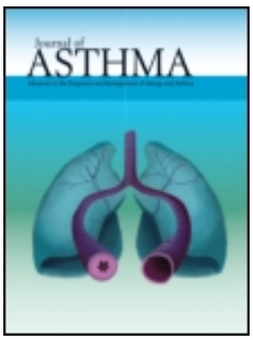

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ORIGINAL ARTICLE

Asthma and Asthma Severity among African American Adults in the Jackson Heart Study

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The aims of this study were to investigate the baseline prevalence of and risk factors associated with asthma, classify asthma severity, and describe medication use in a population-based sample of African American men and women 21 to 84 years of age from the Jackson Heart Study (JHS). Participants provided responses to respiratory and medical history questions and a medication inventory and underwent spirometry and other clinical examinations. These data were used to examine the extent to which novel and traditional risk factors were associated with asthma. Of the 4,098 participants included in this analysis, 9.4% reported lifetime asthma (5.7% current, 3.7% former), and current asthma was higher in women (6.8%) than in men (3.8%). An additional 9.8% reported an attack of wheeze with shortness of breath or non-doctor confirmed asthma (i.e., "probable" asthma). The mean forced expiratory volume in 1 second (FEV_1)% predicted was lower in those reporting current asthma (women: 83.7 ± 18.0; men: 75.2 ± 16.8) compared to those not reporting asthma (women: 95.6 ± 16.7; men: 91.7 ± 16.0). Current and probable asthma was associated with lower serum cortisol levels and hypertension medication use, along with traditional risk factors (i.e., lower socio-economic status, higher global stress scores, obesity, and fair to poor perceived general health). Severe asthma was low among participants reporting current (9.8%), former (3.3%), and probable (4.9%) asthma. Asthma medication use was reported by nearly 60% of the participants reporting current asthma. Asthma in African American adults is associated with decreased serum cortisol, hypertension medication use, and considerable lung function impairment compared to those who did not report asthma. The prevalence of asthma in the JHS is lower than state and national estimates, although the estimates are not directly comparable. Furthermore, asthma is drastically underdiagnosed in this population.

Keywords African Americans, asthma, asthma severity, Jackson Heart Study, wheezing

Introduction

Asthma is a chronic inflammatory condition characterized by episodic and reversible airflow obstruction and airway hyperresponsiveness. In the United States, African Americans as compared with whites generally report a higher prevalence of asthma (1–4). Substantial differences in lung capacity and dynamics between African American and white populations have been well established; African Americans tend to have smaller lung volumes than whites (5–8). Complex interactions between various economical and cultural differences, familial and social constructs, and environmental exposures are suggested as explanatory factors for existing disparities (9–11).

Disparities in asthma morbidity and mortality have received significant public health attention over the past decade. *Healthy People 2010* (12) aims to reduce (1) asthma deaths, (2) hospitalizations from asthma complications (e.g., asthma attacks), and (3) hospital emergency department visits for asthma, all of which are widening disparities among African Americans (13, 14). The prevalence of self-reported asthma among African Americans increased nearly 80% between 1997 and 2004 (3). Moreover, the rates of lifetime and current asthma among African Americans vary geographically with the highest rates in the West Census region and lowest in the South and Northeast (15). Shanawani (11) recommends the need to explore factors such as familial, psychological, and environmental characteristics that contribute to the development of asthma in populations that experience an excess burden of disease.

Serum cortisol levels, diabetes mellitus, *Chlamydia pneumoniae* infection, and hypertension medication use are factors that are increasingly being purported as contributors to asthma and asthma exacerbations. Prolonged secretion of cortisol, the stress hormone, has been shown to cause hyperglycemia (16). Cortisol also increases gluconeogenesis, leading to higher levels of glucose concentrations, and prospective studies have shown decreases in lung function to be associated with glycemic exposure (i.e., glycemic control) and the diabetic state (17), suggesting the lung to be a target organ for diabetes complications. In a recent case-control serologic study, *Chlamydia pneumoniae*-specific immunoglobulin G (IgG) and A (IgA) antibody levels were found to be significantly higher in asthmatics than in the matched control subjects, indicating more chronic

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Chlamydia pneumoniae infection than controls (18). Finally, hypertension medications such as beta-blockers are effective in blood pressure control in that they trigger blood vessel dilation and block beta-receptors on blood vessels. However, beta-blockers are not discriminatory to the type of beta receptor and block beta-receptors on respiratory passages causing airway constriction (19, 20). These biologically plausible factors play a pivotal role in the causal pathway of asthma and warrant investigation among African Americans as this population is disproportionately affected by these psychological and comorbid disease states.

The disease etiology specific to African Americans is not completely understood, and no study has examined the prevalence of asthma and asthma severity in an all–African American population. The aims of this study were to determine the prevalence of self-reported asthma in the Jackson Heart Study (JHS), a cohort of African Americans residing in the Jackson metropolitan statistical area (Jackson MSA), to classify asthma severity and to determine whether serum cortisol levels, diabetes mellitus, *Chlamydia pneumoniae*, and hypertension medication use were associated with asthma in this population. We hypothesized that asthma would be more prevalent in women than in men. We further hypothesized that asthma would be associated with traditional risk factors (such as lower socio-economic status [SES]) and urban residence.

Methods

The JHS is a single-site cohort study designed to investigate the development of cardiovascular disease (CVD) and other chronic disorders in African American adults (21). From September 2000 to March 2004, 5,301 ambulatory and non-institutionalized African Americans, 35 to 84 years of age, residing in the Jackson MSA (Hinds, Rankin, and Madison counties) were recruited and examined (22). Nearly 31% of the cohort was composed of participants from the Atherosclerosis Risk in Communities (ARIC) study. The other study participants were randomly selected and volunteer residents and their family members (22). Eligible family members who were younger or older than the main cohort were allowed to participate as part of the JHS Family Study (23). The study design and data collection methods have been published elsewhere (24–26). Trained interviewers asked participants standard epidemiologic questions regarding history of respiratory and cardiovascular conditions, lifestyle behaviors, and socio-demographic information. Participants brought all prescription and non-prescription medications used within the 2 weeks before their baseline clinic visit. Medication name, strength, and dosing instructions were transcribed verbatim from the medication labels; medications were coded into therapeutic classes using the Medispan dictionary and classified into medication categories according to the Therapeutic Classification System (27).

Current asthma was defined as either (1) an affirmative response to the questions: "Have you ever had asthma?", "Has it been confirmed by a doctor?", and "Do you still have asthma?" or (2) actual asthma medication use. Former asthma was defined as a negative response to the last question. "Probable" asthma was defined as (1) an attack of wheezing with shortness of breath or (2) a self-reported history of asthma, but no self-report of asthma diagnosed by a doctor (28–30).

Table 1.—Classification of respiratory symptoms in the Jackson Heart Study during the baseline examination, 2000–2004.

	Severity*		
	Mild	Moderate	Severe
Wheeze			
Does your chest ever sound wheezy or whistling apart from colds?	Yes	Yes	Yes
Does your chest sound wheezy or whistling most days?	No	Yes	Yes
Have you had an attack of wheezing that has made you feel short of breath?	No	Yes	Yes
Have you had 2 or more such episodes?	No	No	Yes
Cough**			
Do you usually have a cough?	Yes	Yes	Yes
Do you usually cough as much as 4 to 6 times a day, 4 or more days out of the week?	No	Yes or No	Yes
Do you usually cough like this on most days for 3 consecutive months or more during the year?	No	Yes or No	Yes
Phlegm**			
Do you usually bring up phlegm from your chest?	Yes	Yes	Yes
Do you usually bring up phlegm like this as much as much as twice a day, 4 or more days out of the week?	No	Yes or No	Yes
Do you usually bring up phlegm like this on most days for 3 consecutive months or more during the year?	No	Yes or No	Yes

*Severity of respiratory symptoms is classified as Mild Persistent, Moderate Persistent, and Severe Persistent.

**A participant is classified with Moderate Persistent cough or phlegm based on a "yes" response to either of the latter two questions, but not both.

Asthma severity was based on the degree of pulmonary function abnormality (percent predicted forced expiratory volume in 1 second [FEV_1]) and respiratory symptoms and categorized as mild, moderate, or severe persistent in accordance with the National Asthma Education and Prevention Program (See Table 1 for the classification of respiratory symptoms) (31).

Pulmonary function was measured using computerized spirometry; the forced vital capacity (FVC) and FEV_1 were measured and the maximum values were selected for analysis according to recommendations from the American Thoracic Society (32). Predicted values were computed using race- and gender-specific predictive equations from the third National Health and Nutrition Examination Survey (NHANES) (5). Respiratory symptoms, wheeze, cough, breathlessness, and phlegm were assessed using questions adapted from the Adult Respiratory Symptoms Questionnaire (33).

Socio-demographic measures included age, sex, educational attainment, household income, and health insurance status. Health insurance status was defined as having any type (public or private) insurance such as Blue Cross/Blue Shield or Medicare. Each participant's mailing address was geocoded and urban/non-urban residence was determined using the characterization of an urban area as defined by the U.S. Census Bureau (34). Current cigarette smoking was defined as a positive response to "Have you smoked more than 400 cigarettes in your lifetime?" and "Do you now smoke cigarettes?" Former cigarette smoking was defined as a positive response to the first question and a negative response to the latter question. Perceived general health status was assessed using each participant's perception of their current health compared with others their age. Global stress was a

self-reported measure of perceived chronic stress averaged across eight broad domains, with responses ranging from "not stressful" to "very stressful" with an average total score ranging from 0 to 3 (26).

Anthropometric measures (height, weight, body mass index [BMI], and waist and neck circumferences), seated blood pressure measurements, and blood samples (cortisol, *Chlamydia pneumoniae*, and glucose) were obtained using standard techniques after an 8-hour overnight fast (19). BMI was calculated as the ratio of a participant's weight, in kilograms, and height, per square meter. A participant's waist circumference was measured (in centimeters) at the level of the umbilicus, while the neck circumference was measured at the thyroid cartilage, or "Adam's apple." IgG antibodies against *Chlamydia pneumoniae* were determined by a microimmunofluorescence and graded as 0, 1+, 2+, 3+, or 4+. Seropositivity was determined if the serum sample reacted with *Chlamydia pneumoniae* antigen. Diabetes mellitus was defined as a plasma glucose level ≥126 mg/dL and use of anti-diabetic medications or a self-reported history of diabetes (35).

Exclusion Criteria

Participants who did not complete the respiratory symptoms questionnaire (n = 28), answer specific asthma-related and respiratory symptom questions (n = 5), perform spirometry (n = 276), or meet acceptability and reproducibility criteria (n = 147) were excluded from the analysis. Also excluded were participants with a self-reported history of bronchitis or emphysema (n = 313) or coronary heart disease and/or stroke (n = 425) or who were over 84 years of age (n = 10). A total of 4,098 participants (2,605 [63.6%] women; 1,493 men [36.4%]) were included in these analyses.

Statistical Analysis

Sex-specific baseline characteristics were described using counts and percentages and means and standard deviations as appropriate. Chi-square and pooled or unpooled *t* tests were used to contrast differences across asthma categories (current, former, probable, and never), with participants classified with no history of asthma serving as the reference group. Marginally significant (p value < 0.10) variables were included in the logistic regression models. Univariable and multivariable logistic regression models assessed associations between asthma and selected risk factors. Odds ratios (ORs) and 95% confidence intervals (CIs) summarized these results. All analyses were completed in SAS version 9.1 (SAS Institute, Inc).

Results

Of the 4,098 participants included in these analyses, 9.4% reported asthma during their lifetime: 5.7% had current asthma (6.8% of women and 3.8% of men) and 3.7% had former asthma (3.3% of women and 4.4% of men). The prevalence of probable asthma was 9.8% (11.2% of women and 7.4% of men). Among women, current asthma was significantly associated with lower SES and pulmonary function (FEV_1, FVC, and FEV_1/FVC ratio), greater anthropometrics, obesity, fair to poor perceived general health, hypertension medication use, and diabetes mellitus (Table 2). Current asthma was associated with increased waist circumference and lower levels of pulmonary function and serum cortisol levels in men (Table 3). In both men and women, probable asthma was related to lower levels of pulmonary function (FEV_1 and FVC % predicted), greater waist circumference, fair to poor perceived general health, and asthma medication use. In women, probable asthma was also related to lower

Table 2.—Descriptive statistics, mean (SD) or n (%),[†] of baseline characteristics by asthma status among African American women: Jackson Heart Study, 2000–2004.

Variable	Current (N = 177)	Former (N = 85)	Probable (N = 292)	Never (N = 2051)
Age, years	54.3 (12.5)	51.7 (11.1)	54.5 (12.4)	54.2 (12.4)
Urban residence[†]	135 (77.1)	64 (76.2)	224 (77.8)	1570 (77.4)
Less than high school diploma[†]	40 (22.6)***	16 (18.8)	54 (18.5)*	271 (13.3)
Household income <$25,000[†]	70 (39.6)	32 (37.7)	112 (38.4)*	663 (32.5)
Body mass index, kg/m^2	34.8 (7.3)***	33.4 (9.0)	35.4 (8.1)***	32.2 (7.2)
Normal[†]	13 (7.3)***	11 (13.1)	28 (9.6)***	260 (12.7)
Overweight	35 (19.8)	23 (27.4)	52 (17.8)	610 (29.8)
Obese	129 (72.9)	50 (59.5)	212 (72.6)	1180 (57.6)
Waist circumference, cm	105.7 (17.3)***	101.1 (19.5)	105.8 (17.8)***	98.7 (16.1)
Neck circumference, cm	37.4 (3.3)**	37.1 (3.3)	37.5 (3.2)***	36.7 (2.9)
Cigarette smoking status[†]				
Never	134 (76.6)	61 (71.8)***	212 (73.1)	1572 (77.2)
Former	29 (16.6)	7 (8.2)	42 (14.5)	298 (14.6)
Current	12 (6.9)	17 (20.0)	36 (12.4)	167 (8.2)
Perceived general health[†]				
Excellent to good	98 (55.4)***	57 (67.1)	182 (62.3)***	1507 (73.7)
Fair to poor	79 (44.6)	28 (32.9)	110 (37.7)	539 (26.3)
Health insurance status[†]	154 (87.0)	68 (80.0)	243 (83.5)	1775 (87.0)
FEV_1, percent predicted	84.1 (17.6)***	89.4 (17.6)**	91.1 (17.6)***	95.6 (16.7)
FVC, percent predicted	85.6 (16.9)***	89.2 (17.7)*	89.1 (17.4)***	94.0 (17.3)
FEV_1/FVC ratio	78.8 (9.4)***	80.7 (6.4)	82.0 (8.7)	81.7 (7.8)
Chlamydia pneumoniae[†]	123 (71.9)	58 (69.9)	210 (72.9)	1454 (72.3)
Average global stress score	0.8 (0.6)*	0.7 (0.6)	0.8 (0.6)***	0.7 (0.5)
Cortisol, μg/dL	8.8 (4.3)	8.5 (4.1)	8.9 (3.8)	9.1 (3.9)
Hypertension medication use[†]	118 (68.2)***	41 (49.4)	167 (61.4)**	997 (51.1)
Diabetes mellitus[†]	42 (24.3)**	12 (14.6)	61 (21.6)*	327 (16.3)

[†]Columns may not total because of missing values: 30 urban residence, 13 income, 10 education, 18 cigarette smoking status, 5 perceived general health, 12 health insurance, 53, *Chlamydia pneumoniae*, 126 taking hypertension medication, 60 diabetes mellitus.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

TABLE 3.—Descriptive statistics, mean (SD) or n (%),[†] of baseline characteristics by asthma status among African American men: Jackson Heart Study, 2000–2004.

Variable	Current (N = 57)	Former (N = 66)	Probable (N = 110)	Never (N = 1260)
Age, years	52.3 (14.6)	46.9 (11.7)***	54.2 (12.2)	53.1 (12.6)
Urban residence[†]	47 (83.9)	53 (81.5)	84 (77.8)	898 (72.1)
Less than high school diploma[†]	8 (14.3)	5 (7.6)	25 (22.9)	198 (15.8)
Household income <$25,000[†]	12 (21.4)	16 (24.2)	30 (27.3)	261 (20.8)
Body mass index, kg/m^2	31.2 (7.9)	30.2 (5.6)	30.6 (6.0)	29.8 (6.0)
Normal[†]	10 (17.5)	10 (15.2)	17 (15.5)	228 (18.1)
Overweight	20 (35.1)	27 (40.9)	38 (34.6)	522 (41.4)
Obese	27 (47.4)	29 (43.9)	55 (50.0)	510 (40.5)
Waist circumference, cm	104.7 (19.7)*	100.5 (14.5)	104.3 (15.1)*	100.7 (14.9)
Neck circumference, cm	41.6 (4.1)	41.7 (3.4)	41.6 (3.2)	41.2 (3.1)
Cigarette smoking status[†]				
Never	34 (59.7)	41 (62.1)	58 (53.2)	771 (61.8)
Former	12 (21.1)	15 (22.7)	27 (24.8)	278 (22.3)
Current	11 (19.3)	10 (15.2)	24 (22.0)	199 (16.0)
Perceived general health[†]				
Excellent to good	43 (75.4)	52 (78.8)	74 (67.3)*	985 (78.4)
Fair to poor	14 (24.6)	14 (21.2)	36 (32.7)	271 (21.6)
Health insurance status[†]	42 (83.9)	54 (81.8)	97 (88.2)	1088 (86.7)
FEV_1, percent predicted	76.5 (19.0)***	90.6 (14.7)	87.2 (15.3)**	91.7 (16.0)
FVC, percent predicted	82.7 (15.6)***	91.0 (13.6)	86.0 (15.0)**	90.7 (16.1)
FEV_1/FVC ratio	73.1 (11.0)***	80.2 (7.3)	80.4 (7.9)	80.4 (8.6)
Chlamydia pneumoniae[†]	44 (78.6)	47 (71.2)*	101 (83.5)	1024 (82.2)
Average global stress score	0.6 (0.5)	0.7 (0.5)	0.6 (0.5)	0.5 (0.5)
Cortisol, μg/dl	9.6 (4.0)*	11.2 (4.0)	10.9 (3.9)	10.9 (4.0)
Hypertension medication use[†]	23 (46.9)	21 (33.9)	51 (49.0)	468 (39.7)
Diabetes mellitus[†]	8 (14.3)	11 (16.9)	23 (21.1)	179 (14.6)

[†]Columns may not total because of missing values: 20 urban residence, 7 education, 4 income, 13 cigarette smoking status, 4 perceived general health, 6 health insurance, 15 *Chlamydia pneumoniae*, 100 taking hypertension medication, 39 diabetes mellitus.

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

levels of education and total household income, increased anthropometrics and global stress scores, hypertension medication use, and diabetes mellitus; whereas in men, the associations with lower levels of education and diabetes mellitus were marginal ($p < 0.10$).

Table 4 provides the results of the univariable and multivariable logistic regression models predicting current asthma. In the univariable model, there was a higher likelihood of current asthma among participants reporting hypertension medication use and classified with diabetes mellitus; however, only the relationship with hypertension medication use was maintained in the multivariable model. Additionally, the odds of current asthma in the univariable model were greater among participants with higher global stress scores, and counter-intuitively, lower serum cortisol levels; such relationships persisted in the multivariable model. The unadjusted odds of current asthma were roughly two times greater in women than in men, in obese participants than in normal weight participants, and in participants with fair to poor perceived general health than in participants with excellent to good perceived general health. These significant differences were partially attenuated after adjustment for other factors in the multivariable models. The odds of current asthma in the univariable model were greater among participants with less than a high school diploma, a relationship that persisted in the multivariable model. Current asthma was not associated with age, urban residence, household income, cigarette smoking, health insurance, and *Chlamydia pneumonia* infection status. Similar relationships with probable asthma are reported in Table 4.

Table 5 provides a description of the asthma severity and medication use in the JHS. The prevalence of severe asthma (with severe persistent respiratory symptoms) was low among participants classified as having lifetime or probable asthma. Moderate asthma severity was classified in one third of participants reporting current asthma, followed by nearly one fourth of participants with probable and former asthma. The prevalence of severe persistent respiratory symptoms was modest across moderate asthma severity categories for participants reporting current asthma and those classified with probable asthma. Nearly 60% of the participants with current asthma reported asthma medication use. A short-acting β-antagonist (albuterol) inhaler was the most frequently reported asthma medication among participants reporting current asthma, followed by prednisone/methylprednisolone and a leukotriene modifier (Table 5).

DISCUSSION

This is the first presentation of data on asthma prevalence and severity in an all–African American cohort of men and women and suggests that the prevalence of current asthma in the JHS was lower than reported national and state estimates (3, 4, 36). Several possible explanations for the lower prevalence exist. On a state level, the median household income reported in the JHS and metropolitan Jackson area (Jackson MSA) was higher than reported incomes in the remaining Mississippi counties, according to the 2000 U.S. Census; lower incomes and poor living conditions (e.g., cockroach allergen exposure) are associated with higher asthma prevalence (9). Second, environmental pollutant levels are relatively lower in the Jackson MSA than in other metropolitan areas, although this does not rule out investigation into the heterogeneous housing quality and other small-area spatial analyses.

TABLE 4.—Associations between physician-diagnosed current asthma and probable asthma and risk factors of interest among African Americans in the Jackson Heart Study, 2000–2004.

Variable	Current Asthma		Probable Asthma	
	Univariable OR (95% CI)	Multivariable OR (95% CI)	Univariable OR (95% CI)	Multivariable OR (95% CI)
Age				
Lower (21 – 44)	1.0	1.0	1.0	1.0
Middle (45 – 64)	0.90 (0.65, 1.27)	0.79 (0.54, 1.16)	1.26 (0.96, 1.66)	1.14 (0.84, 1.55)
Upper (65+)	1.01 (0.67, 1.51)	0.77 (0.45, 1.30)	1.06 (0.75, 1.49)	0.94 (0.61, 1.43)
Gender				
Male	1.0	1.0	1.0	1.0
Female	1.99 (1.43, 2.77)	1.59 (1.09, 2.32)	1.57 (1.22, 2.01)	1.33 (1.01, 1.74)
Residence				
Rural	1.0	1.0	1.0	1.0
Urban	1.25 (0.88, 1.77)	1.10 (0.76, 1.59)	1.10 (0.85, 1.44)	0.99 (0.75, 1.30)
Educational attainment				
<high school	1.48 (1.03, 2.14)	1.57 (1.02, 2.40)	1.45 (1.08, 1.94)	1.40 (1.00, 1.95)
≥high school	1.0	1.0	1.0	1.0
Household income				
<$25,000	1.28 (0.94, 1.74)	1.01 (0.71, 1.42)	1.35 (1.06, 1.72)	1.07 (0.82, 1.40)
≥$25,000	1.0	1.0	1.0	1.0
Body Mass Index				
Normal	1.0	1.0	1.0	1.0
Overweight	1.21 (0.69, 2.12)	0.98 (0.55, 1.76)	0.96 (0.64, 1.45)	0.94 (0.62, 1.43)
Obese	2.39 (1.43, 4.01)	1.59 (0.92, 2.72)	1.80 (1.25, 2.61)	1.55 (1.05, 2.28)
Cigarette smoking status				
Never	1.0	1.0	1.0	1.0
Former	0.94 (0.64, 1.38)	0.99 (0.66, 1.49)	1.01 (0.74, 1.37)	0.98 (0.71, 1.35)
Current	0.92 (0.58, 1.48)	1.09 (0.65, 1.82)	1.50 (1.08, 2.08)	1.63 (1.15, 2.30)
Perceived general health				
Excellent to good	1.0	1.0	1.0	1.0
Fair to poor	2.09 (1.56, 2.80)	1.59 (1.15, 2.20)	1.76 (1.39, 2.23)	1.34 (1.03, 1.73)
Health insurance				
Yes	1.0	1.0	1.0	1.0
No	1.18 (0.79, 1.76)	1.10 (0.70, 1.71)	1.27 (0.93, 1.73)	1.08 (0.78, 1.52)
Average global stress score				
First (<0.125)	1.0	1.0	1.0	1.0
Second (0.125 – 0.50)	0.97 (0.62, 1.50)	1.05 (0.66, 1.68)	1.21 (0.87, 1.67)	1.18 (0.84, 1.64)
Third (0.50 – 1.00)	1.50 (0.98, 2.30)	1.57 (0.99, 2.50)	1.05 (0.73, 1.49)	1.00 (0.69, 1.45)
Fourth (>1.00)	1.73 (1.16, 2.58)	1.70 (1.08, 2.68)	1.62 (1.18, 2.21)	1.44 (1.02, 2.03)
Cortisol				
First (<6.9)	1.0	1.0	1.0	1.0
Second (6.9 – 9.2)	0.59 (0.40, 0.87)	0.64 (0.43, 0.96)	0.77 (0.56, 1.05)	0.80 (0.58, 1.10)
Third (9.2 – 11.8)	0.63 (0.43, 0.93)	0.73 (0.48, 1.10)	0.78 (0.57, 1.07)	0.84 (0.60, 1.16)
Fourth (>11.8)	0.50 (0.33, 0.74)	0.57 (0.36, 0.88)	0.82 (0.60, 1.12)	0.88 (0.63, 1.22)
Chlamydia pneumoniae				
Yes	0.88 (0.65, 1.24)	0.95 (0.67, 1.35)	0.86 (0.67, 1.11)	0.85 (0.65, 1.10)
No	1.0	1.0	1.0	1.0
Taking hypertension medications				
Yes	2.18 (1.60, 2.95)	2.00 (1.41, 2.83)	1.61 (1.28, 2.02)	1.40 (1.08, 1.83)
No	1.0	1.0	1.0	1.0
Diabetes mellitus				
Yes	1.47 (1.03, 2.11)	1.03 (0.70, 1.53)	1.52 (1.15, 2.01)	1.14 (0.85, 1.55)
No	1.0	1.0	1.0	1.0

Current (and probable) asthma in the JHS was higher in women than in men and was related to lower educational attainment, obesity, higher stress scores, and fair to poor perceived general health, all consistent with the scientific literature (3, 4, 8–11, 13). Current asthma was inversely associated with serum cortisol levels, suggesting higher levels may be protective in the development of asthma. Current asthma was also related to diabetes mellitus, in univariable analysis, and hypertension medication use, emerging risk factors for asthma (19, 20, 37, 38). The benefits of hypertension medication in treating and controlling high blood pressure are well established, albeit beta-blockers (19, 20) and angiotensin-converting enzyme inhibitors (ACEI) (38) are problematic in asthmatic patients. One common side effect of ACEIs is a dry cough resulting from airway activity that mimics the effects of asthma (38). This presents the need for prescribing physicians to closely monitor patient's respiratory function and to be knowledgeable of the medications that are "safe" for individuals with compromised respiratory function.

Asthma severity among current asthmatics was more or less mild to moderate persistent. Participants classified with former asthma had moderate disease severity, indicating that they may not have experienced severe asthma-related morbidity. This is reassuring as African Americans are often less likely to report care consistent with recommendations for medication use (39) and less likely to seek respiratory care (40). Furthermore, lung function in this cohort of African Americans was greater, on average, than other middle-age adult populations (37, 41), although this may not be entirely correct since higher SES African Americans were overrepresented in this cohort.

The underdiagnosis of asthma in this population may be of significant importance. Roughly 10% of JHS participants were classified with probable asthma. Similar estimates of undiagnosed asthma have been reported in other racial/ethnic

TABLE 5.—Asthma severity by asthma classification among African Americans in the Jackson Heart Study during the baseline examination, 2000–2004.

Disease severity*	Current (N = 234)	Former (N = 151)	Probable (N = 402)
Severe asthma	18 (9.8)	5 (3.3)	22 (4.9)
Severe persistent	6	1	5
Moderate persistent	3	1	1
Mild persistent	4	0	5
None	5	3	11
Moderate asthma	69 (37.5)	36 (23.8)	108 (24.1)
Severe persistent	22	2	23
Moderate persistent	4	4	12
Mild persistent	20	4	21
None	23	26	52
Mild asthma	97 (52.7)	110 (72.8)	318 (71.0)
Severe persistent	25	11	51
Moderate persistent	9	11	24
Mild persistent	27	17	60
None	36	71	183
Asthma medication use	130 (55.6)	3 (2.0)	—
Albuterol inhaler	55	0	—
Ipratropium inhaler	7	0	—
Inhaled corticosteroids	24	1	—
Prednisone/methylprednisolone	38	2	—
Long-acting β-adrenergics	12	0	—
Adrenergic combinations			
Albuterol-ipratropium	13	0	—
Fluticasone-salmeterol	24	0	—
Leukotriene modifier	27	0	—
Theophylline	4	0	—

*Severe asthma was defined as a forced expiratory volume in 1 second (FEV_1) $\leq$60% predicted; moderate asthma was defined as FEV_1 >60 – <80% predicted; and mild asthma was defined as FEV_1 $\geq$80% predicted.

adult populations (29, 30, 42). In the Cardiovascular Health Study (CHS), probable (i.e., wheeze with chest tightness or breathless in the last 12 months) and possible asthma (i.e., wheeze brought on by various exposures) were reported to be 11.4% and 4.1%, respectively (29). In that study, Enright et al. (29) compared the asthma symptom severity in these participants and in those who had a diagnosis of asthma and found that a large number of participants not reporting a diagnosis of asthma had reduced quality of life and considerable asthma morbidity–moderate to severe persistent asthma. Probable asthma was classified in approximately 4% of participants in the Strong Heart Study, and asthma medication use was reported in approximately 20% of these individuals, suggesting asthma diagnosis was underestimated in elderly Native American adults (30). Furthermore, Yoo et al. reported a markedly lower prevalence of asthma than the incidence of wheeze, deducing asthma awareness and asthma prevalence to be seriously underdiagnosed in Korean students (42).

There are several potential limitations in this study. First, this study is cross-sectional in design and limits our ability to infer causal relationships between hypertension medication use and the development of asthma. Next, the generalizability of our findings to national prevalence estimates must be made with caution because of the over-representation of higher SES African Americans in the JHS and the additional exclusion criteria of participants. Third is the precision in the classification of prevalent asthma. Some people confuse other respiratory conditions with asthma, which may result in inaccurate estimates of asthma prevalence. Dixon et al. (30) also found that the burden of respiratory symptoms reported by participants recalling "no asthma" was a reflection of other existing respiratory diseases. To enhance the specificity of our definition, participants' self-reporting a history of bronchitis or emphysema or any CVD, or those who were above the age of 84, were excluded. Analyses were conducted with and without these participants to prevent underestimation of asthma, but no significant differences in the results were identified (data not shown).

Clinically, asthma is diagnosed based on a thorough medical history, physical examination, and lung function tests. Spirometry in the JHS was performed with neither a bronchodilator response nor was a metacholine challenge used, either one of which may have confirmed the diagnosis of asthma (31). A well-recognized limitation from using self-report data to define asthma is that of recall bias or misclassification; however, the methods utilized in this study have a long tradition in other epidemiological studies such as NHANES (4), ARIC (37), and the CHS (29). To enhance the validity of our definition of current asthma, we included actual medication use. Those reporting current asthma in the JHS also reported, on average, more respiratory symptoms, suggesting reasonable validity of our definition. Second, probable asthma was defined to address any shortcomings of our definition and to identify additional asthmatics. Finally, the FEV_1 % predicted was used to place participants into asthma severity categories. However, the depth and level of inquiry of the respiratory symptom questions used to further classify asthma severity were limited with no questions regarding allergies or symptom frequency, duration, onset (i.e., nocturnal, at first awakening), or exacerbations.

It is worth noting a number of the strengths of this study. The JHS is the largest single-site population-based study among an all–African American cohort with clinical, subclinical, genetic, and psychosocial data regarding CVD and other chronic diseases, including spirometric data, from over 5,000 adults 21 to 94 years of age. Spirometric data from this cohort addresses the limited existence of such data from this ethnic group, enabling researchers to (1) evaluate normal spirometric reference values in African Americans and (2) examine relationships between respiratory disease and impaired lung function and clinical and subclinical CVD (37), novel inflammatory biomarkers (43), and neighborhood and environmental factors (44). Furthermore, the design of the JHS facilitates extensive genetic information that will provide the opportunity to explore novel genetic mechanisms that influence pulmonary function and respiratory disease.

In conclusion, our findings indicate that in this all–African American cohort, asthma prevalence was lower than generally reported national and state estimates, although the estimates are not directly comparable, and that current asthma was inversely associated with serum cortisol and positively associated with hypertension medication use. There is a growing body of literature highlighting the deleterious effects of hypertension medications on the respiratory system (19, 20, 37, 38), and this study supports the hypothesis that hypertension medications may contribute to the development of asthma and other chronic respiratory conditions. Wyatt et al. (45) reported higher levels of hypertension awareness, treatment, and control in this cohort of African Americans than their national counterparts in NHANES. This provides

an optimal opportunity to prospectively investigate the development of asthma (and other respiratory conditions) among controlled and treated hypertensives and to explore asthma in relation to clinical CVD and other physiological manifestations with ancillary attention to respiratory management and care.

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References

1. Mannino DM, Homa DM, Pertowski CA, Ashizawa A, Nixon LL, Johnson CA, Ball LB, Jack E, Kang DS. Surveillance for asthma–United States, 1960–1995. In: Surveillance Summaries, April 24, 1998. MMWR 1998; 47(SS-5):1–27.
2. Mannino DM, Homa DM, Akinbami LJ, Moorman JE, Geynn C, Redd SC. Surveillance for asthma—United States, 1980–1999. In: Surveillance Summaries, March 29, 2002. MMWR 2002; 51(SS-5):1–13.
3. Moorman JE, Rudd RA, Johnson CA, King M, Minor P, Bailey C, Scalia MR, Akinbami LJ. National Surveillance for Asthma—United States, 1980–2004. In Surveillance Summaries, October 19, 2007. MMWR 2007; 56(SS-08):1–14; 18–54.
4. Arif AA, Delclos GL, Lee ES, Tortolero SR, Whitehead LW. Prevalence and risk factors of asthma and wheezing among US adults: an analysis of the NHANES III data. Eur Respir J 2003; 21:827–833.
5. Hankinson JL, Odencrantz JR, Fedan KB. Spirometric reference values from a sample of the general US population. Am J Respir Crit Care Med 1999; 159:179–187.
6. Hankinson JL, Kinsley KB, Wagner GR. Comparison of spirometric reference values for Caucasian and African American blue-collar workers. J Occup Environ Med 1996; 38:137–143.
7. Enright PL, Arnold A, Manolio TA, Kuller LH. Spirometry reference values for healthy elderly blacks. The Cardiovascular Health Study Research Group. Chest 1996; 110:1416–1424.
8. Jacobs DR, Nelson ET, Dontas AS, Keller J, Slattery ML, Higgins M. Are race and sex differences in lung function explained by frame size? The CARDIA Study. Am Rev Respir Dis 1992; 146:644–649.
9. Gold DR, Wright R. Population disparities in asthma. Ann Rev Pub Heal 2005; 26:89–113.
10. Ford JG, McCaffrey MA. Understanding disparities in asthma outcomes among African Americans. Clin Chest Med 2006; 27:423–430.
11. Shanawani H. Health disparities and differences in asthma: concepts and controversies. Clin Chest Med 2006; 27:17–28.
12. US Department of Health and Human Services. Respiratory Diseases [Goal 24]. In: Healthy People 2010 (Conference ed., Vol II). Washington, DC: US Government Printing Office, Nov 2000.
13. Gupta RS, Carrion-Carire V, Weiss KB. The widening black/white gap in asthma hospitalizations and mortality. J Allergy Clin Immunol 2006; 117:351–358.
14. Lethbridge-Çejku M, Rose D, Vickerie J. Summary health statistics for U.S. Adults: National Health Interview Survey, 2004. National Center for Health Statistics. Vital Health Stat 2006; 10(228).
15. Rose D, Mannino DM, Leaderer BP. Asthma prevalence among US adults, 1998–2000: role of Puerto Rican ethnicity and behavioral and geographic factors. Am J Public Health 2006; 96:880–888.
16. Barseghian G, Levine R, Epps P. Direct effect of cortisol and cortisone on insulin and glucagon secretion. Endocrinology 1982; 111:1648–1151.
17. Davis WA, Knuiman M, Kendall P, Grange V, Davis TME. Glycemic exposure is associated with reduced pulmonary function in type 2 diabetes: The Fremantle Study. Diabetes 2004; 27:752–757.
18. Gencay M, Rüdiger JJ, Tamm M, Solér M, Perruchoud AP, Roth M. Increased frequency of Chlamydia pneumoniae antibodies in patients with asthma. Am J Respir Crit Care Med 2001; 163:1097–1100.
19. Tanaka H, Teramoto S, Oashi K, Saikai T, Tanaka S, Suzuki K, Hashimoto M, Abe S. Effects of candesartan on cough and bronchial hyperresponsiveness in mildly to moderately hypertensive patients with symptomatic asthma. Circulation 2001; 104:281–285.
20. Au DH, Bryson CL, Fan VS, Udris EM, Curtis JR, McDonell MB, Fihn SD. Beta-blockers as single-agent therapy for hypertension and the risk of mortality among patients with chronic obstructive pulmonary disease. Am J Med 2004; 117:925–931.
21. Taylor HA. The Jackson Heart Study: an overview. Ethn Dis 2005; 15(4 suppl 6):S6-1–3.
22. Fuqua SR, Wyatt SB, Andrew ME, Sarpong DF, Henderson FR, Cunningham MF, Taylor HA. Recruiting African-American research participation in the Jackson Heart Study: methods, response rates, and sample description. Ethn Dis 2005; 15(4 suppl 6):S6-18–29.
23. Wilson JG, Rotimi CN, Ekunwe L, Royal CD, Crump ME, Wyatt SB, Steffes MW, Adeyemo A, Zhou J, Taylor HA, Jaquish C. Study Design for Genetic Analysis in the Jackson Heart Study. Ethn Dis 2005; 15(4 suppl 6):S6-30-37.
24. Taylor HA, Wilson JG, Jones DW, Sarpong DF, Srinivasan A, Garrison RJ, Nelson C, Wyatt SB. Toward resolution of cardiovascular health disparities in African Americans: design and methods of the Jackson Heart Study. Ethn Dis 2005; 15(4 suppl 6):S6-4–17.
25. Carpenter MA, Crow R, Steffes M, Rock W, Heilbraun J, Evans G, Skelton T, Jensen R, Sarpong D. Laboratory, reading center, and coordinating center data management methods in the Jackson Heart Study. Am J Med Sci 2004; 328:131–144.
26. Payne TJ, Wyatt SB, Moseley TH, Dubbert PM, Guiterrez-Mohammed ML, Calvin RL, Taylor HA, Williams DR. Sociocultural Methods in the Jackson Heart Study: Conceptual and Descriptive Overview. Ethn Dis 2005; 15(4 suppl 6):S6-38–48.
27. Sketris I, Metge C, Ross J, MacCara M. The use of the World Health Organization anatomical therapeutic chemical/defined daily dose methodology in Canada. Drug Inform J 2004; 38:1–8.
28. CSTE Position Statement 1998-EH/CD 1. Asthma surveillance and case definition. CSTE Annual Meeting (Accessed January 12, 2009).
29. Enright PL, McClelland RL, Newman AB, Gottlieb DJ, Lebowitz MD. Underdiagnosis and undertreatment of asthma in the elderly. Cardiovascular Health Study Research Group. Chest 1999; 116:603–613.
30. Dixon AE, Yeh F, Welty TK, Rhoades ER, Lee ET, Howard BV, Enright PL; for the Strong Heart Study Research Group. Asthma in American Indian adults: The Strong Heart Study. Chest 2007; 131:1323–1330.
31. Guidelines for the diagnosis and management of asthma. Expert Panel Report 2. National Asthma Education Program, Bethesda, MD; National Heart, Lung, and Blood Institute. National Institute of Health Publication 97–4051. 2002.
32. Standardization of Spirometry: 1994 Update. American Thoracic Society. Am J Respir Crit Care Med 1995; 152:1107–1136.
33. National Health, Lung, and Blood Institute. JHS manuals of operation: No 8. Pulmonary function assessment. JHS Coordinating Center, Jackson State University, 2001.

34. Barron WG. Urban area criteria for Census 2000. Federal Register 2002; 67:11663–11670.
35. National Institutes of Health. Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults: Executive Summary of the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). Final. September, 2002. NIH, NHLBI: Bethesda, MD.
36. Self-reported asthma prevalence among adults–United States, 2000. MMWR 2001; 50:682–686.
37. Schanen JG, Iribarren C, Shahar E, Punjabi NM, Rich SS, Sorlie PD, Folsom AR. Asthma and incident cardiovascular disease: the Atherosclerosis Risk in Communities Study. Thorax 2005; 60:633–638.
38. Bucknall CE, Neilly JB, Carter R, Stevenson RD, Semple PF. Bronchial hyperreactivity in patients who cough after receiving angiotension converting enzyme inhibitors. Br Med J 1988; 296:86–88.
39. Williams LK, Joseph CL, Peterson EL, Moon C, Xi H, Krajenta R, Johnson R, Wells K, Booza JC, Tunoeli K, Lafata JE, Johnson CC, Ownby DR, Enberg R, Pladenall M. Race-ethnicity, crime, and other factors associated with adherence to inhaled corticosteroids. J Allergy Clin Immunol 2007; 119:168–175.
40. Krishnan JA, Diette GB, Skinner FA, Clark BD, Steinwachs D, Wu AW. Race and sex differences in consistency of care with national asthma guidelines in managed care organizations. Arch Intern Med 2001; 161:1660–1668.
41. Enright PL, Ward BJ, Tracy BP, Lasser EC. Asthma and its association with cardiovascular disease in the elderly. The Cardiovascular Health Study Research Group. J Asthma 1996; 33:45–53.
42. Yoo Y, Ko HK, Han JJ, Lee Y, Seo KJ, Choung JT, Tockgo YC, Choe J. The prevalence of atopy and asthma among university freshmen in Seoul, Korea: association with obesity. J Asthma 2007; 44: 45–49.
43. Dahl M, Tybjaerg-Hansen A, Vestbo J, Lange P, Nordestgaard BG. Elevated plasma fibrinogen associated with reduced pulmonary function and increased risk of chronic obstructive pulmonary disease. Am J Respir Crit Care Med 2001; 164:1008–1011.
44. Kan H, Heiss G, Rose KM, Whitsel E, Lurmann F, London SJ. Traffic exposure and lung function in adults: the Atherosclerosis Risk in Communities study. Thorax 2007; 62:873–879.
45. Wyatt SB, Akylbekova EL, Wofford MR, Coady SA, Walker ER, Andrew ME, Keahey WJ, Taylor HA, Jones DW. Prevalence, awareness, treatment, and control of hypertension in the Jackson Heart Study. Hypertension 2008; 51:650–656.