Cardiovascular Risk Factor Burden in the United Arab Emirates (UAE): The Africa Middle East (AfME) Cardiovascular Epidemiological (ACE) Study Sub-Analysis

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Highlights

Background
The Africa Middle East (AfME) Cardiovascular Epidemiological (ACE) study demonstrated that cardiovascular risk factors are highly prevalent among relatively young adult outpatients attending general practice clinics across AfME regions.

Objective
Based on broader AfME estimates from the ACE Study, this sub-analysis evaluated the prevalence of cardiovascular risk factors in the United Arab Emirates (UAE), particularly in rural and urban cohorts attending general practice clinics.

Methods
Data from the cross-sectional ACE study were used, comprising stable, adult outpatients attending general practice clinics in the UAE. The prevalence of six cardiovascular risk factors was analyzed: hypertension, diabetes, dyslipidemia, obesity, smoking, abdominal obesity. Rural populations were defined as living >50km from urban centers, or lack of transportation.

Results
In this cohort of 495 patients (aged 45.1 years; 49.8% female) from the UAE, a high prevalence of abdominal obesity (71.5%) and dyslipidemia (74.0%) was found. Nearly half of patients had hypertension (43.0%) and one-third diabetes (32.4%). Nearly all outpatients (92.9%) had ≥1 modifiable risk factor (74.9% had ≥1, 59.7% had ≥3). Observations were similar by gender, and across urban and rural centers. Many outpatients with pre-existing hypertension or dyslipidemia did not meet recognized blood pressure or low-density lipoprotein cholesterol goals.

Conclusions
Cardiovascular risk factors are prevalent among relatively young adult, clinically stable outpatients attending clinics across the UAE. These findings support targeted screening of outpatients visiting a general practitioner, which may provide opportunity for early discovery and ongoing management of risk factors, including recommending lifestyle changes. The ACE trial is registered under NCT01243138.

Keywords: Cardiovascular risk factor management; United Arab Emirates; risk factor screening; Africa Middle East Cardiovascular Epidemiological (ACE) study


Introduction
There has been a widespread global increase in modifiable risk factors for cardiovascular disease (CVD), which has contributed globally towards a growing burden of non-communicable diseases [1,2]. Even though it is estimated that up to 80% of deaths in developing countries are secondary to CVD, there is an absence...
of systematic epidemiological data on cardiovascular (CV) risk factors from these developing countries [3,4]. The majority of epidemiological studies from the developing world pre-date recent socioeconomic developments and are either too country-specific or only recruited patients from specific healthcare settings (outpatients, specialist or acute care settings) [5-7].

As a result of considerable urbanization in recent years, an epidemiological transition has occurred in countries such as Africa and the Middle East (AfME) similar to that seen in other developing regions [4,5]. For example, the proportion of individuals living in urban centers in developing countries doubled between 1970 and 1994, and it is expected to double again by 2025 [8]. This rapid increase in urbanization has been paralleled by a rising burden of chronic diseases that has not been matched by the development of national preventive health systems and screening programs. In the absence of an infrastructure for universal CV screening in many developing countries, targeted screening strategies may be a useful solution for improving early detection of CV risk factors, particularly if screening is targeted at adults who attend general practice clinics [9-11].

The United Arab Emirates (UAE) in the AfME region has a population growth that is among the highest in the world, mostly due to job-related migration (expatriate); for example there was a seven-fold increase between 1975 and 2005 [12]. Furthermore, the UAE has a unique model of population growth and an urban population contributing to 85.5% of the total population [13]. Therefore, the contribution of CV risk from the UAE into the AfME region is quite significant, and therefore warrants specific analysis. The Africa Middle East Cardiovascular Epidemiological (ACE) study was undertaken to estimate the prevalence of CV risk factors in outpatients attending general practice and non-specialist clinics in urban and rural communities across the AfME region [14]. We sought to conduct a sub-analysis of UAE data collected in the ACE cross-sectional study, in order to determine the prevalence of CV risk factors in outpatients attending urban and rural general practice clinics specifically in the UAE. Our study provides an excellent opportunity to examine shifting patterns of CV risk in this region.

Methods

Study design and objectives

The ACE study has been described in full elsewhere [14]. Briefly, it was a cross-sectional epidemiological study conducted in clinics across the AfME region between July 2011 and April 2012 [14]. This sub-analysis evaluated only data generated from the UAE region. Site selection in the UAE, was based on the ability of a site to conduct clinical studies and the availability of clinical research expertise, infrastructure and ethical oversight, as designated in the ACE protocol [14].

The objective of this analysis was to conduct an in-depth sub-analysis of data generated from the UAE region of the ACE study, in order to estimate the prevalence of CV risk factors in outpatients attending general practice, and other non-specialist outpatient clinics in urban and rural communities. Additionally, for patients with a pre-existing diagnosis of hypertension or dyslipidemia, the ACE study and our sub-analysis aimed to assess the degree of control of these risk factors. The ACE study defined rural areas according to Chadhi (1998), as "those isolated from urban centers by a distance of >50 km, or those with a lack of easy access to commuter transportation"[15]. Ethical approval was obtained from all participating centers and appropriate regulatory bodies in each country of the ACE study. The study protocol therefore conforms to the ethical guidelines of the 1975 Declaration of Helsinki as reflected in a priori approval by the institution’s human research committee. The ACE study was registered on clinicaltrials.gov under the identifier: NCT01243138 [14].

Patient population

Only subjects presenting to sites in the UAE were taken into consideration from the parent ACE study [14]. Male and female outpatients aged >18 years were enrolled after signing an informed consent form. Pregnant women, lactating mothers and outpatients with life-threatening illnesses were excluded from the study. In order to minimize selection bias, every fifth outpatients seen by a physician was included in the sub-analysis. Physicians evaluated outpatients via history taking, physical examination and carrying out laboratory investigations. Evaluations were typically undertaken during the same clinic visit; however, for patients who were non-fasting during the first clinic visit, a second visit was arranged to obtain fasting blood samples.

Definitions

In the ACE study [14] - and therefore the UAE sub-analysis - dyslipidemia was recorded if the patient was receiving lipid-regulating drugs, or if the patient had a high fasting lipid sample documented, according to the National Cholesterol Education Program Adult Treatment Panel (NCEP ATP) III guidelines [16]: high low-density lipoprotein (LDL) cholesterol; high total cholesterol; low high-density lipoprotein (HDL) cholesterol; or high triglyceride level Outpatients on lipid-regulating therapy were considered to have controlled LDL cholesterol if their values were at goal according to their CV risk category, based on the NCEP ATP III recommendations [16], mentioned below:

<table>
<thead>
<tr>
<th>Risk Level</th>
<th>LDL-C Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHD and CHD Risk Equivalent*</td>
<td>&lt;100 mg/dL</td>
</tr>
<tr>
<td>Multiple (≥) Risk Factors</td>
<td>&lt;130 mg/dL (LDL-C goal for multiple-risk-factor persons with 10-year risk &gt;20 % = &lt;100 mg/dL.)</td>
</tr>
<tr>
<td>0–1 Risk Factor</td>
<td>&lt;160 mg/dL</td>
</tr>
</tbody>
</table>

*CHD Risk Equivalent, included are those with peripheral arterial disease, abdominal aortic aneurysm, carotid artery disease (symptomatic e.g., transient ischemic attack or stroke of carotid origin) or >50 percent stenosis on angiography or ultrasound, and likely other forms of clinical atherosclerotic disease (e.g., renal artery disease).

Blood pressure (BP) was recorded as the higher of two consecutive seated BP measurements, which were taken once from each arm using a standardized BP monitoring device, and after the outpatient had been sitting quietly for at least 5 minutes. Hypertension was defined as currently receiving antihypertensive drugs, or having a high BP reading according to the European Society of Cardiology (ESC) Cardiovascular Prevention guidelines [17]. Outpatients receiving antihypertensive drugs were considered to have controlled BP if recorded as below 140/90 mmHg (as defined by the ESC guidelines [17]).
The following modifiable CV risk factors were captured in the ACE study [14]: diabetes mellitus (diabetes), according to the American Diabetes Association criteria [18]; smoking, either current or past consumption of cigarettes, a pipe or water pipe (shisha); obesity, defined as body mass index (BMI) ≥30 kg/m²; and abdominal obesity, defined as a waist circumference ≥94 cm in male and ≥80 cm in female outpatients, according to the International Diabetes Federation (IDF) harmonized criteria [19].

Outpatients were also analyzed by age group (younger [aged <40 years], middle aged [aged 40-60 years], older [aged >60 years]), by gender (male vs female), and according to reported nationality (national vs non-UAE national).

### Statistical methods

The same statistical methodology used in the principal ACE study [14] was extended to evaluate the UAE sub-group. Categorical data are summarized using percentages and 95% confidence intervals. Continuous data are reported using n, mean ± standard deviation or median (25th, 75th percentiles) as appropriate.

In order to minimize data acquisition bias, data from every fifth outpatient seen by a physician was included in the sub-analysis. Data analysis was done by a statistician and interpretation by the authors, which was then put together in the final manuscript.

### Results

In total, 495 subjects from general practice outpatient clinics across the UAE were analyzed. Approximately one-quarter (26.1%) were enrolled from centers in rural communities. The mean age of the overall cohort was 45.1 years, with near-equal representation of genders (Table 1). Half of the outpatients (50.5%) were younger than 45 years, and only 9.5% aged ≥65 years. The majority of outpatients (92.9%) had at least one of the six modifiable CV risk factors (Figures 1 and 2). Three-quarters (74.9%) had two or more risk factors, and more than half (59.7%) had three or more CV risk factors (Figure 1).

#### Dyslipidemia: prevalence and risk-factor control

Dyslipidemia was the most prevalent CV risk factor, recorded in nearly three out of every four outpatients (74.0%) (Figure 2). For the overall cohort, median [25th, 75th percentiles] lipid values were: 181.5 [152.0, 208.5] mg/dl (total cholesterol), 110.0 [84.9, 135.5] mg/dl (LDL cholesterol), 46.0 [37.0, 54.8] mg/dl (HDL cholesterol), and 109.0 [79.7, 148.0] mg/dl (triglycerides) (Table 1).

Despite the high prevalence of dyslipidemia, less than one-third (29.5%) of outpatients were on a lipid-altering drug, which was predominantly a statin. The most common component of dyslipidemia was presence of low HDL cholesterol, recorded in 30.3% of the whole study cohort. The majority of outpatients who were on lipid-lowering agents were not at their LDL cholesterol goal, particularly those in the moderate and high CV risk categories (defined by NCEP ATP III [16]). Overall, 11.1% of low-risk, 66.7% of moderate-risk and 40.4% of high-risk outpatients were not at their LDL cholesterol goals. Of outpatients with dyslipidemia (n=344), screening identified one new dyslipidemia diagnosis for every patient with an existing dyslipidemia diagnosis.

### Hypertension: prevalence and risk-factor control

Hypertension was identified in 43.0% of outpatients (Figure 2) and 36.8% of the study cohort had a previous history of hypertension. In the overall cohort, median [25th, 75th percentiles] systolic and diastolic BPs were 130.0 [120.0, 144.0] mmHg and 81.0 [74.0, 90.0] mmHg (Table 1). Among outpatients with an abnormal BP reading at study entry, 36.0% had an isolated elevation in systolic BP, 25.9% had an isolated elevation in diastolic BP and 18.8% had elevations in both systolic and diastolic BP readings. Of the 182 outpatients with a pre-existing diagnosis of hypertension and currently on antihypertensive therapy, more than one-

### Table 1. Baseline parameters of outpatients across the UAE, by gender, unspecified and overall.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Male</th>
<th>Female</th>
<th>Unspecified</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number (%) of Subjects</td>
<td>279</td>
<td>215</td>
<td>1</td>
<td>495</td>
</tr>
<tr>
<td>Age, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;18</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>18-44</td>
<td>142 (50.9)</td>
<td>107 (49.8)</td>
<td>1 (100.0)</td>
<td>250 (50.5)</td>
</tr>
<tr>
<td>45-64</td>
<td>107 (38.4)</td>
<td>90 (41.9)</td>
<td>0</td>
<td>197 (39.8)</td>
</tr>
<tr>
<td>≥65</td>
<td>29 (10.4)</td>
<td>18 (8.4)</td>
<td>0</td>
<td>47 (9.5)</td>
</tr>
<tr>
<td>Unspecified</td>
<td>1 (0.4)</td>
<td>0</td>
<td>0</td>
<td>1 (0.2)</td>
</tr>
<tr>
<td>Mean age, years (range)</td>
<td>45.6 (19.0-84.0)</td>
<td>44.5 (18.0-88.0)</td>
<td>31.0 (31.0-31.0)</td>
<td>45.1 (18.0-88.0)</td>
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<tr>
<td>Systolic blood pressure (mmHg)</td>
<td></td>
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<tr>
<td>median (25th, 75th percentile)</td>
<td>132.0 (120.0, 144.0)</td>
<td>130.0 (120.0, 143.0)</td>
<td>131.0 (131.0, 131.0)</td>
<td>130.0 (120.0, 144.0)</td>
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<tr>
<td>Diastolic blood pressure (mmHg)</td>
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<tr>
<td>median (25th, 75th percentile)</td>
<td>80.0 (74.0, 90.0)</td>
<td>81.0 (75.0, 90.0)</td>
<td>73.0 (73.0, 73.0)</td>
<td>81.0 (74.0, 90.0)</td>
</tr>
<tr>
<td>Waist circumference (cm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>median (25th, 75th percentile)</td>
<td>98.0 (88.0, 106.0)</td>
<td>94.0 (86.0, 104.0)</td>
<td>99.0 (99.0, 99.0)</td>
<td>96.0 (87.0, 105.0)</td>
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<tr>
<td>BMI (kg/m²)</td>
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<td></td>
</tr>
<tr>
<td>median (25th, 75th percentile)</td>
<td>27.9 (25.5, 31.3)</td>
<td>30.2 (25.4, 35.1)</td>
<td>30 (30.0, 30.0)</td>
<td>28.7 (25.5, 32.9)</td>
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<tr>
<td>Total cholesterol (mg/dl)</td>
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<tr>
<td>median (25th, 75th percentile)</td>
<td>181.5 (149.0, 207.0)</td>
<td>181.0 (154.4, 209.0)</td>
<td>173.0 (173.0, 173.0)</td>
<td>181.5 (152.0, 208.5)</td>
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<tr>
<td>LDL-C (mg/dl)</td>
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<tr>
<td>median (25th, 75th percentile)</td>
<td>111.0 (83.4, 136.0)</td>
<td>106.6 (86.0, 130.0)</td>
<td>130.0 (130.0, 130.0)</td>
<td>110.0 (84.9, 135.5)</td>
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<tr>
<td>HDL-C (mg/dl)</td>
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<td></td>
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<tr>
<td>median (25th, 75th percentile)</td>
<td>41.4 (35.0, 51.0)</td>
<td>49.0 (40.9, 59.0)</td>
<td>25.0 (25.0, 25.0)</td>
<td>46.0 (37.0, 54.8)</td>
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<tr>
<td>Triglycerides (mg/dl)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>median (25th, 75th percentile)</td>
<td>117.0 (87.0, 156.7)</td>
<td>102.8 (72.6, 137.5)</td>
<td>87.0 (87.0, 87.0)</td>
<td>109.0 (79.7, 148.0)</td>
</tr>
<tr>
<td>Fasting plasma glucose (mmol/l)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>median (25th, 75th percentile)</td>
<td>5.7 (5.2, 8.7)</td>
<td>5.5 (5.0, 6.6)</td>
<td>4.9 (4.9, 4.9)</td>
<td>5.6 (5.1, 6.6)</td>
</tr>
</tbody>
</table>

Legend BMI: body mass index, HDL-C: high-density lipoprotein cholesterol, LDL-C: low-density lipoprotein cholesterol.
third (34.1%) had BP readings above ESC-defined levels [17]. Of outpatients with hypertension (n=213), screening identified 31 patients (14.6%) who were newly diagnosed with hypertension.

**Obesity: prevalence**

The overall prevalence of abdominal obesity, defined by waist circumference, was nearly twice as common compared with obesity defined by BMI ≥30 kg/m² (Figure 2). Of the total outpatients screened (N=495), 71.5% (n=354) had abdominal obesity and 40.4% (n=200) had BMI obesity.

**Diabetes: prevalence**

Nearly one-third of the eligible population had diabetes (32.4%), the highest prevalence was in those aged >60 years (Figure 3A). Overall, the median fasting plasma glucose level for the whole cohort was 5.6 [5.1, 6.6] mmol/l (Table 1). Of outpatients with diabetes, 89.9% (n=133) had a pre-existing diabetes diagnosis. An additional 10.1% (n=15) were diagnosed at the time of study entry (based on a single fasting plasma glucose measurement of ≥7 mmol/l).

**Smoking: prevalence**

The overall prevalence of smoking was 26.6%, where 13.7% were current smokers and 12.9% were past smokers (Figure 2). Smoking was most common in younger outpatients, with only 3.6% of those aged >60 years being a current smoker (Figure 3A).

**The prevalence of cardiovascular risk factors by age, gender, community (urban vs rural) and nationality**

Dyslipidaemia, hypertension and obesity were present in a notable proportion of younger outpatients (Figure 3A). For example, approximately one in every two outpatients aged <40 years had dyslipidaemia or abdominal obesity, but the prevalence of these risk factors was higher still in middle aged/older patients (aged ≥40 years) (Figure 3A).

Male outpatients had a larger waist circumference (98.0 [88.0, 106.0] cm) but lower median BMI (27.9 kg/m²) compared with female outpatients (waist circumference: 94.0 [86.0, 104.0] cm, BMI: 30.2 kg/m²) (Table 1). Regardless of criteria used, obesity was more common in female than male outpatients (Figure 3B).

Female outpatients exhibited a higher prevalence of obesity (50.7%) and even higher prevalence of abdominal obesity (85.1%), whereas male outpatients had higher prevalence of dyslipidaemia (80.5%), hypertension (45.5%), diabetes (35.6%) and smoking (22.9%) (Figure 3B).

Rural areas recorded higher rates of most CV risk factors compared with urban areas. However, smoking was notably more prevalent in urban than rural areas (15.0% vs 10.1%) (Figure 3C).
UAE nationals exhibited slightly higher prevalence of obesity and diabetes compared with non-nationals (Figure 3D). For example, the percentage of nationals with obesity (BMI ≥30 kg/m²) was 47.6% (vs 32.0% of non-nationals), while the prevalence rates for abdominal obesity and diabetes were higher for UAE nationals versus non-nationals (77.2% vs 64.9% and 35.9% vs 28.6%, respectively). Smoking and dyslipidemia were notably more prevalent in non-nationals (16.7% and 78.4%) compared with nationals (11.2% and 70.0%). Hypertension was comparable between both nationals and non-nationals (Figure 3D).

After the initiation of the primary ACE study, US dyslipidemia guidelines were revised by the ACC/AHA [20], and the approach to dyslipidemia management was changed from a target-based approach to a risk based approach, therefore targets of therapy changed from those used in the ACE protocol (NCEP ATP III, 2002). The ACC/AHA (2013) Guidelines [20] identified four statin benefit groups; namely 1) Atherosclerotic Cardiovascular Disease (ASCVD), 2) Untreated LDL-C ≥190 mg/dL, 3) Diabetes Mellitus (40-75 years, LDL-C 70-189 mg/dL) and 4) Without clinical ASCVD, unlike the NCEP ATP III, 2002 guideline [16], which defined LDL-C goals based on number of risk factors, as outlined above.

An analysis of the NCEP ATP III guidelines versus the ACC/AHA guidelines showed a considerable increase in the proportion of patients eligible for statin therapy based on the updated ACC/AHA 2013 recommendations. According to the NCEP ATP III guidelines, 19.6% patients (n=97) were eligible for statin therapy, but this increased to 35.2% of outpatients (n=174) being eligible for statin therapy based on the 2013 recommendations from the ACC/AHA; this was an increase of 79.6%, or 77 outpatients (Figures 3E and 3F).

Discussion
This analysis of 495 outpatients from across the UAE demonstrates a high prevalence of CV risk factor clustering, in line with observations from the larger ACE study across the whole AFME region [14]. In our UAE sub-analysis, nine out of 10 screened outpatients had at least one conventional risk factor for CVD, with dyslipidemia and abdominal obesity being the most prevalent, affecting more than two-thirds of screened outpatients. Diabetes, hypertension and smoking followed closely in terms of overall prevalence. Although some specific differences were noted, similar observations were seen across gender, age, and for urban and rural communities, highlighting the unmet need for CV risk factor management in the UAE as a whole.

In order to tackle the global burden of CVD, some regions of the world have adopted critical measures, including primary prevention strategies that include early detection and targeted control of conventional modifiable risk factors [10,21,22]. In the Middle East, nine modifiable CV risk factors, including the six risk factors analyzed in the present study, almost completely explain the risk of acute myocardial infarction in this region [21]. In the INTERHEART Study, CV risk from these factors combined was higher in the Middle East compared with other regions of the world, perhaps highlighting the need for more aggressive preventive measures to be adopted than in these other regions [23]. Nonetheless, CVD prevention is dependent on early detection, but the majority of developing countries have deficiencies in their national infrastructure to set up and run a comprehensive screening program [24]. The findings of our study from the under-studied UAE region provides a compelling rationale for targeted screening of CV risk factors at general practice primary care clinics across the UAE, to act as a substitute, or rather an alternative, to more expensive and comprehensive population-wide screening approaches. Our findings demonstrate that targeted screening at the general practice consultation is able to provide significant results when identifying individuals at risk, who may then be able to make good use of primary preventive measures.

Given the relative young age of the current study population (mean age 45 years), the CV burden observed is quite alarming: half (50.5%) of the cohort were younger than 45 years of age and 90.3% were younger than 65 years. In many recent studies conducted in the Middle East region, patients who exhibited manifestations of CVD, including acute coronary syndrome or atrial fibrillation, appeared at least 10 years younger than their age-matched counterparts in developed countries [25-28]. In other words, complications associated with atherosclerosis (target organ damage) have been temporally shifted backwards by a decade, which may negatively influence preventive strategies aimed to start after a given age. It is unclear whether our observations simply reflect differences in population demographics (e.g., a generally younger population in developing countries) or whether they are indicative of a predisposition to premature CVD in developing countries [29]. The prevalence of undiagnosed and uncontrolled CV risk factors observed in our relatively young adult population in the UAE appears consistent with other observations [30]; in addition, our study underscores a pathophysiological substrate for the predisposition towards early onset of CVD.

Social and economic structures have appeared to condition disease profiles in societies throughout history. Certain developments have been directly linked to alterations in disease patterns [31,32], and population movement from rural to urban areas has led to an increase in the burden of CV risk factors [2,33]. In the present study the more recognizable observation, in our opinion, is the discreet difference between urban and rural communities in the prevalence of most of these modifiable risk factors, in comparison with a conventional pattern that often displays more prevalent risk factors in urban communities [2,33]. Moreover, rural communities may be reaching prevalence rates for CV risk that are similar to their urban counterparts. Although we accept that our study cannot fully explain the discreet gap in CV risk factors between rural and urban communities; it does indicate that perhaps adoption of an “urban” lifestyle in rural communities may be a contributing factor to this shift in CV risk. It has been noted in this study (Figure 3C) that in rural communities, 76.7% had abdominal obesity, and smoking frequency appeared to be similar in both urban and rural cohorts. Therefore, rural communities need to receive as much attention as their urban counterparts in efforts to fight CVD in developing countries [34,35].

We found that obesity and abdominal obesity were particularly widespread in this UAE cohort, with a substantially higher prevalence in female than male outpatients, regardless of
obesity definition used. The prevalence of obesity was relatively consistent across age groups, and in both urban and rural communities. When using waist circumference as a measure of obesity, as suggested by the IDF [19] and other international organizations, a 31% higher prevalence was noted in those classified as ‘obese’ compared with if using BMI ≥30 kg/m² (71.5% vs 40.4%, respectively). Studies of acute myocardial infarction in multiethnic cohort of patients, such as in INTERHEART [23], have demonstrated the limited value of BMI as a measure of obesity, and a close link between waist and hip circumference, and their ratios, with the risk for myocardial infarction, even after adjustment for BMI and other risk factors. Furthermore, an INTERHEART sub-analysis also observed a significant link between the risk of myocardial infarction and abdominal obesity (which accounted for ~25.0% of the population-attributable risk) in a Middle East cohort [7]. Since the prevalence of obesity appears to be epidemic in our study cohort, this emphasizes the necessity of devising new strategies to control the increasing prevalence of obesity in order to reduce the long-term burden on CV health. Decreasing the obesity burden will likely require more than a silo approach of interventional pharmacological or surgical efforts, or sporadic weight loss campaigns, since none of these strategies individually will likely have a sustained effect on weight control [36]. A more promising approach would seem to be a behavioral strategy that concentrates on encouraging and maintaining a healthy lifestyle, starting as early as childhood [37]. Strategies such as these require the reinforcement of widespread public policies that specifically focus on definitions of healthy dietary intake, as well as considering more general aspects of urban planning and workplace environments in efforts to promote communities focused on healthy living [38,39].

Limitations
We focused this sub-analysis of the ACE study on the UAE, due to the paucity of data on CV risk factors from this region. Unlike past studies that focused on inpatients or subspecialty settings, our data are more representative of the general population since it comprises a cohort recruited from the outpatient/primary care setting. However, the UAE sub-analysis was limited by the design of the primary ACE study [14]. The cross-sectional design and obligatory reliance on one-time measurements of risk factors in addition to the lack of data on other variables that may have an effect on CV risk, such as social class and health insurance status, restricted the outcomes of the sub-analysis. Therefore, this analysis should provide the foundation for larger prospective studies, with a longitudinal and more comprehensive design to overcome these limitations. Moreover, selection bias may have occurred since this cohort of patients had access to primary care; therefore, may be representative of a wealthier UAE cohort, compared with the general more representative expatriate population.

Conclusions
Young male and female adults attending general practice outpatient clinics across urban and rural communities in the UAE appear to have a high incidence of CV risk factors. This study adds to pre-existing literature of CV epidemiology in developing countries by providing new insights into the risk associated with modifiable CV risk factors in the UAE. Our findings support the view that multiple CV risk factors are clustering earlier than traditionally understood for atherosclerotic risk, thus conditioning future preventive strategy. Put simply, earlier screening initiatives may be a crucial factor in the reduction of CV burden. Indeed, the concept of targeted screening of CV risk by general practitioners is greatly supported by the findings of this study, since it demonstrates a good opportunity for early detection as well as management that includes lifestyle interventions. Extending the concept of a healthy lifestyle is essential, and should be undertaken as a serious commitment by governments, policymakers, healthcare professionals and all other stakeholders in the UAE, in order to ensure CVD prevention. The adoption of such measures should aid a decrease in the rates of stroke and myocardial infarction, both of which have become so prevalent in developing nations.

Declarations of Interest
Dr. Ghazi Radaideh has acted as a consultant to Pfizer, Bayer, Amgen, Sanofi, MSD, AstraZeneca, Takeda and Novartis. Dr Nikolaos Tzemos has acted as a consultant to Pfizer, Sanofi and Amgen. Yasser Eldershaby, Jean Jourey and Paula Abreu are employees of Pfizer.

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