Differences in Cardiovascular Disease Risk Factors in Elderly and Younger Patients with Type 2 Diabetes in the West Indies

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ABSTRACT

Objective: To assess the cardiovascular disease (CVD) risk factors in elderly (≥60 years) and younger patients with Type 2 diabetes visiting two primary care clinics in Trinidad.

Materials and methods: Fasting blood samples were taken from one hundred and ninety-one (127 females, 64 males) patients with Type 2 diabetes visiting two primary care clinics between 1 January and 30 April 2000. Anthropometric indices, blood pressure, plasma glucose, serum lipids and insulin were measured. Homeostasis Model Assessment (HOMA) was used to assess basal insulin resistance (IR).

Results: Of the 191 patients studied, 58.6% were <60 years old while 41.4% were ≥60 years old. The younger patients had higher prevalence rates of cigarette smoking and use of alcoholic drinks ($p<0.05$). The female younger patients had significantly higher mean body mass index (BMI), glycated haemoglobin (HbA_{1c}), triglyceride, total-cholesterol, fasting plasma glucose and IR than the elderly female patients ($p<0.05$). Similarly, the younger male patients had significantly higher mean HbA_{1c}, creatinine, fasting plasma glucose, IR and lower HDL-cholesterol levels than the elderly male patients ($p<0.05$). Generally, the younger patients had significantly higher prevalence rates of hypertriglyceridaemia, obesity, poorer glycaemia and blood pressure control.

Conclusion: The results indicate that younger patients with Type 2 diabetes had poorer metabolic control and higher prevalence rates of CVD risk factors than the elderly patients. The greater risk of CVD in younger patients was not independent of gender and ethnicity.

Keywords: cardiovascular disease, elderly, primary care, Type 2 diabetes

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INTRODUCTION

The United Nations report projects that by the year 2025, the world elderly (person ≥60 years of age) population would have increased from 200 million to 1.2 billion[1]. The ageing of population is now a world-wide phenomenon, more evident in developed countries but occurring more rapidly in developing countries due to declining mortality and improving health and hygiene[1]. Perhaps, because ageing is not a modifiable cardiovascular disease (CVD) risk factor, there is excess CVD mortality in elderly subjects in all countries, developed and developing[2,3]. The increased risk of elderly persons to CVD may be related to the deterioration in glucose and lipid metabolism with increasing age[4-6]. The prevalence of Type 2 diabetes and hypertension, two important risk factors for CVD, increases as population ages[7]. It has been suggested that this deterioration in glucose metabolism may not be a primary consequence of biological ageing process but may instead be due to age-associated diseases. The proposed age-related variables include increased obesity[8], changes in body fat distribution[9,10] and physical inactivity[11,12]. There are inconsistent reports on the effect of ageing on glucose tolerance even as related to gender[12,13], however, all reports agreed that elderly subjects are at increased risk for CVD in comparison to younger subjects. Thus, with the increasing longevity in the developing countries[1], it is probable that the prevalence of non-communicable diseases will be increasing proportionately. Indeed, there are reports of increasing prevalence of CVD in the developing countries such as Taiwan[14], Mexico[15] and United Arab Emirates[16] attributable to lifestyle modifications and adoption of western diet[17,18]. Of concern were the reports of studies in developing countries associating CVD risk with obesity, even in non-diabetic subjects[19,20]. This is worrisome especially as obesity is one of the proposed factors for increased CVD risk in the elderly[8]. In Trinidad and Tobago, we had previously identified increased obesity as the major risk factor contributing to increased CVD risk among newly diagnosed patients with Type 2 diabetes[21].

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Trinidad and Tobago, is a multi-ethnic country undergoing socioeconomic transformations, with Type 2 diabetes prevalence rate of 16-20%[22,23]. Diabetes is indeed, a major public health problem for Trinidad and Tobago with a population of 1.25 million people[24]. In this regard, we aimed to assess, for the first time, the CVD risk factors in elderly and younger patients with Type 2 diabetes visiting two primary care clinics in this country.

PATIENTS AND METHODS

The study was conducted between 1 January and 30 April 2000, and 191 (127 females, 64 males) patients with Type 2 diabetes constituting over 85% of Type 2 diabetic patients visiting out-patient clinics at Arima and Chaguanas within this period participated in the study. The research Assistants randomly approached the patients on clinic days and explained to them the aims and objectives of our study as well as the study protocol. Only patients who provided informed voluntary consent were allowed to participate in the study. All the patients were nationals of Trinidad and Tobago, and comprised mainly peoples of African (40%) or East Indian origin (40%) and mixed (18%) ethnic groups[24]. Trinidad is the larger part of the Twin Island Republic, Trinidad and Tobago, located about 11 km off the northern coast of Venezuela in South America. The Arima and Chaguanas health clinics are designated primary care diabetes centres covering at least 70% of diabetes patients in the North West Regional Health Authority (NWRHA) in Trinidad. These centres offer basic diabetes health education to the patients on weekly basis. NWRHA is the central and largest of the four regional health authorities in the country, and Arima and Chaguanas clinics each provide regular diabetes care clinics twice per week. Furthermore, NWRHA, being in the centre of Trinidad, serves people of all ethnic groups (African or East Indian origin and mixed race) and is strategically located that the two clinics serve the majority of diabetes patients requiring care in the region. All the patients gave informed voluntary consent to participate and our institutional Ethics Committee approved the study protocol.

STUDY PROTOCOL

The patients came to the primary health care centres in the morning (0700-0800 h) after an overnight fast. An overnight fasting state was ascertained by direct questioning and later by checking the plasma samples for lipemic clouding[19,21]. Details of ethnic origin and age were directly ascertained from the subjects; waist (cm), at the level of the umbilicus with the patient standing and breathing normally, and hip circumferences (cm), at the level of the largest projection of the buttocks, were obtained by tape measure while weight (kg), with standard hospital balance, and height (m), with metal rule, were measured (in light clothing, without shoes). After 10 minutes' rest, systolic (first phase) and diastolic (fifth phase) blood pressures (sBP, dBP) were taken on the dominant arm in a sitting position, using a standard mercury gauge sphygmomanometer (cuff size 23 x 22.5 cm, Accoson, England, UK). A 10 ml venous blood sample was taken from each patient and put into fluoride (for plasma glucose measurement), EDTA (for glycated haemoglobin, HbA_{1c}) and plain (for serum insulin and lipid measurement) tubes. Blood samples were separated (for plasma glucose and serum lipids only) within 2h of collection and the plasma or serum stored at -20ºC.

DEFINITIONS FOR BLOOD PRESSURE AND METABOLIC CONTROL LEVELS

Metabolic control was considered poor if total cholesterol (T-chol) levels >5.2 mmol/L or low-density lipoprotein-cholesterol (LDL-Chol) >3.37 mmol/L or triglyceride >2.26 mmol/L[25] or total-cholesterol/HDL-cholesterol >6[26] or blood pressure >144/83 mmHg or fasting plasma glucose >7.0 mmol/L or glycated haemoglobin (HbA_{1c}) levels >7.0%[27,28]. Generalised obesity was defined as body mass index (BMI) >30 kg/m^2 while upper body obesity was defined as waist-to-hip ratio (WHR) >0.85 and 1.0 for females and males respectively[29].

BIOCHEMICAL ANALYSIS

The serum insulin levels were determined by standard radioimmunoassay method using commercial insulin kits (Coat-A-Count Insulin, Diagnostic Products Corporation, Los Angeles, USA). The sensitivity of the assay was 1.2µIU/ml with intra- and inter-assay coefficients of variation of 4% and 6%, respectively. Plasma glucose, serum total cholesterol (T-Chol), triglycerides (TG) and high-density lipoprotein-cholesterol (HDL-Chol) concentrations were measured using commercial kits (dry slides) in multi-channel auto-analysers (Johnson & Johnson, Ortho-Clinical Diagnostics Inc., Rochester NY 14626, USA). Low-density lipoprotein-cholesterol (LDL-Chol) was calculated using Friedwald method[30]. Glycated haemoglobin (%HbA_{1c}) was measured by an affinity microchromatographic methodology using Helena Glyco-Tek HemeSpec^R Plus Spectrophotometer (HemeSpec Plus, Helena Laboratories, 1530 Lindbergh Drive, Beaumont, Texas, USA). The precision of the HbA_{1c} measurement was checked using the normal

Table I. Background characteristics of the patients.

Parameters	Patients < 60 years			Patients > 60 years		
	All	Men	Women	All	Men	Women
N; Sex	112	34	78	79	30	49
Occupation **, b, d						
* Employed (%)	40 (35.7)	22 (64.7)	18 (23.1)	3 (3.8)	1 (3.3)	2 (4.1)
* Not employed (%)	64 (57.1)	7 (20.6)	57 (73.1)	39 (49.4)	2 (6.7)	37 (75.5)
* Retired (%)	8 (7.1)	5 (14.7)	3 (3.8)	37 (46.8)	27 (90.0)	10 (20.4)
Education*, d						
* Primary	80 (71.4)	21 (61.8)	59 (75.6)	64 (81.0)	24 (80.0)	40 (81.6)
* Secondary	26 (23.2)	10 (29.4)	16 (20.5)	9 (11.4)	6 (20.0)	3 (6.1)
* Tertiary	4 (3.6)	1 (2.9)	3 (3.8)	–	–	–
* No formal education	2 (1.8)	2 (5.9)	–	6 (7.6)	–	6 (12.2)
Ethnic group *, a						
* African origin (%)	23 (20.5)	7 (20.6)	16 (20.5)	31 (39.2)	16 (53.3)	15 (30.6)
* East Indian origin (%)	84 (75.0)	26 (76.5)	58 (74.4)	41 (51.9)	13 (43.3)	28 (57.1)
* Mixed race (%)	5 (4.5)	1 (2.9)	4 (5.1)	7 (41.4)	1 (3.3)	6 (12.2)
Cigarette smoking *, a						
* Smoker (%)	21 (18.8)	16 (47.1)	5 (6.4)	5 (6.3)	4 (13.3)	1 (2.0)
Alcohol consumption **, c, a						
* Yes (%)	33 (29.5)	17 (50.0)	16 (20.5)	9 (11.4)	7 (23.3)	2 (4.1)

*p<0.05, **p<0.001 for all patients: <60 years vs. ≥60 years: [a] p<0.05, [b] p<0.001 for men: <60 years vs. ≥60 years; [c] p<0.05, [d] p<0.001 for women: <60 years vs. ≥60 years; T = trend towards <0.05

and abnormal quality control samples contained in the assay kits and the intra- and inter-assay coefficients of variation were 1.5% and 1.8% respectively.

DATA ANALYSES

The results are expressed as mean ± SE. Insulin resistance (IR), calculated as the product of fasting serum insulin and plasma glucose divided by 22.5 was assessed using values of fasting serum insulin and fasting plasma glucose concentrations in Homeostasis Model Assessment (HOMA) Calculator Programme Version 2.00 based on HOMA method[31]. The Statistical Package for the Social Sciences (SPSS Inc., 233 South Wacker Drive, Chicago IL 60606-6307, USA) software was used in all analyses[32]. Within gender comparisons between the two age groups (<60 years old vs. >60 years old) were performed using Students' t-tests, chi-square (X^2) for non-parametric analysis and multiple linear regression analysis for assessing the influence of independent contributing factors. Raw data on fasting triglycerides, insulin and HOMA-derived insulin resistance were log transformed to normalise data distributions. A p-value <0.05 was considered statistically significant.

RESULTS

Table I summaries the background characteristics of patients studied. Of the 191 patients studied, 112 (58.6%) were <60 years old while 79 (41.4%) were ≥60 years old with similar male/female distribution (p>0.05). Expectedly, smaller percent of the elderly patients were employed (p<0.001) or attained higher education (p<0.05). The majority of patients were of East Indian Ethnic group (p<0.05). Overall, female patients had lower prevalence rates of cigarette smoking (Table I, p<0.05), although the younger patients generally had higher prevalence rates of cigarette smoking and use of alcoholic drinks (p<0.05). The female younger patients were heavier and had significantly higher mean BMI than the elderly female patients (p<0.05) whereas the BMI of the male patients were similar irrespective of age (Table II, p>0.05). The younger male patients had significantly higher mean HbA_{1c}, creatinine, fasting plasma glucose, insulin resistance and lower HDL-cholesterol and systolic BP levels than the elderly male patients (Tables II and III). Similarly, the younger female patients had significantly higher mean HbA_{1c}, triglyceride, T-chol., fasting plasma glucose and a trend towards higher insulin resistance than the elderly female patients (Table III). General assessment (Table IV) shows that the elderly and younger patients had similar risk of heart disease (cholesterol:HDL ratio). However, the younger patients had significantly higher prevalence rates of hypertriglyceridaemia, obesity and poorer glycaemic control (HbA_{1c}). Furthermore, younger female patients had a trend towards hypercholesterolaemia than their elderly counterparts (p=0.051). Overall, multiple linear regression analysis (Tables V and VI) shows that age, duration of diabetes, sex and ethnicity significantly influenced different cardiovascular risk factors

Table II: Age, anthropometric indices and blood pressure (BP) of the two groups of patients.

Parameters	Patients <60 years			Patients >60 years		
	All n=112	Men n=34	Women n=78	All n=79	Men n=30	Women n=49
Age (yr.)	48.7 ± 0.7	49.4 ± 1.4	48.4 ± 0.8	67.8 ± 0.6*	69.5 ± 1.1[b]	66.8 ± 0.8[d]
Duration of diabetes (yr.)	7.6 ± 0.7	9.2 ± 1.5	7.0 ± 6.4	11.3 ± 1.0*	12.5 ± 1.8	10.6 ± 1.3[c]
Weight (kg)	73.0 ± 1.2	73.2 ± 2.2	73.0 ± 1.5	67.6 ± 1.3*	67.6 ± 2.3	67.5 ± 1.5[c]
Height (cm)	1.6 ± 0.01	1.7 ± 0.02	1.6 ± 0.01	1.6 ± 0.01	1.7 ± 0.01	1.6 ± 0.01
BMI (kg/m2)	28.1 ± 0.5	24.8 ± 0.7	29.5 ± 0.6	26.4 ± 0.5*	23.9 ± 0.8	27.9 ± 0.6[T]
Waist circumference (cm)	95.4 ± 1.0	93.5 ± 1.7	96.3 ± 1.3	93.9 ± 1.1	90.5 ± 1.8	95.9 ± 1.2
Hip circumference (cm)	105.8 ± 1.4	96.1 ± 2.8	110.2 ± 1.3	104.0 ± 1.1	97.0 ± 1.3	108.2 ± 1.1
Waist-to-hip ratio	0.97 ± 0.1	1.2 ± 0.2	0.87 ± 0.01	0.90 ± 0.01	0.93 ± 0.01	0.88 ± 0.01
Systolic BP (mmHg)	134.7 ± 1.9	130.3 ± 3.2	136.6 ± 2.3	144.5 ± 2.3*	147.2 ± 4.1[a]	142.9 ± 2.8
Diastolic BP (mmHg)	84.2 ± 1.2	83.7 ± 2.1	84.5 ± 1.5	83.5 ± 1.7	82.8 ± 2.6	83.9 ± 2.3

* p<0.05; ** p<0.001 for all patients: <60 years vs. ≥60 years; [a] p<0.05, [b] p<0.001 for men: <60 years vs. ≥60 years;
[c] p<0.05, [d] p<0.001 for women: <60 years vs. ≥60 years; T = trend towards <0.05

Table III. Comparison of biochemical risk factors for cardiovascular disease in the two groups of patients.

Parameters	Patients <60 years			Patients >60 years		
	All n=112	Men n=34	Women n=78	All n=79	Men n=30	Women n=49
Glycated HbA_{1c} (%)	10.7 ± 0.2	10.6 ± 0.4	10.8 ± 0.3	9.1 ± 0.3[a]	8.5 ± 0.4[b]	9.4 ± 0.4[c]
Triglyceride (mmol/L)	2.4 ± 0.2	2.3 ± 0.3	2.5 ± 0.2	1.8 ± 0.1**	1.7 ± 0.3	1.8 ± 0.1[c]
T-cholesterol (mmol/L)	6.1 ± 0.1	5.4 ± 0.2	6.3 ± 0.2	5.7 ± 0.1*	5.4 ± 0.2	5.8 ± 0.2[c]
Creatinine ((mol/L)	79.8 ± 5.7	87.6 ± 4.7	76.4 ± 7.9	91.7 ± 3.8	115.2 ± 7.1[b]	78.3 ± 3.1
HDL-chol (mmol/L)	1.1 ± 0.03	0.9 ± 0.05	1.1 ± 0.03	1.1 ± 0.04	1.1 ± 0.01[a]	1.1 ± 0.05
LDL-chol (mmol/L)	4.5 ± 0.1	4.1 ± 0.2	4.7 ± 0.2	4.2 ± 0.1	4.0 ± 0.2	4.4 ± 0.2
Fasting glucose (mmol/L)	9.8 ± 0.3	9.9 ± 0.6	9.8 ± 0.4	7.8 ± 0.3**	7.2 ± 0.4[b]	8.1 ± 0.4[c]
Fasting insulin (pmol/L)	159.8 ± 9.3	139.4 ± 18.4	168.3 ± 10.7	134.0 ± 7.9	108.8 ± 9.2	150.8 ± 11.0
IR (pmol/mmol/L)	72.6 ± 6.1	66.4 ± 14.9	75.1 ± 6.0	46.8 ± 3.2**	35.8 ± 3.8*	54.1 ± 4.4[T]
Insulin/glucose ratio	18.0 ± 1.2	15.6 ± 2.0	19.1 ± 1.4	18.6 ± 1.3	15.8 ± 1.4	20.6 ± 1.9

* p<0.05, ** p<0.001 for all patients: <60 years vs. ≥60 years; [a] p<0.05, [b] p<0.001 for men: <60 years vs. ≥60 years;
[c] p<0.05, [d] p<0.001 for women: <60 years vs. ≥60 years; [T] = p = 0.060

Table IV. Assessment of the prevalence rates of CVD risk factors in the two groups of patients.

Parameters	Patients <60 years			Patients >60 years		
	All n=112	Men n=34	Women n=78	All n=79	Men n=30	Women n=49
T-Chol/HDL Ratio >6.0 (%)	50 (44.6)	17 (50.0)	33 (42.3)	26 (32.9)	10 (33.3)	16 (32.7)
Systolic BP >144mmHg (%)	29 (26.4)	6 (18.2)	23 (29.9)	33 (42.3)*	14 (48.3)[a]	19 (38.8)
Diastolic BP >83 mmHg (%)	54 (49.1)	15 (45.5)	39 (50.6)	38 (48.7)	13 (44.8)	25 (51.0)
Glycated HbA_{1c} >7.0% (%)	101 (92.7)	32 (97.0)	69 (90.8)	61 (81.3)*	22 (73.3)[a]	39 (86.7)
Fasting glucose >7.0 mmol/L (%)	88 (78.6)	28 (82.4)	60 (76.9)	44 (55.7)**	14 (46.7)[a]	30 (61.2)[T]
T-Cholesterol >5.2 mmol/L (%)	79 (70.5)	16 (47.1)	63 (80.8)	49 (62.0)	17 (56.7)	32 (65.3)[T]
Triglyceride >2.26 mmol/L (%)	45 (40.5)	12 (36.4)	33 (42.3)	13 (16.7)**	3 (10.0)[a]	10 (20.8)[c]
LDL-chol >3.37 mmol/L (%)	91 (82.0)	23 (69.7)	68 (87.2)	59 (74.7)	20 (66.7)	39 (79.6)
BMI >30 kg/m^2 (%)	42 (37.5)	7 (20.6)	35 (44.9)	16 (20.5)*	3 (10.0)	13 (27.1)[c]
W/H Ratio >0.85 (females) (%)			50 (64.1)			35 (71.4)
W/H Ratio >1.0 (males) (%)		6 (17.6)			4 (13.3)	

* p<0.05, ** p<0.001 for all patients: <60 years vs. ≥60 years; [a] p<0.05, [b] p<0.001 for men: <60 years vs. ≥60 years;
[c] p<0.05, [d] p<0.001 for women: <60 years vs. ≥60 years; [T] = trend towards <0.05

Table V. Multiple linear regression analysis showing the contributions of BMI, age, sex, duration of diabetes, cigarette smoking and ethnicity to the differences in CVD risk factors in the two groups of patients.

	Independent contributing factors					
	BMI	Age#	Sex#	Duration#	Ethnicity#	Smoking#
Log fasting insulin (pmol/L)	0.35**	-0.08	0.04	0.05	0.26**	0.03
Log insulin resistance (pmol/mmol/L)	0.31**	-0.19*	0.08	0.17	0.19*	-0.03
Glycated haemoglobin A1c (%)	-0.00	-0.27**	0.15	0.22*	-0.03	-0.09
Log triglycerides (mmol/L)	0.04	-0.12	0.06	0.05	0.32**	0.06
Total cholesterol (mmol/L)	0.04	-0.03	0.21*	0.06	0.09	0.02
Low-density lipoprotein cholesterol (mmol/L)	0.06	0.01	0.18	0.06	0.12	-0.03
High-density lipoprotein cholesterol (mmol/L)	0.01	-0.01	0.19*	-0.04	-0.33	0.07
Systolic Blood pressure (mmHg)	0.12	0.25**	-0.02	0.13	-0.07	0.12
Diastolic Blood pressure (mmHg)	0.15	0.01	-0.03	-0.00	-0.06	0.02
Total cholesterol/HDL-cholesterol ratio	0.07	-0.01	-0.01	0.05	0.23**	-0.01

*p<0.05; **p<0.01; # Regression coefficients (β),

Table VI. Multiple linear regression analysis showing the contributions of age, sex, duration of diabetes, cigarette smoking and ethnicity (after adjusting for BMI) to the differences in CVD risk factors in the two groups of patients.

	Independent contributing factors				
	Age#	Sex#	Duration#	Ethnicity#	Smoking#
Log fasting insulin (pmol/L)	-0.12	0.17*	-0.01	0.27**	0.04
Log insulin resistance (pmol/mmol/L)	-0.23**	0.19*	0.12	0.20**	-0.02
Glycated haemoglobin A_{1c} (%)	-0.27**	0.15	0.22*	-0.03	-0.09
Log triglycerides (mmol/L)	-0.12	0.07	0.05	0.32**	0.06
Total cholesterol (mmol/L)	-0.03	0.23*	0.05	0.09	0.02
Low-density lipoprotein cholesterol (mmol/L)	0.00	0.20*	0.05	0.12	-0.02
High-density lipoprotein cholesterol (mmol/L)	-0.01	0.19	-0.04	-0.33**	0.07
Systolic blood pressure (mmHg)	0.24*	0.03	0.12	-0.07	0.12
Diastolic blood pressure (mmHg)	-0.02	0.03	-0.02	-0.06	0.03
Total cholesterol/HDL-cholesterol ratio	-0.00	-0.05	0.11	0.24**	-0.03

* p<0.05, ** p<0.01, # Regression coefficients (β)

much more than body mass index (obesity); and this persisted after adjusting for BMI (Table VI).

DISCUSSION

We have characterised the biochemical risk factors for cardiovascular disease in elderly and younger patients with Type 2 diabetes. The results indicate that younger patients with Type 2 diabetes had poorer glycaemic control and higher prevalence of CVD risk factors than the elderly patients. These findings in primary care setting in a developing country are further discussed regarding its implications in the primary prevention of late diabetic complications.

The implication of poor glycaemic control among the patients is increased risk of developing late diabetic complications such as myocardial infarction[33], retinopathy and nephropathy[34,35]. Indeed, analysis of the United Kingdom landmark study of patients with Type 2 diabetes suggests that risk of cardiovascular diseases increases steadily with increasing numbers and levels of CVD risk factors[36,37]. Thus, with the difference in glycated haemoglobin levels between the elderly and younger patients, it appears that younger patients are at greater risk of vascular complications than elderly patients contrary to the well-known greater risk of CVD in the elderly[4-6]. This greater CVD risk among the younger patients appears to manifest first with dyslipidaemia with hypertriglyceridaemia as the first important CVD risk factor[38]. This is particularly important when it is recognised that there is a highly atherogenic, small dense LDL particle that is often predominant in hypertriglyceridaemic states but not in conditions of very low triglyceride concentrations[39,40].

There were high prevalence rates of obesity, cigarette smoking, alcohol use, poor blood pressure control and increased risk of heart disease among all the patients. These constitute additional CVD risk burdens to the patients who are already at an increased risk for cardiovascular disease[41]. Thus, cardiovascular disease previously thought to be more prevalent in the developed countries of Europe and North America[18], may be increasing in developing countries[3,14-20]. The observation of higher prevalence rates of CVD risk factors among the younger patients in this study suggests that CVD risk have a novel pattern in developing countries. For example, elderly non-diabetic female African subjects had been shown to have higher prevalence rates of CVD risk factors than males[19] in contrast to male sex preponderance in white population[42]. Nonetheless, our present finding of higher CVD risk factors among the younger patients cannot be completely explained. However, multiple linear regression analysis, adjusting for body mass index, showed that, in addition to age, gender and ethnicity contributed significantly to the observed differences. This analysis appeared consistent with our previous report that female diabetic patients and males of East Indian ethnic group were at greater risk of cardiovascular disease than their counterparts[21]. Although the higher prevalence rate of cigarette smoking among the younger patients did not significantly influence the CVD risk factors on multiple linear regression analysis, acute cigarette smoking has been shown to aggravate insulin resistance[43] and, incidentally, the younger patients had higher levels of insulin resistance (Table III). This may partly explain the increased CVD risk among the younger patients since insulin resistance is central to syndrome X and cardiovascular diseases[41,44]. Furthermore, the absolute higher number of females among the younger patients might, in part, contribute to the excess CVD risk since female diabetics have higher risk of cardiovascular diseases than males[42].

It has been recommended that the management of patients with Type 2 diabetes should be team-work involving all health care providers[27,28]. In developing countries, this proposition may be difficult because of paucity of well-trained health educators[45]. This might be complicated further by the underlying poverty among patients visiting primary care clinics, for instance and expectedly too, only 3.8% of the elderly patients in the present study were employed. This finding is worsened by the fact that drugs unavailable in the public sector had to be obtained privately and strict compliance with drug and dietary prescriptions in such circumstances remains doubtful. We suggest that any attempts at containing the possible explosion of CVD in this population would first start with adequate diabetes health education as previously recommended[27,28]. For instance, obesity, which is quantitatively higher in the younger female and male patients (Table IV) could be controlled, in addition to other methods, through adequate health education counselling and dietary management especially as obesity constitutes a major CVD risk factor in newly diagnosed Type 2 diabetic patients[21]. Furthermore, the prevalence rate of cigarette smoking among the younger patients could be controlled through increased diabetes health education to re-emphasise the harmful effect of this habit.

It has been argued that there is "no magic bullet" for improving the quality of health care[46], educational intervention and risk-assessing studies such as ours have the potential to bring about modest improvement in quality of care in primary health care setting. Although educational intervention had previously achieved little change in indicators of metabolic control[47], a modest improvement in total quality of healthcare could be achieved on long-term basis[47,48]. Thus, we suggest extensive and intensive diabetes health education at the primary care setting aimed at dietary management and the need for strict compliance with drug prescriptions. We believe that practical application of the results of research studies, such as this, could potentially assist in minimising the progression of diabetes to cardiovascular disorder in developing countries.

In conclusion, the results indicate that younger patients with Type 2 diabetes had poorer metabolic control and higher prevalence rates of CVD risk factors than the elderly patients. The greater risk of cardiovascular disease in younger patients was not independent of gender and ethnicity.

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