CASE REPORT

Neisseria elongata endocarditis of a native aortic valve

Mohammed Samannodi, Sujit Vakkalanka, Andrew Zhao, Michael Hocko

SUMMARY

Neisseria elongata is a part of the common bacterial flora of the oropharynx but has caused sepsis, osteomyelitis and infective endocarditis on rare occasions. We report the case of a 56-year-old Caucasian woman who was admitted to hospital with a 5-week history of fever, malaise and fatigue. Two blood cultures grew Gram-negative rods which were confirmed to be N. elongata subspecies nitroreducens via bacterial DNA sequence analysis. An echocardiogram showed a large mobile vegetation on the right and non-coronary cusps of the aortic valve. The patient underwent aortic valve replacement and antibiotic therapy for 6 weeks. We suggest that clinicians should consider extended antibiotic treatment and early surgical evaluation based on the nature and aggressiveness of N. elongata.

BACKGROUND

Neisseria elongata is part of the common bacterial flora of the oropharynx but has caused sepsis, osteomyelitis and infective endocarditis on rare occasions. Initially described by Hovre and Holten1 in 1969, the potential pathogenicity of this organism was not reported until 1983 by Simor and Salt.2 The species was differentiated into three subspecies (N. elongata subsp. nitroreducens, N. elongata subsp. elongata and N. elongata subsp. glycolytica) by Grant et al3 in 1990; subsequent literature provided evidence identifying N. elongata subsp. nitroreducens as the primary pathogenic subspecies. A total of 23 cases of N. elongata-related infective endocarditis have been reviewed, with our study being the latest. Eighteen cases were summarised in an earlier study by Hsiao et al.4,5 Our literature review revealed four additional cases since then.4,6-9 These four cases and our case described in this report are summarised in table 1.

CASE PRESENTATION

A 56-year-old Caucasian female patient was admitted to the Sisters of Charity Hospital, Buffalo, with a 5-week history of fever, malaise and fatigue. Three days prior to the admission, the patient was seen in the emergency department for fever and asymptomatic bacteriuria. Blood and urine cultures were sent at that time and the patient was discharged home on the same day with a 5-day course of ciprofloxacin. There was a history of travel to Germany a few weeks prior to this illness. She had no history of intravenous drug abuse, recent dental procedures or congenital heart diseases. On admission, the temperature was 39.2°C, heart rate 94 bpm, blood pressure 113/46 mm Hg and respiratory rate 18/min. Heart sounds were normal with no murmurs. There was neither evidence of cardiac failure nor peripheral stigmata of infective endocarditis. The rest of her dental, chest, abdomen and neurological examination was unremarkable. There were no signs of meningeval inflammation. She had a leucocyte count of 12 000/mm³ (88% neutrophils with 10% bands), a platelet count of 281 000/mm³, a C reactive protein level of 224 mg/L and an erythrocyte sedimentation rate of 107 mm/h. The results of liver and renal function tests were normal. Urine analysis revealed moderate blood and trace protein. An ECG showed only sinus tachycardia. CTs of the head, chest and abdomen were unremarkable. A transthoracic echocardiogram showed an ejection fraction of 60% and a large mobile vegetation, 9 mm x 4 mm, was seen on the right and non-coronary cusps of the aortic valve with moderate aortic valve regurgitation (figures 1 and 2). Two blood cultures were performed; the first was performed 3 days prior to admission in the emergency department and the second at the time of admission, and both returned positive for Gram-negative rods. The urine culture that was performed 3 days prior to admission did not show any growth. Intravenous ceftriaxone 1 g was started during admission. Two days after admission, the Gram-negative rods were identified as N. elongata subsp. nitroreducens via bacterial DNA sequence analysis. The organism was antibiotic susceptible. After 1 week, two additional blood cultures were performed and returned negative. The patient was discharged home on intravenous ceftriaxone to complete 6 weeks duration of therapy.

Five days later, the patient was readmitted with new onset of congestive heart failure (New York Heart Association Class IV). At that time, three more blood cultures were drawn but returned negative. A transoesophageal echocardiogram showed an ejection fraction of 40%, vegetation on the two cusps of the aortic valve, severe aortic regurgitation with a mean gradient of 5 mm Hg and a hypokinetic inferior septum (figure 3). After 1 week, the patient underwent a successful aortic valve replacement with a pericardial tissue heart valve. The surgical report revealed a very myxomatous valve with destroyed cusps and a phlegmon in the annulus at the junction between the right and non-coronary cusps. A week after the operation, the patient was discharged to subacute rehabilitation on intravenous ceftriaxone to complete the full 6-week duration of treatment.
Rare disease

Table 1 Summary of the four new cases reported from 2008 to 2015

<table>
<thead>
<tr>
<th>Reference</th>
<th>Age (years)</th>
<th>Risk factors</th>
<th>Number of positive blood cultures</th>
<th>Subspecies</th>
<th>Echo findings</th>
<th>Duke’s criteria</th>
<th>Medication and duration</th>
<th>Complications</th>
<th>Surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hsiao et al</td>
<td>42</td>
<td>Dental procedure</td>
<td>2 of 7</td>
<td>Glycolytica</td>
<td>Vag on MV, MR</td>
<td>1 major, 3 minor</td>
<td>Penicillin, 1 week Gentamicin, 1 week Ceftriaxone, 7 weeks</td>
<td>Thalamic infarct, splenic infarct, thalamic brain abscess</td>
<td>MVR</td>
</tr>
<tr>
<td>Yoo et al</td>
<td>27</td>
<td>Cellulitis</td>
<td>3 of 3</td>
<td>Nitroreducens</td>
<td>Vag on TV, VSD</td>
<td>2 major</td>
<td>Cefazolin, 1 day Vancomycin, 2 weeks</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Herbst</td>
<td>43</td>
<td>None</td>
<td>2 of 2</td>
<td>Nitroreducens</td>
<td>Vag on MV</td>
<td>2 major</td>
<td>Ciprofloxacin, 7 weeks</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Osuka et al</td>
<td>78</td>
<td>None</td>
<td>2 of 3</td>
<td>Nitroreducens</td>
<td>Vag on AV, AR</td>
<td>1 major, 3 minor</td>
<td>Meopenem, 4 days Ceftriaxone, 2 weeks</td>
<td>None</td>
<td>AVR</td>
</tr>
<tr>
<td>Samanodi et al (2016)</td>
<td>56</td>
<td>Recent travel</td>
<td>2 of 2</td>
<td>Nitroreducens</td>
<td>Vag on AV, AR</td>
<td>2 major, 1 minor</td>
<td>Ceftriaxone 6 weeks CHF</td>
<td>ATR</td>
<td></td>
</tr>
</tbody>
</table>

AR, aortic regurgitation; AV, aortic valve; AVR, aortic valve replacement; CHF, congestive heart failure; MR, mitral regurgitation; MV, mitral valve; MVR, mitral valve replacement; IV, tricuspid valve; VSD, ventricular septal defect.

INVESTIGATIONS

- Blood cultures
- Transthoracic two-dimensional echocardiogram
- Transoesophageal echocardiogram

TREATMENT

- Aortic valve replacement surgery
- Medical management of the heart failure with diuretics before the surgery
- Antibiotics for 6 weeks for the infective endocarditis treatment, continued after surgery

OUTCOME AND FOLLOW-UP

- The patient had no recurrence of heart failure
- One and half year follow-up has been uneventful

DISCUSSION

We report a case of a rare causative microorganism of infective endocarditis of a native aortic valve—N. elongata subsp. nitroreducens—which was identified and confirmed by means of DNA sequence analysis. This organism is non-motile, oxidase positive, catalase negative and reduces nitrates

Neisseria endocarditis usually results in acute febrile illness with large valvular vegetations and severe cardiac and systemic complications such as systemic embolism, thrombotic thrombocytopenic purpura, heart failure and myocardial abscesses.

In our case, the patient presented to us with acute febrile endocarditis and large mobile vegetation on the native aortic valve with moderate aortic regurgitation. Initially, a two-dimensional echocardiogram was performed to look for foci of infection. During the first admission, the patient was stable with a controlled infection with no evidence of heart failure, systemic embolisation or severe valvular dysfunction. On the basis of these findings, a transoesophageal echocardiogram was not performed. However, on the basis of the European Society of Cardiology guidelines and the presence of large vegetations and aortic regurgitation found in the transthoracic echocardiogram, a transoesophageal echocardiogram should have been part of the initial assessment of this patient. We also did not consider surgical evaluation during the first admission based on the patient’s clinical status, but as a matter of fact the International Collaboration on Endocarditis recommended that optimal treatment is early surgery combined with long-term antibiotic therapy for infective endocarditis due to non-HACEK (Haemophilus, Aggregatibacter, Cardiobacterium, Eikenella, Kingella) Gram-negative bacteria.

Finally, although this was

![Figure 1](image1.png) Transthoracic two-dimensional echocardiography showing large vegetation on the aortic valve. Size of the vegetation is 9 mm x 4 mm. LV, left ventricle; Ao, aorta; RV, right ventricle; LA, left atrium.

![Figure 2](image2.png) Transthoracic two-dimensional echocardiography showing moderate aortic regurgitation. LV, left ventricle; Ao, aorta; RV, right ventricle; LA, left atrium.
10 cases of the aortic valve. On the basis of the aggressive nature of this organism, we suggest that clinicians should consider extended antibiotic treatment and early surgical evaluation.

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Contributors MS was the leader of team and he participated in writing the manuscript and abstract and was participating in designing the article. SV was participating in designing the article, writing the manuscript and literature review. AZ was responsible about the literature review and participating in designing the article. MH was participating on writing the manuscript, literature review and designing the article.

Competing interests None declared.

Patient consent Obtained.

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REFERENCES


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**Learning points**

- Although a component of the oropharyngeal bacterial flora, *Neisseria elongata* can be an aggressive organism, causing osteomyelitis, sepsis and infective endocarditis.
- *N. elongata* infective endocarditis most commonly affects the mitral and aortic valves.
- A transoesophageal echocardiogram should be performed as part of the initial assessment in patients with *N. elongata* infective endocarditis in order to assess the extent of infection, size of vegetation and valvular function.
- Most patients with non-HACEK Gram-negative bacteria like *N. elongata* infective endocarditis require prolonged antibiotic therapy and early surgical evaluation.
- In patients with infective endocarditis, the Outpatient Parental Antibiotic Therapy (OPAT) guidelines should be referenced before discharging patients on ambulatory antibiotic therapy.

Health behavior and perceptions among African American women with metabolic syndrome

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Background: Metabolic syndrome is a cluster of different risk factors (abdominal obesity, insulin resistance, high blood pressure, and high cholesterol) that predispose to the development of cardiovascular diseases. African American women (AAW) are easily predisposed to metabolic syndrome due to higher levels of insulin resistance. Various sociodemographic factors further contribute to higher prevalence.

Aim: This study evaluates the current prevalence of metabolic syndrome in AAW and identifies the related sociodemographic risk factors.

Methods: The study utilized 2007–11 National Health and Nutrition Examination Survey (NHANES) data sets from the Centers for Disease Control (CDC). The sample was divided into two groups: AAW with and without metabolic syndrome. Sociodemographic, physical examination, laboratory parameters, and health perceptions were compared between the two groups.

Results: Out of the available sample of 30,442 individuals, 1918 (6.4%) met the inclusion criteria (AAW, age > 20, non-pregnant women). The prevalence of metabolic syndrome was 47%. Older age, lower education level, low socioeconomic status, unmarried status, low physical activity level, and smoking were associated with higher prevalence of metabolic syndrome (p < 0.001). The prevalence of borderline hypertension, hypertension, diabetes, stroke, and cardiovascular diseases was significantly higher in AAW with metabolic syndrome (p < 0.001).

Conclusion: In spite of the focus on prevention of cardiovascular risk factors and elimination of ethnic and gender disparities, metabolic syndrome is still widely prevalent in AAW and poses a threat to the goals of Healthy People 2020.

Keywords: African American women; health disparities; health education; risk factors; cardiovascular health

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Prevention of cardiovascular diseases was a significant challenge to achieve the goals and objectives listed in Healthy People 2000 and 2010. The objective to decrease the mortality from stroke and cardiovascular diseases was accomplished, but gender and ethnic disparities still persist and continue to be a challenge to Healthy People 2020 (1).

Metabolic syndrome is a combination of factors that increase the prevalence and mortality of cardiovascular diseases (2–4). The genetic basis of metabolic syndrome is insulin resistance (5). African Americans are genetically predisposed to metabolic syndrome because of higher insulin resistance than other ethnic groups (6). Ethnic and gender-based differences also exist in the prevalence of acquired factors (dietary habits, higher prevalence of obesity, and inadequate physical inactivity) that elicit higher levels of insulin resistance in African American women (AAW) (7–9).

Objectives of this study

1. Identify the current prevalence of metabolic syndrome in this high-risk population of AAW
2. Identify the prevalence of cardiovascular diseases in AAW with metabolic syndrome
3. Identify the sociodemographic risk factors in the AAW with metabolic syndrome

Methods

We used the definition formulated by the National Cholesterol Education Program (NCEP) expert panel's third report on detection, evaluation, and treatment of
cholesterol in adults (Adult Treatment Panel (ATP) III) that defined metabolic syndrome by using five criteria (Table 1). The presence of three out of five clinical criteria defines metabolic syndrome (10).

**Data source**

We retrieved the data from National Center for Health Statistics (NCHS) data sets of the Centers for Disease Control and Prevention (CDC) (11). The survey combines interviews and physical examinations. The examination consists of medical, dental, physiological measurements, and some laboratory tests conducted in a mobile examination clinic (MEC). The fasting blood draws are taken after an overnight fast of at least 9 h (11). We used the data sets from 2007 to 2011.

**Demographic variables**

Demographic variables such as age (recategorized into age groups: 20–40, 41–60, and 61–79 years), pregnancy and marital status, educational level, and annual household income were recorded. Data of physical examination variables such as body mass index (BMI), waist circumference (cm), and blood pressure (mmHg) were recorded. The average of the available blood pressure measurements was computed to define current blood pressure measurement.

All the participants were asked about their level of physical activity. Health and Human Services defined the physical activity in four categories (inactivity, low, medium, and high activity levels), and the available data were computed into these categories by a rigorous statistical analysis (12).

**Laboratory variables**

Data of laboratory variables like fasting blood glucose (mg/dl), HDL cholesterol (mg/dl), LDL cholesterol (mg/dl), total cholesterol (mg/dl), triglyceride level (mg/dl), and hemoglobin A1c (%) were recorded from the data set.

**Definition of metabolic syndrome**

A combination of different variables as listed below was used to define the presence of metabolic syndrome as per the ATP III definition (10).

- a. Abdominal obesity, defined as waist circumference \( \geq 88 \) cm
- b. Triglycerides \( \geq 150 \) mg/dL, or under medication for high cholesterol
- c. HDL cholesterol \( <50 \) mg/dL
- d. Blood pressure \( \geq 130/\geq 85 \) mmHg or under medication for high blood pressure or a preexisting diagnosis of hypertension
- e. Fasting glucose \( \geq 110 \) mg/dL or currently on insulin or other medications for diabetes or a preexisting diagnosis of diabetes or hemoglobin A1c level \( >5.5\% \) (13)

The number of criteria in each participant was recorded and the sample was divided into two groups: with three or more criteria (with metabolic syndrome) and less than three criteria (without metabolic syndrome).

**Health variables**

The participants’ health status was identified from their history of stroke, coronary artery disease, heart attack, hypertension, prehypertension, diabetes mellitus, prediabetes, and high cholesterol, and if they have a place to go for routine health care. They were asked if they were currently trying to lose weight, decreasing salt and fatty foods and trying to increase physical activity. They were labeled as smokers if they smoked at least 100 cigarettes in their lifetime.

We used SPSS version 21.0 to analyze this complex NHANES data. We analyzed between-group differences on baseline characteristics by using chi-square test for categorical variables and t tests for continuous variables. We took the \( p \) value as less than 0.05 for statistical significance.

**Results**

A total of 30,442 people participated in the survey. Out of them, 1965 met the inclusion criteria (African Americans, non-pregnant, and age \( >19 \)). Pregnant women (44) and participants with extremely high BMI were excluded because waist circumference is one of the criteria to define metabolic syndrome (Fig. 1).

The NHANES had a total sample of 30,442. Out of them, 1965 met the inclusion criteria (African Americans, non-pregnant and age \( >19 \)). Pregnant women (44) and three participants with extreme values of BMI were excluded from the sample.
Prevalence of metabolic syndrome

Overall, the prevalence of metabolic syndrome in AAW is 47% (901 out of 1918). All five components of metabolic syndrome are present in 14% of them and at least four are present in 28.7% of AAW.

Table 2 illustrates the prevalence of components of metabolic syndrome in AAW. We noticed a statistically significant difference in the prevalence of all the five components (or its equivalents) of metabolic syndrome ($p < 0.001$) between the two groups.

Sociodemographic characters

Table 3 describes the demographic characteristics of the selected population. There seems to be a significant difference in age of the AAW with metabolic syndrome (mean = 57.2, SD = 14.3) and without metabolic syndrome (mean = 43.1, SD = 16.8), $p < 0.001$. The prevalence of metabolic syndrome increases with an increasing age (45.6% in > 60 years age group compared with 14.2% in 20–40 years age group). The prevalence of metabolic syndrome varied by marital status, $p < 0.001$. The syndrome was more prevalent in AAW whose highest educational level is high school or lesser, $p < 0.001$. A lower household income (< $20,000) was significantly associated with higher prevalence of metabolic syndrome (36.3%), $p = 0.009$. Women with low physical activity had higher prevalence of metabolic syndrome as compared to medium and high physical activity levels, $p < 0.001$. Out of the study population, 69.1% of the women without metabolic syndrome never smoked as compared with 58.6% of the women with the syndrome.

Almost 95.7% of the women with metabolic syndrome had access to health care as compared to 90.0% without metabolic syndrome, $p < 0.001$. About 89.3% of AAW with syndrome used an outpatient clinic or a health center for routine visits; which was significantly more than the women with metabolic syndrome (81.5%).

Prevalence of medical conditions

The physical examination, laboratory parameters, and medical comorbidities of the sample are described in Table 4. BMI, waist circumference, systolic blood pressure, diastolic blood pressure, fasting glucose level, total cholesterol, hemoglobin A1c level, triglyceride, and LDL cholesterol levels were significantly higher in the AAW with metabolic syndrome ($p < 0.001$). HDL or good cholesterol level was significantly lower in AAW with metabolic syndrome ($p < 0.001$). We observed a significant difference in the prevalence of borderline hypertension, essential hypertension, prediabetes, dyslipidemia, diabetes mellitus, coronary artery disease (angina, history of heart attacks, etc.), and stroke in AAW with and without the syndrome ($p < 0.001$).

Discussion

The NHANES data from 1988 to 1994 showed that the prevalence of metabolic syndrome was about 20.9% (14) and it increased to 39.4% as per the 2003–2006 NHANES census (15). Our study, which utilizes NHANES data from 2007 to 2011, shows that the prevalence has, in fact, increased to 47%. We had a sample of 1918 AAW as compared to the reference studies that had sample of 600–700.

In December 2010, Department of Health and Human Services launched the Healthy People 2020 with four overarching goals. Cardiovascular disease prevention will continue to be a significant challenge to achieve these goals (16).

This increasing prevalence could be explained by the epidemic of obesity. Among African Americans, women had about 57% higher prevalence of obesity than men (17). Some studies report that missing data in health records had led to an underdiagnosis of metabolic syndrome (18). Issues with health insurance and inadequate access to health care were listed as other reasons for this diagnosis (19).

The contribution of metabolic syndrome to cardiovascular mortality is very complex. There is a strong influence
Table 3. Physical examination, laboratory parameters, and comorbidities of the sample

<table>
<thead>
<tr>
<th>Parameters</th>
<th>AAW without metabolic syndrome (mean (SD))</th>
<th>AAW with metabolic syndrome (mean (SD))</th>
<th>or n (%)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI</td>
<td>29.6 (7.6)</td>
<td>34.4 (8.3)</td>
<td>29.6 (7.6)</td>
<td>34.4 (8.3)</td>
</tr>
<tr>
<td>Waist circumference (cm)</td>
<td>94.3 (16.1)</td>
<td>108.3 (15.2)</td>
<td>94.3 (16.1)</td>
<td>108.3 (15.2)</td>
</tr>
<tr>
<td>Systolic BP (mm Hg)</td>
<td>120.2 (19.1)</td>
<td>132.5 (21.5)</td>
<td>120.2 (19.1)</td>
<td>132.5 (21.5)</td>
</tr>
<tr>
<td>Diastolic BP (mm Hg)</td>
<td>120.2 (19.1)</td>
<td>132.5 (21.5)</td>
<td>120.2 (19.1)</td>
<td>132.5 (21.5)</td>
</tr>
<tr>
<td>Laboratory parameters</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fasting glucose (mg/dl)</td>
<td>88.7 (20.2)</td>
<td>116.4 (65.1)</td>
<td>88.7 (20.2)</td>
<td>116.4 (65.1)</td>
</tr>
<tr>
<td>HDL cholesterol (mg/dl)</td>
<td>63.3 (16.7)</td>
<td>54.2 (15.6)</td>
<td>63.3 (16.7)</td>
<td>54.2 (15.6)</td>
</tr>
<tr>
<td>LDL cholesterol (mg/dl)</td>
<td>108.9 (33.9)</td>
<td>120.3 (37.9)</td>
<td>108.9 (33.9)</td>
<td>120.3 (37.9)</td>
</tr>
<tr>
<td>Total cholesterol (mg/dl)</td>
<td>186.3 (36.7)</td>
<td>196.3 (44.6)</td>
<td>186.3 (36.7)</td>
<td>196.3 (44.6)</td>
</tr>
<tr>
<td>Triglycerides (mg/dl)</td>
<td>76.2 (34.8)</td>
<td>138.4 (88.6)</td>
<td>76.2 (34.8)</td>
<td>138.4 (88.6)</td>
</tr>
<tr>
<td>Medical conditions, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Borderline hypertension</td>
<td>111 (11.1)</td>
<td>220 (25.5)</td>
<td>111 (11.1)</td>
<td>220 (25.5)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>252 (24.8)</td>
<td>677 (75.1)</td>
<td>252 (24.8)</td>
<td>677 (75.1)</td>
</tr>
<tr>
<td>Prediabetes</td>
<td>37 (3.9)</td>
<td>61 (10.8)</td>
<td>37 (3.9)</td>
<td>61 (10.8)</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>45 (4.4)</td>
<td>307 (34.1)</td>
<td>45 (4.4)</td>
<td>307 (34.1)</td>
</tr>
<tr>
<td>High cholesterol</td>
<td>139 (17.3)</td>
<td>482 (59.2)</td>
<td>139 (17.3)</td>
<td>482 (59.2)</td>
</tr>
<tr>
<td>Angina</td>
<td>9 (0.9)</td>
<td>35 (3.9)</td>
<td>9 (0.9)</td>
<td>35 (3.9)</td>
</tr>
<tr>
<td>Heart attack</td>
<td>17 (1.7)</td>
<td>42 (4.7)</td>
<td>17 (1.7)</td>
<td>42 (4.7)</td>
</tr>
<tr>
<td>Coronary artery disease</td>
<td>5 (0.5)</td>
<td>26 (3.9)</td>
<td>5 (0.5)</td>
<td>26 (3.9)</td>
</tr>
<tr>
<td>Stroke</td>
<td>32 (3.1)</td>
<td>73 (8.1)</td>
<td>32 (3.1)</td>
<td>73 (8.1)</td>
</tr>
</tbody>
</table>

AAW, African American women; BMI, body mass index; BP, blood pressure; HDL, high-density lipoprotein; LDL, low-density lipoproteins.

of many variables on obesity like lifestyle; quality of care, access to care, social constraints, etc (20). The mean age of diagnosis in our study was 57.2 years. Prevalence of metabolic syndrome increases with age as aging per se increases insulin resistance, hormonal alterations, and body fat (21). These innate genetic factors are inevitable, and focus on prevention of metabolic syndrome should rely on modification of sociodemographic factors from a very early age. Like in our study, there are earlier reports saying that marital status seems to influence the prevalence, and high-quality marriages are at lower risk of developing the syndrome (22). Out of the study population, 29.6% of AAW with metabolic syndrome had less than high school education in our study. Lower educational levels are associated with decreased levels of self-efficacy to physical activity (23). Our study also shows that prevalence is higher in AAW with annual household income less than $20,000. Lower income and unsafe environment may limit access to structured exercise facilities and discourage exercise in AAW (24). Cigarette smoking has been described as both a causal and associated factor of metabolic syndrome, and the overall cardiovascular risk increases with cigarette smoking (23).

Many studies have described BMI as a strong predictor of metabolic syndrome (25). There is a greater stigma toward obesity among white women as compared with black women and being thin was not an indicator of health for black women (26). In a study, AAW lost less weight during an intensive weight loss phase as compared to white women (26). This presents the difficulty in weight loss and maintenance in AAW by behavioral lifestyle interventions. Our study shows that the prevalence of hypertension, diabetes, cardiovascular diseases, and cerebrovascular

Table 4. Sociodemographic characteristics of AAW with and without metabolic syndrome

<table>
<thead>
<tr>
<th>Sociodemographic variable</th>
<th>AAW without metabolic syndrome</th>
<th>AAW with metabolic syndrome</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age categories</td>
<td>N (%) or mean (SD)</td>
<td>N (%) or mean (SD)</td>
<td>---</td>
</tr>
<tr>
<td>20-40 years</td>
<td>494 (48.6)</td>
<td>126 (14.2)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>40-60 years</td>
<td>339 (33.3)</td>
<td>362 (40.2)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>&gt;60 years</td>
<td>184 (18.1)</td>
<td>411 (45.6)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Age, mean (SD)</td>
<td>43.1 (16.8)</td>
<td>57.2 (14.3)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
<td></td>
<td>---</td>
</tr>
<tr>
<td>Single</td>
<td>275 (27)</td>
<td>289 (32.1)</td>
<td>0.016</td>
</tr>
<tr>
<td>Married</td>
<td>742 (73)</td>
<td>612 (67.9)</td>
<td>---</td>
</tr>
<tr>
<td>Education level</td>
<td></td>
<td></td>
<td>---</td>
</tr>
<tr>
<td>Less than high school</td>
<td>214 (21.1)</td>
<td>267 (29.6)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>High school</td>
<td>581 (57.2)</td>
<td>523 (58.1)</td>
<td>---</td>
</tr>
<tr>
<td>College or above</td>
<td>219 (21.6)</td>
<td>111 (12.3)</td>
<td>---</td>
</tr>
<tr>
<td>Annual household income ($)</td>
<td></td>
<td></td>
<td>---</td>
</tr>
<tr>
<td>&lt;20,000</td>
<td>165 (28.2)</td>
<td>181 (36.3)</td>
<td>0.009</td>
</tr>
<tr>
<td>20,000 to 45,000</td>
<td>189 (32.1)</td>
<td>160 (32.0)</td>
<td>---</td>
</tr>
<tr>
<td>&gt;45,000</td>
<td>253 (30.7)</td>
<td>158 (31.7)</td>
<td>---</td>
</tr>
<tr>
<td>Physical activity</td>
<td></td>
<td></td>
<td>---</td>
</tr>
<tr>
<td>Low activity</td>
<td>183 (27.2)</td>
<td>218 (41.9)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Medium activity</td>
<td>146 (21.7)</td>
<td>100 (19.2)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>High activity</td>
<td>343 (51.0)</td>
<td>202 (38.8)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Access to health care</td>
<td></td>
<td></td>
<td>---</td>
</tr>
<tr>
<td>Yes</td>
<td>97 (9.5)</td>
<td>34 (3.8)</td>
<td>---</td>
</tr>
<tr>
<td>No</td>
<td>829 (81.5)</td>
<td>805 (89.3)</td>
<td>---</td>
</tr>
<tr>
<td>Routine health-care place</td>
<td></td>
<td></td>
<td>---</td>
</tr>
<tr>
<td>Health-care center</td>
<td>186 (18.5)</td>
<td>96 (10.7)</td>
<td>---</td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td></td>
<td>---</td>
</tr>
<tr>
<td>Smoking</td>
<td></td>
<td></td>
<td>---</td>
</tr>
<tr>
<td>Never smoker</td>
<td>703 (59.1)</td>
<td>528 (58.6)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Ex-smoker</td>
<td>79 (7.8)</td>
<td>170 (18.9)</td>
<td>---</td>
</tr>
<tr>
<td>Current smoker</td>
<td>235 (23.1)</td>
<td>203 (22.5)</td>
<td>---</td>
</tr>
</tbody>
</table>

AAW, African American women.
diseases is significantly high in AAW with metabolic syndrome. The increasing prevalence of metabolic syndrome will further increase the prevalence of these diseases.

Surprisingly, 95.7% of AAW with metabolic syndrome had access to health care and 89.3% of them regularly visit an outpatient clinic or health-care center. Most of the AAW who do carry any medical diagnosis that warrants a treatment and ‘who are otherwise healthy’ might have never been told that they have a syndrome that is of significant concern. They do have a diagnosis of metabolic syndrome and this is the group that needs more focus on the lifestyle modifications. Women who are not ‘diagnosed’ with metabolic syndrome will obviously not carry a ‘risk perception’ for the disease.

The designation of metabolic syndrome as a ‘syndrome’ was a controversial topic as some experts felt that focusing on the individual constituents is more important than lumping those metabolic abnormalities into a syndrome (3, 27, 28). But in a study by Jumean et al., a randomized controlled trial in which 74 people were randomized to receive either a diagnosis of metabolic syndrome or individual cardiovascular risk factors, the patients who received the diagnosis of metabolic syndrome were more likely to modify their health behavior (29).

Strengths
The strength of this study is using a national level data and a large sample size. Very few studies have been done in the past exclusively on AAW health perceptions in relation to the metabolic syndrome. Using a wide number of variables increased the sensitivity of identifying its prevalence.

Limitations
The data is completely based on self-reporting. The data collection was not done in a blinded pattern. The study did not take dietary patterns into consideration because the 2011–2012 data was still not released by NHANES at the time of the study.

Conclusions
In spite of the focus on prevention of cardiovascular risk factors and elimination of ethnic and gender disparities, this study shows that metabolic syndrome is still widely prevalent in AAW. This pattern can be clearly attributed to the sociodemographic risk factors, which are otherwise completely preventable by increasing the early identification and risk perception of the syndrome.

Conflict of interest and funding
The authors have not received any funding or benefits from industry or elsewhere to conduct this study.

References