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Coronary Risk Assessment in Diabetic Population in Primary Care Setting in Bahrain Using the UKPDS Risk Engine

Abeer Al-Saweer, Arab Board*

Background: Cardiovascular morbidity and mortality are more prevalent in the diabetic population.

Objective: To estimate the 10-year risk rate for cardiovascular mortality and morbidity in a diabetic population.

Setting: Primary Health Center, Bahrain.

Design: Cross sectional study.

Method: Two hundred thirty patients were recruited. Cross sectional study measuring the cardiovascular morbidity and mortality in a diabetic population using the UKPDS risk engine software.

Result: Two hundred thirty patients were enrolled in the study. The cardiovascular risk rate calculated by the UKPDS risk engine was comparable to other risk rates. Association of risk rates with majority of risk factors was significant though total cholesterol and HbA1c showed selective significance. Dividing the population into low and high risk yielded a significant relation of all risk factors to risk rates.

Conclusion: Risk rates for cardiovascular endpoint events in our diabetic population are comparable to other diabetic populations. Risk factors for fatal and non-fatal cardiovascular and stroke are either non-modifiable, such as age, sex and genetics or modifiable such as hypertension, hypercholesterolemia, diabetes mellitus and smoking. Reduction of the modifiable risk factors would reduce cardiovascular and stroke risks. Coronary risk assessment is an essential part in the assessment of diabetic population showed.

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Coronary artery disease is considered one of the major co-morbidities associated with diabetes[1]. There is a close association between diabetes and cardiovascular disease. In fact, diabetes causes a state of atherogenic liability and is considered a cardiac disease by itself. Patients with type 2 diabetes have two to four folds higher risk of cardiovascular events compared with non-diabetic patients. Furthermore, the cardiovascular disease in diabetics tends to be and more aggressive[2].

Haffner et al assessed 7-year incidence of myocardial infarction in non-diabetic individuals

* Consultant Family Physician
Primary Care, MOH
Kingdom of Bahrain
Email: asaweer@health.gov.bh

compared with the incidence in patients with type 2 diabetes. The incidence of myocardial infarction was 3-6 folds more in diabetics than non-diabetics[3].

Cardiovascular disease is the most common cause of mortality in patients with type 2 diabetes. Mortality rate from cardiovascular disease in patients with type 2 diabetes was 52% in a study done by Morrish et al[4].

Current guidelines for the management of diabetes in primary care setting emphasize the importance of cardiac risk assessment for diabetic patients. Different parameters are set to evaluate such risk, including BMI, periodic blood pressure monitoring, periodic lipid profile monitoring and ECG[5].

The American Diabetes Association recommends non-invasive techniques to assess coronary risk in asymptomatic type 2 diabetics with no history of cardiovascular events[6]. These include exercise stress test or thallium stress test in persons with diabetes who have peripheral arterial disease (PAD), proteinuria or major CVD risk factors and over 65 years of age[6]. These techniques are not available in the primary care setting. Risk assessment tools estimating absolute coronary or cardiovascular risk should be used to identify high-risk people for primary prevention. Risk factor oriented techniques should be implemented to assess such risk.

Several coronary risk engines are available that determine patients liability for cardiovascular events in the coming 10 years[7].

Coronary and cardiovascular risk assessment tools are used to predict high-risk people for primary prevention. These tools are helpful in deciding if the patient needs intensive interventions in conjunction with clinical judgment[8].

Examples of such engines or tools include Framingham Heart Study engine, the Joint British Societies Coronary Risk Prediction Chart and the European SCORE Project[9].

The various engines compared between risk-groups in terms of predictive values, prognostic agreements and transferability among populations. The Framingham-based tool was claimed to overestimate the risk in certain populations by 30%[10].

All of the previous engines are designed to assess coronary risk in the general population. The UKPDS model provides an equation for estimating the risk of new CHD events in people with type 2 diabetes and no history of CHD or stroke. It provides risk estimates and 95% confidence intervals, in individuals with type 2 diabetes.

The aim of the study is to assess cardiac risk in a diabetic population in a local health center using the UKPDS cardiac risk assessment engine.

METHOD

Two hundred thirty diabetic patients seen during the months of March, April and May 2007 by the authors were included in the study. Only patients with type 2 diabetes mellitus were included. Patients with previous history of coronary heart disease were excluded.

The following variables were documented: HbA1c, systolic blood pressure, lipid levels (total HDL cholesterol ratio), age at time of diabetes diagnosis, sex, ethnic group, smoking and time since diagnosis of diabetes. These variables are included in the UKPDS risk engine software.

Statistical Analysis

Data was entered in the UKPDS risk engine software and the engine calculated the individual risk for each patient. Thereafter, the average absolute 10-years risk for non-fatal and fatal coronary heart disease and non-fatal and fatal stroke was calculated for the diabetic population.

Significance of association between certain risk factors and the end-point events were examined using the appropriate tests either t-test or z-test.

The participants were divided into two groups, low and high risk based on their total event risk. If the participant scored 15% or less, it is considered low risk category[10].

RESULT

Two hundred thirty patients were recruited in the study, 116 were females. The mean age at diagnosis of diabetes of the sample was 48 years (SD ± 11.39). The mean duration of diabetes was 10 years (SD ± 07.55). The mean systolic blood pressure was 134 mmHg (SD ± 016.86). The mean HbA1c was 8.1% (SD ± 02.4). The mean cholesterol level was 5.2 mmol/L (SD ± 01.20) and the mean HDL level was 1.3 mmol/L (SD ± 0.4). Seventy-one patients (31%) were either former or current smokers, see table 1.

Table 1: Sample Characteristics

Mean Duration of Disease (years)	Mean Systolic BP (mmHg)	Mean HbA1c (Reference 4.8-6%)	Ever Smoked	Mean Total Cholesterol (mmol/L) (less than 5.3)	Mean HDL (mmol/L)
10	134	08.1%	31%	05.20	1.3

The 10-year non-fatal coronary heart disease risk rate was 19.7% (CI 13.8 - 26.3) and the 10-year fatal coronary heart disease risk rate was 14.4% (CI 10.0 - 19.9). The 10-year non-fatal stroke risk rate was 9.6% (CI 5.4 - 15.8) and the 10-year fatal stroke disease risk rate was 1.4% (CI 0.7 - 2.7).

Both fatal and non-fatal cardiovascular risk rates are significantly increased in males compared to females, see table 2. Total cholesterol, HbA1c and HDL are significantly increased in females, see table 3.

Table 2: The Mean 10 Years Risk of Fatal and Non-fatal CHD, Stroke and Gender

Variables	Females (Mean)	Males (Mean)	Significance
10 year risk rate for non-fatal coronary heart disease	15.9% (CI 10.7-21.0)	23.4% (CI 16.7-31.3)	t=3.9043 p=0.0001
10 year risk rate for fatal coronary heart disease	11.9% (CI 8.5-16.2)	16.7% (CI 11.4-23.4)	t=2.5749 p=0.0107
10 year risk rate for non-fatal stroke	7.3% (CI 4.4-11.9)	11.8% (CI 6.3-19.6)	t=3.2538 p=0.0013

10 year risk rate for fatal stroke	1.1% (CI 0.6-2.1)	1.7% (CI 0.9-3.3)	t=2.6939 p=0.0076

Table 3: The Mean Total Cholesterol, HbA1c, HDL and Gender

Variables	Females (Mean)	Males (Mean)	Significance
Serum Cholesterol	5.522	4.968	t=3.6643 P=0.0003
HbA1c	8.399	7.814	t=1.8959 p=0.0592
HDL	1.357	1.244	t=2.1398 p=0.0334

Table 4 reveals the association between both fatal and non-fatal cardiovascular events and certain variables. Significant relations of both fatal and non-fatal cardiovascular events can be seen with duration of disease, age at diagnosis disease and systolic blood pressure. HDL levels and HbA1c show significant association with fatal and non-fatal coronary heart disease. Total cholesterol and history of smoking show no significant association with any event.

Table 4: Association between Risk Factors to Outcomes

	Non-fatal Coronary Heart	Fatal Coronary Heart Disease	Non-fatal Stroke	Fatal Stroke
Duration of disease	r=0.263 p<0.0001	r=0.335 p<0.0001	r=0.438 p<0.0001	r=0.393 p<0.0001
Age at diagnosis	r=0.355 p<0.0001	r=0.3 p<0.0001	r=0.27 p<0.0001	r=0.307 p<0.0001
Systolic blood pressure	r=0.22 p=0.0006	r=0.226 p=0.0005	r=0.16 p=0.0149	r=0.298 p<0.0001
Total serum cholesterol	r=0.11 p=0.0953	r=0.07 p=0.2894	r=0.003 p=0.9638	r=0.04 p=0.5453
HDL	r=-0.22 p<0.0008	r=-0.136 p=0.0383	r=0.025 p=0.7055	r=0.025 p=0.7055
HbA1c	r=0.45 p<0.0001	r=0.5 p<0.0001	r=0.006 p=0.9277	r=0.02 p=0.7624
Ever smoked	r=0.068 p=0.5676	r=-0.04 p=0.7369	r=0.219 p=0.0627	r=0.203 p=0.0850

Since no association was found between some of the fatal and non-fatal cardiovascular events and total cholesterol, HDL and HbA1c, the sample was stratified into males and females as shown in table 5. Table 5 further reveals this association in males and females separately. It shows that total cholesterol is significantly associated with an increase in 10 years risk of fatal/non-fatal CHD and fatal/non-fatal stroke in females. There was no significant association between total cholesterol and fatal/non-fatal CHD and stroke in males. The total cholesterol showed protective effect in males against non-fatal and fatal stroke risk. HbA1c and HDL in males and females showed no significant association with non-fatal/fatal stroke risk.

Table 5: Certain Risk Factors in Association with Outcomes and Gender

		Non-fatal Coronary Heart	Fatal Coronary Heart Disease	Non-fatal Stroke	Fatal Stroke
Serum cholesterol					
	Females	r=0.24 p=0.0008	r=0.24 p=0.0105	r=0.39 p<0.0001	r=0.37 p<0.0001
	Males	r=0.01 p=0.9140	r=-0.0 p=1	r=-0.2 p=0.0292	r=-0.2 p=0.0292
HbA1c		r=0.459	r=0.491	r=0.05	r=0.07
	Females	P=0.001	p=0.001	p=0.6	p=0.46
	Males	r=0.552 p=0.001	r=0.580 p=0.001	r=0.02 p=0.82	r=0.02 p=0.82
HDL		r=-0.171	r=-0.099	r=-0.1	r=-0.1
	Females	p=0.07	p=0.300	p=0.2920	p=0.2920
	Males	r=-0.223 p=0.015	r=-0.134 p=0.147	r=0.15 p=0.10	r=0.16 p=0.08

As soon as the population was divided to high and low risk, it was noted that all risk factors showed significant association. The UKPDS engine was able to show higher prediction of all non-fatal and fatal cardiovascular and stroke events in the high-risk group, see table 6.

Table 6: Risk Factors in Association with Outcomes in Low Risk and High Risk Groups

	Low Risk Group (106)	High Risk Group (124)	
Duration of disease	7.97	6.27	t=3.597 (p<0.01)
Age at diagnosis	43.7	52.0	t= 6.338 (p<0.01)
Systolic blood pressure	131.04	136.57	t=2.489 (p<0.05)
Total serum cholesterol	5.16	5.30	t = 0.856 (p>0.05)
HDL	1.43	1.18	t=5.124 (p<0.01)
HbA1c	7.46	8.63	t=3.951 (p<0.01)
Ever smoked	7%	16%	Z=2.105 (p<0.05)
Male proportion	34%	66%	Z=4.84 (p<0.01)
Female proportion	66%	34%	Z=4.84 (p<0.01)

DISCUSSION

The 7 year cardiovascular mortality rate in a study of diabetic population without previous history of cardiovascular disease was 20.2%[11]. The 10-year fatal CHD event rate (95% CI) observed in the UKPDS was 6.3% (CI 5.5-7.1)[9].

On the other hand, the 7-year cardiovascular mortality rate in non-diabetic population without previous history of cardiovascular disease was 3.5%[11].

In our study, the 10-year non-fatal coronary heart disease risk rate was 19.7% (CI 13.8-26.3) while the 10-year fatal coronary heart disease risk rate was 14.4% (CI 10.0-19.9). Because the population had no history of cardiac event, the 10-year fatal coronary heart disease risk rate is more than the UKPDS study[9].

The 10-year non-fatal stroke risk rate was 9.6% (CI 5.4-15.8) while the 10-year fatal stroke risk rate was 1.4% (CI 0.7-2.7). The 10-year risk of fatal and non-fatal stroke in the WEDSR cohort was 13.2%, which is more than found in our study.

This study highlights the role of age, duration of diabetes and hypertension as prognostic factors for the development of all endpoint events.

In our study, males tend to show significant increase in risk rate for all events; it is attributable to female hormones, which act as a protective factor in cardiovascular disease. Diabetic females may lose this protective factor though our diabetic female population shows they still have it. This protective effect may be due in part to the younger age of this population.

The UKPDS trial identified LDL as the major risk factor and predictor of cardiovascular fatal and non-fatal events in the diabetic population. HbA1c was rated third significant predictor for cardiovascular fatal and non-fatal events in the UKPDS diabetic population[11]. In our study, there was definite association between all fatal and non-fatal cardiovascular and stroke events risk and cholesterol in female gender while this association was not found in males. HbA1c showed significant risk association in both sexes of fatal and non-fatal cardiovascular events.

In this study, HDL was not a significantly protective factor in all events except CV morbidity. Other studies revealed that HDL is a protective factor in both diabetic and non-diabetic population[12].

More significant association was noted with all risk factors after dividing our population into high risk and low risk for CHD. This finding is consistent with other studies[13,14]. Strong association of serum cholesterol and HbA1c in predicting cardiovascular endpoint events was noted[12].

The insignificant results before the division into low and high-risk group may be attributed to the small number of patients in this study, the relatively young mean age of the population, the relatively controlled cholesterol and HbA1c levels. The fact that the UKPDS engine is designed to measure risk for diabetics with little or no diabetes treatment could be another factor as well[15].

CONCLUSION

UKPDS risk assessment engine reveals that our diabetic population is at risk for all endpoint cardiovascular events. The 10-year non-fatal coronary heart disease risk rate was 19.7% while the 10-year fatal coronary heart disease risk rate was 14.4%. The 10-year non-fatal stroke risk rate was 9.6% and the 10-year fatal stroke risk rate was 1.4%. Though each risk assessment engine has its advantages and disadvantages, it highlights the importance of mandatory screening for coronary disease in our diabetic population. Meticulous control of blood pressure, HbA1c and serum lipids in reducing cardiovascular events should be emphasized. Smoking cessation, though not significantly influential in this cohort, is a major risk factor for the development of all end-point cardiovascular disease.

The author of this study recommends a case control prospective method to affirm the results and rectify the gaps.

Potential conflicts of interest: No

Competing interest: None **Sponsorship:** None

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