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Cardiovascular risk profiles of adults with type-2 diabetes treated at urban hospitals in Riyadh, Saudi Arabia

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Abstract Diabetes mellitus substantially increases cardiovascular disease (CVD) risk. Among Saudi Arabian citizens with diabetes, little is known about the prevalence and control of other CVD risk factors.

We extracted data from medical records of a random selection of 422 patients seen between 2008 and 2012 at two diabetic clinics in Riyadh, Saudi Arabia. We calculated the proportion of patients who had additional CVD risk factors: obesity (body mass index ≥ 30 kg/m²), hypertension (BP $\geq 140/90$ mmHg), elevated cholesterol fractions, and multiple risk factors). Further, we calculated the proportion of patients meeting the American Diabetes Association's recommended care targets for each risk factor.

Of 422 patients (mean age, 52 years), half were women, 56% were obese, 45% had hypertension, and 77% had elevated LDL concentrations. In addition to diabetes, 70% had two or more CVD risk factors. Although 9% met both target HbA1c and BP values, only 3.5% had optimum HbA1c, BP, and lipid values.

In Saudi Arabia's best diabetes clinics, most patients have poor control of their disease. This huge disease burden and related care gaps have important health and financial implications for the country.

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1. Introduction

Since 2000, several studies have estimated the prevalence of type-2 diabetes mellitus (DM) in the Kingdom of Saudi Arabia (KSA) to be between 20% and 35% [10–12], the third highest in the world [10]. Diabetes is the most costly medical disorder in the KSA, consuming 23% of the healthcare expenditures and 11% of all direct medical services [13]. One out of every five Saudi patients with diabetes experiences nephropathy, which can lead to end-stage renal disease. The per-patient cost for dialysis in the KSA is \$14,000 per year, with a total cost of \$540 million for the country for all diabetes-related dialysis [14]. Additionally, the approximate cost of managing one patient with an amputation ranges between \$40,000 and \$75,000 per year [15], and 4000 foot or leg amputations are performed in KSA each year [1].

Patients with diabetes also have a higher risk of cardiovascular disease (CVD) compared with patients without diabetes [2]. Adjusting for age, obesity, hypertension, dyslipidemia and tobacco use, people with diabetes still have a fourfold greater risk of experiencing a CVD event than do people without diabetes [3,4]. Additionally, the risk of a first myocardial infarction (MI) in patients with diabetes is five times as high as that for non-diabetics, and the risk for recurrent MI is twice that of people with a history of MI who do not have diabetes [5]. Patients with diabetes also have an increased risk of stroke [6].

In 2009, in the KSA, 2.7% of patients with diabetes also had CVD [11]. Awareness of the risks of developing CVD is low among those with diabetes. Risk factors for CVD (obesity, hypertension, dyslipidemia) are commonly observed in diabetes clinics, but the actual proportion of diabetic patients with these risk factors and how well they are being controlled is unknown.

Several studies of patients with diabetes have found that close control of glycemia and major CVD risk factors, such as hypertension and dyslipidemia, substantially reduced CVD morbidity and mortality [7,16–18]. The United Kingdom Prospective Diabetes Study (UKPDS) reported that a 1% reduction in HbA1c concentration decreased micro- (e.g., retinopathy, nephropathy, neuropathy) and long-term macro-vascular (e.g., coronary events and strokes) diabetes-related complications and mortality [19].

Given the high human and financial costs of diabetes and CVD, it is important to determine the scope of the problem in the KSA. It was reasoned that the patients most likely to have these risk

factors under control were those being treated at diabetes clinics at leading major urban hospitals. Accordingly, the present study was undertaken to determine the proportion of diabetes patients at two of these clinics who had other CVD risk factors and how well their risk factors were controlled.

2. Methods

The study was approved by the Institutional Review Boards of Emory University (Atlanta, USA) and King Fahd Medical City (KFMC) (Riyadh, KSA). This study involved collaboration with the KSA's Ministry of Health (MoH).

2.1. Research questions

Three research questions were asked:

- 1) What are the proportions of patients with type-2 diabetes seen at two leading diabetes clinics in Riyadh, KSA, between 2008 and 2012, who presented with other CVD risk factors?
- 2) What proportion of these patients was meeting the American Diabetes Association's recommended care targets for these CVD risk factors?
- 3) What protocols were associated with achieving optimal control of CVD risk factors in these patients?

The literature shows some variation in CVD risk factors among men and women in the KSA; therefore, data were analyzed for men and women separately.

2.2. Study population

Data were collected from medical records chosen by a systematic random sampling of outpatients treated at the diabetes clinics of KFMC's Diabetic Center and Prince Salman Hospital's Al Sheikh Diabetic Center. Patients were eligible if they had a diagnosis of type-2 diabetes, were between 30 and 79 years old, were Saudi nationals, had no previous history of CVD, and were not pregnant.

2.3. Sampling procedure

Records were systematically selected at each hospital. At Prince Salman Hospital, patient data were stored in a paper-based filing system. As such, every third file on every shelf was selected. If the patient was eligible for the study, the information was abstracted from the record. If not, the record was ignored and the next third file was taken.

At KFMC, patient data were stored electronically. A systematic random list of all patients with

a diagnosis of diabetes was generated using the software program available at the hospital. The above process of reviewing every third record for inclusion or exclusion was used to select the files of diabetes patients. Since KFMC has relatively better medical records compared with most hospitals, it was chosen as one of the hospitals to study. However, since typically KFMC only sees Saudi patients, the present study was restricted to Saudi patients.

2.4. Measurements

For each patient, data were extracted based on age, sex, height, weight, most recent blood pressure measurement, and most recent serum concentrations of low-density lipoprotein (LDL), high-density lipoprotein (HDL), total cholesterol, triglycerides, and glycated hemoglobin (HbA1c). Body mass index (BMI) was computed using height and weight and reported in kg/m^2 . Thresholds defining CVD risk factors are shown in Table 1. At both hospitals, in order to best assess the current status of control of CVD risk factors, the most recent HgA1c value, lipid profile, and BP values were used (available in the last three months). If any of them were missing, that file was excluded.

2.5. Statistical methods

Descriptive statistics for continuous variables were summarized using means and standard deviations, and categorical data were reported as counts and percentages. Outliers and influential or extreme values were examined graphically with boxplots, histograms, scatterplots, and quantitatively with residual analyses. Demographic, clinical, and metabolic features were compared between the two hospitals using a Chi-Square test or Fisher exact tests (when the sample size distributions

for categories of these variables were skewed or small). Metabolic and clinical features of subjects with hypertension were tested for an association to assess whether they differed between the hospitals.

3. Results

Data from 470 patients were extracted from the medical records of the two clinics. After excluding 48 patients who did not meet the inclusion criteria data, 422 patients met the criteria for inclusion.

The average age of patients was 52 years, and half were women ($n = 212$). Mean age did not differ between men and women (Table 2).

More than half the patients were obese ($\text{BMI} \geq 30 \text{ kg}/\text{m}^2$), and almost half (45%) had a diagnosis of hypertension (a systolic blood pressure $\geq 140 \text{ mmHg}$ or a diastolic blood pressure $\geq 80 \text{ mmHg}$). The proportion of those who had LDL concentrations greater than $3.4 \text{ mmol}/\text{L}$ was 77% (Table 2). Many patients had more than one risk factor, with most having two to four (Table 4).

Among patients with complete data ($n = 168$), only a minority met the target values of any CVD risk factor except LDL (Table 4).

4. Discussion

Among 422 people with diabetes attending large urban hospital clinics in Riyadh, KSA, 70% had two or more CVD risk factors, and large proportions were not controlling their risks.

With regard to poor control of CVD risk-factors, the KSA is not alone in the Middle East. For example, a retrospective United Arab Emirates (UAE) study of 382 patients with diabetes found that 59% did not meet their targeted glycated

Table 1 Outcome variables in a study of the prevalence of cardiovascular risk factors in patients with diabetes in Saudi Arabia.

Outcomes	Elevated values	Optimal values ^b
Low-density lipoprotein ^a , mg/dL (mmol/L)	>130 (>3.4)	<100 (<2.6)
High-density lipoprotein, men ^a , mg/dL (mmol/L)	<40 (<1.00)	>40 (1.00)
High-density lipoprotein, women ^a , mg/dL (mmol/L)	<40 (<1.00)	>50 (>1.3)
Total cholesterol, mg/dL (mmol/L)	>200 (>5.172)	<200 (<5.172)
Triglyceride, mg/dL (mmol/L)	≥ 200 (≥ 2.26)	<150 (<1.7)
Blood pressure, mmHg	...	<130/80
Glycated hemoglobin (HbA1c), mg/dL (mmol/L)	...	$\leq 7.0\%$
Obesity/body mass index, kg/m^2	≥ 30	...

^a Adult Treatment Panel III guidelines [83].

^b Optimal control of CVD risk factors among people with diabetes were defined using the American Diabetic Association (ADA) Standard of Care guidelines from 2013 [82].

Table 2 Distribution of Cardiovascular Risk Factors in Saudi Arabian Patients with Diabetes, by Sex.

Risk factor	Total sample, <i>n</i> = 422	Women, <i>n</i> = 212	Men, <i>n</i> = 210
Age, mean (SD), years	52.0 (10.26)	51.3 (9.49)	52.8 (10.95)
HbA1c mean (SD), % (<i>n</i> = 375)	9.00 (0.15)	9.22 (2.09)	8.76 (2.19)
HbA1c < 6.5%	43 (11.47)	19 (5.07)	24 (6.40)
HbA1c ≥ 6.5%	332 (88.53)	177 (47.20)	155 (41.33)
Body mass index, mean (SD), kg/m ² (<i>n</i> = 415)	31.67 (7.9)	33.95 (9.06)	29.37 (5.68)
Obesity (BMI ≥ 30), <i>n</i> (%)	235 (56.63)	147 (35.42)	88 (21.20)
Hypertension, mean (SD) diastolic pressure, mmHg (<i>n</i> =422)	77.15 (10.86)	75.62 (10.98)	78.69 (10.54)
Hypertension, mean (SD) systolic pressure, mmHg (<i>n</i> = 422)	131.61 (18.25)	132.82 (19.23)	130.39 (17.15)
Hypertension diagnosis with and without Systolic BP ≥ 140 mmHg and Diastolic BP ≥ 80 mmHg, <i>n</i> (%)	190 (45.02)	109 (25.83)	81 (19.19)
Total cholesterol, mean (SD), mmol/L (<i>n</i> = 418)	4.65 (1.21)	4.65 (1.16)	4.65 (1.25)
Cholesterol > 5.18 mmol/L, <i>n</i> (%)	125 (29.90)	61 (14.59)	64 (15.31)
HDL, mean (SD), mmol/L (<i>n</i> = 373)	1.17 (0.41)	1.25 (0.44)	1.08 (0.36)
HDL < 1.0 mmol/L, <i>n</i> (%)	137 (36.73)	53 (14.21)	84 (22.52)
LDL, mean (SD), mmol/L (<i>n</i> = 363)	2.75 (0.94)	2.78 (0.9)	2.73 (0.99)
LDL > 3.4 mmol/L, <i>n</i> (%)	77 (21.21)	40 (11.02)	37 (10.19)
Triglyceride, mean (SD), mmol/L (<i>n</i> = 416)	1.74 (1.16)	1.6 (0.97)	1.9 (1.32)
Triglycerides ≥ 2.26 mmol/L, <i>n</i> (%)	86 (20.67)	35 (8.41)	51 (12.26)

Total cholesterol = <200 mg (or <5.172 mmol/L, LDL = >130 mg/dL (or >3.4 mmol/L), HDL = <40 mg/dL for both (or <1.00 mmol/L for both), Triglyceride = ≥200 mg/dL (or ≥2.26 mmol/L).

hemoglobin (HbA1C) values, 53% did not meet the target values for systolic blood pressure, 27% did not meet the target values for diastolic blood pressure, and 28% did not meet the target values for LDL concentrations [22,23]. In Lebanon, a National Health Registry Study found that almost half the participants had HbA1C concentrations greater than 8%, and more than half had total cholesterol concentrations of more than 5.0 mmol/L [24].

4.1. Cardiovascular disease risk factors

4.1.1. A1c concentrations

Most patients in this study had HbA1c concentrations that were higher than 7% (mean, 9%; SD, 2.15%), well above the current ADA-recommended goal of less than 7% to reduce CVD complications. In a study over 8 years of subjects aged 45-79 in Norfolk, United Kingdom, for every 1% increase in HbA1c concentration, there was a 38% higher risk of a macrovascular event, a 40% higher risk of a microvascular event, and a 38% higher risk of death [21]. Only 19% of patients with diabetes met the ADA-recommended HbA1c concentration, a proportion similar to the 21.8% found in a 2010 study of 1,188 patients in the Riyadh region [26]. Thus, there is an urgent need to aggressively control

HbA1c concentrations and reduce them to under 7% while also considering individualized recommendations for high-risk patients [25].

4.1.2. Hypertension

In this study, only 12% of 168 patients with complete data had acceptable blood pressure measurements (Table 4). This finding is much lower than that in a 2010 study done at The King Fahd National Guard Hospital, King Abdulaziz Medical City, with participants in the same age group. That study found that 39.0% of patients had optimal control of their systolic blood pressure, and 40.6% had optimal control of diastolic blood pressure [26]. The UKPDS trial demonstrated that tight blood pressure control compared with less tight control resulted in 24% lower diabetes-related end points, 32% lower deaths related to diabetes, 44% in strokes, and 37% lower in microvascular end points, predominantly owing to a reduced risk of retinal photocoagulation. After 9 years of follow-up, the group assigned to tight blood pressure control also had a 34% reduction in risk in the proportion of patients with deterioration of retinopathy [55]. Reducing high blood pressure is important because it increases fatal and nonfatal microvascular and macrovascular complications, as well as the relative risk of fatal or nonfatal strokes [8].

4.1.3. Hypercholesterolemia

In the 168 patients with complete lipid data, 82% had optimal concentrations for total cholesterol, 63% for triglyceride concentrations, 44% for HDL concentrations, and 62% for LDL concentrations. These results are slightly better than those of another KSA study in which 55.5% of the participants had optimal LDL concentrations [26]. Participants in this study had a similar proportion with optimal LDL concentrations as the participants in a 2005 United States study (62.2%) [27]. A 2006 Australian study also found that 60% of participants had optimal LDL concentrations [28]. The Cholesterol and Recurrent Events (CARE) trial and the diabetic subset of the Scandinavian Simvastatin Survival Study (4S) revealed a striking decrease in CVD risk total mortality (0.57 [95% CI, 0.30 to 1.08; $P = 0.09$]) and major coronary heart disease (CHD) events (0.45 [95% CI, 0.27 to 0.74; $P = 0.002$]) when participants aimed for optimal concentrations [9,20].

4.2. Multiple CVD risk factors

Almost half the patients in this study had more than three CVD risk factors (Table 3). The associated morbidities of having multiple risk factors are multiplicative rather than additive. It is imperative that treatment and monitoring be instituted to help prevent these morbidities [29,30]. This group needs to be studied further; in particular, it needs to be determined whether having multiple risk factors varies by socioeconomic status. In a 2006 study, the combination of risk factors, such as hypertension, smoking, high serum cholesterol, and high blood glucose concentrations, accounted for less than one third of CHD mortality, implying

Table 3 Frequency of multiple cardiovascular risk factors among 232 Saudi Arabian Citizens with diabetes.

Risk factors ^a per person, <i>n</i>	<i>n</i> (%)
0	1 (0.43)
1	20 (8.6)
2	48 (20.7)
3	72 (31.0)
4	43 (18.5)
5	34 (14.7)
6	11 (4.7)
7	3 (1.3)

^a Glycated hemoglobin, low-density lipoprotein, high-density lipoprotein, triglyceride, total cholesterol, blood pressure, body mass index.

that stress linked to low socioeconomic status is a stronger predictor of mortality [31]. Similarly, a study in the KSA showed that the proportion of DM was higher in older people and among women, widows, divorced persons, and the unemployed [11].

4.3. Control of risk factors

The present study found that 7.1% of diabetes patients had optimal control of their HbA1c concentrations, blood pressure and LDL concentrations (Table 4). In the KSA, a cross-sectional study of 1,107 participants of the same age group found that 4.5% had optimal control of glucose and LDL cholesterol concentrations and blood pressure [32]. Only 3.6% of participants in this study had optimal control of HbA1c and lipid (LDL, HDL, triglyceride, and total cholesterol) concentrations and blood pressure. This percentage would be lower if obesity and smoking were included as additional risk factors. Accordingly, the factors associated with optimal and suboptimal control of combined CVD risk factors need to be identified and addressed.

4.4. Barriers to controlling risk factors

The pronounced presence of multiple CVD risk factors among people with diabetes are the result of structural deficiencies in healthcare, communication gaps between healthcare providers and patients, and suboptimum adherence by patients to preventive health behaviors.

A 2006 World Health Organization (WHO) report indicated that in 2004, the KSA had 1.3 physicians per 1,000 patients (ranking 77th among the countries surveyed), 0.22 pharmacists per 1000 patients (ranking 78th), and 3.0 nurses per 1000 patients (ranking 88th) [33]. Although the number of these practitioners has risen in the past 10 years, there are not enough to take a full history, make complete examinations, or explain results for each patient. Lack of multidisciplinary care teams is an additional impediment. Under these conditions, physicians find it difficult to improve their clinical skills and to teach patients behavioral strategies for controlling CVD risk factors [34].

Another barrier to providing optimal care is the inability to track patient care and health outcomes. Neither hospital in the study had a computerized information system; both relied on paper

Table 4 Proportion of 232 Saudi patients with diabetes and optimal control of cardiovascular disease risk factors.

CVD risk factors under control	n (%)
Glycated hemoglobin + blood pressure	15 (8.93)
Glycated hemoglobin + LDL	21 (12.50)
Glycated hemoglobin + blood pressure + LDL	12 (7.14)
Glycated hemoglobin + LDL + HDL + triglyceride + total cholesterol	10 (5.95)
Glycated hemoglobin + blood pressure + all lipids	6 (3.57)

Using the ADA guideline, HbA1c < 7, BP < 130/80, LDL < 100 mg/dL (or <2.6 mmol/L), HDL ≥ 40 mg/dL (or 1.00 mmol/L) for men, >50 mg/dL (or >1.3 mmol/L) for women, total cholesterol = <200 mg (or <5.172 mmol/L). Triglyceride ≤ 150 mg/dL (or 1.7<mmol/L).

LDL, low-density lipoprotein; HDL, high-density lipoprotein; ALL lipids, LDL, HDL, triglyceride and total cholesterol.

files and did not have the capacity to track patients over time [35].

Cultural differences between health providers and patients can also impinge risk-control efforts. In 2010, only 21% of MoH physicians were Saudi nationals and therefore may not be able to communicate effectively with Saudi patients [36].

In addition, poor reading skills and low health literacy among patients are associated with a range of adverse health outcomes and increased risk of hospitalization and mortality. Thus, healthcare providers need to be aware of the health literacy levels of their patients. This information should be documented clearly in the medical record so that providers can attend to patients' individual needs [37].

Proper adherence to treatment also affects the control of risk factors. Several studies show that diabetes patients do not usually adhere to treatment, which has been linked to increases in morbidity, mortality and healthcare costs. Adherence ranged from 62% to 64% in a review of the literature from 1966 through 2003; high adherence contributes greatly to achieving optimal control over multiple CVD risk factors. Adherence can be improved with electronic patient monitoring systems. Improving adherence also requires identifying patients who are not adhering to their prescribed treatment. Then, those with poor glycemic control resulting from poor adherence need to be distinguished from those in whom poor control is caused by ineffective medication, and finally, patients' individual needs must be addressed [36].

4.5. Strengths and limitations of the study

Because of limited resources, the sample was smaller than desirable. Data entry and collection by

hospital staff may not have been completely accurate, given the hospitals' use of paper medical records, but there is no reason to believe that any inaccuracies were systematic and therefore a source of bias. No differences in optimal diabetes control were found between the tertiary and secondary hospitals studied, but the power of the small sample was insufficient to detect important differences. Another limitation is that duration since diagnosis of diabetes was not abstracted for this study. Such information is useful to determine if there was sufficient time for control of risk factors at the hospital for the patients. Quantification of duration of diabetes would be useful in future studies. In addition, quantifying cardiovascular events in diabetic patients would be useful in future investigations as well.

Although smoking is a great predictor of mortality and is possibly the single most preventable risk factor for CHD, data on smoking status were not routinely included in the medical records reviewed. The relative risk for all-cause mortality is twice as high among diabetic patients who smoke than it is among those who do not [37]. The prevalence of smoking in the KSA is about 15% (including cigarettes and shisha). A 2012 ban on smoking in public and a ban on tobacco sales in Makkah and Madinah have greatly reduced the incidence, but without data on these patients, bias cannot be ruled out.

This study pertains to hospital-based clinics and cannot be completely generalized to primary healthcare clinics where the severity of diabetes is likely less. However, the level of expertise, resources and monitoring in the primary healthcare clinics are less than hospital-based clinics, and thus there is reason to assume low levels of control of CVD risk factors among diabetic patients in the primary healthcare clinics as well.

Conflict of interest

None declared.

References

- [1] Fong DS et al. Diabetic retinopathy. *Diabetes Care* 2003;26(Suppl 1):S99–S102.
- [2] Cade WT. Diabetes-related microvascular and macrovascular diseases in the physical therapy setting. *Phys Ther* 2008; 88(11):1322–35.
- [3] Buyken AE et al. Type 2 diabetes mellitus and risk of coronary heart disease: results of the 10-year follow-up of the PROCAM study. *Eur J Cardiovasc Prev Rehabil* 2007;14(2):230–6.
- [4] Ohira T et al. Risk factors for ischemic stroke subtypes: the Atherosclerosis Risk in Communities study. *Stroke* 2006; 37(10):2493–8.
- [5] Haffner SM et al. Mortality from coronary heart disease in subjects with type 2 diabetes and in nondiabetic subjects with and without prior myocardial infarction. *N Engl J Med* 1998;339(4):229–34.
- [6] Mulnier HE et al. Risk of stroke in people with type 2 diabetes in the UK: a study using the General Practice Research Database. *Diabetologia* 2006;49(12):2859–65.
- [7] Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). UK Prospective Diabetes Study (UKPDS) Group. *Lancet* 1998;352(9131):837–53.
- [8] Tight blood pressure control and risk of macrovascular and microvascular complications in type 2 diabetes: UKPDS 38. UK Prospective Diabetes Study Group. *BMJ* 1998;317(7160): 703–13.
- [9] Pyorala K et al. Cholesterol lowering with simvastatin improves prognosis of diabetic patients with coronary heart disease. A subgroup analysis of the Scandinavian Simvastatin Survival Study (4S). *Diabetes Care* 1997;20(4): 614–20.
- [10] Al-Nozha MM et al. Diabetes mellitus in Saudi Arabia. *Saudi Med J* 2004;25(11):1603–10.
- [11] Al-Baghli NA et al. Awareness of cardiovascular disease in eastern Saudi Arabia. *J Family Community Med* 2010;17(1): 15–21.
- [12] Alqurashi KA, Aljabri KS, Bokhari SA. Prevalence of diabetes mellitus in a Saudi community. *Ann Saudi Med* 2011;31(1): 19–23.
- [13] Al-Rubeaan K. The cost of diabetes in the Kingdom of Saudi Arabia, 2005.
- [14] Alwakeel JS et al. Factors affecting the progression of diabetic nephropathy and its complications: a single-center experience in Saudi Arabia. *Ann Saudi Med* 2011;31(3): 236–42.
- [15] Al-Wahbi AM. Impact of a diabetic foot care education program on lower limb amputation rate. *Vasc Health Risk Manag* 2010;6:923–34.
- [16] Gaede P et al. Multifactorial intervention and cardiovascular disease in patients with type 2 diabetes. *N Engl J Med* 2003;348(5):383–93.
- [17] Turnbull F et al. Effects of different blood pressure-lowering regimens on major cardiovascular events in individuals with and without diabetes mellitus: results of prospectively designed overviews of randomized trials. *Arch Intern Med* 2005;165(12):1410–9.
- [18] Collins R et al. MRC/BHF Heart Protection Study of cholesterol-lowering with simvastatin in 5963 people with diabetes: a randomised placebo-controlled trial. *Lancet* 2003;361(9374):2005–16.
- [19] Stratton IM et al. Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35): prospective observational study. *BMJ* 2000; 321(7258):405–12.
- [20] Goldberg RB et al. Cardiovascular events and their reduction with pravastatin in diabetic and glucose-intolerant myocardial infarction survivors with average cholesterol levels: subgroup analyses in the cholesterol and recurrent events (CARE) trial. The Care Investigators. *Circulation* 1998;98(23):2513–9.
- [21] Khaw KT, Wareham N, Bingham S, Luben R, Welch A, Day N. Association of haemoglobin A1c with cardiovascular disease and mortality in adults: the European prospective investigation into cancer in Norfolk. *Ann Intern Med* 2004;141: 413–20.
- [22] Afandi B et al. Audit of a diabetes clinic at Tawam hospital, United Arab Emirates, 2004–2005. *Ann N Y Acad Sci* 2006;1084:319–24.
- [23] Al-Hussein FA. Diabetes control in a primary care setting: a retrospective study of 651 patients. *Ann Saudi Med* 2008; 28(4):267–71.
- [24] Hirbli KI et al. Prevalence of diabetes in greater Beirut. *Diabetes Care* 2005;28(5):1262.
- [25] Winocour PH. Effective diabetes care: a need for realistic targets. *BMJ* 2002;324(7353):1577–80.
- [26] Kharal M et al. Meeting the American Diabetic Association standards of diabetic care. *Saudi J Kidney Dis Transpl* 2010;21(4):678–85.
- [27] Grant RW, Buse JB, Meigs JB. Quality of diabetes care in U.S. academic medical centers: low rates of medical regimen change. *Diabetes Care* 2005;28(2):337–442.
- [28] Bryant W et al. Diabetes guidelines: easier to preach than to practise? *Med J Aust* 2006;185(6):305–9.
- [29] WHO. The World Health Report 2006 – working together for health, 2006.
- [30] Whittmore R. Strategies to facilitate lifestyle change associated with diabetes mellitus. *J Nursing Scholarship* 2000;32(3):225–32.
- [31] Kirkman MS et al. Impact of a program to improve adherence to diabetes guidelines by primary care physicians. *Diabetes Care* 2002;25(11):1946–51.
- [32] MOH, Health Indicators for 1431, 2011.
- [33] Ishikawa H et al. Patient health literacy and patient-physician information exchange during a visit. *Fam Pract* 2009;26(6):517–23.
- [34] Cramer JA. A systematic review of adherence with medications for diabetes. *Diabetes Care* 2004;27(5): 1218–24.
- [35] Tight blood pressure control and risk of macrovascular and microvascular complications in type 2 diabetes: UKPDS 38. UK Prospective Diabetes Study Group. *BMJ* 1998 Sep 12;317(7160):703–13.

- [36] Blackburn DF, Swidrovich J, Lemstra M. Non-adherence in type 2 diabetes: practical considerations for interpreting the literature. *Patient Prefer Adherence* 2013;7:183–9.
- [37] Ford ES, DeStefano F. Risk factors for mortality from all causes and from coronary heart disease among persons with diabetes. Findings from the National Health and Nutrition Examination Survey I Epidemiologic Follow-up Study. *Am J Epidemiol* 1991;133(12):1220–30.

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