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ORIGINAL RESEARCH

Cardiovascular disease among patients attending a specialist diabetes clinic in Jamaica

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Trevor S Ferguson[1]
Marshall K Tulloch-Reid[1]
Novie OM Younger[1]
Rosemarie A Wright-Pascoe[2]
Michael S Boyne[1]
Shelly R McFarlane[1]
Damian K Francis[1]
Rainford J Wilks[1]

[1]Epidemiology Research Unit and Tropical Metabolism Research Unit, Tropical Medicine Research Institute, [2]Department of Medicine, The University of the West Indies, Mona, Kingston, Jamaica

Background: This study aimed to estimate the prevalence of cardiovascular disease (CVD) among patients attending The University Hospital of the West Indies diabetes clinic and to examine the relationship between prevalent CVD and its risk factors.

Methods: We analyzed data from 174 patients selected from the University Hospital of the West Indies diabetes clinic using gender-stratified random sampling. An interviewer-administered questionnaire was used to obtain data on self-reported CVD (coronary heart disease [CHD], cerebrovascular disease, and peripheral vascular disease [PVD]), physical activity, alcohol consumption, and smoking. Trained nurses performed blood pressure and anthropometric measurements. A capillary blood sample was collected to measure glycosylated hemoglobin, and urine was tested for protein and microalbumin. Means and proportions for patient characteristics, CVD outcomes, and risk factors were calculated. Logistic regression was used to identify factors independently associated with CVD.

Results: Data from 129 women and 45 men (mean age 55.7 ± 14.7 years) were analyzed. The prevalence of any self-reported CVD (CHD, cerebrovascular disease, or PVD) was 34.5% (95% confidence interval [CI] 27.4–41.6). PVD had the highest prevalence (25.9%), compared with CHD (6.9%) and cerebrovascular disease (16.1%). There were no gender differences in the prevalence of CVD. Prevalence of CVD was higher among people ≥50 years, and those with high blood pressure, central obesity, high total cholesterol, and duration of diabetes ≥20 years. In multivariable models, duration of diabetes was the most consistent factor associated with CVD, odds ratio 1.41 (95% CI 1.15–1.73, $P = 0.001$) per five-year increment. Having blood pressure at the goal of <130/80 mmHg and at least three physical activity sessions/week were associated with lower odds of CVD, odds ratios 0.42 (95% CI 0.20–0.87, $P = 0.020$) and 0.37 (95% CI 0.16–0.82, $P = 0.014$), respectively.

Conclusion: In this Jamaican setting, 35% of patients with diabetes have at least one CVD. Odds of CVD increased with diabetes duration, while good blood pressure control and increased physical activity were ameliorating factors.

Keywords: cardiovascular disease, diabetes, Jamaica, diabetic complications, Caribbean

Introduction

Diabetes mellitus is an independent risk factor for cardiovascular disease (CVD) in both men and women, and has been designated as a CVD risk equivalent.[1,2] Atherosclerotic vascular disease affecting the coronary, cerebral, and lower extremity vessels accounts for 80% of mortality and 75% of hospitalizations in persons with diabetes.[3,4] CVD is also the largest contributor to the direct and indirect costs of diabetes mellitus.[5] With the expected increase in the number of persons with diabetes in the coming decades,[6,7] the challenge of CVD management in patients with diabetes

Correspondence: Trevor Ferguson
Epidemiology Research Unit,
Tropical Medicine Research Institute,
The University of the West Indies,
Mona, Kingston, Jamaica
Tel +1 876 927 2471
Fax +1 876 927 2984
Email trevor.ferguson02@uwimona.edu.jm

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will likely become an increasingly important problem for members of the health care team.

Despite being a major cause of morbidity and mortality in Jamaica and other Caribbean countries,[8] there are few published data on CVD complications among persons with diabetes in the region. Early reports from the 1950s showed increased mortality among diabetic patients admitted with myocardial infarction in Jamaica, and data from the 1980s showed increased risk of coronary heart disease (CHD) among persons with diabetes in a Trinidadian cohort,[8,9] but there are limited data available from studies conducted in the last 20 years. Recently, we have shown that almost 60% of persons admitted to The University Hospital of the West Indies with a diagnosis of diabetes also had some form of CVD recorded on their discharge summary, and that self-reported prevalence of stroke was higher among persons with diabetes compared with persons without diabetes,[10,11] but there are no published reports on the overall prevalence of CVD among the diabetic population in Jamaica.

The aim of this study was to estimate the prevalence of CVD (CHD, cerebrovascular disease, and peripheral vascular disease [PVD]) among patients with diabetes attending The University Hospital of the West Indies diabetes clinic and to evaluate the relationship between CVD and its risk factors.

Methods

Study design and sampling

A cross-sectional survey was conducted among patients attending The University Hospital of the West Indies diabetes clinic, a specialist clinic staffed by endocrinologists or diabetes specialists and residents in The University Hospital of the West Indies internal medicine training program. Participants were evaluated between August 2009 and September 2010. The study was designed primarily to estimate the prevalence of diabetic foot complications. The sampling frame was compiled from a list of patients seen in the diabetes clinic in 2008. Participants were selected using gender-stratified random sampling, with a target sample size of 278 persons based on an estimated prevalence of foot complications of 12%[12] with a 5% margin of error at the 95% confidence level. The study was approved by The University Hospital of the West Indies, University of the West Indies, Faculty of Medical Sciences ethics committee.

Recruitment

Patients selected for the study were contacted by telephone and invited to participate. Written informed consent was obtained prior to data collection. Successful contact was made with 253 of the potential participants or their relatives. Of those contacted, 15 were reported to have died, 29 were unable to come in for evaluation or refused to participate, four reported that they did not have diabetes, one person had emigrated, and 16 persons missed appointments, resulting in a final recruited sample of 188 persons (74.3% of contacted persons). Reasons for nonparticipation among those unable to come in for an appointment included being unable to get time off from work, difficulty with transport, and being too ill. The final sample for this analysis included 174 participants with data on CVD outcomes. This sample size was estimated to have a power of 79% to detect an 11% prevalence of stroke with a margin of error of 7%, and a power of 76% to detect a 12% prevalence of CHD with a margin of error of 7%. Estimated prevalence of stroke and CHD was based on previously published data from persons admitted with diabetes at The University Hospital of the West Indies.[10]

Measurements and definitions

All measurements were performed by trained staff. An interviewer-administered questionnaire was used to collect information on general health, diabetes control, and diabetes complications. Participants were asked if they had been told by a doctor or other health care professional that they had any of the following conditions: heart disease, stroke, transient ischemic attacks, or PVD. For heart disease, participants were asked to specify if they had been diagnosed with heart attack, angina, or heart failure. Participants who reported having heart attack or angina were classified as having CHD and those who reported stroke or transient ischemic attacks were classified as having cerebrovascular disease. For PVD, participants were asked if they had been told by a doctor that they had claudication pain, rest pain, or PVD; they were told that this referred to poor circulation in the arteries of the leg and not to leg swelling that resolves with leg elevation. Participants who reported a history of doctor-diagnosed PVD, claudication, or rest pain were classified as having PVD.

Body weight was measured to the nearest 0.1 kg using a portable digital scale, while height was measured to the nearest 0.1 cm using a portable stadiometer. Body mass index (BMI) was calculated as weight in kilograms divided by the square of height in meters, and participants were categorized as normal (BMI < 25 kg/m^2), overweight (BMI 25.0–29.9 kg/m^2), or obese (BMI ≥ 30 kg/m^2). Waist and hip circumference were obtained using a nonstretchable tape.

Waist circumference was measured midway between the lowest rib and the iliac crest, and hip circumference at the level of the greater trochanter. Central obesity was defined as waist circumference ≥80 cm in women and ≥94 cm in men, as recommended by the International Diabetes Federation.[13]

Blood pressure was obtained using a mercury sphygmomanometer. Three blood pressure measurements were taken at one-minute intervals from the right arm after the participant had been seated for five minutes.[14] The mean of the second and third blood pressure measurements was used in the analysis. Participants were classified as having high blood pressure if their systolic blood pressure was ≥130 mmHg, diastolic blood pressure ≥80 mmHg, or if they were on medication for high blood pressure.[5]

A capillary blood sample was collected for the measurement of glycosylated hemoglobin (HbA1c) using a point of care instrument (NycoCard® Reader II, Axis-Shield, Rodelokka, Oslo, Norway). This reader is certified by the National Glycohemoglobin Standardization Program US.[15,16] Participants were classified as having good control (HbA1c < 7.0), inadequate control (HbA1c 7.0–8.9), or poor control (HbA1c ≥ 9.0).

Urine protein excretion was measured on a freshly voided urine specimen using standard urine test strips. A colorimetric principle was used to obtain a semiquantitative estimate of urine protein excretion and coded as negative or positive. Positive test results were further classified as trace, 1+, 2+, or 3+. Urine samples that were negative for protein were also tested for microalbumin using a semiquantitative test strip (Teco Diagnostics, Anaheim, CA). Participants were then classified as "no albuminuria" if negative on both urine dipstick and microalbumin tests, "microalbuminuria" if positive on the microalbumin test but negative on the standard urine dipstick test, or "gross proteinuria" if positive on the urine dipstick test.

Data on lipids (total cholesterol, high-density lipoprotein cholesterol [HDL], low-density lipoprotein cholesterol [LDL], and triglycerides) were abstracted from the patient's record using the last recorded values on the docket. Cutoff values were defined as follows: high total cholesterol, ≥5.2 mmol/L; low HDL, <1.0 mmol/L in men and <1.3 mmol/L in women; high triglycerides, >1.7 mmol/L; and high LDL, ≥2.6 mmol/L.

Statistical analysis

Data were entered into an electronic database using EpiData 3.1, with range and consistency checks used to minimize data entry errors. Data analysis was done using Stata 10.1 (Stata Corporation, College Station, TX). Prevalence estimates for CVD complications in the entire sample and according to risk factor categories were obtained. Means and proportions were obtained for participant characteristics and CVD risk factors. Differences in proportions for categorical variables were compared using χ^2 tests or Fisher's Exact test as appropriate, while the *t*-test was used for difference in means.

Multivariate logistic regression was used to obtain adjusted odds ratios (OR) for the presence any CVD, CHD, cerebrovascular disease, or PVD. Models for each outcome were created by sequentially adding variables to a base model containing gender and age (in five-year increments). The variables assessed were blood pressure (categorized as at goal [<130/89 mmHg] or not at goal), waist circumference (as a continuous variable), total cholesterol (normal/high/unknown), low HDL (normal/high/unknown), smoking status, alcohol consumption, physical activity category, albuminuria category, diabetes control category, and diabetes duration (five-year increments). The effect of each variable on the model was determined using the likelihood ratio test. The Hosmer-Lemeshow test for goodness of fit was used to assess the final models. For the explanatory variables with missing values, we used imputation (based on participant's age and gender) when the variable was included as a continuous variable; alternatively, missing values were treated as a separate category when the variable was included in the model as a categorical variable.

Results

Of the 188 patients recruited, 174 persons (129 women, 45 men; mean age 56 years; mean diabetes duration 16 years) had available data on the CVD outcomes of interest. All the excluded participants were women, and except for a lower mean height (157 cm versus 163 cm), there were no significant differences between those excluded and the analyzed sample.

Summary statistics for the participant characteristics are presented in Table 1. Mean values for these characteristics were generally similar for men and women, except for BMI, total cholesterol, and HDL, which were higher in women, and height, which was higher in men.

Prevalence of estimates for overall CVD and its subtypes are shown in Table 2. The overall prevalence on any CVD (CHD, cerebrovascular disease, or PVD) was 34.5% (95% confidence interval [CI] 27.4–41.6). Of these persons with CVD, 67% reported one CVD, 27% reported two CVDs, and 6% reported all three CVDs. PVD was the most common of

Table 1 Characteristics of study participants with comparison of means for participant characteristics and cardiovascular risk factors by gender

Characteristic	Men Mean ± SD n = 45	Women Mean ± SD n = 129	Total Mean ± SD n = 174
Age (years)	56.5 ± 14.8	55.4 ± 14.7	55.7 ± 14.7
Height (cm)***	172.4 ± 5.6	160.0 ± 7.2	163.2 ± 8.7
Weight	81.0 ± 16.2	77.0 ± 16.9	78.0 ± 16.8
Body mass index** (kg/m^2)	27.3 ± 5.6	30.1 ± 6.2	29.4 ± 6.1
Waist circumference (cm)	94.2 ± 16.1	95.4 ± 13.9	95.1 ± 14.5
Hip circumference** (cm)	100.9 ± 9.5	106.4 ± 11.9	104.9 ± 11.6
Waist/hip ratio	0.93 ± 0.09	0.90 ± 0.07	0.90 ± 0.08
Systolic BP (mmHg)	129.2 ± 20.4	128.5 ± 22.3	128.7 ± 21.8
Diastolic BP (mmHg)	71.7 ± 12.7	70.7 ± 13.2	70.9 ± 13.0
Pulse rate (bpm)	74 ± 13	78 ± 14	77 ± 14
Total cholesterol** (mmol/L)	4.2 ± 1.2	5.1 ± 1.4	5.0 ± 1.3
LDL cholesterol (mmol/L)	3.0 ± 1.0	3.3 ± 1.2	3.2 ± 1.1
HDL cholesterol* (mmol/L)	1.2 ± 0.2	1.3 ± 0.3	1.2 ± 0.3
Triglycerides (mmol/L)	1.21 ± 0.9	1.4 ± 1.1	1.3 ± 1.0
HbA1c (%)	7.3 ± 1.6	7.8 ± 2.0	7.6 ± 1.9
Duration of DM (years)	18.0 ± 13.2	15.9 ± 10.0	16.4 ± 10.9
Age at diagnosis (years)	38.9 ± 15.1	40.0 ± 12.8	39.7 ± 13.4

Notes: *$P < 0.05$; **$P < 0.01$; ***$P < 0.001$; P values are for male/female differences. Data for height, weight, BMI, waist circumference, hip circumference, and waist/hip ratio include six imputed values. Imputed values were also used for total cholesterol (21), LDL (34), HDL (36), triglycerides (21), duration of diabetes (26), and age at diagnosis (26).
Abbreviations: bpm, beats per minute; LDL, low-density lipoprotein; HDL, high-density lipoprotein; DM, diabetes mellitus; HbA1c, glycosylated hemoglobin; BMI, body mass index; BP, blood pressure; SD, standard deviation.

the three CVDs, with a prevalence of 25.9% compared with 16.1% for cerebrovascular disease and 6.9% for CHD. There were no statistically significant gender differences in the prevalence of overall CVD or its subtypes, but a higher proportion of women reported cerebrovascular disease and a higher proportion of men reported CHD. None of the men reported a history of angina pectoris, and a higher proportion of women reported transient ischemic attacks.

Table 3 shows the percentage of participants with various CVD risk factors within and across gender categories. The majority of participants (68%) were 50 years or older, 72% had high blood pressure, 34% were overweight, and 39% were obese. Prevalence of obesity was higher in women compared with men (43% versus 27%). Women also had a higher prevalence of central obesity (85% versus 42%), high total cholesterol (83% versus 53%), and low HDL cholesterol (47% versus 20%). More men reported a history of past or current tobacco smoking (64% versus 13%). Only two participants gave a history of current smoking. There was no significant difference in current alcohol use, but past alcohol use was higher in men compared with women (51% versus 23%). A majority of patients (53%) reported engaging in work-related or leisure time physical activity of at least 20 minutes' duration on three or more days per week. Forty-three percent of participants had good diabetes control (HbA1c $<$ 7.0%) while more women than men had poor control (26% versus 11%).

Table 4 shows the prevalence of overall CVD and its subtypes within categories of selected risk factors. Patterns were generally similar for all CVD subtypes. Factors associated with increased prevalence of CVD included the following: older age (42% in persons $\geq$50 years compared with 18% in those $<$50 years); hypertension (41% versus 18%); central obesity (39% versus 23%); and diabetes duration (62% among those with diabetes mellitus for $\geq$20 years versus 23% for those with diabetes duration $<$20 years). Participants with blood pressure at the recommended goal of $<$130/80 mmHg and those who engaged in work-related or leisure physical activity for three or more days per week

Table 2 Prevalence of overall cardiovascular disease and subtypes among study participants by gender

Characteristic	Men % (95% CI) n = 45	Women % (95% CI) n = 129	Total % (95% CI) n = 174
Any cardiovascular disease	37.8 (23.4–52.2)	33.3 (25.1–41.6)	34.5 (27.4–41.6)
Coronary heart disease	4.4 (0–10.6)	7.8 (3.1–12.4)	6.9 (3.1–10.7)
Angina	–	5.4 (1.5–9.4)	4.0 (1.1–7.0)
Heart attack	4.4 (0–10.6)	2.3 (0–5.0)	2.9 (0.4–5.4)
Cerebrovascular disease	13.3 (3.2–23.4)	17.1 (10.5–23.6)	16.1 (10.6–21.6)
Transient ischemic attack	2.2 (0–6.6)	7.8 (3.1–12.4)	6.3 (2.7–10.0)
Stroke	11.1 (1.7–20.5)	9.3 (4.2–14.4)	9.8 (5.3–14.2)
Peripheral vascular disease	31.1 (17.3–44.9)	24.0 (16.6–31.5)	25.9 (19.3–32.4)

Notes: Any cardiovascular disease includes a combination of coronary heart disease, cerebrovascular disease, and peripheral vascular disease. Coronary heart disease includes angina and heart attack, and cerebrovascular disease includes stroke and transient ischemic attacks.
Abbreviation: CI, confidence interval.

Table 3 Percentage of participants in cardiovascular disease or diabetes risk categories by gender

Characteristic	Men % (SE) n = 45	Women % (SE) n = 129	Total % (SE) n = 174
Age category			
<50 years	28.9 (6.8)	32.6 (4.1)	31.6 (3.5)
≥50 years and older	71.1 (6.8)	67.4 (4.1)	68.4 (3.5)
High blood pressure (≥130/80 mmHg or on medication)	71.1 (6.8)	72.1 (4.0)	71.8 (3.4)
Blood pressure not at goal (≥130/80 mmHg with or without medication)	51.1 (7.5)	46.5 (4.4)	47.7 (3.8)
BMI category			
Overweight (BMI 25–29.9)	35.6 (7.2)	33.3 (4.2)	33.9 (3.6)
Obese (BMI ≥ 30)*	26.7 (6.7)	42.6 (4.4)	38.5 (3.7)
Central obesity*** (WC > 80 cm in women; >94 cm in men)	42.2 (7.4)	84.5 (3.2)	73.6 (3.4)
Lipid profile			
High total cholesterol*** (≥5.2 mmol/L or on medication)	53.3 (7.5)	82.9 (3.3)	75.3 (3.3)
High LDL-C for diabetes (≥2.6 mmol/L with or without medication)	48.9 (7.5)	54.3 (4.4)	52.9 (3.8)
Low HDL-C*** (<1.0 mmol/L in men or <1.3 mmol/L in women)	20.0 (6.0)	47.3 (4.4)	40.2 (3.7)
High triglycerides (≥1.7 mmol/L)	15.6 (5.5)	20.9 (3.6)	19.5 (3.0)
Smoking status			
Never smoked tobacco***	35.6 (7.2)	85.3 (3.1)	72.4 (3.4)
Past or current smoker***	64.4 (7.2)	13.2 (3.0)	26.4 (3.4)
Alcohol consumption			
Never drank alcohol***	37.8 (7.3)	69.7 (4.1)	61.5 (3.7)
Past alcohol use**	51.1 (7.5)	23.3 (3.7)	30.5 (3.5)
Current alcohol use	11.1 (4.7)	7.0 (2.3)	8.0 (2.1)
Physical activity category			
No significant exercise	20.0 (6.0)	28.7 (4.0)	26.4 (3.4)
Exercises two or less times per week	22.2 (6.3)	17.8 (3.4)	19.0 (3.0)
Exercises three or more times per week	57.8 (7.4)	51.9 (4.4)	53.4 (3.8)
Albuminuria			
Microalbuminuria	13.3 (5.1)	17.1 (3.3)	16.1 (2.8)
Gross proteinuria	55.6 (7.4)	58.1 (4.3)	57.5 (3.8)
Current insulin treatment	68.9 (7.0)	69.0 (4.1)	69.0 (3.5)
Diabetes control			
Good (HbA1c < 7.0%)	44.4 (7.5)	42.6 (4.4)	43.1 (3.8)
Inadequate (HbA1c 7%–8.9%)	44.4 (7.5)	31.8 (4.1)	35.1 (3.6)
Poor (HbA1c ≥ 9%)*	11.1 (4.7)	25.6 (3.9)	21.8 (3.1)

Notes: $^{*}P < 0.05$; $^{**}P < 0.01$; $^{***}P < 0.001$; P values are for male/female differences. For proportion calculations, participants with missing values treated as separate category hence denominator for all proportions are as per column total.
Abbreviations: LDL, low-density lipoprotein; HDL, high-density lipoprotein; WC, waist circumference; HbA1c, glycosylated hemoglobin; BMI, body mass index; SE, standard error.

were less likely to have CVD. The prevalence estimate for CVD was 23% among persons with blood pressure at goal compared with 47% among persons whose blood pressure was not at goal. Similarly, prevalence of CVD among persons who reported physical activity three or more times per week was 26% compared with 39% among those reporting physical activity two or fewer times per week, and 50% among those reporting no significant work-related or leisure physical activity.

In order to describe the relationship between clustering of CVD risk factors within individuals and the prevalence of CVD, we created a variable for the number of risk factors per individual, using the risk components of the United Kingdom Prospective Diabetes Study Risk Engine.[17] We included all components, except for atrial fibrillation, for which we had no data. However, we used the components as categorical variables to facilitate a count of the number of risk factors per individual. Components counted in the risk score were age ≥50 years, male gender, diabetes duration of ≥20 years, past or current smoking, poor glycemic control (HbA1c ≥ 9.0%), high total cholesterol, low HDL cholesterol, and blood pressure ≥130/80 mmHg. The distribution of number of risk factors in gender categories is shown in Figure 1. Most participants (66%) had three or four risk factors, but a higher proportion of men had 5–7 risk factors ($P < 0.001$ for difference between males and females). Figure 2 shows the prevalence of overall CVD by number of risk factors. Prevalence increased from 29% among persons with one or two risk

Table 4 Prevalence of cardiovoscular disease by risk factor categories

Characteristic	Any CVD %	CHD %	Stroke/TIA %	PVD %
Age category				
<50 years	18.2	1.8	3.6	16.4
≥50 years	42.0***	9.2*	21.8***	30.3*
Blood pressure				
Not hypertensive (<130/80 mmHg without medication)	18.4	2.0	8.1	14.3
Hypertensive (≥130/80 mmHg or on medication)	40.8**	8.8*	19.2*	30.4*
Blood pressure goal				
Not at goal (≥130/80 mmHg)	47.0	9.6	22.9	34.9
At goal (<130/80 mmHg)	23.1***	4.4	9.9*	17.6**
BMI category				
Not overweight (BMI < 25.0)	21.4	–	2.4	19.0
Overweight (BMI 25–29.9)	37.3	8.5	20.3	22.0
Obese (BMI ≥ 30)	41.8	9.0*	21.0***	34.3
Central obesity (WC >80 cm in women; >94 cm in men)				
No central obesity	22.5	–	7.5	17.5
Central obesity present	39.1*	8.6***	18.8*	28.9
High total cholesterol (≥5.2 mmol/L or on medication)				
Absent	21.9	3.1	6.3	15.6
Present	38.9*	7.6	19.1*	29.0
High LDL-C for diabetes (≥2.6 mmol/L with or without medication)				
Absent	39.6	5.4	12.5	29.2
Present	32.6	8.3	15.2	26.1
Low HDL-C (<1.0 mmol/L in men or <1.3 mmol/L in women)				
Absent	38.2	4.4	11.8	32.4
Present	31.4	7.1	15.7	21.4
High triglycerides (≥1.7 mmol/L)				
Absent	31.9	5.8	11.8	24.3
Present	38.2	5.8	20.6	29.4
Smoking status				
Never smoked tobacco	31.0	7.9	14.3	22.2
Past or current smoker	43.5	4.3	19.6	34.8
Alcohol consumption				
Never drank alcohol	36.4	9.3	17.8	26.2
Past alcohol use	35.8	1.8	15.1	28.3
Current alcohol use	14.3	7.1	7.1	14.3
Physical activity level				
No significant exercise	50.0	13.0	26.1	37.0
Exercises two or less times per week	39.4	3.0	15.2	33.3
Exercises three or more times per week	25.8*	5.3	11.8	18.3*
Albuminuria				
No albuminuria	14.3	–	7.1	7.1
Microalbuminuria	28.6	10.7	21.4	14.3
Gross proteinuria	39.0	7.0**	15.0	30.0*
Diabetes control				
Good (HbA1c < 7.0%)	34.7	6.7	18.7	26.7
Inadequate (HbA1c 7%–8.9%)	34.4	6.6	16.4	27.9
Poor (HbA1c ≥ 9%)	34.2	7.9	10.5	21.1
Diabetes duration				
Less than 20 years	23.3	2.9	7.8	16.5
20 years or more	62.2***	15.6*	35.6***	48.9***

Notes: *$P < 0.05$; **$P < 0.01$; ***$P < 0.001$; P values are for comparison across CVD risk factor categories.

Abbreviations: LDL, low-density lipoprotein; HDL, high-density lipoprotein; WC, waist circumference; CVD, cardiovascular disease; CHD, coronary heart disease; TIA, transient ischemic attacks; PVD, peripheral vascular disease; HBA1c, glycosylated hemoglobin.

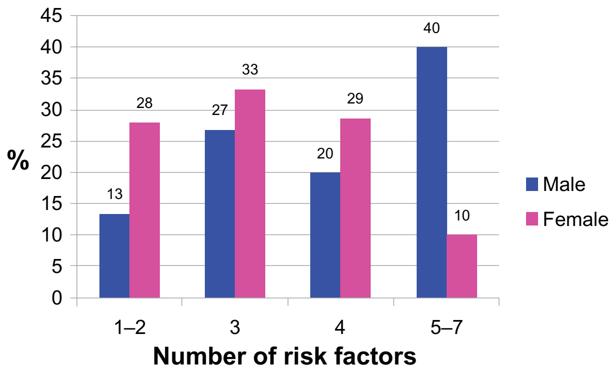

Figure 1 Percentage of participants with United Kingdom Prospective Diabetes Study Risk Engine components.
Note: $P \leq 0.001$ (male/female difference in proportions for entire distribution).

factors to 48% among persons with 5–7 risk factors ($P = 0.05$ for association and $P = 0.019$ for trend).

The results for the multivariable analyses are shown in Table 5. Separate models were created for any CVD (CHD, cerebrovascular disease, or PVD), CHD, cerebrovascular disease, and PVD. Diabetes duration was consistently associated with CVD in all the models, with a 31%–41% increase in the odds for CVD for each five-year increase in diabetes duration. OR were: any CVD 1.41, $P = 0.001$; CHD 1.34, $P = 0.034$; cerebrovascular disease 1.31, $P = 0.021$; and PVD 1.39, $P = 0.002$. Blood pressure <130/80 mmHg was associated with a 29%–58% reduction in the odds of CVD, but achieved statistical significance only in the model for any CVD. Physical activity was also associated with reduced odds of any CVD (OR 0.37, $P = 0.014$ for three or more physical activity sessions per week compared with no significant physical activity), while higher waist circumference was associated with increased odds of CVD in models for CHD and cerebrovascular disease (OR 1.05, $P = 0.043$ per 1 cm difference in waist circumference for CHD and 1.04, $P = 0.031$ per 1 cm difference in waist circumference for cerebrovascular disease).

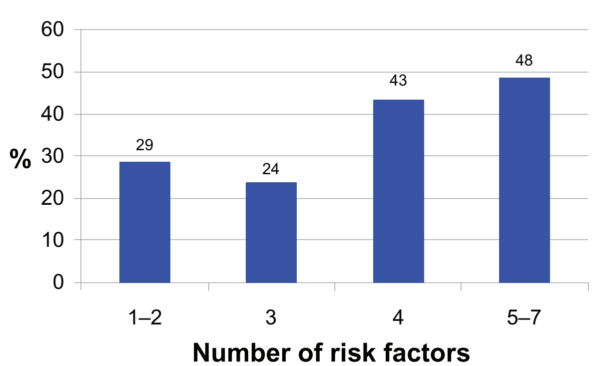

Figure 2 Proportion of participants with overall cardiovascular disease by number of risk factors.
Notes: $P = 0.050$; P (trend) $= 0.019$. P-values are for the entire distribution.

Discussion

In this study we found that 35% of patients with diabetes attending a specialist diabetes clinic had at least one major CVD. Although PVD had the highest prevalence (26%) of the three categories of CVD studied, a significant proportion of participants reported CHD (7%) and cerebrovascular disease (16%). There were no gender differences in the prevalence of CVD in this study. Prevalence of CVD was higher among persons ≥50 years, those with high blood pressure, central obesity, or high total cholesterol, and among persons with a diabetes duration ≥20 years. In multivariable models, duration of diabetes was the most consistent factor associated with prevalent CVD, while having a blood pressure at goal of <130/80 mmHg and engaging in three or more physical activity sessions per week were associated with lower odds of CVD.

Few studies have reported prevalence estimates for CVD in patients with diabetes. However, the estimates found in our study are similar to self-reported CVD prevalence in persons with diabetes in the US where the prevalence of any CVD was 32.5% among persons ≥35 years in 2005.[18] In that study, prevalence of CVD was lower in blacks (27.1%) compared with whites (33.7%). In another study from Catalonia in Spain, the prevalence of CVD (CHD, stroke, or PVD) among persons with diabetes obtained from patient interviews and medical records was 22.0%.[19] These studies confirm the high prevalence of CVD in patients with diabetes, and support the recommendations for intensive CVD prevention strategies in patients with diabetes, by the American Diabetes Association and National Cholesterol Education Programme.[1,5]

Prevalence of heart attack and stroke in this study (2.9% and 9.8%, respectively) was much higher than seen in the general Jamaican population (0.7% for heart attacks, 1.4% for stroke) but was similar to rates among persons with diabetes selected from the general population (1.8% for heart attacks and 7.2% for strokes).[11] This suggests that, although the patients were selected from a specialist diabetes clinic, the CVD experience may not be significantly different from a population-based sample of persons with diabetes.

The association between CVD risk factors and CVD events in this study were, in the main, consistent with the literature, and were similar to the findings in the North Catalonia Diabetes Study.[19] The absence of any association with glycemic control is consistent with other studies which

Table 5 Factors associated with major cardiovascular disease in multivariable logistic regression models

Variable	Odds ratio	95% CI	*P* value
Any cardiovascular disease (CHD, stroke/TIA, PVD)			
Men (versus women)	1.13	0.5–2.5	0.769
Age (per 5-year increment)	0.99	0.86–1.15	0.938
Duration of diabetes (per 5-year increment)	1.41	1.15–1.73	0.001
Blood pressure at goal (<130/80 mmHg versus ≥130/80 mmHg)	0.42	0.20–0.87	0.020
1–2 physical activity sessions/week (versus no significant physical activity)	0.61	0.22–1.67	0.337
≥3 physical activity sessions/week (versus no significant physical activity)	0.37	0.16–0.82	0.014
Coronary heart disease (heart attack or angina)			
Men (versus women)	0.36	0.06–2.02	0.244
Duration of diabetes (per 5-year increment)	1.34	1.02–1.76	0.034
Blood pressure at goal (<130/80 mmHg versus ≥130/80 mmHg)	0.71	0.19–2.68	0.613
Waist circumference (per cm)	1.05	1.00–1.10	0.043
Cerebrovascular disease (stroke or TIA)			
Men (versus women)	0.49	0.16–1.51	0.213
Age (per 5-year increment)	1.09	0.89–1.34	0.407
Duration of diabetes (per 5-year increment)	1.31	1.04–1.65	0.021
Blood pressure at goal (<130/80 mmHg versus ≥130/80 mmHg)	0.59	0.23–1.50	0.265
Waist circumference (per cm)	1.04	1.00–1.07	0.031
Low HDL cholesterol (versus normal HDL)	1.38	0.48–3.97	0.546
HDL unknown (versus normal HDL)	4.67	1.40–15.68	0.012
Peripheral vascular disease			
Men (versus women)	1.33	0.57–3.12	0.514
Age (per 5-year increment)	0.96	0.81–1.13	0.606
Duration of diabetes (per 5-year increment)	1.39	1.12–1.72	0.002
Blood pressure at goal (<130/80 mmHg versus ≥130/80 mmHg)	0.55	0.25–1.21	0.137
Waist circumference (per cm)	1.02	0.99–1.05	0.139
1–2 physical activity sessions/week (versus no significant physical activity)	0.93	0.32–2.67	0.893
≥3 physical activity sessions/week (versus no significant physical activity)	0.45	0.19–1.08	0.074

Abbreviations: CI, confidence interval; TIA, transient ischemic attack; CHD, coronary heart disease; PVD, peripheral vascular disease; HDL, high-density lipoprotein.

have failed to show that tight glycemic control reduces macrovascular complications of diabetes and may increase the risk of mortality,[20,21] although previous epidemiological studies had shown higher CVD risk among persons with higher HbA1c.[22]

The use of self-reports to assess CVD outcome status may be considered a limitation of this study. Although ascertainment of outcome status by use of medical records or direct measurement may have been advantageous, the use of self-reporting is a generally accepted means of outcome assessment, and has been shown to have fairly good validity in epidemiological studies.[23–27] For example, Okura et al found that self-reported data from questionnaires had a sensitivity of 90% for heart attack and 78% for stroke, while specificity was 98% for heart attack and 99% for stroke.[25] In another study, researchers from Australia were able to demonstrate good agreement between prevalence of diabetic foot disease, including PVD, obtained from questionnaires and estimates from clinical examination or medical records.[28] We therefore believe that the estimates presented for this study are plausible.

While we were able to show associations between CVD and a number of risk factors, we are unable to infer causality because of the cross-sectional design of the study. For instance, the association between CVD prevalence and blood pressure may be a result of more aggressive blood pressure control in the setting of CVD. CVD may also affect an individual's ability to exercise, and these patients might report lower levels of physical activity. However, the associations found are consistent with the general medical literature which has previously established temporal relationship in prospective studies, thus giving support to a likely causal association.[29,30]

Missing data for some study participants is another potential limitation of the study. However, we note that only a small proportion had missing data on CVD outcome, and while these were all women, they were similar to the analyzed sample, except for lower mean height. Where participants had missing data for explanatory variables, we used imputation or the creation of a separate category to facilitate inclusion in analyses. It is therefore unlikely that missing data would have influenced any of the findings from the study. We also acknowledge that the number of men in this study was relatively small, but the proportion of men in the sample (24%) was consistent with the proportion of men registered in the clinic (29%). The female predominance in the clinic is consistent with the higher prevalence of diabetes in women in Jamaica,[11,31] but may also reflect gender differences in health-seeking behavior. This may limit our ability to generalize to all men in the Jamaican community, but still represents our best estimate of the burden of CVD among men with diabetes. No conclusions can be drawn from the finding of an association between cerebrovascular disease and participants with unknown HDL, but this suggests the need for further research in this area.

Although the study was conducted in a specialist diabetes clinic, we note that the estimated prevalence of heart attack and stroke were generally similar to that among persons with diabetes in the general population of Jamaica,[11] therefore implying that the findings may be generalizable to the population of persons with diabetes in Jamaica and possibly to other black populations of similar age and diabetes duration.

It is also important to note that the findings in this study represent only persons who have had nonfatal CVD, and will therefore underestimate the full impact of CVD among persons with diabetes. Additionally, some of the significant associations may be factors associated with survival with CVD and not necessarily the factors associated with incident CVD. This supports the need for more prospective studies of diabetes complications in black populations living in countries undergoing epidemiological transition.

This study is the first to report on the prevalence of CVD and its risk factors among patients attending diabetes clinics in Jamaica, and reiterates the need for CVD prevention and control among persons with diabetes and the importance of addressing CVD as part of any patient diabetes education intervention. We are unaware of any other studies from developing countries which have examined this issue in a predominantly black population. In light of the World Health Organisation reports suggesting that approximately 80% of CVD deaths occur in developing countries,[32] this study is an important addition to the literature in this field.

From our analyses, duration of diabetes had the strongest and most consistent association with CVD, suggesting that strategies for controlling CVD must include delaying the onset of diabetes. Additionally, it is critical that health care providers be more aggressive in their screening for symptoms of coronary disease among older patients with longstanding diabetes as a means of secondary prevention of the consequences of this disorder. They should also have a high level of suspicion for coronary disease should these patients present to hospital. Ensuring adequate blood pressure control and encouraging increased physical activity should also be a part of the strategy for CVD reduction. Clinicians should screen annually for cardiovascular risk factors, as recommended by international and regional guidelines.[33,34] Cardiac testing should be initiated in individuals with typical or atypical cardiac symptoms or an abnormal resting electrocardiogram, as recommended by the American Diabetes Association,[34] and efforts to increase patients' access to these services should be encouraged. All patients with diabetes should have some assessment performed to determine their cardiovascular risk and should receive appropriate preventative measures.[34,35] The high prevalence of established disease in this population with diabetes also points to the need for aggressive secondary and tertiary prevention measures for patients who are at very high risk for recurrent cardiovascular events and significant morbidity from the disease. Governments should consider a greater subsidy for cardiovascular medications and services for patients with diabetes as one means of stemming this epidemic. Educational programs for patients with diabetes must include a significant CVD prevention component, and should include strategies for behavior change which will enhance interventions for primary and secondary prevention of CVD.

Conclusion

Approximately 35% of patients with diabetes mellitus in this tertiary care setting had at least one CVD. CVD prevalence is associated with age, diabetes duration, and uncontrolled hypertension and is more common among the physically inactive. Physicians should ensure that CVD risk reduction strategies are incorporated in the care of patients with diabetes.

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Disclosure

The authors report no conflicts of interest in this work.

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