td>
<td>99.0 ± 13.8</td>
<td>107.1 ± 11.3</td>
<td>106.6 ± 12.7</td>
<td>106.9 ± 12.4</td>
<td>&lt;0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SBP (mmHg)</td>
<td>115.3 ± 12.7</td>
<td>120.8 ± 15.5</td>
<td>129.9 ± 16.6</td>
<td>123.9 ± 16.7</td>
<td>&lt;0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DBP (mmHg)</td>
<td>72.0 ± 8.8</td>
<td>76.7 ± 10.1</td>
<td>78.3 ± 11.7</td>
<td>76.0 ± 12.1</td>
<td>&lt;0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FPG (mmol/l)</td>
<td>4.9 ± 0.3</td>
<td>5.4 ± 0.5</td>
<td>6.3 ± 1.3</td>
<td>8.0 ± 3.3</td>
<td>&lt;0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hba1c (%)</td>
<td>5.5 ± 0.3</td>
<td>6.0 ± 0.3</td>
<td>6.9 ± 0.6</td>
<td>7.8 ± 1.9</td>
<td>&lt;0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T-chol (mmol/l)</td>
<td>4.7 ± 0.9</td>
<td>4.7 ± 1.0</td>
<td>5.1 ± 1.1</td>
<td>4.3 ± 1.1</td>
<td>&lt;0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LDL-C (mmol/l)</td>
<td>3.1 ± 0.8</td>
<td>3.1 ± 0.9</td>
<td>3.4 ± 1.0</td>
<td>2.6 ± 0.9</td>
<td>0.006</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HDL-C (mmol/l)</td>
<td>1.2 ± 0.3</td>
<td>1.1 ± 0.4</td>
<td>1.2 ± 0.3</td>
<td>1.1 ± 0.3</td>
<td>0.03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TG (mmol/l)</td>
<td>0.9 ± 0.5</td>
<td>1.1 ± 0.5</td>
<td>1.2 ± 0.4</td>
<td>1.4 ± 0.8</td>
<td>&lt;0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Albuminuria (mg/mmol)</td>
<td>6.1 ± 9.0</td>
<td>7.0 ± 10.1</td>
<td>10.9 ± 16.8</td>
<td>12.8 ± 29.8</td>
<td>0.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sl (m/s)</td>
<td>7.9 ± 1.8</td>
<td>8.5 ± 1.9</td>
<td>10.3 ± 7.8</td>
<td>8.5 ± 2.1</td>
<td>0.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gestational diabetes (%)</td>
<td>10.8</td>
<td>10.0</td>
<td>21.7</td>
<td>33.7</td>
<td>&lt;0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family history of T2D (%)</td>
<td>52.8</td>
<td>65.8</td>
<td>41.2</td>
<td>61.2</td>
<td>N S</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>63.5</td>
<td>N S</td>
</tr>
</tbody>
</table>

Legend: Data are mean ± SD, or percentage. P-values (ANOVA/Chi-square) are for tests of heterogeneity, i.e. any differences among groups. BMI: body mass index. SBP: systolic blood pressure. DBP: diastolic blood pressure. FPG: fasting plasma glucose. LDL-C: low-density lipoprotein cholesterol. HDL-C: high-density lipoprotein cholesterol. TG: triglycerides. SI: stiffness index. T2D: type 2 diabetes. PHC: primary health care. NS: not significant. NA: not available. Albuminuria is defined as urine albumin/creatinine.

Statistical analysis

Data were analyzed using SPSS version 18 (SPSS Inc., Chicago, IL, USA). Standard descriptive statistics were used. Linear and logistic regression analysis was used for multivariate analysis with continuous and binary dependent variables, respectively. Analysis of criteria for T2D screening was carried out by selecting all cases without prior diagnosis, and performing stepwise (forward selection) logistic regression with undiagnosed diabetes as the dependent variable. All demographic, socio-economic, behavioral, and anthropometric variables that were obtained through simple non-invasive means, e.g. by asking a simple question, were taken as independent variables.

Results

Prevalence of undiagnosed diabetes and diabetes risk factors in patients from PHC clinics

118 (32.4%) of the 364 patients had known diagnosed T2D. OGTT was performed in 121 pa-
tients. Based on 2-hr OGTT (≥11.1 mmol/l), only 3 (2.5%) patients without diabetes history were diagnosted as T2D-positive. The 3 identified patients had FPG ≥7 mmol/l, or HbA1c ≥6.5%. Based on FPG and HbA1c, 239 of the 246 patients without history of T2D were classified as follows (Table 1):

- Undiagnosed diabetes (35 patients; 14.6%)
- Low risk for T2D (130 patients; 54.4%)
- Increased risk for T2D (74 patients; 31%).

Seven patients could not be classified as their HbA1c results were not available. Where T2D had been identified by either FPG, or HbA1c (n = 35), 11.4% were identified only by FPG, 68.6% only by HbA1c, and 20% by both criteria. Among the patients with increased risk for T2D, 13.9% were identified only by FPG, 52.8% only by HbA1c, and 33.3% by both tests.

Compared with other patients, those with diagnosed and undiagnosed T2D were more likely to be older, to have obesity, dyslipidemia, hypertension, albuminuria, history of gestational diabe-
tes, and increased stiffness index. All patients identified as undiagnosed diabetics were ≥45 years and/or had BMI ≥25 kg/m². The only independent predictors of undiagnosed T2D were age (adjusted OR per year 1.07, 95% CI 1.04-1.11, one tailed p-value < 0.001) and BMI ≥25 (adjusted OR 4.2, 95% CI 0.91-19.7, one tailed p-value =0.033).

Clinical profile of diabetic patients seen at PHC clin-
ics and the diabetes center

Baseline characteristics of the participants by their diabetes status are shwon in Table 1. More female pa-
tients were treated at PHC clinics. Amongst all 275 di-
agnosed T2D patients, including those attending PHC clinics and those followed at the diabetes center, it was found that obesity occurred in 46.6% of men, and 73.5% of women. 26% of all women reported history of gestational diabetes. More than half of the latter were treated with insulin.

Diabetic patients followed at the diabetes center had longer duration of diabetes, and were more likely to be using insulin, and taking lipid lower-
ing medications (Table 2). Hypertension and lipid abnormalities were common (reported in 55.7% and 73.6% of all patients, respectively). Whereas, micro-
and macrovascular complications were less prevalent (20.3 and 28.4%, respectively). Abnor-
amal DNS score was found in one-quarter of pa-
tients, but abnormal DNE scores were rare. Ab-
normal ACR was found in approximately half of

<table>
<thead>
<tr>
<th>Variable</th>
<th>All patients (n = 275)</th>
<th>PHC clinics (n = 118)</th>
<th>Diabetes center (n = 157)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time since diagnosis (yr)</td>
<td>9.5 ± 7.5</td>
<td>6.3 ± 7.0</td>
<td>11.7 ± 7.1</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Way of diagnosis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Screening</td>
<td>23.6</td>
<td>27.7</td>
<td>20.6</td>
<td>NS</td>
</tr>
<tr>
<td>Incidental</td>
<td>51.7</td>
<td>50.0</td>
<td>52.9</td>
<td>NS</td>
</tr>
<tr>
<td>Symptoms</td>
<td>24.7</td>
<td>22.3</td>
<td>26.5</td>
<td>NS</td>
</tr>
<tr>
<td>Treatment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lifestyle only</td>
<td>5.1</td>
<td>9.6</td>
<td>1.9</td>
<td>0.01</td>
</tr>
<tr>
<td>OGLD only</td>
<td>65.1</td>
<td>79.1</td>
<td>54.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Insulin + OGLD</td>
<td>29.8</td>
<td>11.3</td>
<td>43.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Anti-lipid medication</td>
<td>73.6</td>
<td>67.2</td>
<td>78.4</td>
<td>0.03</td>
</tr>
<tr>
<td>Hypertension medication</td>
<td>55.7</td>
<td>54.4</td>
<td>56.7</td>
<td>NS</td>
</tr>
<tr>
<td>Microvascular compl.</td>
<td>20.3</td>
<td>13.6</td>
<td>25.5</td>
<td>0.01</td>
</tr>
<tr>
<td>Macrovascular compl.</td>
<td>28.4</td>
<td>22.0</td>
<td>33.1</td>
<td>0.06</td>
</tr>
<tr>
<td>Abnormal DNS score</td>
<td>25.1</td>
<td>20.3</td>
<td>28.7</td>
<td>NS</td>
</tr>
<tr>
<td>Abnormal DNE score</td>
<td>8.5</td>
<td>6.8</td>
<td>9.7</td>
<td>NS</td>
</tr>
<tr>
<td>Care practices</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥3 physician visits/ year</td>
<td>87.6</td>
<td>80.5</td>
<td>92.4</td>
<td>0.01</td>
</tr>
<tr>
<td>Retinopathy screening</td>
<td>60.7</td>
<td>50.9</td>
<td>67.7</td>
<td>0.01</td>
</tr>
<tr>
<td>Diabetes educator visit</td>
<td>12.0</td>
<td>8.9</td>
<td>14.3</td>
<td>NS</td>
</tr>
<tr>
<td>Dietitian visit</td>
<td>61.3</td>
<td>43.4</td>
<td>74.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Self-management and habits</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regular self-monitor BG</td>
<td>79.5</td>
<td>61.4</td>
<td>92.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Follows diet most times</td>
<td>40.1</td>
<td>29.2</td>
<td>48.1</td>
<td>0.005</td>
</tr>
<tr>
<td>Walking in last 2 wk</td>
<td>28.2</td>
<td>23.9</td>
<td>31.4</td>
<td>NS</td>
</tr>
<tr>
<td>Smoking</td>
<td>6.7</td>
<td>4.4</td>
<td>8.4</td>
<td>NS</td>
</tr>
</tbody>
</table>

Legend: Data are mean ± SD, or percentage. P-values by chi-square test. DNE: diabetes neuropathy examination. DNS: diabetes neuropathy symptom. OGLD: oral glucose lowering drugs. PHC: primary health care. NS: not significant.
the studied patients. Few patients had been hospitalized in the preceding twelve months.

Care practices of diabetic patients at PHC clinics and the diabetes center

Most patients (87.6%) visited their physicians 3 times or more often per year. 60.7% reported that they had been screened for retinopathy in the past, and 79.5% did self-glucose monitoring (Table 2). Only few patients (12%) had ever visited a diabetes educator. 61.3% of patients reported having visited a dietitian, but only 40.1% followed dietary recommendations. Only few patients smoked cigarettes (6.7%), and less than a third (28.2%) reported that they had walked for the purpose of exercise in the previous two weeks. More than 90% reported having had HbA1c, cholesterol, and urine albumin measurements in the preceding year (data not shown).

Metabolic profile and achievement of targets

Patients followed at the diabetes center had significantly lower cholesterol, LDL-C, and systolic blood pressure compared with patients followed at PHC clinics (Table 1). The proportion of patients who achieved recognized targets are shown in Table 3. Except for lipid control, all targets were achieved in less than half of the patients, and only 13.5% attained all 3 internationally recognized targets of HbA1c < 7%, blood pressure < 130/80 mmHg, and LDL-C < 2.6 mmol/l. Only one-third of patients were at the HbA1c goal. Logistic regression analysis showed that diabetes duration was the only independent factor of HbA1c target achievement (adjusted OR per year 0.93, 95% CI 0.89-0.98, p < 0.01). No significant differences were found in the achievement of these targets between PHC and diabetes center patients except for LDL-C target, which was better achieved at the diabetes center (p = 0.04). Similar findings were made when adjusting for age, gender, and diabetes duration, and using stepwise (forward selection) logistic regression.

### Table 3. Metabolic control of diabetic patients followed at primary health care clinics and diabetes center according to internationally recommended targets

<table>
<thead>
<tr>
<th>Target</th>
<th>All patients (n = 275)</th>
<th>PHC clinics (n = 118)</th>
<th>Diabetes center (n = 157)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>FPG ≤ 7.2 mmol/l</td>
<td>44.8</td>
<td>50.0</td>
<td>40.6</td>
<td>0.08</td>
</tr>
<tr>
<td>HbA1c &lt;7%</td>
<td>32.7</td>
<td>37.2</td>
<td>29.0</td>
<td>NS</td>
</tr>
<tr>
<td>BP &lt;130/80 mmHg</td>
<td>48.7</td>
<td>47.8</td>
<td>49.3</td>
<td>NS</td>
</tr>
<tr>
<td>TG &lt;1.7 mmol/l</td>
<td>78.9</td>
<td>76.3</td>
<td>81.0</td>
<td>NS</td>
</tr>
<tr>
<td>LDL-C &lt;2.6 mmol/l</td>
<td>68.4</td>
<td>61.4</td>
<td>73.9</td>
<td>0.04</td>
</tr>
<tr>
<td>HDL-C &gt;1 mmol/l (men), &gt;1.3 mmol/l (women)</td>
<td>61.1</td>
<td>61.7</td>
<td>60.6</td>
<td>NS</td>
</tr>
<tr>
<td>HbA1c &lt;7% BP &lt;130/80 mmHg, LDL-C &lt;2.6 mmol/l</td>
<td>13.5</td>
<td>13.4</td>
<td>13.7</td>
<td>NS</td>
</tr>
</tbody>
</table>

Legend: Data are presented as percentage. P-values by chi-square test. BP: Blood pressure. FPG: fasting plasma glucose. LDL-C: low-density lipoprotein cholesterol. HDL-C: high-density lipoprotein cholesterol. TG: triglycerides. PHC: primary health care. NS: not significant.

### Discussion

Screening for undiagnosed T2D

We found a prevalence of undiagnosed diabetes of 14.6% among adult patients attending PHC clinics. As expected, this rate is higher than our previous result of 10.1% found in a population-based sample of Emirati adults using HbA1c [18]. Individuals who attend PHC for routine care for other reasons than diabetes are usually less healthy, and older than the rest of the population, and may be at a higher risk for T2D. We also found a considerable discordance between FPG and HbA1c-based diagnosis of diabetes and increased risk for diabetes, with more patients identified by HbA1c. This discordance may be attributed to the greater amount of women than men in the sample studied (as women are more likely to be identified by HbA1c than FPG), and possibly other factors that are relatively common in Emirati citizens such as hemoglobinopathies and iron deficiency anemia. UAE national screening guidelines are similar to the American Diabetes Association (ADA) guidelines [15] except for a lower age cut-off (≥30 years). All patients identified in our study as undiagnosed diabetics were ≥45 years, or had BMI ≥ 25 kg/m². These patients would have been identified by following the ADA recommendations for screening, since they have an additional risk factor (high-risk ethnic population). Lowering the age of screening in the UAE to ≥30 years would likely identify only few more cases, and therefore would not be a cost-effective strategy.
We did not examine whether community screening would be a recommendable strategy in the UAE. Given the data retrieved, we were unable to assess whether screening should be carried out within the health care setting only for targeting high-risk individuals, as recommended by international organizations [15, 19]. People identified with positive tests by community screening may not seek, or may not have access to, appropriate follow-up testing and care. On the one hand, screening tests at health care centers and clinics showed that high-risk individuals can be successfully introduced to lifestyle counseling [20]. Whereas, tests carried out in public campaigns outside health care centers rarely led to such beneficial contacts. Community screening in the UAE would be preferable, if a substantial percentage of individuals with undiagnosed diabetes otherwise rarely visit PHC clinics. Provided that when diagnosed through screening, the individuals would comply with treatment, and the medical infrastructure can cope with the extra workload without loss of quality of care. However, it is questionable whether the ideal responses can be achieved in the UAE. PHC clinics and diabetes centers in the UAE are already under pressure, and would need extra resources to cope with the increase in workload.

Prevention of type 2 diabetes

We found that 31% of patients attending PHC clinics are at increased risk for T2D. Studies have shown that T2D can be effectively prevented in high-risk individuals by lifestyle changes, which include increased physical activity and reduced intake of dietary fat [21-23]. Lifestyle intervention can also reduce the risk of cardiovascular disease and mortality [5, 24]. Programs addressing lifestyle intervention strategies in the PHC setting have been successful in reducing the progression of T2D in individuals at high risk [20]. Long follow-up periods are needed to see whether this effect will last over time. Also, community-wide prevention programs that raise public awareness of the importance of lifestyle behaviors are needed [25]. Prevention programs were implemented in some countries, and they have been successful in reducing coronary heart disease, and stroke mortality [26]. Recently, the “Weqaya” cardiovascular screening program was introduced by the Health Authority in Abu Dhabi. In the first 2 years, this program has obtained a Framingham Risk Score for almost every adult Emirati [27]. Also, it addresses a spectrum of behavioral change interventions, which are aimed at the individual, group, and population level [27].

Management of type 2 diabetes

Although micro- and macrovascular complications were not commonly reported among our diabetic patients, cardiovascular risk factors such as hypertension, dyslipidemia, vascular stiffness, obesity, and sedentary lifestyle were highly prevalent. Fortunately, smoking was not common (6.7%). Recent long-term clinical trials, aimed at controlling hyperglycemia and lowering known risk factors for cardiovascular disease, have demonstrated benefits of early intervention by reducing micro- and macrovascular diabetes complications [9, 28].

Only 40% of our studied patients followed dietary recommendations, and very few reported that they have ever visited a diabetes educator. These results are in accordance with our previous findings [2, 29, 30]. Education of patients with T2D is considered a fundamental aspect of diabetes care. It is important to recognize that all contacts between patients and practitioners can be opportunities for education [31]. Because patients are responsible for the day-to-day control of their diabetes, it is critical that patients understand the disease, and how to treat it [32]. Education can be carried out on a one-to-one basis, in groups, or both. However, it is not yet clear which education strategy is the most effective one regarding behavioral change, self-management, and physical and psychological outcomes [33].

Promotion of behavioral change among patients requires underlying patient-education programs that include and ensure appropriate training for health professionals. Priority should be given to programs that target patients at high risk of diabetes complications, and that make use of intensive contact and proactive follow-up. In contrast, programs targeting the whole population of diabetes patients, with a low frequency of contact, are likely to have a lower success rate, as high-risk individuals are more likely to slip through the net. Also, it could be beneficial if disease managers are able to start or modify medical treatment proactively [32, 34].

Education programs for educators have been developed internationally by several organizations. We have previously organized several diabetes education courses in collaboration with the Diabetes Education Consultative Section (DECS) of the International Diabetes Federation (IDF). These courses aimed at educating health care pro-
professionals, such as dietitians, pharmacists, and nurses, who interact with patients suffering from diabetes. The courses were based on the IDF curriculum for Diabetes Health Professional Education, and were generally well attended and well received [35]. National policy initiatives are needed to support the role of diabetes educators and self-management education programs to improve the health of diabetic patients.

Diabetes control in patients from primary health care and diabetes clinics

In our study, only 13.5% of patients attained all three internationally recognized targets. This value is similar to that found by a recent study from the United States [36], but slightly better than that in developing countries [11]. The achievement of treatment goals was not significantly different between PHC clinics and the diabetes center except for the LDL-C target. This could be due to a more aggressive lipid lowering therapy in patients followed at the diabetes center.

Although the achievement of treatment goals has been shown to significantly reduce the risk of morbidity and mortality in T2D, health care practice in community and referral centers often falls short of these goals [10, 11, 36]. While numerous interventions to improve adherence to the recommended standards have been implemented, a major contributor to suboptimal care is a system poorly designed for the delivery of chronic care [15]. Implementation of structured and multifaceted intervention for disease management is needed to deliver effective care. This should include patient education, psychological intervention, dietary education, self-monitoring, telemedicine, and other components [34, 37]. In recent meta-analysis, the most effective components of such programs were a high frequency of patient contact, and an ability for disease managers to adjust treatment with, or without, prior physician approval [34, 38].

As the site of care for the majority of T2D patients is the primary health care clinic, it is important to improve diabetes management interventions in this environment [39]. A recent multi-component intervention trial in community primary care practices showed that implementation of an electronic diabetes registry, visit reminders, patient-specific physician alerts, pre-visit planning, and monthly review of performance with a local physician, resulted in better target achievement in twelve months [40]. Also, it may be helpful to have target, or points-based, systems to remunerate successful practices [15].

Limitations

The prevalence rate of undiagnosed T2D may be affected by recruitment biases, and the use of HbA1c rather than the more sensitive OGTT. Also, patients were recruited from one large medical center in Abu Dhabi, which may not necessarily represent the overall adult Emirati diabetic population. Similarly, our quality of care results may not apply to Emirati patients attending privately-owned facilities. However, previous studies in the UAE accord with our findings regarding care practices, and achievement of treatment targets [2, 28]. Finally, our study was cross-sectional in nature. Undiagnosed T2D was not confirmed, and self-reported diabetes complications were not fully verified.

Conclusions

In our study, almost half of patients without diabetes history attending PHC clinics had undiagnosed T2D, or were at increased risk. This represents a high proportion of patients living without adequate diabetes intervention at early stages of the disease. Therefore, new prevention programs need to be implemented to identify diabetic patients and persons at risk, and to deliver the appropriate care for an effective prevention of diabetic complications. Lifestyle intervention strategies including increased physical activity and reduced intake of dietary fat can result in moderate weight loss and reduce risk. Community-wide prevention programs can raise public awareness of the importance of lifestyle behavior.

Only 40% patients with diagnosed T2D followed dietary recommendations, and very few reported visiting a diabetes educator, or performing regular exercise. Only 13.5% of all patients attained all three internationally acknowledged targets. Care practices and achievement of treatment targets in diabetic patients could be improved by structured multifaceted interventions. National policy initiatives, that support the role of diabetes educators and self-management education programs, are needed to improve the health of diabetic patients.

Acknowledgements: This study was supported by a research grant from the Emirates Foundation. We are grateful to Thikra Abdella for data collection and Sameera Mahmoud, Shamsa Al Shamsi, and Mariam
Al-Neyadi for technical assistance. We also thank the staff at Al Bateen and Al Khaleej PHC clinics, SKMC diabetes center, and SKMC laboratories for their valuable help.

Disclosures (conflict of interests statement): The authors report no conflict of interests.

References


