Am J Cardiovasc Dis 2016;6(3):129-137
www.AJCD.us /ISSN:2160-200X/AJCD0032089

Original Article

Diabetic indicators are the strongest predictors for cardiovascular disease risk in African American adults

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Received May 12, 2016; Accepted August 21, 2016; Epub September 15, 2016; Published September 30, 2016

Abstract: African Americans have higher risk of developing type 2 diabetes and cardiovascular disease (CVD) compared to other racial groups. Modifiable and non-modifiable factors play a role in the development of both diseases. This study assessed diabetes indicators in relation to other CVD risk factors taking into account confounders, among African American adults. This was a cross-sectional study in mid-life and older African Americans (≥45 years) who were recruited from the local churches. Fasting blood was collected and serum analyzed for diabetes indicators, apolipoproteins, adipokines, and lipid profile. CVD risk scores were determined using the American Heart Association and Framingham Risk Score assessments. Homeostasis Model Assessments (HOMAs) were calculated using glucose and insulin concentrations. Confounding variables were assessed by questionnaires. Data were analyzed using SPSS software, version 21, and $p<0.05$ was deemed significant. Descriptive statistics was used to analyze continuous variables. Frequencies and percentages were used to examine categorical variables. T-tests compared different groups while Pearson correlations provided preliminary relationships and determined variables for multiple regression analyses. A total of n=79 participants were evaluated (69% women), 59.3±9.2 years, BMI=34.7±8.3 (mean±SD). As expected, AA men had higher fasting blood glucose than women (123.6±54.9 mg/dL versus 99.0±21.8 mg/dL), and AA women had higher insulin (11.8±13.1 mg/dL versus 7.6±6.0 mg/dL). Our study confirmed that it is likely for AA men to have significantly lower adiponectin concentrations in comparison to AA women. Based on the CVD risk assessments, men had a significantly higher risk of developing CVD than women, which has been shown previously. Apolipoproteins, adipokines, and lipid profile also negatively influenced the cardiovascular health outcomes in men. Dietary intake, probably by influencing participants' weight/adiposity, contributed to the differences in cardiovascular outcomes between men and women. In conclusion, the findings of this study revealed that diabetes and serum glucose appeared to be the leading factors for high CVD risk, on the contrary to some other indicators reported in some studies, e.g. hypertension or dyslipidemia.

Keywords: African Americans, aging, blood glucose, cardiovascular disease risk, type 2 diabetes, diet

Introduction

Type 2 diabetes mellitus (T2DM) is a prevalent chronic disease in the United States, affecting approximately 29 million Americans, with the disproportionately higher distribution among African American (AA) adults [http://www.cdc.gov]. Approximately 9.3% AA adults and 5.9% Caucasian American (CA) adults have T2DM [http://www.cdc.gov]. The two groups also differ regarding the prevalence of obesity, with about 48% of AA and 33% of CA adults being classified as obese [http://www.cdc.gov]. It is well established that adiposity plays a major role in the development of T2DM and other chronic diseases [http://www.cdc.gov]. Individuals with T2DM have additional cardiovascular disease (CVD) risk factors such as hypertension and dyslipidemia [1, 2].

Previous research showed that T2DM indicator serum hemoglobin A1c (HbA1c) concentration is positively associated with low density lipoprotein (LDL) concentration and systolic blood pressure [3], while higher fasting insulin concentration is a strong indicator of diabetes in women [4]. It has been shown that AA men have higher fasting blood glucose than CA men [5]. Additionally, in comparison with CA women, AA women have a higher prevalence of insulin resistance according to the homeostasis model assessment (HOMA) -- a calculation using

serum insulin and glucose to determine the degree of the body's response to insulin and functioning of pancreatic beta cells [5].

It is well established that both age and gender play a role in CVD risk factors [4-6]. Past research also showed that the prevalence of T2DM differed based on education and income, suggesting that the social determinants to health outcomes are important [7]. Socioeconomic status may be associated with diet and physical health [6], and in particular, educational level may predict cardiovascular health [8]. Dietary intake, including energy and fat consumption, as well as physical activity are well known modifiable health-risk factors. Having a long-term high energy and fat intake and sedentary lifestyle may increase the chance of uncontrolled blood glucose, lead to weight gain, and eventually increase the incidence of both T2DM and CVD [9, 10]. In addition to the above indicators, other confounding factors like marital status, current and/or past smoking, perceived health status, and medication use may play an important role in CVD health outcomes [7, 8, 11-13].

It is well established that AA adults have been typically excluded from clinical trials or other research projects, because they were characterized as being a high risk group for adverse cardiovascular health [14]. The eligibility criteria for research needs to be expanded to increase the potential for exploring multiple confounding factors, but particularly race, in CVD health in this population. For such reasons, further research is needed in the AA adult population to provide more clarification for specific T2DM outcomes and CVD risk factors [15]. The aim of this study was to assess T2DM indicators in relation to selected CVD risk factors (blood pressure and lipid profile), accounting for the confounding factors in mid-life and older AA adults who were recruited from a church-based health intervention study. We hypothesized that several factors will be associated with higher CVD risk in this cohort, but particularly high glucose levels.

Methods

Participants

The participants included n=79 mid-life and older (≥45 years old) AA men and women, recruited from six churches in North Florida participating in a church-based longitudinal intervention to reduce CVD risk, as described previously [16]. For this study, only baseline data were used. The protocol was approved by the Institutional Review Board.

Anthropometric and blood pressure measurements

Weight was measured in pounds with the Tanita digital scale (Arlington Heights, IL) and converted to kg. Using a Charder Stadiometer (Issaquah, WA), height was measured in centimeters (cm). For such measurements, the participants wore light clothing and no shoes. The abdomen, hip, and waist were measured in cm with a plastic non-flexible measuring tape (Issaquah, WA). The abdomen was measured at the top of the iliac crest, the hip at the largest circumference around the buttocks, and waist at the narrowest part of the torso, while each participant was exhaling. Blood pressure was measured on the non-dominant arm after each participant rested for a few minutes, using a digital device (A&D Medical, Miltitas, CA).

Cardiovascular risk assessments

The risk for CVD was determined using the Framingham CVD risk score assessments and the American Heart Association Guidelines [http://www.framinghamheartstudy.org, http://my.americanheart.org]. As determined by the Framingham Heart Study and the American Heart Association, such risk scores take into account blood pressure, use of blood pressure medications, perceived health for diabetes, smoking status, age, and gender [http://www.framinghamheartstudy.org, http://my.americanheart.org]. The American Heart Association Guidelines also take into account race, cholesterol, and HDL [http://my.americanheart.org]. In addition, the Framingham risk scores include either BMI or cholesterol and HDL [http://www.framinghamheartstudy.org].

The Framingham risk scores range from 0-30, whereas the American Heart Association risk scores range from 0-100 [http://www.framinghamheartstudy.org, http://my.americanheart.org]. In regards to the Framingham risk score, each factor is associated with a score to calculate the chance of adverse health within a 10-year period [http://www.framinghamheart-

study.org]. For example, a total number of 9 points is associated with a <1% chance of a 10-year risk for women and 5% chance for men; 20 points is associated with 11% chance of coronary heart disease in 10 years for women and 30% chance for men [http://www.framinghamheartstudy.org].

T2DM indicators

Fasting serum glucose and insulin were used to calculate HOMA-IR (insulin resistance) and HOMA-β (beta-cell functioning) [5, 17, 18], and they were used as T2DM indicators. Fasting serum glucose >126 mg/dL is associated with T2DM [17], while fasting serum insulin of >21 μ/mL is characterized as insulin resistance [19].

Confounding factors

Underlying factors such as gender, education level, marital status, current smoking status, perceived health status, and medication intake were collected using a self-administered questionnaire at data collection sessions at the churches. Education level was based on the following codes: 1=some high school, 2=high school graduate, 3=some college, 4=Bachelor's Degree, and 5=Post-baccalaureate. In addition, marital status was coded 1=single, 2=married, 3=divorced/separated, and 4=widowed. Current smoking status was coded as 1=smoker and 2=non-smoker. Perceived health was based on participants indicating they had the following health problems: T2DM, hypertension, and dyslipidemia. Medication intake was determined from those who had a perceived health problem (T2DM, hypertension, dyslipidemia). Participants who were taking medications were coded as 1 and those who did not as 0.

Dietary and physical activity assessments

The 24-hour dietary recalls were collected and analyzed for energy and fat consumption using Food Processor (Esha, Salem, Oregon). Physical activity was coded as 1=0 minutes, 2=15 minutes, 3=30 minutes, 4=45 minutes, and 5=60 minutes per day. The types of physical activity included gardening, household chores, running/walking, and other types of habitual activities, as described previously [16].

Clinical parameters

Overnight fasting blood samples were collected at data collection sessions. The red blood cells were separated by centrifugation and serum was stored at -80°C until further analyses. The routine tests like glucose, insulin, and lipid profile were analyzed by a contracting laboratory (Clinical Laboratory, Tallahassee Memorial Hospital, FL). Apo A1, Apo B, and adiponectin were analyzed in our laboratory, by commercially available enzyme-linked immunosorbent assay (ELISA) kits (Parameter, R&D Systems).

Data analysis

Using IBM SPSS, version 21 (Armonk, NY), the data were analyzed by calculating descriptive statistics, t-tests, Pearson correlations, and regression analyses. The descriptive statistics (means and the standard deviation) included the continuous values for most of the variables, while frequencies and percentages were used to analyze the categorical variables (gender, education level, marital status, current smoking status, perceived health status, medication use, and physical activity). The Pearson's correlations of specific factors were used to identify the variables for the multiple regression analyses. The significant differences between men and women were determined using two sample t-tests, taking into account the Levene's test to assess the equality of variances. T-tests were also used to compare participants who took medication (for diabetes, hypertension, and/or dyslipidemia) with those who did not take such medications. A p-value less than 0.05 was deemed significant.

Results

Of 79 participants, 69% were women. Sample size varied for some variables due to missing data and is noted in tables. Most of the participants were married (51.9%) and had a college level education (59.5%). Men were more likely to smoke and use T2DM medication than women. Over half of the participants (58%) were taking medication(s) for at least one of the following: diabetes, blood pressure, and dyslipidemia. Among the participants taking medications, more men tended to have diabetes than women. Not surprisingly, the frequency and number of medications in the older participants

Table 1. Anthropometrics and blood pressure of participants (Mean±SD)

Variables	No medications[a] (n=33)	Medications (n=46)	Men (n=23)	Women (n=51)	Total (n=79)[c]
Age (years)	55.4±7.4*	62.1±9.5*	59.3±9.3	59.6±9.6	59.3±9.2
Height (cm)	167.9±9.8	165.3±10.7	174.0±11.4*	163.1± 8.1*	166.4±10.4
Weight (kg)	92.8±27.5	99.6±27.9	108.8±32.4*	92.3±24.3*	96.8±27.8
BMI (kg/m^2)	32.7±8.2	36.3±8.2	35.7±9.0	34.5± 8.0	34.7±8.3
Abdomen circumference (cm)	105.2±15.0	116.0±17.4	112.6±16.8	111.6 ± 17.4	111.5±17.2
Hip circumference (cm)	115.3±14.8	121.5±15.9	115.4±14.7	120.4± 15.7	118.9±15.7
Waist circumference (cm)	101.6±18.2	108.8±17.6	110.6±17.9	103.9± 16.9	105.8±18.1
Systolic blood pressure (mmHg)[b]	130.4±20.2	133.9±17.6	133.9±14.3	131.8± 20.1	132.5±18.7
Diastolic blood pressure (mmHg)[b]	83.2±13.1	79.7±10.8	80.2±12.8	81.7± 11.6	81.2±11.9

SD, standard deviation; cm, centimeter; kg, kilogram; m, meter; BMI, body mass index; mmHg, millimeter of mercury. [a]42% of the total sample was not taking medications. [b]53% of the participants were taking blood pressure medications. [c]Sample size ranged from n=74 to n=79 because of missing data. *Statistically significant as compared between men and women and/or between those with and without medications.

Table 2. Energy and fat consumption and physical activity (Mean±SD)

Variables	No medications[a] (n=31)	Medications (n=46)	Men (n=23)	Women (n=51)	Total (n=74)
Energy Intake (kcal/day)	1584.8±549.4	1552.1±461.9	1918.9±587.5*	1409.8±366.8*	1565.2±495.7
Fat Intake (% of kcal/day)	32.3±8.9*	37.1±8.8*	36.2±8.6	34.9±9.1	35.2±9.1
Fat Intake (g/day)	57.0±23.1	64.9±28.9	76.6±26.6*	55.7±24.9*	61.7±26.8
Physical Activity[b] (min/day)			Number (%)		
0 minutes	4 (12.1)	6 (13.0)	2 (8.7)	8 (15.7)	10 (12.7)
15 minutes	8 (24.2)	11 (23.9)	3(13.0)	15 (29.4)	19 (24.1)
30 minutes	5 (15.2)	9 (19.6)	5 (21.7)	9 (17.6)	14 (17.7)
45 minutes	12 (36.4)	18 (39.1)	11 (47.8)	19 (37.3)	30 (38.0)
60 minutes	0 (0)	1 (2.2)	1 (4.3)	0 (0)	1 (1.3)

SD, standard deviation; kcal, kilocalorie; g, gram; min, minutes. [a]42% of the total cohort was not taking medications. [b]Physical activity includes any movement such as gardening, household chores, running. *Statistically significant as compared between men and women and/or between those with and without medications.

were higher compared to younger ones in the cohort.

Age, anthropometrics, and blood pressure of the participants are presented in **Table 1**. As expected, the weight and height were higher in men than in women, but the BMI was insignificantly ($p>0.05$) different between them, possibly due to a small effect size of 0.14. Weight and height each had a large effect size, increasing the chance to detect a significant difference between men and women. The participants who were taking medications were significantly older and tended to be heavier, but no other statistical significance was noted compared to those not taking medications.

Energy and fat intake also differed based on gender, as depicted in **Table 2**, with men having significantly ($p<0.05$) higher energy and fat intake in comparison to women. Differences in energy and fat intake were also noted among the participants who took medication(s); they consumed a significantly higher percentage of energy from fat. Among all of the participants, a lower percentage of men were sedentary in comparison to women.

Furthermore, men had significantly ($p<0.05$) higher fasting serum glucose, and women had higher insulin, which is typical in the AA population (**Table 3**). Scores for HOMA-IR, and HOMA-β were also higher among women (**Table 3**). Among people who took medication(s), women had significantly higher HOMA-β scores than men. On average, men tended to have higher systolic blood pressure, triglycerides, LDL, VLDL, cholesterol/HDL ratio, and Apo B concentrations.

Table 3. Clinical parameters (Mean±SD)

Variables	No medications[a]	Medications[b]	Men[c]	Women[d]	Total[e]	Normal
Glucose (mg/dL)[f]	104.0±44.7	107.9±28.6	123.6±54.9	99.0±21.8	106.2±36.1	≤110
Insulin (microU/mL)[f]	12.6±14.9	8.5±7.5	7.6±6.0	11.8±13.1	10.3±11.4	<21
HOMA-IR	2.9±2.8	2.3±2.5	2.3±2.1	2.8±2.9	2.6±2.6	<2.68
HOMA-β	56.8±335.2	83.7±70.4	64.0±50.9	77.5±279.4	72.0±225.6	>40%
Triglycerides (mg/dL)	91.6±43.8	76.7±58.6	87.3±46.0	83.9±57.9	83.0±53.1	<150
Cholesterol (mg/dL)[g]	192.9±35.1	182.6±37.2	183.7±36.0	189.4±37.7	186.9±36.5	<200
HDL (mg/dL)	47.6±15.3	51.7±15.1	39.9±10.9*	53.7±14.5*	50.0±15.2	40-60
LDL (mg/dL)	126.9±29.0	114.2±28.8	126.4±32.7	117.8±28.7	119.6±29.4	<130
VLDL (mg/dL)	18.3±8.8	13.8±4.9	17.5±9.2	15.4±6.1	15.7±7.2	5-40
Cholesterol/HDL	4.3±1.3	3.8±1.2	4.9±1.5	3.7±1.0	4.0±1.3	<5
Adiponectin (μg/mL)	6.0±3.7	5.6±2.7	4.5±2.7*	6.1±3.0*	5.8±3.1	3-14
Apo A1 (mg/mL)	6.1±3.9	5.4±3.2	4.4±3.0	5.9±3.5	5.7±3.5	>1.2
Apo B (mg/mL)	1.7±0.9	1.4±0.9	1.8±0.9	1.5±0.9	1.5±0.9	<0.8

mg/dL, milogram/deciliter; microU/mL, microunits/milliliter; HOMA-IR, Homeostasis Model Assessment-Insulin Resistance; HOMA-β, Homeostasis Model Assessment-Beta Cell Functioning; HDL, High Density Lipoprotein; LDL, Low Density Lipoprotein; VLDL, Very Low Density Lipoprotein; μg/mL, microgram/milliliter; Apo A1, Apolipoprotein A1; Apo B, Apolipoprotein B. [a]42% of the total sample was not taking medications. Sample size ranged from n=32 to n=33 because of missing data. [b]Sample size ranged from n=42 to n=46 because of missing data. [c]The number of men ranged from n=19 to n=23 because of missing data. [d]The number of women ranged from n=49 to n=51 because of missing data. [e]Sample size ranged from n=74 to n=79 because of missing data. [f]21% of the participants were taking medication for diabetes. [g]35% of the participants were taking medication for cholesterol. *Statistically significant as compared between men and women.

Table 4. Cardiovascular disease (CVD) assessments (Mean±SD)

Assessment	No medications (n=28)	Medications (n=46)	Men (n=23)	Women (n=51)	Total (n=74)
Framingham[a]	12.7±8.9[c]	22.3±7.5[c]	24.8±6.2	15.9±9.1	18.7±9.3
Framingham[b]	11.0±8.3[c]	16.7±8.3[c]	21.3±7.6[c]	11.5±7.4[c]	14.5±8.7
American Heart Association	7.2±5.7	15.8±11.2	17.6±12.6[c]	10.3±8.3[c]	12.5±10.4

[a]Body Mass Index (BMI) is used to calculate the risk score for CVD. [b]The lipid profile is used to calculate the risk score for CVD. [c]Statistically significant as compared between men and women and/or between those with and without medications.

In comparison, women had higher diastolic blood pressure, total cholesterol, HDL, adiponectin, and Apo A1. Men had significantly ($p<0.05$) lower HDL concentrations in the total population. A similar trend of significantly ($p<0.05$) lower HDL concentrations was observed with men not taking medication(s).

The CVD risk assessed either by Framingham or American Heart Association assessment yielded higher 10-year CVD risk scores for men compared to women (**Table 4**). The aforementioned phenomenon of CVD risk between men and women also occurred among participants who took medication(s) and those who did not. The AHA risk score and Framingham Assessment that included the lipid profile were significantly ($p<0.05$) different between men and women in the total population. However, in the population of participants taking medication(s), each CVD risk assessment was significantly ($p<0.05$) higher for men in comparison to women. A similar trend of significant CVD risk scores was also observed for participants not taking medication(s).

Pearson Product Moment analysis revealed significant correlations among the clinical parameters. Insulin and HOMA-IR were significantly and negatively correlated with adiponectin in the total sample ($r=-0.389$; $p<0.05$). In addition, HOMA-β was significantly positively correlated with cholesterol ($r=0.369$; $p<0.05$) and LDL ($r=0.359$; $p<0.05$). Similar trends were observed with participants not taking medication(s). Furthermore, glucose was significantly correlated with cholesterol ($r=0.375$; $p<0.05$) and LDL ($r=0.431$; $p<0.05$) among the partici-

Table 5. Multiple regression models with CVD risk score and diabetes indicators as dependent variables

Dependent variables	Explanatory variables	β	*p*	Model $R^2_{(adj)}$
Model 1[a]				
HOMA-β	Cholesterol	0.32	<0.01	0.26
	Insulin	-0.38	<0.001	
Model 2[a,b]				
Framingham CVD assessment	Glucose	0.08	<0.01	0.29
	Age	0.42	<0.001	
Model 3[a,c]				
Insulin	Adiponectin	-1.5	<0.001	0.21
	Physical activity	-2.7	<0.01	
Model 4[d]				
Glucose	Waist circumference	0.53	0.02	0.21
	HOMA-β	-0.17	<0.01	

CVD, cardiovascular disease; adj, adjusted; HOMA-β, Homeostasis Model Assessment-Beta Cell Functioning. [a]The multiple regression model was for the total cohort. [b]The lipid profile was used to calculate the risk score for CVD. [c]A similar multiple regression model occurred in for the participants not taking medications. [d]The multiple regression model was for participants taking medications.

pants not taking medication(s). Multiple regression models (**Table 5**) with CVD risk score and diabetes indicators as dependent variables show multiple factors influencing the cardiovascular health of the total cohort.

Discussion

The overall purpose of this study was to assess T2DM indicators in relation to selected CVD risk factors (blood pressure and lipid profile) and confounding factors in mid-life and older AA adults, in a church-based health intervention study, utilizing only baseline data. Unlike some of the past research [14], our study included the participants taking medications and those with T2DM to account for a wider health range of mid-life and older AA adults. Previous research about the enrollment of AA adults reported that AA adults were often excluded from research due to multiple morbid conditions, including T2DM [14], leading to gap in research in that population, which this study is trying to reduce.

In brief, we showed that a higher percentage of men used T2DM medication than women (30.4% versus 19.6%), indicating that the T2DM was more prevalent in men than in women, as has been also corroborated in other studies [7]. However, observing similar trends among people were taking medications and those who were not, adds to the novelty of this study.

Men had a larger waist circumference than women (110.6±17.9 cm vs 103.9±16.9 cm), although not statistically significant, and the average waist circumference and BMI in men were associated with CVD risk factors from the Framingham and American Heart Association assessments. Men also had lower adiponectin concentrations than women, possibly due to greater adiposity, as shown in a previous study, where adiponectin was lower in AA adults with T2DM than in those who were not diabetic [18]. Dietary choices (higher energy and fat consumption) were influencing the cardiovascular outcomes in this population. As reviewed recently [20], inflammation and oxidative stress, caused by an unhealthy and pro-inflammatory diet are associated with multiple chronic diseases.

Of the T2DM indicators (insulin and glucose), men had higher fasting serum glucose but women had higher insulin concentrations, which was consistent with some previous research [4, 7] where women had higher insulin concentration and increased CVD risk [4]. Therefore, the type of diabetes indicator has played a role in the conclusions about the susceptibility to CVD. Past research about dietary intake in community-based participatory study also reported higher glucose in men [11] and higher HOMA-IR in women. Similar results were also supported by the findings of previous

research [5], where the CVD risk factors in AA adults were investigated and showed higher glucose among men. Hence, T2DM indicators assessed in our study were able to detect adverse health based on gender, which is corroborated in previous research that examined CVD risk factors [4].

Bertoni et al., investigated the proportion of overweight and obese adults having met the American Diabetes Association criteria for T2DM, including hypertension and dyslipidemia and found that AA adults were less likely to have control of the CVD risk factors in comparison to CA adults [7]. In addition, lower adiponectin concentrations found in our study were associated with T2DM, consistent with the study of glucose tolerance in AA adults where adiponectin was significantly lower among participants with the disease [18]. The high cholesterol/HDL ratio, indicating higher CVD risk, is comparable to the study in middle and older age AA women that linked body fat or blood lipids with CVD risk factors [21].

We also assessed other CVD risk factors (hypertension [systolic and diastolic blood pressure] and dyslipidemia [triglycerides, cholesterol, HDL, LDL, VLDL, cholesterol/HDL, Apo A1, Apo B, and adiponectin]) in our cohort. Similar to past research that investigated CVD risk factors [5], AA men had a higher systolic blood pressure, and AA women had a higher diastolic blood pressure. Men in our study had higher serum triglycerides concentrations compared to women, which was also corroborated in other studies [5, 22]. Among cohorts of Caucasians and African Americans, it has been determined that women tend to have better cardiovascular health than their male counterparts based on triglycerides and HDL. Another study showed similar gender differences among African Americans only [22]. Women in our study also had higher serum HDL concentrations. This could have been influenced by the fact that less women smoked. Regarding other factors related to dyslipidemia, men had higher LDL, VLDL, and Apo B. The cholesterol/HDL ratio was higher for men, as well, while women on average had higher cholesterol, adiponectin, and Apo A1. Overall, women had better cardiovascular health compared to men, possibly due to the higher adiponectin and Apo A1 concentrations. As a leading risk factor, high glucose may have caused men to have higher rate of comorbidities than women (65.2% versus 47.1%).

Consistent with a past study [11], AA men in our study consumed diets higher in energy and fat, which might have also contributed to the worse CVD outcomes. With regard to other confounders, women have been more likely to have higher education and be non-smokers in our study, as well as in others [11]. T2DM duration and family history are other fundamental factors for future research, which were not evaluated in our study. Being able to add to current scientific knowledge and detect CVD risks through multiple measures can be incorporated into clinical practice as a more comprehensive approach that can be specific for men and women who identify as AA.

Our study has some limitations. We used the American Heart Association CVD Assessment and the Framingham Risk Assessments to determine the susceptibility to and/or predictability for CVD [http://www.framinghamheartstudy.org, http://my.americanheart.org]. The Framingham Risk Scores tended to be higher than the American Heart Association Guidelines Scores. Such findings could have been influenced by race. Unlike the Framingham Risk Scores, the American Heart Association considers race in determining the CVD risk [http://www.framinghamheartstudy.org, http://my.americanheart.org]. The assessments collectively indicated that men had a higher 10-year risk for adverse cardiovascular health and the main determining factors included smoking, higher weight/adiposity, and higher serum glucose. It needs to be noted that research suggests the need for gender-specific indicators for cardiovascular health, as has been determined for diabetes, hypertension, and dyslipidemia [23]. The influence of specific fat (saturated and unsaturated) consumption was also not investigated in our study. Since inflammation and oxidative stress, caused by an unhealthy and pro-inflammatory diet [20] are associated with chronic diseases, related dietary markers would have increased the strength of the study. However, the strengths and novelty of this study include the use of clinical and self-reported data, as well as the multiple CVD assessments and inclusion of multiple confounders, including medication use.

In conclusion, our study showed that men had higher serum glucose, the latter contributing to a higher 10-year risk scores for CVD; therefore, we speculate that T2DM as reflected by high glucose was a leading factor in cardiovascular health when participants were separated by gender. Lifestyle choices such as diet and smoking, played a role in influencing the CVD risk indicating that lifestyle factors may need to be altered to improve cardiovascular health.

Acknowledgements

This study was supported by the National Institute on Minority Health & Health Disparities, National Institutes of Health R24MD002807 (P.A. Ralston, PI). The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institute on Minority Health & Health Disparities or the National Institutes of Health. The participants of this study are greatly appreciated.

Disclosure of conflict of interest

None.

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