

# **Cardiovascular disease risk factors and treatment in the Eastern Mediterranean Region in Men and Women**

Karam Turk-Adawi, Nizal Sarrafzadegan, Ibtihal Fadhil, Kathryn Taubert, Masoumeh Sadeghi, Nanette Wenger, Nigel Tan, Sherry L. Grace

## **Authors:**

Corresponding author:

Nizal Sarrafzadegan. Isfahan Cardiovascular Research Center, Cardiovascular Research Institute, Isfahan University of Medical Sciences, Khorram Ave, PO Box 81465-1148 Isfahan, Iran

Email: [nsarrafzadegan@gmail.com](mailto:nsarrafzadegan@gmail.com)

Phone: 0098 31 33377888

Karam I. Turk-Adawi. Public Health Department, College of Health Sciences, Qatar University, Doha, Qatar

Kathryn Taubert. Vice President, International Science and Health Strategies, American Heart Association. Aeschengraben 14, Basel 4051 Switzerland

Masoumeh Sadeghi. Cardiac Rehabilitation Research Center. Cardiovascular Research Institute. Isfahan University of Medical Sciences, Khorram Ave, PO Box 81465-1148 Isfahan, Iran

Ibtihal Fadhil. Regional Adviser, Noncommunicable Diseases, World Health Organization, East Mediterranean Regional Office, Cairo Egypt

Nanette K. Wenger. Department of Medicine, Division of Cardiology, Emory University School of Medicine, 49 Jesse Hill Jr. Drive, SE, Atlanta, GA 30303, United States

Nigel Tan. Peter Munk Cardiac Centre, University Health Network, University of Toronto, 27 King's College Circle, Toronto, Ontario M5S 1A1 Canada

Sherry L. Grace. School of Kinesiology and Health Science, York University, Bethune 368, 4700 Keele Street, Toronto, Ontario, M3J 1P3, Canada & University Health Network

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## **Abstract**

The Eastern Mediterranean Region (EMR) is comprised of 22 countries, with a population of almost 600 million people. The region has experienced the shift in burden of disease from communicable to non-communicable --primarily cardiovascular diseases (CVD). The estimated CVD mortality rate was 27.4% in 2015, and it is expected to increase-- more dramatically than in any other region except Africa. CVD, primarily ischemic heart disease, accounts for 9.2% of disability-adjusted life years. The risk factors of tobacco consumption, physical inactivity, depression, overweight/obesity, as well as hypertension and diabetes are particularly challenging. However, many are unaware of their risk factor status, and even if treated, these risk factors are often not controlled. Low use of Emergency Medical Services, delays in care access and inappropriate/lack of cardiac catheterization impact diagnosis. Treatment of CVD is also suboptimal; it is comprised primarily of thrombolysis, with insufficient provision of timely revascularization. Secondary prevention through cost-effective strategies such as cardiac rehabilitation is limited by low availability, but evidence-based medication prescription rates are generally high (but variable). To aid decision-makers with CVD prevention and management, the aim of this review was to synthesize what is known about CVD burden, associated risk factors, and treatment in the EMR.

## **Introduction**

The Eastern Mediterranean Region (EMR), one of the 6 official World Health Organization (WHO) regions, is comprised of 22 countries (i.e., Afghanistan, Bahrain, Djibouti, Egypt, Iraq, Iran, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Palestine, Pakistan, Qatar, Saudi Arabia, Somalia, Sudan, Syria, Tunisia, United Arab Emirates (UAE), Yemen), with a population of approximately 583 million people.<sup>1</sup> Accordingly, there is wide variation in culture, language, religion, political and social context, historical background, and economic status across this region.<sup>2</sup> Indeed, the Human Development Index ranges from .85 in Qatar to .47 in Djibouti.<sup>3</sup> There are 8 official languages (with many dialects) across these countries, and three major religions practiced. Over half of EMR countries are considered low or middle-income (i.e., 13 or 59.1%). Several EMR countries have long histories of political instability, war, and social conflicts, which have led to massive internal and external displacement of populations; indeed half of EMR countries currently have acute or chronic emergencies. These social determinants of health and associated inequities affect health status and health care across the EMR.

As is being observed globally, the region has experienced the shift in burden of disease from communicable to non-communicable (NCD). The NCD mortality rate (654/100,000) in the EMR is higher than that globally (539/100,000),<sup>4</sup> with the greatest increase by 2030 expected to take place in this region.<sup>5</sup> A full 58.4% of total deaths in the EMR were due to NCDs in 2015, with the primary cause being cardiovascular disease (CVD; 27.4% of total deaths) (Table 1).<sup>6</sup> For this reason, it is imperative to better understand the nature of CVD in this region. Accordingly, the aim of this review was to synthesize what is known about CVD burden, its risk factors, and treatment in the EMR.

## **Burden of CVD in the EMR**

### *Incidence and prevalence*

The incidence and prevalence of CVD in the EMR are not well known. Data from the Global Burden of Disease Study (2004) suggests an incidence of 0.4 million for heart failure (HF), and a prevalence of 4.1 million for angina pectoris in the EMR.<sup>7</sup> Data from the Prospective Urban Rural Epidemiological (PURE) study, of community-dwelling residents of Iran and UAE (i.e., Middle East region for this cohort), 5.9% had coronary heart disease and 3.0% had a stroke.<sup>8</sup> With regard to type of CVD in the EMR, ischemic heart disease is the most common (49.7%), followed by cerebrovascular disease (i.e., stroke, transient ischemic attack, subarachnoid hemorrhage, and vascular dementia; 21.8%),<sup>9</sup> inflammatory heart diseases (2.8%), and rheumatic heart disease (2.1%).<sup>7</sup>

A few national studies report incidence or prevalence of CVD. In Egypt, the overall prevalence of coronary heart disease was 8.3% (8.9% for women and 8.0% for men), based on a nationally-representative survey, conducted between 1991 and 1993.<sup>10</sup> In the 1995-2000 Coronary Artery Disease In Saudis (CADIS) study, the prevalence among adults (30-70 years) was 5.5% (6.6% in men and 4.4% in women).<sup>11</sup> With regard to incidence, stroke rates have been reported for 4 Gulf countries: Bahrain (57.0 per 100,000/year; 1995 hospital-based study),<sup>12</sup> Kuwait (27.6 per 100,000/year; prospective study over 3 years: 1989, 1992 and 1993).<sup>13</sup>

Qatar (41.0 per 100,000/year; 1997 hospital-based study),<sup>14</sup> Saudi Arabia (29.8 per 100,000/year in the Eastern Province of Saudi Arabia, based on stroke registry).<sup>15</sup>

### *Morbidity*

Globally, CVD is responsible for 151.4 million disability-adjusted-life-years (DALYs), of which 62.6 million are due to ischemic heart disease and 46.6 million to cerebrovascular disease.<sup>16</sup> CVD is the leading cause of disability in the EMR. It accounts for 9.2% of total DALYs.<sup>7</sup> Ischemic heart disease accounts for 47.0% of CVD DALYs, followed by cerebrovascular disease (20.6%), hypertensive diseases (7.2%), rheumatic heart disease (4.5%) and inflammatory heart disease (4.1%).<sup>7</sup>

Hospitalization rates due to CVD in the EMR are not highly available. In a Lebanese study, the number of hospitalizations due to HF was 11,324 in 2012, with a total hospitalization cost of US\$38.1 million.<sup>17</sup> In Oman, about 1% of National Health Service expenditure is spent on HF alone-- mainly on hospitalization.<sup>18</sup> Five percent of all hospital admissions are due to HF, and there are high readmission rates of 25–30% among these patients.<sup>18</sup>

### *Mortality*

As it is in the rest of world, CVD is the leading cause of mortality in the EMR (WHO global status, 2014),<sup>19</sup> and of premature mortality. Based on the WHO's projections, regional mortality rates related to CVD ranged from 12.0% in Africa to 47.0% in Europe in 2015 (Table 1).<sup>6</sup> The EMR had a CVD mortality rate of 27.4% in that same year; however, it is estimated to increase to 32.1% in 2030, which represents the second greatest increase after the African region, across all the WHO regions.<sup>19</sup> CVD mortality rates in the other regions (i.e., Europe, Americas, Western Pacific) are projected to decrease, or increase only slightly (i.e., South East Asia) (Table 1).<sup>19</sup> Of the CVD deaths in the EMR, ischemic heart disease was the major cause of mortality followed by stroke, similar to the global trend (Table 2).<sup>6</sup>

The CVD mortality rate by EMR country is shown in Figure 1. The rate ranged from 6.0% in Somalia to 49.0% in Tunisia. In a recent study, CVD was estimated to account for

45.0% of deaths in the six Gulf Council countries (i.e., Oman, Kuwait, Saudi Arabia, UAE, Bahrain, and Qatar).<sup>20</sup> Among these countries, the highest proportion of CVD deaths was in Saudi Arabia (46.0%), followed by Kuwait (41.0%).<sup>20</sup>

### **CVD risk factor burden**

There has been a dramatic increase in CVD risk factors in the EMR.<sup>21</sup> Risk factors for CVD onset are behavioral (i.e., tobacco exposure, physical inactivity, poor diet, and harmful alcohol consumption), and clinical (i.e., obesity, hypertension, dyslipidemia, diabetes, and depression) in nature. Available data on the prevalence of these risk factors in the general population is described below, followed by information regarding awareness and control in the EMR.

#### *Behavioral risk factors*

The prevalence of tobacco smoking in the EMR was 25.4% in 2015, higher than the global prevalence (22.7%), but lower than in Europe (27.3%) and the Western Pacific regions (25.8%).<sup>22</sup> As displayed in Table 3, Syria had the highest prevalence of tobacco smoking, while Oman had the lowest. The overall prevalence of smoking is higher in males (40.0%) than females (6.8%).<sup>19</sup>

Use of other forms of tobacco, such as water pipe smoking, have gained popularity in the EMR. Indeed, water pipe smoking has already replaced cigarettes as the most common form of tobacco used (Figure 7).<sup>23</sup> The prevalence of water pipe smoking ranged from 9.0% to 15.0%, among representative samples of 13–15 years old students in several EMR countries (i.e., Bahrain, Oman, Qatar, UAE, Kuwait and Yemen).<sup>23</sup> While social mores limit cigarette smoking in public in women and youth, use of these alternate forms of tobacco is more socially and culturally accepted, rendering it a major threat to CV health going forward.<sup>24</sup>

Globally, 23.0% of adults (aged 18 years and over) accrue insufficient physical activity (i.e., < the recommended 150 minutes of moderate or vigorous-intensity physical activity per week).<sup>19</sup> The EMR has the highest prevalence of insufficient physical activity of any region of the globe (Figure 2). As shown in Table 3, at a national level, insufficient physical activity was highest in Saudi Arabia and lowest in Jordan.<sup>19</sup> Specifically, according to the Saudi Health Information Survey (SHIS), 46.0% of men and 75.1% of women engaged in low to no physical activity.<sup>25</sup> In a recent systematic review, physical inactivity ranged from 53.2% to 98.1% among Saudi women.<sup>26</sup>

A diet protective from CVD consists of low sodium and sugar consumption, minimizing intake of processed foods and trans fats, and increasing consumption of fiber, as well as fruit and vegetables. With regard to the former, sodium intake by global region is presented in Figure 3. The Middle East and North Africa region (where 18 of 20 countries are in the EMR) ranked 7th highest among 21 regions; the estimated daily sodium intake was 3.95 grams/day.<sup>27,28</sup> This is within the recommendations of the recent World Heart Federation, the European Society of Hypertension and the European Public Health Association technical report on sodium intake and CVD.<sup>29</sup>

The prevalence of low intake of fruit and vegetables is not sufficiently investigated in the EMR. However, the WHO is in the process of releasing new data on this risk factor. Data are available for some countries, but date prior to 2008.<sup>30</sup> Most EMR countries have a high prevalence (>50%) of inadequate consumption of fruit and vegetables (Table 4). For example, only 7.3% of Saudis aged 15–64 years reported consuming at least five servings of fruit and vegetables a day.<sup>31</sup> Further, a recent comprehensive systematic analysis including the WHO's STEPs database and the Food and Agriculture Organization's food balance sheet data showed

that the mean daily fruit and vegetable intake in the Middle East and North Africa region is less than the recommended guidelines (Figure 4).<sup>32</sup> In this region, the mean daily fruit intake was < 130 g/day and the mean daily vegetable intake was < 200 g/day (whereas the WHO recommendation to reduce NCDs is  $\geq 400$  g/day of both).<sup>32</sup>

With regards to harmful use of alcohol, the EMR has the lowest per capita consumption of any global region.<sup>19</sup> This is likely partially attributable to religious considerations.

### *Clinical Risk Factors*

Across all global regions, obesity is third highest in the EMR (Figure 6). The prevalence of obesity in the EMR is 23.6% for women and 14.6% for men. Based on WHO data, over 50.0% of women are overweight in the EMR, and almost half of overweight women are obese (24.0%).<sup>19</sup> Within the EMR, the Gulf countries have the highest obesity rates, with the highest rates observed in Qatar (Table 5). However, a current study, projected higher obesity prevalence in Saudi Arabia than in Qatar in 2017 with a total prevalence of 52.9% (38.2% for men and 67.5% for women).<sup>33</sup> Based on a recent systematic review, among Saudi women, the prevalence of overweight was 27.0%, of whom 40.2% were obese.<sup>26</sup> Further, in 2008, the Weqaya screening program in the UAE (specifically in Abu Dhabi) revealed that 67.0% out of 50,138 adults (aged  $\geq 18$  years) were either overweight or obese.<sup>34</sup> In the Dubai Shopping for Cardiovascular Risk Study (DISCOVERY) in the UAE which is a voluntary point-of-care CVD risk factor screening program conducted in 4 shopping malls, 9 outpatient health care facilities, and 3 labor camps, found that 20.0% of 4,128 participants were obese.<sup>35</sup>

Among the WHO regions, the prevalence of hypertension is second highest in the EMR.<sup>19</sup> By country, the prevalence of hypertension is highest in Somalia (26.4%), followed by Morocco (25.3%); UAE has the lowest hypertension prevalence (Table 5).<sup>19</sup> However, the



Weqaya screening program of Abu Dhabi, the largest emirate in the UAE, revealed hypertension rates of 23.0% among adults >18 years old.<sup>34</sup> Within the Gulf area, the recent Saudi SHIS study estimated the prevalence of hypertension to be 17.7% for males and 12.5% for females.<sup>36</sup> The hypertension rate among refugees from the EMR is estimated at 16.2%.<sup>37</sup> In the UAE, again the above DISCOVERY study reported a hypertension rate of 31.0%.<sup>35</sup>

The most recent global data available regarding prevalence of dyslipidemia stems from the WHO in 2008; it shows that the prevalence of elevated total cholesterol (i.e.,  $\geq 5.0$  mmol/l or  $\geq 190$  mg/dl) among adults aged  $\geq 25$  years was 38.9% (37.3% for men and 40.2% for women).<sup>38</sup> By WHO region, the prevalence of elevated cholesterol was third highest in the EMR, at 38.4% (40.4% for women and 36.2% for men).<sup>39</sup> In the majority of Gulf countries, elevated cholesterol prevalence is  $\geq 50\%$ ; the UAE had the highest prevalence at 56.7% (Table 5).<sup>7</sup> In Saudi Arabia specifically, the prevalence of hypercholesterolemia among those >15 years old was 9.5% for males and 7.3% for females.<sup>36</sup> In the UAE, the DISCOVERY study showed that 69.0% of the volunteers who participated in the CVD risk factor screening program had dyslipidemia.<sup>35</sup>

Globally, the prevalence of diabetes was 9.0% in 2014.<sup>19</sup> Across all regions, it is highest in the EMR, at 14.0%. Qatar, Saudi Arabia and Kuwait specifically are among the top 10 countries in prevalence of diabetes globally.<sup>40</sup> The number of cases of diabetes is expected to double in EMR countries in the next 25 years, where four out of ten adults with diabetes are undiagnosed.<sup>40</sup> In Abu Dhabi of the UAE, the diabetes rate was 18.0% in 2008 and 27.0% of the population had evidence of pre-diabetes.<sup>34</sup> Further, the DISCOVERY study in the UAE reported a diabetes rate of 32.0%.<sup>35</sup>

Finally, depression is recognized as a risk factor for CVD,<sup>41,42</sup> and for poor prognosis in those with CVD, by the American Heart Association.<sup>43</sup> Indeed, a recent review showed that

major depressive disorders explained 3.8 million ischemic heart disease DALYs.<sup>44</sup> Despite the social, economic, and political instability in many EMR countries which would negatively impact mental health, there is lack of data on the prevalence of depression. Moreover, depression rates in the EMR are most likely under-estimated due to lack of mental health services or access to such services (especially in politically unstable areas),<sup>45</sup> as well as stigma and taboos. A recent systematic review showed that countries with the world's highest depression rates are found in the Middle East and North Africa region (Figure 5).<sup>44</sup> The highest depression rate in any country globally was reported in the EMR country Afghanistan, where more than one in five people suffer from depression.<sup>44</sup> In Morocco, the point prevalence for major depressive disorder was 26.5% (Okasha 2012).<sup>45</sup> This is in stark contrast to depression prevalence rates of 3.2% reported from the WHO World Health Surveys across 60 countries in all regions of the world.<sup>45</sup>

Finally, in a multi-national study, the Africa Middle East Cardiovascular Epidemiological (ACE) Study showed the prevalence of CVD risk factors in outpatients general practice clinics. The prevalence of these CVD risk factors were as following: 69.5% dyslipidemia, 42.8% hypertension, 36.7% obesity, 25.2% diabetes, 14.3% smoking.<sup>47</sup>

### ***CVD awareness, screening and diagnosis in the EMR***

#### ***CVD Knowledge***

Despite this high risk factor and disease burden, public knowledge and awareness of CVD and its' risk factors are incredibly low in the EMR. Among 900 surveyed Kuwaiti individuals, participants' knowledge of CVD and its' symptoms was considered moderate at best.<sup>48</sup> Specifically, 59.4% did not know of any type of CVD, 40.7% were not aware of any heart attack symptoms, and 47.8% were not aware of any stroke symptoms. Similarly, a Jordanian study reported limited knowledge and awareness of CVD among 1000 individuals.<sup>49</sup>

### *Awareness of Risk Factor Status and Control, Primarily in Those Without CVD*

Awareness of CVD risk factors is necessary to initiating therapy and achieving control. The WHO STEPwise survey is a household-based, interviewer-administered survey that assesses control rates for the main NCD risk factors, which are applicable to CVD.<sup>50</sup> Data from the few countries that reported this data is presented below, as rates can be compared due to consistent methodology. First, according to Jordanian STEPS data, regarding dyslipidemia, of the 7.1% of respondents who reported being told they have dyslipidemia, 62.1% were taking lipid-lowering medication.<sup>51</sup> In Egypt, 12.2% of participants reported being diagnosed with hypertension by a healthcare worker, but 8.5% of them were taking anti-hypertensive medication.<sup>51</sup> Further, only 4.6% of diabetic patients (3.9% men, 5.4% women) were taking oral medications, and 2.4% were taking insulin.<sup>51</sup> In a more recent STEPwise survey, 39.5% of patients (40.9% males, 37.9% females) with hypertension reported not taking antihypertensive medication.<sup>51</sup> In Lebanon, among those 16.5% who reported being previously diagnosed with dyslipidemia, 41.2% were taking cholesterol-lowering medication, 58.3% were engaging in exercise upon advice from a doctor or healthcare worker, and 74.5% were currently following a cholesterol-lowering diet.<sup>51</sup> Additionally, 79.5% (76.3% men, 81.9% women) of Lebanese with hypertension were taking an antihypertensive.<sup>51</sup> In Iraq, the latest STEPS data showed that only 50.0% of hypertensive patients were taking antihypertensive medications.<sup>51</sup> In Kuwait, 73.6% (69.6% men, 77.1% women) of those diagnosed with hypertension were taking antihypertensive medication; 85.4% (89.8% men, 81.6% women) of diabetics were taking medications; and 50.4% (54.5% men, 47.0% women) of those diagnosed with raised total cholesterol were taking lipid-lowering medication.<sup>51</sup> Finally, in Pakistan, among diagnosed participants, only 52.9% of

those with hypertension, 43.3% of those with hyperlipidemia, and 74.5% of those with diabetes were taking corresponding medications to control these risk factors.<sup>51</sup>

Other multi-country studies also demonstrates low risk factor control rates in the EMR. In the PURE study, among 2074 participants from 2 EMR countries (plus Turkey in this paper), 52.5% were aware they were hypertensive, 50.8% were treated, but only 17.1% were controlled.<sup>52</sup> With regard to dyslipidemia, the Centralized pan-Middle East Survey on the Under-treatment of Hypercholesterolemia (CEPHEUS) conducted in 6 Arabian Gulf countries highlighted the sub-optimal management of hypercholesterolemia; the low-density lipoprotein cholesterol goal was attained in 91.1% of low CVD risk, 52.7% of high-risk, and 32.0% of very high-risk patients.<sup>53</sup> Finally, in the Dyslipidemia International Study (DYSIS)-Middle East, there were 2,182 patients (of which 52.3% had established CVD) from 4 EMR countries who had been on a statin for  $\geq 3$  months.<sup>54</sup> Among 61.8%, their low-density lipoprotein was not at target, for 55.5% their high-density lipoprotein was not at target, and in 48.5% their triglycerides were elevated.

A few more country-specific studies were identified in the literature. An Iranian national household survey revealed 53.8% of residents were unaware of having hypertension.<sup>55</sup> Only 17.6% of individuals with hypertension were receiving antihypertensive medication.<sup>55</sup> In a population-based Palestinian hypertension survey, 49.0% were unaware.<sup>56</sup> In Lebanon, among patients assessed in public primary healthcare units who reported not suffering from diabetes or hypertension, 11.0% had blood glucose levels indicative of diabetes and 17.0% had blood pressure levels indicative of hypertension.<sup>57</sup> In Palestine, among hypertensive patients, 40.2% were on treatment, yet only 9.5% achieved the guideline target for blood pressure (<140/90 mm Hg).<sup>56</sup>

Overall, these data demonstrate gaps in control of CVD risk factors, which could be related to health care system organization, lack of awareness by patients and promotion of self-care to optimize adherence to treatment, as well as lack awareness of risk factor targets among healthcare providers. With regard to the latter, a study in Saudi Arabia revealed gaps in primary and specialist physicians' knowledge of risk reduction targets.<sup>58</sup> The proportion of physicians who were aware of the recommended risk reduction targets for patients with coronary artery disease (CAD) were: 32.0% for blood pressure, 40.0% for low density lipoprotein-cholesterol (LDL-C), and 70.0% for blood glucose.<sup>58</sup>

#### *CVD Risk Assessment in Primary Care*

Primary care is a key setting for CVD prevention, through global risk factor assessment and patient counselling. The WHO and the International Society of Hypertension developed CVD prediction charts to support physicians to estimate overall CVD risk; this risk score is then used to inform treatment decisions (i.e., lifestyle advice or medication). However, an Egyptian survey showed that only 23.0% of family physicians reported the routine use of CV risk assessment tools, with a preference to apply American tools (30.8%) rather than those recommended by the WHO for Egypt specifically (20.2%).<sup>59</sup> Moreover, older (i.e.,  $\geq 30$  years) physicians with  $\geq 5$  years of experience, seeing more patients per week, were more likely to use the CVD risk assessment tools than younger, less experienced, and unqualified physicians.<sup>59</sup> In Saudi Arabia, CVD risk assessment charts were rarely used by primary care physicians; only 6.7% of 29 physicians reported the use of a risk chart to assess their patients for CVD risk, though the majority (75.9%) of these physicians were aware about CVD risk assessment score systems.<sup>60</sup>

#### *Diagnosis*

Despite the low degree of healthcare received in the majority of EMR countries, expensive and invasive diagnostic tests such as coronary angiography are widely available in some countries, and are often used inappropriately. A Lebanese study demonstrated that the density of cardiac catheterization centers is almost three times that of France (9.3 vs. 2.9 per 1,000,000 individuals); indeed it is among countries with the highest catheterization rates in the world, at 53 per 10,000 individuals. This places Lebanon third after the United States and Germany.<sup>10,61,62</sup>

The Lebanese study also showed that the majority (84.3%) of patients did not have an evaluation by any non-invasive test prior to cardiac catheterization; only 11.0% of patients were referred for an exercise stress test, 4.0% for stress echocardiography, and 1.5% for thallium stress tests.<sup>63</sup> The rate of appropriateness of these catheterizations was deemed only 54.7%, and males were significantly more likely than females to be referred appropriately. Appropriateness of the tests decreased with increased availability of catheterization laboratories in the area. This suggests financial factors are driving catheterization rates, rather than evidence and patient care considerations, which is supported by the fact that catheterizations were generally publicly-funded, while non-invasive tests were not.<sup>63</sup> Consistently, a study in Oman showed that the use of cardiac catheterization was not related to patient characteristics, but rather was associated with hospital characteristics. In addition, high-risk patients had less catheterization than low-risk patients.<sup>62</sup>

Overall however, across the EMR, the reported rate of catheterization among patients with ACS is low (only 20% in those presenting to the emergency department with chest pain), compared to other regions, where 60% of patients access catheterization.<sup>64</sup> Inappropriate use of catheterization is shown to pervade across the region as well.

## ***CVD Treatment in the EMR***

### *Acute CVD treatment*

Patients experiencing acute coronary syndrome (ACS) should urgently access care. In the Gulf Registry of Acute Coronary Events (Gulf RACE-3Ps) involving 6 Middle Eastern countries (Oman, UAE, Qatar, Bahrain, Kuwait, and Yemen), under-use of Emergency Medical Services (i.e., ambulances) was observed, with only 3.7% arriving from home to the hospital by the Red Crescent.<sup>65</sup> Moreover, patients experienced system-related delays of 175 minutes (median) from symptom-onset to Emergency Department arrival (longer than the 140-170 minutes in the Western world),<sup>66,67</sup> mainly due to under-development of Emergency Medical Services. Similar to other regions,<sup>68</sup> pre-hospital delay times were significantly longer for females than for males (median 13 vs. 5 hours, respectively). This was attributed to family responsibilities, lack of knowledge of acute myocardial infarction symptoms, traffic congestion, long travel distance, and cultural factors such as that women cannot travel to hospital unless accompanied by a male relative.<sup>24,69</sup> Similarly in Gulf RACE-2, only 19.1% of ACS patients arrived by ambulance.<sup>24</sup> Further, 88% of patients received diagnostic electrocardiograms (ECGs) at clinics or hospitals, but none had ECGs in an ambulance, which could greatly facilitate initiation of appropriate treatment. Clearly there is a need to strengthen the infrastructure for Emergency Medical Services in the EMR.<sup>65</sup>

Where ACS diagnosis is made, patients should have fast access to revascularization through PCI or coronary artery bypass grafting as appropriate, but if not available through thrombolysis, to restore blood flow to the heart muscle and prevent death.<sup>69,70</sup> The Gulf RACE-2 study reported 79.3% of ST-elevation myocardial infarction patients (n=2416) were admitted to hospitals within 12 hours of symptom onset. Of these, 65.7% received thrombolytic therapy

while only 13.3% received PCI.<sup>71-73</sup> The median door-to-needle time for those thrombolized in the Gulf RACE-2 registry was 39 minutes, and the median door-to-balloon time for those revascularized was 87 minutes.<sup>24</sup> Over half of those revascularized received drug-eluting stents (56.6%). As in other regions, patients who received PCI were less likely to have recurrent ischemic events compared to those who received thrombolytic therapy.<sup>72</sup> The low use of PCI was mainly due to lack of cardiac catheterization laboratories in hospitals where patients were admitted.<sup>64</sup> However, some patients do not receive care due to inability to pay.<sup>24</sup>

Bypass surgery is even less common. In a consecutive Saudi Arabian cohort of patients with established CVD, 15.9% had ever had such surgery.<sup>74</sup> In another cohort of 7931 ACS patients across 65 hospitals in 6 Arabian Gulf countries (Gulf RACE-2), 2.9% of patients underwent bypass surgery on presentation (vs. 21.0% receiving PCI; clinical appropriateness unknown).<sup>24</sup> The in-hospital mortality was 4.6% (consistent with Western countries), but the 30-day mortality was 7.2%, and at 1 year after hospital discharge the mortality rate was 9.4% (higher than Western countries). These patients were quite young with many uncontrolled risk factors. Clearly acute management is quite poor, likely due to a combination of delayed presentation and lack of revascularization capacity, and long-term outcomes are even poorer.

The median length of ACS stay in the Gulf RACE-2 registry was 5 days.<sup>24</sup> Prior to hospital discharge, guidelines recommend ACS patients should be prescribed a regimen of 4 evidence-based medications, namely an antiplatelet agent, an angiotensin converting enzyme inhibitors (ACE-I) or angiotensin receptor blockers (ARB), a  $\beta$ -blocker, and a statin.<sup>75</sup> However, registry data across 6 EMR counties demonstrates adherence to these recommendations is suboptimal; of the 8154 patients with ACS, an average of 49.0% were prescribed all 4 evidence-based medications at hospital discharge, with variation across countries ranging from 38.0% in



Kuwait to 68.0% in the UAE.<sup>76</sup> In the Saudi Project for Assessment of Coronary Events, generally high rates of individual cardiac medication use was observed at hospital discharge: aspirin (97.7%), ACE-I or ARB (75.1%),  $\beta$ -blocker (81.6%), and statins (93.3%).<sup>24</sup>

What about other cardiac conditions such as arrhythmias and HF? The Gulf Survey of Atrial Fibrillation Events (SAFE) registry reports on outcomes among 1741 patients (>40% women) from 23 hospitals in 6 countries.<sup>77</sup> The cohort was younger than their Western counterparts, and they had a more favorable risk factor profile (except for diabetes). Just over half of patients (50.9%) were not prescribed oral anti-coagulation at discharge (i.e., Warfarin). At 12 months, there were 70 strokes, corresponding to an incidence of 4.1 events per 100 patient-years; female gender was not related to stroke risk.

With regard to access to device therapy for arrhythmias, results from the worldwide cardiac pacing and implantable cardioverter-defibrillator (ICD) survey, in 61 countries including five from the Middle East (Bahrain, Iran, Oman, Qatar, and Sudan), conducted in 2009 and compared to the 2005 results, reported an increase in ICD implantation rates across all EMR countries.<sup>78</sup> For example, the number of centers implanting ICDs in Iran increased from 41 in 2005 to 54 in 2009, with the number of implants increasing sharply from 2,529 to 3,373 cases correspondingly.<sup>78</sup>

With regard to heart failure, data from the Gulf acute heart failure (CARE) registry reports on acute care in 2012 in over 5,000 patients from 47 hospitals, across 7 countries.<sup>79</sup> CAD was the most common etiology (53.0%), and most had heart failure with reduced ejection fraction (69.0%; median left ventricular ejection fraction 35.0%). Less than 10% of patients had received a cardiac intervention or implantable device. Use of medication was 71.0% for beta-blockers and 78.0% for ACE-I/ARBs upon discharge. Despite being approximately 10 years younger than

their Western counterparts, in-hospital mortality rates were comparable at 6.3%; cumulative re-hospitalization at 1 year post-discharge was 40.0% and mortality was 20.0%.

Finally, heart transplantation is the only option for end-stage disease.<sup>80</sup> Saudi Arabia has a high-volume heart transplantation center, and transplantation rates increased by 4.5-fold between the periods 1989-2004 and 2005-2010.<sup>81</sup> Overall, anecdotal evidence suggests that invasive interventions are widely practiced in the region, but not necessarily appropriately. This could be attributed to the absence of prevention programs and expansion of private practices.*Secondary Prevention*

Management of CVD risk factors is essential to preventing a recurrent cardiac event. Unfortunately, suboptimal management is documented in the EMR.<sup>82</sup> For example, among outpatients diagnosed with atherothrombosis in the Middle East, anti-hypertensive medications, namely  $\beta$ -Blockers and ACE-I, were prescribed for 61.1% and 57.5%, respectively. Conversely, antiplatelet therapy, namely aspirin, was prescribed for 90.7% of outpatients, and lipid-lowering statin drugs for 85.2%, which is excellent.<sup>82</sup> In the PURE study, of the participants with CVD recruited from UAE and Iran (i.e., Middle East), 64.3% were on blood-pressure lowering drugs, 49.7% on anti-platelets, 42.9% on  $\beta$ -Blockers, 35.7% on statins, 24.5% on ACE-I or ARBs, 17.6% on calcium-channel blockers, and 11.2% on diuretics. This was somewhat lower than what was observed in North America and Europe, but considerably higher than what was reported in South Asian (which included Pakistan), China, Malaysia and Africa.<sup>83</sup> Moreover, PURE data suggest that only ~2% of these participants with CVD engaged in the 3 key heart-health behaviors (i.e., diet, tobacco abstention, physical activity).<sup>8</sup>

There are some other country-specific medication data as well. First, in Iran, prescription of antihypertensive medications by cardiologists was also much lower than the WHO's

recommendations.<sup>84</sup>  $\beta$ -blockers were the most commonly prescribed drug (46.2%), followed by calcium-channel blockers (19.2%), ACE-I (13.7%), ARBs (9.2%), and diuretics (10.3%).<sup>84</sup> In Saudi Arabia, initiation of risk factor management for CAD patients by primary and specialist physicians was low, except for anti-platelet therapy; >95.0% of physicians initiated it. For example, ACE-I was recommended by 52.0% of physicians; statins by 61.0% of physicians, and nicotine replacement therapy for smokers was recommended by  $\leq$ 50.0% of physicians.<sup>58</sup> In a consecutive cohort of CAD patients in Saudi Arabia, a chart review revealed only 10.4% of patients were on optimal medical therapy (yet the patients were very adherent to their medication regimens).<sup>74</sup> The rate of achievement of target systolic blood pressure was 76.5%, of target diastolic blood pressure was 88.0%, target LDL 68.0%, and target glycated hemoglobin was 24.0% among those with comorbid diabetes. Interestingly however, very few patients had a lipid profile on file within the last year (13.0%). The least well-controlled risk factor was physical activity (70.5%).

With regard to cardiac rehabilitation (CR), only eight of the 22 EMR countries (36.4%) have any of these services, despite their proven efficacy and cost-effectiveness.<sup>85-87</sup> Indeed, outcome studies in the EMR also show that participation in CR is associated with significant reductions in systolic blood pressure, lipids, weight, body mass index, waist circumference, fasting blood glucose, and heart-health behaviors, as well as significant improvements in HDL, functional capacity, left ventricular ejection fraction, and quality of life.<sup>88,89</sup> Programs are most often available in high-income EMR countries, but availability is still much lower than is observed in high-income countries in other regions of the globe.<sup>85,90</sup> Even where available, there is insufficient capacity to treat all indicated patients. As shown in Table 6, CR density in the EMR ranges widely from one program per 1.4–40.4 million inhabitants.

Further, CR utilization rates are low. In a survey conducted in Iran, cardiologists reported that <15% of patients are referred to CR.<sup>91</sup> Even where patients are referred, participation and completion rates are low as well. Studies, primarily from Iran, report dropout rates as high as 82.0%.<sup>92</sup> For example, among 4735 patients who underwent coronary bypass surgery in Iran, 44.6% were referred, 18.7% enrolled, and only 16.5% completed the program; completion rates were substantively lower in women than in men (15.6% vs 20.0%, respectively).<sup>92</sup> While barriers among women are likely many, women and men are often required to have separate classes for cultural/religious reasons, and this requires more space and resources. Another study from Pakistan showed 36.2% of referred patients participated in CR, of whom 73.4% completed at least 6 weeks of the program.<sup>93</sup>

Overall, the studies reviewed above point to lack of preventive CVD care, inadequate knowledge of CVD management recommendations on the part of both patients and providers, an inadequate healthcare system that emphasizes advanced acute cardiac care services,<sup>74</sup> and lack of patient follow-up and monitoring. Moreover, many patients pay out-of-pocket for their care,<sup>5</sup> which is a clear disincentive to preventive care, and is catastrophic for families where acute CVD care is required. Clearly, policies are required at the national level to tackle this epidemic of CVD.

### ***Public Policy to Address CVD***

Table 7 presents national government capacity across all 22 EMR countries to tackle NCDs, including CVD, as assessed by the WHO in 2015. Overall, the data revealed lack of policies and systems to address NCDs. Nine (40.9%) countries reported they have evidence-based national guidelines/protocols/standards for the management of NCDs through primary care (e.g., glucose, lipid, and blood pressure measurement and management); 8 (36.4%) reported that

they have an operational unit in their Ministry of Health with responsibility for NCDs; 3 (13.6%) reported having an operational multi-sectoral national policy, strategy or action plan for NCDs; and only 1 (4.5%) country reported having an NCD surveillance and monitoring system in place to enable reporting against the nine global NCD targets.<sup>19,94</sup> With regard to risk factor control specifically, 13 (59.1%) of the EMR countries reported an operational policy, strategy or action plan to reduce the burden of tobacco use, 8 (36.4%) reported an action plan to reduce physical inactivity, and another 8 (36.4%) have an action plan related to diet.<sup>94</sup> Caution is warranted in over-interpreting these data however, as the degree of implementation of these strategies or plans was not considered.

### ***Implications and Conclusions***

Caution is warranted in interpreting this synthesis for several reasons. As outlined in the introduction, there is considerable heterogeneity across the EMR. While attempts were made to specify countries from which data were collected and hence results applied, findings reported should not be considered reflective across the EMR. In particular, results from the Gulf registries would not be applicable to countries such as Sudan, Egypt, Pakistan, Syria or Djibouti. As an example, over-use of cardiac catheterization was reported in some settings, with extremely limited access in most others. Moreover, this was a narrative review. Hence, the identification of studies was not systematic and exhaustive, and the limitations of individual studies reviewed were not specifically assessed and reported. Finally, there is a dearth of data from the region; subsequently some older data is reported, and the degree to which these rates reflect current reality cannot be known. Indeed, comparisons across countries should be made with particular caution due to different timing of assessment (in addition to methods).

In summary, the burden of CVD risk factors in EMR countries is high – particularly for obesity, physical inactivity and dyslipidemia. Accordingly, a rapid increase in CVD burden across the EMR is projected, with corresponding increases in mortality. Public awareness of CVD risk factors, as well as signs and symptoms must be increased. Primary (particularly screening, EMR-specific total risk assessment, lifestyle counselling and chronic CVD management/monitoring) and acute CVD care capacity needs to be augmented; with regard to the latter, timely diagnostic ECG and catheterization, and primary PCI access in particular are urgently needed to save lives. Individuals must have coverage for CVD care and medications, so high, consistent use of all clinical practice recommendations is achieved. Surveillance is required so there is more information on health system performance, including consideration of sex differences given the inequities identified through this review.

More broadly, given there exists little capacity to control CVD across most EMR countries, there is a need for robust multi-sectoral systems supporting primary (e.g., public health campaigns, built environment), secondary and tertiary prevention. The United Nations Relief and Works Agency for Palestine Refugees in the Near East has developed a healthcare system to manage NCD risk factors; this should serve as a model for the many countries in the region in the midst of acute and chronic emergencies.<sup>65</sup> Cost-effective preventive strategies (Table 8) such as smoking cessation, salt reduction, access to affordable medication, as well as CR delivery should be widely supported.<sup>95</sup> There is currently considerable international will working towards reducing premature CVD mortality by 25% by the year 2025,<sup>96</sup> and certainly these efforts bolster what needs to be done to mitigate the CVD burden in the EMR.

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### **Key Points**

- The CVD mortality rate in the EMR is estimated to increase more dramatically than in any other global region except Africa; it is the leading cause of premature mortality and disability in the region.
- The risk factors of tobacco consumption (including water pipes), physical inactivity, depression, overweight/obesity, as well as hypertension and diabetes are particularly challenging in this region.
- Despite the high risk factor and disease burden, knowledge and awareness of CVD and its risk factors are incredibly low in the EMR, and gaps in control of CVD risk factors are prominent
- Treatment of CVD is suboptimal; it is comprised primarily of thrombolysis, with insufficient provision of timely revascularization. Secondary prevention through cost-effective strategies such as cardiac rehabilitation is limited by low availability.



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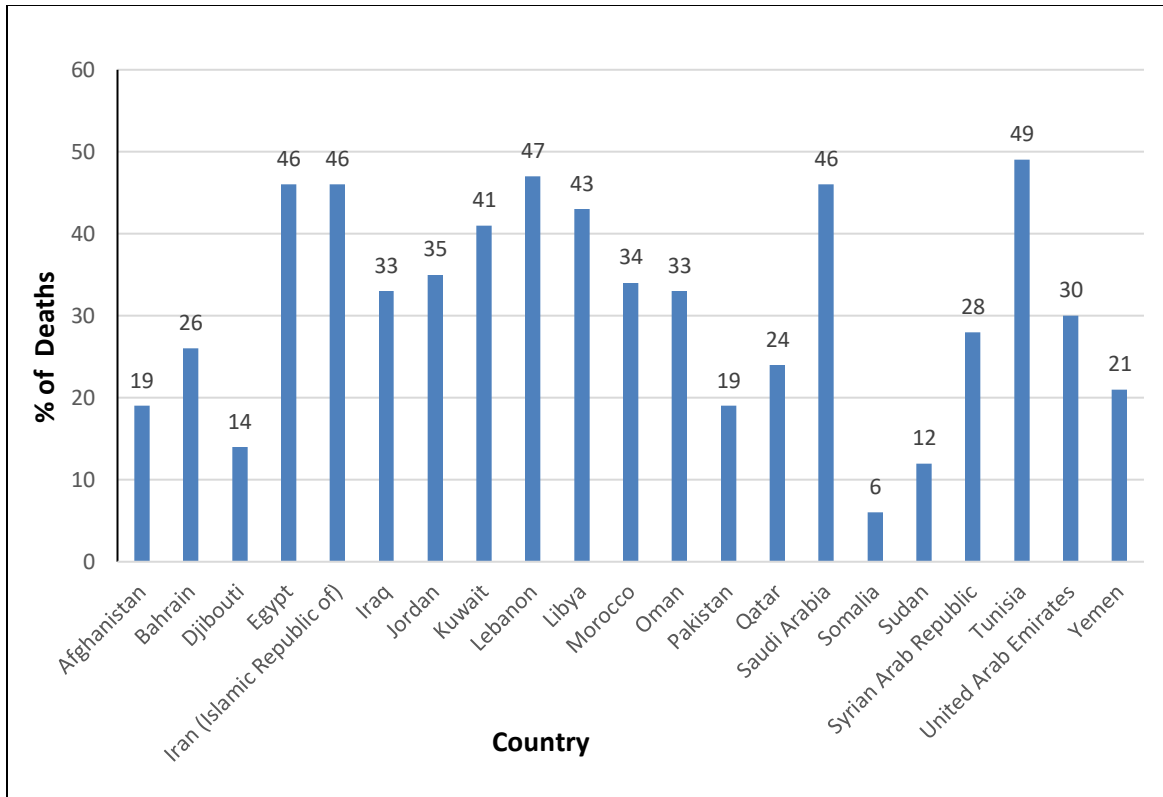
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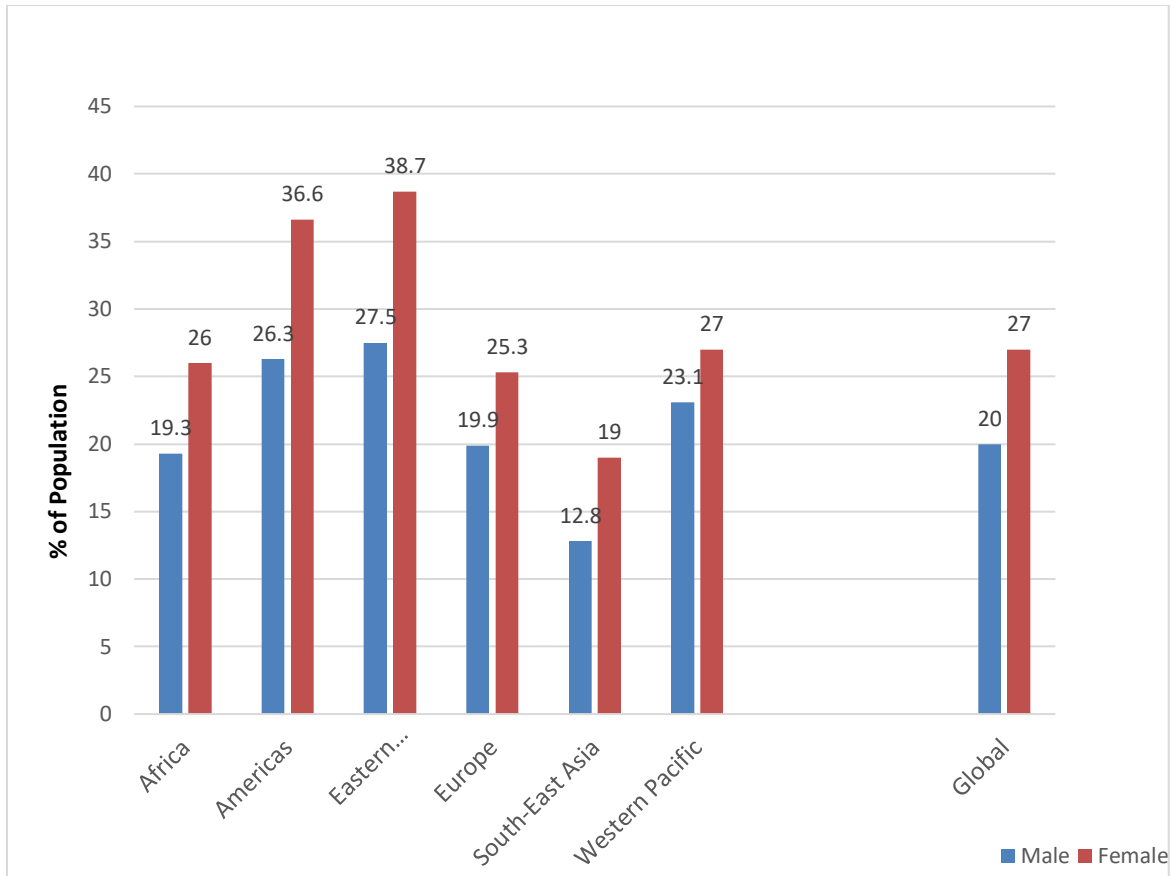
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**Figure 1 | Mortality Rates from Cardiovascular Disease in EMR Countries, 2012**  
**EMR, Eastern Mediterranean Region**  
**Source: reference 93**



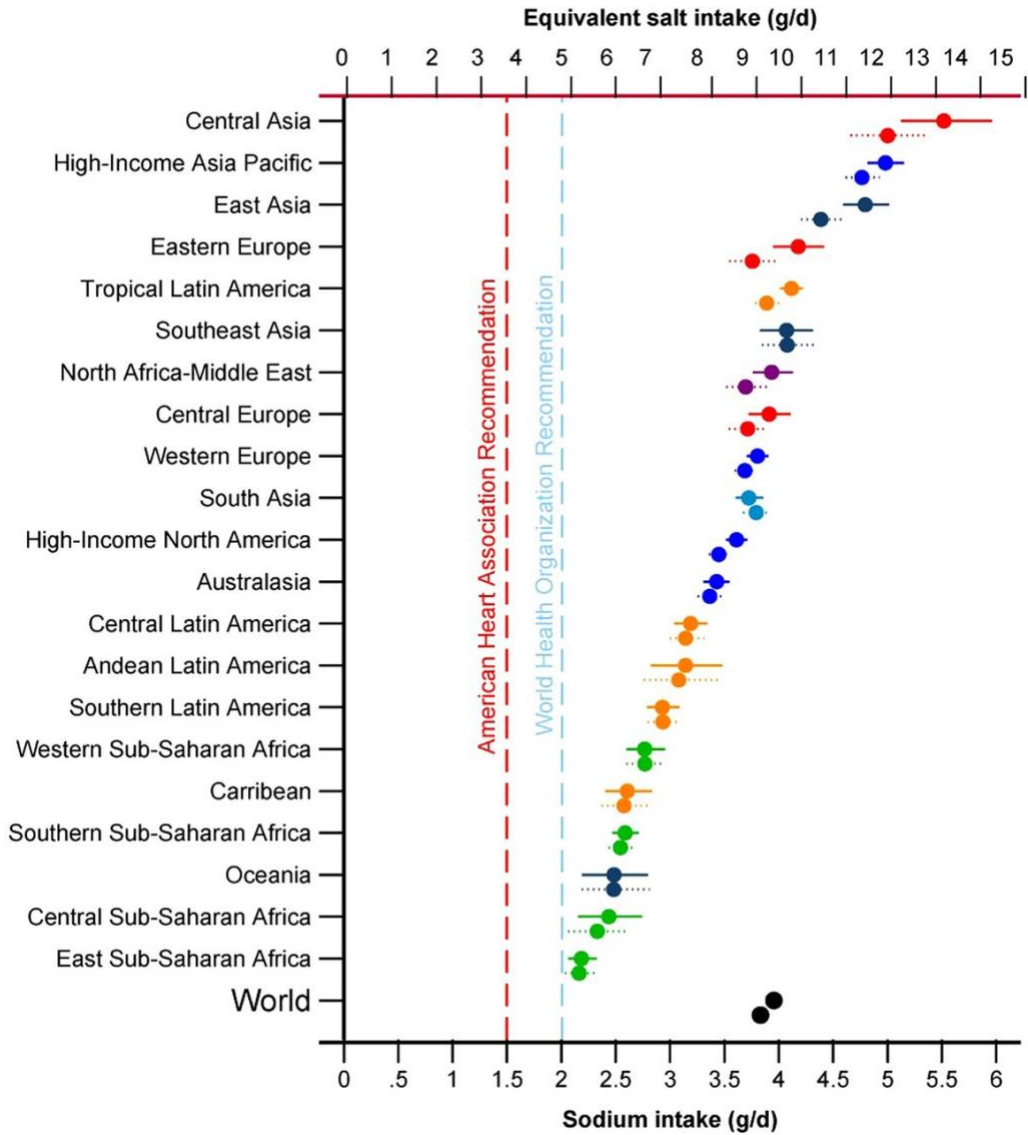
**Figure 2| Age-standardized\* prevalence of insufficient physical activity§ by World Health Organization region and sex, 2010**

\*Among adults  $\geq 18$  years old

§ Recommended at least 150 minutes of moderate intensity physical activity per week for adults

Adapted with .... from reference 19 (Need permission from WHO)



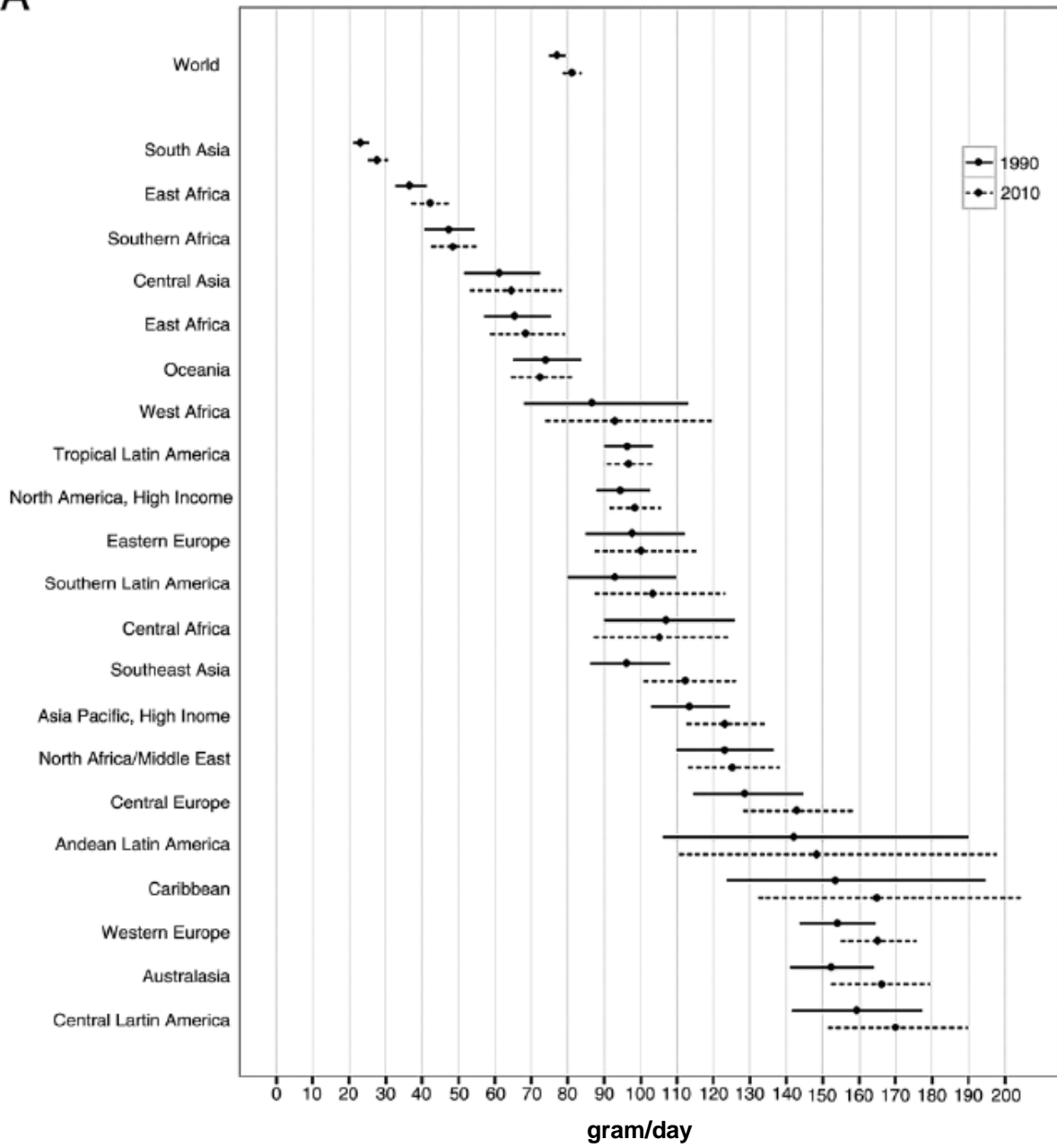


**Figure 3| Mean (95% uncertainty interval) age-standardized sodium intake in 1990 and 2010 by world region**

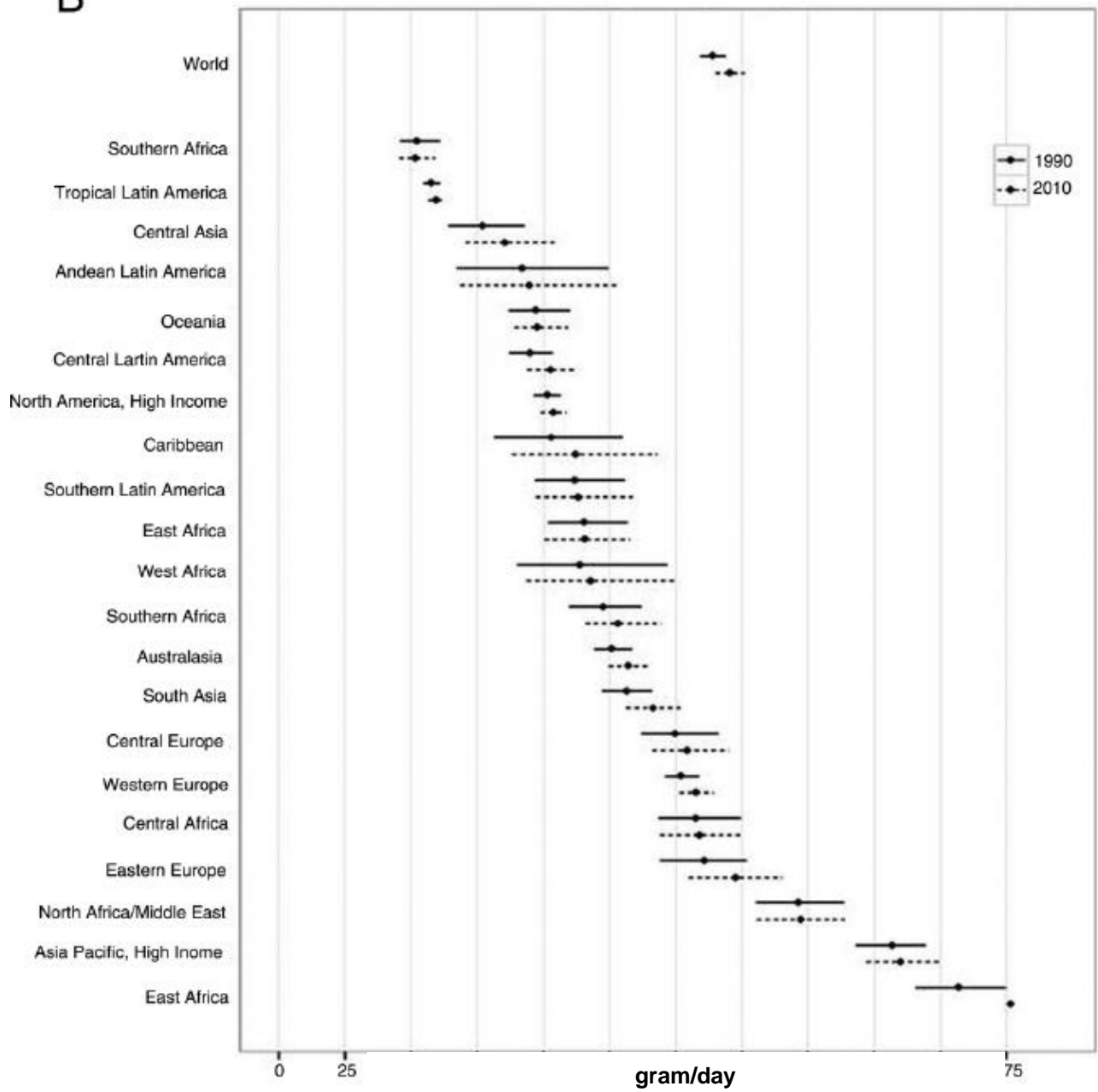
(g/d)=grams/day

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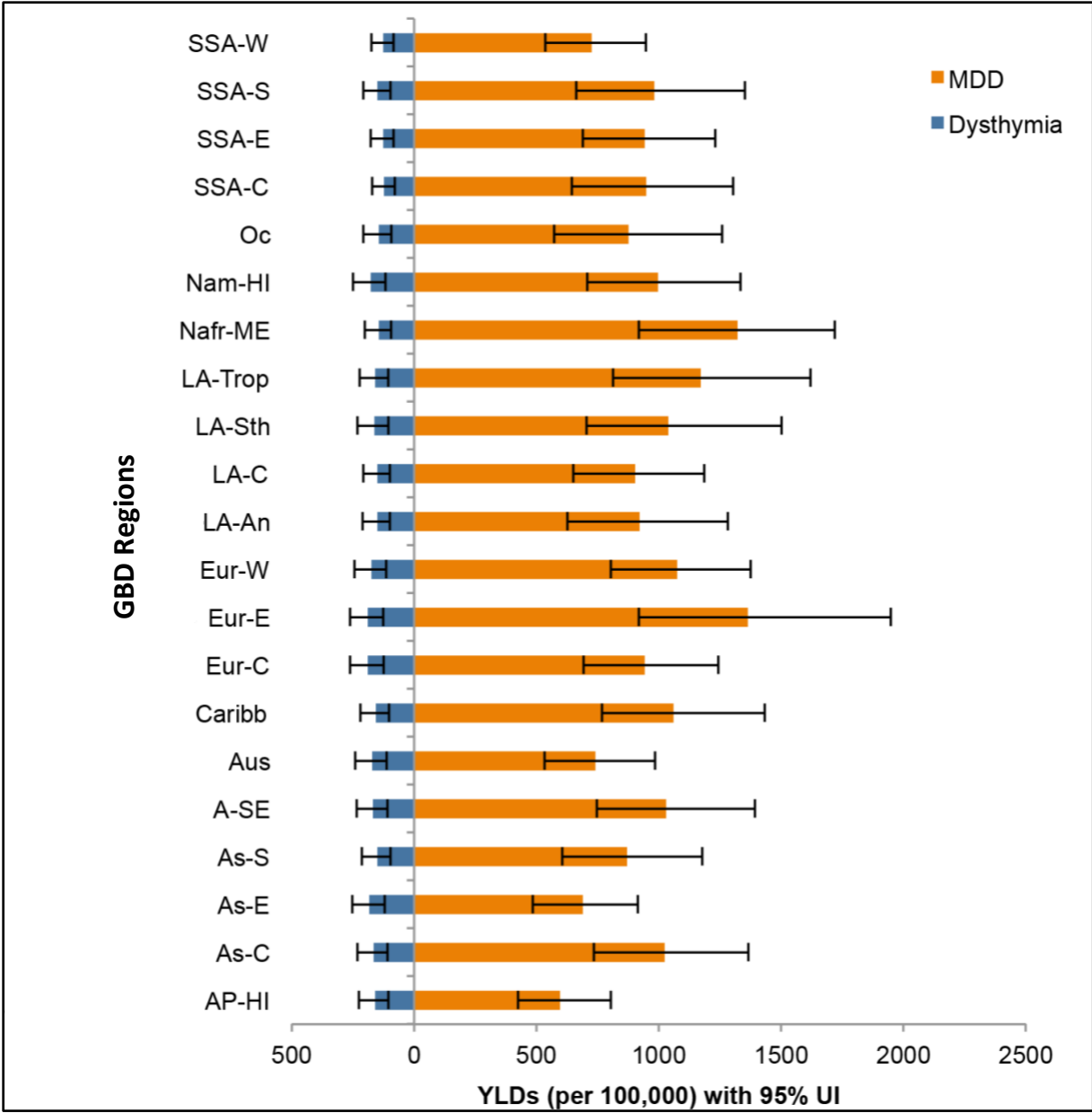
A



B



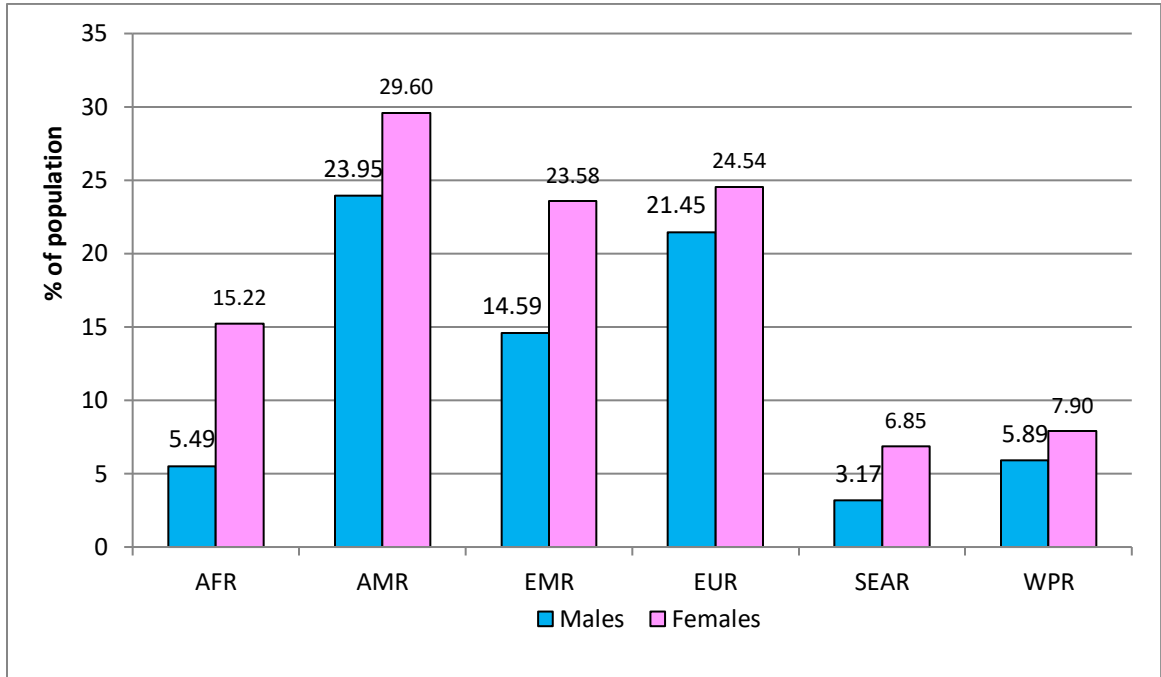
**Figure 4: Global and regional mean fruit (A), and vegetable (B) intake in 1990 and 2010, for adults  $\geq 20$  years of age in relation to their uncertainty  
Reproduced with ...from reference 32 Permission is needed)**



**Figure 5| Depression burden in regions around the world, as measured by years living with disability (YLD), in 2010. MDD, Major Depressive Disorder; UI, uncertainty interval**

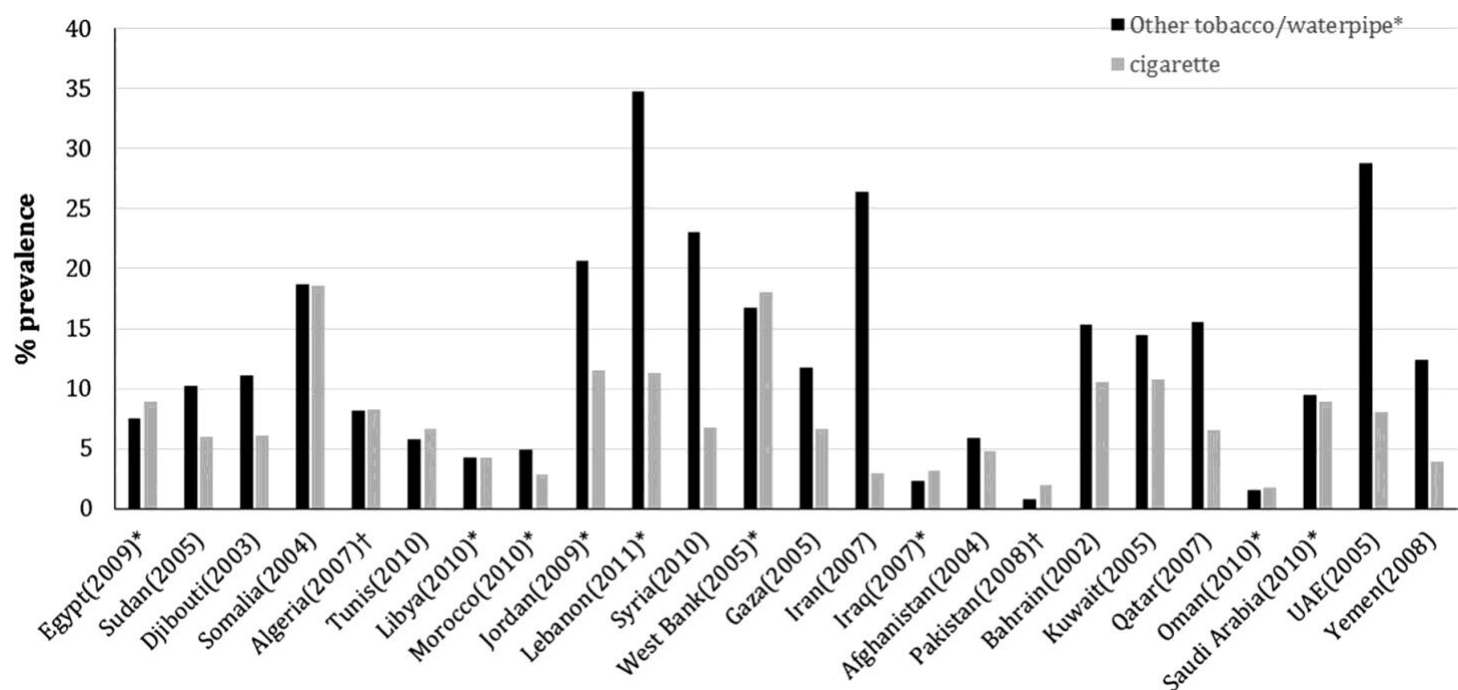
AP-HI, Asia Pacific, high income; As-C, Asia Central; AS-E, Asia East; AS-S, Asia South; A-SE, Asia Southeast; Aus, Australasia; Caribb, Caribbean; Eur-C, Europe Central; Eur-E, Europe Eastern; Eur-W, Europe Western; LA-An, Latin America, Andean; LA-C, Latin America, Central; LA-Sth, Latin America, Southern; LA-Trop, Latin America, Tropical; Nafr-ME, North Africa/Middle East; Nam-HI, North America, high income; Oc, Oceania; SSA-C, Sub-Saharan Africa, Central; SSA-E, Sub-Saharan Africa, East; SSA-S, Sub-Saharan Africa Southern; SSA-W, Sub-Saharan Africa, West <sup>4</sup>

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**Figure 6| Age standardized prevalence of obesity by WHO regions (adults 18+), 2014** AFR, African; AMR, American; EMR, East Mediterranean Region; SEAR, South-East Asia Region, EUR, European Region, WPR, Western Pacific Region

Reproduced with ... from reference 19 (Permission needed from WHO: [www.who.int/about/licensing/copyright\\_form/en/index.html](http://www.who.int/about/licensing/copyright_form/en/index.html))



**Figure 7** | Current other tobacco/water pipe vs cigarette smoking among adolescents 13–15 year-olds in selected countries according to the most recent Global Youth Tobacco Survey.

\*Specifically inquired about water pipe smoking, otherwise other tobacco use is represented.

†More than one survey, and the average of their prevalence measures is reported as Algeria

UAE, United Arab Emirates

Source: reference 23. Reproduced as per journal's policy requirement (Journal policy: No need for permission as long as it is not for commercial and is properly cited)





**Table 1| Projected Deaths from Cardiovascular Diseases in 2015 and 2030 by WHO region<sup>6</sup>**

Region		2015		2030	
		NCD	CVD	NCD	CVD
<b>Eastern Mediterranean Region</b>	Deaths (/100,000)	363.0	170.0	445.0	208.0
	% total	58.4	27.4	68.7	32.1
<b>African Region</b>	Deaths (/100,000)	390.0	125.0	345.0	150.0
	% total	33.0	12.0	42.5	16.3
<b>Region of the Americas</b>	Deaths (/100,000)	550.0	199.0	651.0	222.0
	% total	80.3	29.1	82.8	28.3
<b>South-East Asian Region</b>	Deaths (/100,000)	491.0	217.0	611.0	266.0
	% total	63.5	28.0	72.5	31.6
<b>European Region</b>	Deaths (/100,000)	873.0	465.6	893.3	433.1
	% total in the region	88.2	47.0	88.9	43.1
<b>Western Pacific Region</b>	Deaths (/100,000)	587.0	284.0	735.0	325.0
	% total in the region	84.1	40.7	87.2	38.6
<b>WORLD</b>	Deaths (/100,000)	5406.4	2465.0	6252.5	2686.0
	% total	68.4	31.2	73.9	31.7

Source: reference 6

CVD: cardiovascular diseases; NCD: non-communicable diseases; WHO: World Health Organization.

**Table 2 | Cardiovascular Disease Deaths by Type in 2015**

EMR	World
-----	-------

	Deaths/10 0,000	Deaths (000s)	% Total deaths	Deaths/ 100,000	Deaths (000s)	% Total deaths
<b>Cardiovascular diseases</b>	170.0	1107.0	27.4	246.5	17867.0	31.2
<b>Rheumatic heart disease</b>	6.0	41.0	1.0	5.1	371.0	0.6
<b>Hypertensive heart disease</b>	12.0	81.0	2.0	15.7	1137.0	2.0
<b>Ischemic heart disease</b>	79.0	517.0	12.8	104.8	7594.0	13.2
<b>Stroke</b>	53.0	346.0	8.5	92.4	6700.0	11.7
<b>Cardiomyopathy, myocarditis, endocarditis</b>	6.0	41.0	1.0	6.6	482.0	0.8
<b>Other circulatory diseases</b>	12.0	81.0	2.0	21.8	1584.0	2.8

EMR, Eastern Mediterranean Region

Source: reference 6

Table 3: Prevalence of tobacco smoking and physical inactivity, by sex and EMR country

	Current tobacco smoking, %			Insufficient physical activity, %*		
	Men	Women	Total	Men	Women	Total
<b>Afghanistan</b>	..	..	..	..	..	..
<b>Bahrain</b>	36.6	7.9	26.6	..	..	..
<b>Djibouti</b>	26.2	2.4	..	..	..	..
<b>Egypt</b>	43.2	0.5	21.8	25.1	39.4	32.3
<b>Iran</b>	23.5	1.3	..	24.1	42.9	33.5
<b>Iraq</b>	46.9	7.3	..	52.8	45.8	49.3
<b>Jordan</b>	63.2	10.4	..	15.6	15.6	15.6
<b>Kuwait</b>	..	..	..	49.2	63.9	56.6
<b>Lebanon</b>	43.9	30.9	37.6	43.9	33.8	38.8
<b>Libya</b>	..	..	..	32.8	43.3	32.8
<b>Morocco</b>	37.9	2.3	..	..	..	..
<b>Palestinian Occupied Territories</b>	..	..	..	..	..	..
<b>Oman</b>	18.3	1.1	12.4	..	..	..
<b>Pakistan</b>	40.2	3.5	22.2	20.2	31.7	26.0
<b>Qatar</b>	31.0	2.0	..	33.4	49.7	41.6
<b>Saudi Arabia</b>	26.3	4.0	..	53.2	68.7	61.0
<b>Somalia</b>	..	..	..	..	..	..
<b>Sudan</b>	..	..	..	..	..	..
<b>Syrian Arab Republic</b>	76.7	21.0	..	..	..	..
<b>Tunisia</b>	55.9	4.0	..	19.7	27.3	23.5
<b>United Arab Emirates</b>	30.0	3.2	..	32.2	44.6	38.4
<b>Yemen</b>	..	..	..	..	..	..

--Indicates no data. EMR, Eastern Mediterranean Region.

Smoking Adults 15+, 2012

\* < 150 minutes of moderate or vigorous-intensity physical activity per week among adults ≥18 years

Adapted with ....from reference 19. (Permission is needed)

**Table 4| Prevalence of Low Fruit and Vegetable Intake (% ≤ 5 serving per day)**

<b>Year</b>	<b>Country</b>	<b>Male</b>	<b>Female</b>	<b>Total</b>
<b>2007</b>	Bahrain	-	-	44.0
<b>2006</b>	Egypt	-	-	79.0
<b>2005</b>	Iraq	-	-	91.4
<b>2007</b>	Jordan	-	-	57.0
<b>2014</b>	Kuwait	81.4	86.0	83.8
<b>2006</b>	Oman	-	-	33.2
<b>2007</b>	Saudi Arabia	92.8	92.0	93.5
<b>2003</b>	Syrian Arab Republic	-	-	95.7

-Not available

Sources: references 31, 32, and 51

**Table 5: Prevalence (%) of obesity, high blood pressure, cholesterol and impaired glucose, by sex and EMR country**

Country	Hypertension*, age 18+ years (2014)			Raised blood glucose level **, age 18+ years (2014)			Dyslipidemia, age 25+ (2008)			Overweight BMI≥25) ‡, age 18+ years (2014)			Obese (BMI≥30) §, age 18+ years (2014)		
	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total
<b>Afghanistan</b>	22.0	21.4	21.7	9.9	9.3	9.6	20.9	22.7	21.9	13.4	19.1	16.2	1.8	4.1	2.9
<b>Bahrain</b>	20.6	16.8	19.2	18.0	16.2	17.3	52.5	54.2	53.4	70.2	74.0	71.7	30.5	42.8	35.1
<b>Djibouti</b>	26.6	22.2	24.4	9.2	8.2	8.7	36.8	36.3	36.7	26.9	37.0	31.9	5.6	13.5	9.6
<b>Egypt</b>	23.0	24.0	23.5	17.2	20.6	18.9	38.2	41.2	39.9	55.8	68.2	62.0	20.3	37.5	28.9
<b>Iran (Islamic Republic of)</b>	21.2	19.6	20.4	11.6	12.7	12.2	49.8	58.1	54.1	59.5	65.1	62.3	20.1	32.0	26.1
<b>Iraq</b>	22.1	21.4	21.8	16.5	17.2	16.8	43.7	44.1	44.0	53.3	62.7	57.9	17.2	30.5	23.8
<b>Jordan</b>	21.5	16.9	19.3	14.6	15.3	14.9	47.8	49.6	48.8	62.0	70.0	65.9	22.7	38.6	30.5
<b>Kuwait</b>	23.1	15.0	19.9	21.0	18.9	20.1	56.2	55.7	56.2	75.2	75.8	75.4	35.5	45.9	39.7
<b>Lebanon</b>	25.2	18.9	22.1	13.7	11.5	12.6	41.0	47.0	44.2	67.4	70.1	68.7	26.3	37.7	31.9
<b>Libya</b>	23.9	20.0	21.9	16.8	17.3	17.0	34.8	36.6	35.6	66.5	70.9	68.7	26.6	39.5	33.1
<b>Morocco</b>	25.0	25.5	25.3	13.8	13.1	13.5	35.3	39.0	37.2	52.0	60.8	56.5	16.2	28.3	22.3
<b>Oman</b>	17.6	16.5	17.2	17.2	15.1	16.4	48.4	50.7	49.6	66.1	69.8	67.4	27.2	37.7	30.9
<b>Pakistan</b>	24.6	21.3	23.0	10.7	10.9	10.8	30.5	31.4	31.0	20.8	25.3	23.0	3.7	7.3	5.4
<b>Qatar</b>	19.5	13.6	18.1	23.4	21.4	23.0	56.8	57.5	57.0	77.8	78.9	78.1	40.0	49.7	42.3
<b>Saudi Arabia</b>	23.8	19.1	21.8	19.3	16.9	18.3	36.4	42.1	39.0	68.0	71.9	69.6	29.9	41.4	34.7
<b>Somalia</b>	27.9	24.9	26.4	7.1	6.6	6.8	23.6	25.5	24.7	14.9	26.5	20.7	2.1	7.2	4.6
<b>Sudan</b>	26.1	22.7	24.4	9.5	10.6	10.0	33.1	32.6	32.9	21.5	34.1	27.8	4.0	11.1	7.5

<b>Syrian Arab Republic</b>	22.2	20.4	21.3	13.3	14.5	13.9	38.3	42.4	40.5	54.8	62.3	58.5	17.4	29.9	23.5
<b>Tunisia</b>	24.7	24.1	24.4	13.3	13.4	13.3	37.3	43.8	40.7	59.3	66.4	62.9	20.3	33.8	27.1
<b>United Arab Emirates</b>	16.7	10.3	14.7	19.1	17.6	18.6	56.8	58.2	57.6	73.1	75.8	74.0	33.8	45.1	37.2
<b>Yemen</b>	23.0	23.5	23.3	15.4	15.7	15.5	30.7	33.6	32.3	39.9	53.7	46.8	11.1	23.4	17.2

EMR, Eastern Mediterranean Region

\* Hypertension (Systolic BP $\geq$ 140 and/or Diastolic BP $\geq$ 90), (age-standardized prevalence of hypertension among persons aged 18+ years, 2014)

\*\* Raised blood glucose (fasting glucose  $\geq$ 7.0 mmol/l (126 mg/dl) or on medication for raised blood glucose or with a history of diagnosis of diabetes), (age-standardized prevalence of raised blood glucose among persons aged 18+ years, 2014)

‡BMI body mass index. Overweight (BMI $\geq$ 25) (age-standardized prevalence of raised blood pressure among persons aged 18+ years, 2014)

§ obesity: BMI $\geq$ 30 (age-standardized prevalence of raised blood pressure among persons aged 18+ years, 2014)

Adapted with ...from references 19 and 39 (Permission needed)

**Table 6| Density of cardiac rehabilitation in EMR countries**

<b>Country</b>	<b>Population (millions)</b>	<b>Number of programs</b>	<b>Density (million inhabitants per program)</b>
<b>Algeria</b>	40.4	1	40.4
<b>Bahrain</b>	1.4	1	1.4
<b>Egypt</b>	94.3	2	47.2
<b>Qatar</b>	2.3	1	2.3
<b>United Arab Emirates</b>	9.3	2	4.7
<b>EMR</b>	583	7	83.3

EMR, Eastern Mediterranean Region

Source: references 85 and 90



**Table 7** | Country Capacity for Cardiovascular Disease Control

Country	Has an operational NCD unit/branch or department within the Ministry of Health, or equivalent	Has an operational multi-sectoral national policy, strategy or action plan that integrates several NCDs and shared risk factors	Has an operational policy, strategy or action plan to reduce physical inactivity and/or promote physical activity	Has an operational policy, strategy or action plan to reduce the burden of tobacco use	Has an operational policy, strategy or action plan to reduce unhealthy diet and/or promote healthy diets	Has evidence-based national guidelines/protocols/standards for the management of major NCDs through a primary care approach	Has an NCD surveillance and monitoring system in place to enable reporting against the nine global NCD targets
<b>Afghanistan</b>	No	No	No	No	No	No	No
<b>Bahrain</b>	Yes	Yes	Yes	Yes	Yes	Yes	No
<b>Djibouti</b>	No	No	No	No	No	No	No
<b>Egypt</b>	No	No	No	Yes	No	Yes	No
<b>Iran</b>	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<b>Iraq</b>	DK	No	Yes	Yes	Yes	No	No
<b>Jordan</b>	No	No	Yes	Yes	Yes	Yes	No

<b>Kuwait</b>	Yes	No	No	No	No	DK	No
<b>Lebanon</b>	No	DK	DK	Yes	DK	Yes	No
<b>Libya</b>	Yes	No	No	No	No	No	No
<b>Morocco</b>	No	No	No	Yes	No	No	No
<b>Oman</b>	Yes	No	Yes	Yes	Yes	No	No
<b>Pakistan</b>	Yes	No	No	No	No	No	No
<b>Qatar</b>	Yes	Yes	Yes	Yes	Yes	Yes	No
<b>Saudi Arabia</b>	Yes	No	Yes	Yes	Yes	DK	No
<b>Somalia</b>	No	No	No	No	No	No	No
<b>Sudan</b>	No	No	Yes	Yes	Yes	Yes	No
<b>Syrian Arab Republic</b>	No	No	No	Yes	No	Yes	No
<b>Tunisia</b>	No	No	No	Yes	No	No	No
<b>United Arab Emirates</b>	No	No	No	No	No	Yes	No
<b>Yemen</b>	No	No	No	No	No	No	No

NCD,

noncommunicable disease; DK, do not know

Source: reference 94

**Table 8| “Best Buy” Interventions**

<b>Risk factor / disease</b>	<b>Interventions</b>
<b>Tobacco use</b>	<ul style="list-style-type: none"><li>• Tax increases</li><li>• Smoke-free indoor workplaces and public places</li><li>• Health information and warnings</li><li>• Bans on tobacco advertising, promotion and sponsorship</li></ul>
<b>Harmful alcohol use</b>	<ul style="list-style-type: none"><li>• Tax increases</li><li>• Restricted access to retailed alcohol</li><li>• Bans on alcohol advertising</li></ul>
<b>Unhealthy diet and physical inactivity</b>	<ul style="list-style-type: none"><li>• Reduced salt intake in food</li><li>• Replacement of trans fat with polyunsaturated fat</li><li>• Public awareness through mass media on diet and physical activity</li></ul>
<b>Cardiovascular disease (CVD) and diabetes</b>	<ul style="list-style-type: none"><li>• Counselling and multi-drug therapy for people with a high-risk of developing heart attacks and strokes (including those with established CVD)</li><li>• Treatment of heart attacks with aspirin</li></ul>

Source: reference 97

Reproduced with .. from reference 97

Authors' Biographies:

**Karam Turk-Adawi:** Dr. Karam Turk-Adawi is Assistant Professor of Public Health at the College of Health Science, Qatar University. She undertook her doctoral studies in Health Policy at Brandeis University, MA, USA. She was a recipient of the Palestinian Faculty Development Program Scholarship in 2006. Dr. Adawi's research interest is in preventive cardiology with a special focus on cardiac rehabilitation globally. Currently, she holds a co-lead position in conducting a global cardiac rehabilitation study under the banner of the International Council of Cardiovascular Prevention and Rehabilitation

**Nizal Sarrafzadegan:** Dr. Nizal Sarrafzadegan is a Professor of cardiology in Isfahan University of Medical Sciences in Iran and affiliate Prof. in the School of Population and Public Health in the University of British Columbia in Canada. She is the Founding Director of the Isfahan Cardiovascular Research institute, a WHO collaborating centre for research and training in cardiovascular disease. She combines her clinical background with strong interest and expertise in CVD prevention and rehabilitation. She had published about 400 papers in peer-reviewed journals, books and book chapters. She is a WHO advisor, international invited speaker and, a member of the editorial board of cardiology journals. She won the 2016 WHO/EMR award for her extensive research in CVD

**Ibtihal Fadhil:** Dr Fadhil is Assistant Professor Public Health, Retired Regional Adviser, Non Communicable Diseases, World Health Organization, founder of the regional network on Non communicable research and Regional NCD Alliance. Dr Fadhil received her medical degree from Medical college, University of Basrah, Iraq, Obtained MSc and PhD from LSHTM, University of London, UK. Prior joining WHO, Dr Fadhil held several positions in clinical medicine, academia and research in Iraq, Jordan, United Kingdom, New Zealand, and Bahrain. Dr FADHIL served as member of several national and international medical committees and public health associations,. Dr. Fadhil research interest in Non Communicable diseases epidemiology and risk factors,. Published as main author and coauthor in several scientific journals

**Kathryn Taubert:** Dr. Kathryn Taubert is Vice President of International Science and Health Strategies for the American Heart Association and is based in Basel, Switzerland. She is responsible for advancing their mission on a global scale by forming collaborations and establishing relationships and partnerships with international organizations such as the World Health Organization as well as with international cardiovascular associations/ societies/ foundations to broaden the AHA's support and impact on global health. She is also Adjunct Professor of Physiology at UT Southwestern Medical School. Prior to joining AHA she was Chief Science Officer for the World Heart Federation in Geneva.

**Masoumeh Sadeghi:** Dr. Masoumeh Sadeghi, professor of cardiology, received her cardiology degree from Isfahan University of Medical Sciences. She is the head of Cardiac Rehabilitation Research Center and the deputy of research in Isfahan Cardiovascular Research Institute(a WHO Collaborating Center). She is the editor in chief of ARYA Atherosclerosis Journal. She started her national and international studies emphasizing on cardiovascular diseases in women and secondary prevention and rehabilitation of cardiac patients since 2000 and published more than 240 articles in local and international peer-reviewed journals. She is a recipient of national awards as a distinguished researcher or doctor in national festivals on Medical Sciences in Iran.

**Nanette k. Wenger :** Dr. Wenger is Professor of Medicine in the Division of Cardiology at the Emory University School of Medicine and Consultant to the Emory Heart and Vascular Center. Coronary heart disease in women is one of Dr. Wenger's research interests. She chaired the U.S. National Heart, Lung, and Blood Institute Conference on Cardiovascular Health and Disease in Women. She has expertise in cardiac rehabilitation. She chaired the World Health Organization Expert Committee on Rehabilitation after Cardiovascular Disease, and co-chaired the Guideline Panel on Cardiac Rehabilitation for the U.S. Agency for Health Care Policy and Research. Dr. Wenger has had a longstanding interest in geriatric cardiology, is Past President of the Society of Geriatric Cardiology and was Editor-in-Chief of the American Journal of Geriatric Cardiology for more than 15 years. Dr. Wenger has authored or coauthored over 1500 scientific and review articles and book chapters.

**Nigel S. Tan:** Dr. Nigel S. Tan is an Adult Cardiology resident in the Department of Medicine at the University of Toronto, Toronto, Canada. He has broad research interests within cardiology, including acute coronary syndromes and arrhythmia care.

**Sherry L. Grace, PhD, FCCS:** is Full Professor in the Faculty of Health at York University, Toronto, Canada; she is also Sr. Scientist at the Cardiovascular Rehabilitation Program of the University Health Network. Her research centers on global cardiovascular rehabilitation delivery and access, as well as cardiac psychology.

Prof. Grace was recognized with a Canadian Association of Cardiovascular Prevention and Rehabilitation Leadership award for Knowledge Translation. She currently serves as Chair of the International Council on Cardiovascular Prevention and Rehabilitation ([www.globalcardiacrehab.com](http://www.globalcardiacrehab.com)). Through her work, she aims to recognize and address gaps in cardiac rehab care.