Experiences of Racism and the Incidence of Adult-Onset Asthma in the Black Women's Health Study

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Background: Chronic stress resulting from experiences of racism may increase the incidence of adult-onset asthma through effects on the immune system and the airways. We conducted prospective analyses of the relation of experiences of racism with asthma incidence in the Black Women's Health Study, a prospective cohort of black women in the United States followed since 1995 with mailed biennial questionnaires.

Methods: Among 38,142 participants followed from 1997 to 2011, 1,068 reported incident asthma. An everyday racism score was created based on five questions asked in 1997 and 2009 about the frequency in daily life of experiences of racism (eg, poor service in stores), and a lifetime racism score was based on questions about racism on the job, in housing, and by police. We used Cox regression models to derive multivariable incidence rate ratios (IRRs) and 95% CIs for categories of each racism score in relation to incident asthma.

Results: The IRRs were 1.45 (95% CI, 1.19-1.78) for the highest compared with the lowest quartile of the 1997 everyday racism score (P for trend $< .0001$) and 1.44 (95% CI, 1.18-1.75) for the highest compared with the lowest category of 1997 lifetime racism. Among women who reported the same levels of racism in 1997 and 2009, the IRRs for the highest categories of everyday and lifetime racism were 2.12 (95% CI, 1.55-2.91) and 1.66 (95% CI, 1.20-2.30), respectively.

Conclusions: Given the high prevalence of experiences of racism and asthma in black women in the United States, a positive association between racism and asthma is of public health importance.

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Abbreviations: BWHS = Black Women's Health Study; IRR = incidence rate ratio

The burden of asthma in the United States is high, with the prevalence rising from 3.1% in 1980 to 8.2% in 2009.¹ In 2009, the annual incidence rate of adult-onset asthma was 3.8 in 1,000, and 17.5 million adults were affected by the disease.¹ The established risk factors for adult-onset asthma include

obesity^{2,3} and certain occupational exposures.⁴ Sedentaryness,^{5,6} smoking,^{5,7} female hormone supplements,⁸ acetaminophen,⁹ and short stature^{5,6,10} have also been implicated.

In various studies, war-related stress,¹¹ perceived stress,¹² and abuse during childhood¹³ have been asso-

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ciated with an increased risk of adult-onset asthma. Racism is a source of stress for blacks,¹⁴⁻¹⁸ and experiences of racism have been associated with several adverse health outcomes, including hypertension,¹⁹

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preterm birth,^{20,21} sleep disturbance,²² and obesity.²³ A stress pathway has been hypothesized to explain the association between experiences of racism and adverse health outcomes.¹⁵ The physiologic response to chronic stress, particularly its effects on the immune system and the airways,²⁴⁻²⁶ may be relevant to asthma.

The objective of the current analysis was to test the hypothesis that experiences of racism are positively associated with adult-onset asthma incidence. The data were derived from 14 years of follow-up of a large cohort study of black women.

MATERIALS AND METHODS

Establishment of the Black Women's Health Study

The Black Women's Health Study (BWHS) is a prospective cohort study established in 1995, when 59,000 black women aged 21 through 69 years enrolled by completing health questionnaires.²⁷ The baseline questionnaire elicited information on demographic and lifestyle factors, reproductive history, and medical conditions. The cohort is followed biennially by mailed questionnaires to update exposures and ascertain incident disease. Follow-up of the original cohort through seven completed questionnaire cycles is 80%. The study protocol was approved by the institutional review board of Boston University School of Medicine (H-31125). Participants indicate consent by completing and returning the questionnaires.

Diagnosis of Asthma

On all questionnaires from 1997 through 2011, participants were asked whether they had been diagnosed with asthma in the previous 2-year interval, the year in which they had first been diagnosed, and if they used "inhalers or pills" for asthma at least 3 days per week. Adult-onset asthma was defined as an initial physician diagnosis of asthma made after 1997 through 2011, with concurrent use of asthma medication. In a subset of 43 women who met the case definition and who gave permission to contact their physicians, 39 (91%) were confirmed by the physician as having asthma.

Ascertainment of Racism

The 1997 follow-up questionnaire contained eight questions on experiences of racism adapted from an instrument developed by Williams et al.¹⁶ Five questions about everyday racism asked about the frequency in daily life of the following experiences: "You receive poorer service than other people in restaurants or stores," "People act as if they think you are not intelligent," "People act as if they are afraid of you," "People act as if they think you are dishonest," and "People act as if they are better than you." Response options were "never," "a few times a year," "once a month," "once a week," and "almost every day," coded as 1 through 5. An everyday racism score was created by averaging subjects' responses to the five questions. Three questions ascertained lifetime racism by asking whether the participant was ever "treated unfairly due to your race" on the job, in housing, and by the police. Response categories were "yes" and "no." A lifetime racism score summed the positive responses (0, 1, 2, or 3). The racism questions were asked again on the 2009 questionnaire and scored in the same way.

Covariates

Data on weight, height, and education were obtained at baseline in 1995; weight was updated on each subsequent follow-up

questionnaire. Data on smoking, alcohol consumption, hours/week spent in vigorous physical activity, and use of female hormone supplements were ascertained at baseline and updated at every questionnaire cycle. In 1997, respondents were asked about exposure to secondhand tobacco smoke at ages 0 to 10 years (home), 11 to 20 years (home), 21 to 30 years (home and work), 31 to 40 years (home and work), and currently (home and work), with exposure defined as being "in the same room with a smoker for at least an hour a day for 12 consecutive months or more." Follow-up questionnaires also obtained information on asthma in the participant's mother or father and whether the participant had health insurance and a regular doctor (ascertained in 1997), household income (ascertained in 2003), whether the participant was abused as a child (ascertained in 2005), and whether the participant's mother smoked when pregnant with her (ascertained in 2009).

Analytic Cohort

Follow-up for the current analysis was 1997 through 2011. Of 51,070 women who completed the 1997 questionnaire and at least one follow-up questionnaire, we excluded those who did not answer all of the racism questions ($n = 4,381$), had prevalent lung cancer ($n = 41$), were missing information on smoking ($n = 27$), reported childhood asthma ($n = 866$), or reported prevalent asthma as of 1997 ($n = 4,987$). We also excluded 1,110 women who reported a diagnosis of asthma but no concurrent asthma medication use, 1,430 women who reported asthma medication use but no diagnosis of asthma, and 86 women who met the case criteria but who disconfirmed having asthma on a supplemental questionnaire. After exclusions, 38,142 women remained in the analytic cohort, of whom 1,068 met the case criteria.

Statistical Analysis

We used Cox proportional hazards regression models to estimate incidence rate ratios (IRRs) and 95% CIs for incident asthma. Participants contributed person-time from 1997 until diagnosis of asthma, death, loss to follow-up, or end of follow-up, whichever came first. In an initial model, we adjusted only for age and questionnaire cycle (time period). In a multivariable model, we added covariates that may be risk factors for adult-onset asthma: BMI, weight in kg/height² in m (< 25.0 , $25.0-29.9$, $30.0-34.9$, $35.0-39.9$, ≥ 40.0); pack years of smoking (0, 1-4, 5-14, 15-24, ≥ 25); current smoking (yes, no); exposure to secondhand smoke at each of ages 0-10, 11-20, 21-30, and 31-40 years and currently (yes, no); vigorous exercise in hours/week (0, < 5 , ≥ 5); female hormone use (never, < 5 years, ≥ 5 years); parental history of asthma (yes, no, unknown); mother's smoking status (yes, no, unknown); education in years (≤ 12 , 13-15, 16, ≥ 17); household income ($\leq \$25,000$, $\$25,001-50,000$, $\$50,001-100,000$, $> \$100,000$); and alcohol consumption in drinks/week (never, past any amount, current 1-3, 4-6, 7-13, ≥ 14). Alcohol consumption was a risk factor for asthma in a large Danish study²⁸ and was associated with asthma incidence in the BWHS. The addition of indicators for having health insurance and a regular doctor, and the presence of childhood abuse (associated with asthma incidence in the BWHS),¹³ did not change the results. Missing values were modeled as separate categories. We tested for trend by including the everyday and lifetime racism scores in the model as ordinal variables.

RESULTS

Women in the analytic cohort were followed for an average of 13 years, for a total of 227,651 person-years. At baseline in 1997, compared with women in the lowest quartile of the everyday racism score, those in

the highest quartile were younger, more highly educated, and heavier; had greater exposure to second-hand smoke; and were more likely to have used female hormones, to be current drinkers, and to report more pack-years of smoking (Table 1). Women who answered “yes” to all three lifetime racism questions were older than those who answered “no” to all questions; had higher levels of education, income, and exercise; and were more likely to be current drinkers and to have been exposed to secondhand smoke.

Table 2 shows data on the relation between everyday and lifetime racism scores and asthma incidence. In the initial model adjusted for age and time period only, relative to the first quartile of the everyday racism score, IRRs increased with increasing quartiles to 1.68 (95% CI, 1.37-2.04) for the fourth quartile (P for trend $< .0001$). Adjustment for confounders in the multivariable model attenuated the association; the IRR in the highest quartile of everyday racism was 1.45 (95% CI, 1.19-1.78) (P for trend $< .0001$).

In the initial model, the IRRs for the lifetime racism categories (Table 2) increased with increasing quartiles to 1.52 (95% CI, 1.25-1.84) in the highest compared with the lowest category. In the multivariable model, the IRR in the highest category was 1.44 (95% CI, 1.18-1.75) (P for trend = .0004).

We conducted a subanalysis confined to women who answered the racism questions in 2009 as well as in 1997; the results were similar to those shown in Table 2 (data not shown). In an analysis of women who were in the same quartile of everyday racism

($n = 11,256$) or category of lifetime racism ($n = 13,083$) in both time periods (Table 3) and may have had more consistent experiences of racism over time, the IRRs were higher than in the main analysis. The multivariable IRRs for the highest categories of everyday and lifetime racism were 2.12 (95% CI, 1.55-2.91) and 1.66 (95% CI, 1.20-2.30), respectively. In a sensitivity analysis, we expanded the incident case definition to include all physician-diagnosed asthma, regardless of medication use ($n = 2,102$); the results were similar to the main results (data not shown).

DISCUSSION

In this large population of black women, experiences of everyday and lifetime racism were associated with an increased incidence of adult-onset asthma. The associations were stronger when we confined the analyses to women who reported the same level of everyday and lifetime racism in 1997 and 2009; these women may have had more consistent experiences of racism over time.

Previous studies, none reporting on racism, have found associations between a variety of types of stress and asthma incidence.^{11-13,29,30} A prospective study that followed children from birth to age 3 years found that the presence of maternal intimate partner violence increased the odds of doctor-diagnosed asthma (OR = 1.8; 95% CI, 1.0-3.5).³⁰ In another study in children up to age 9 years, levels of community violence were associated with asthma risk, with an OR of

Table 1—Baseline Characteristics According to Summary Racism Scores, BWHS

Characteristics ^a	Summary Everyday Racism		Summary Lifetime Racism	
	Quartile 1	Quartile 4	No to All	Yes to All
Participants	7,277	9,087	11,916	4,072
Age, y	43.9 ± 11.7	38.2 ± 9.4	40.3 ± 11.2	41.8 ± 9.7
College graduate (1995)	43	47	42	52
Income > \$50,000 (2003)	42	43	42	46
Female hormone use, ever	17	21	18	20
BMI, kg/m ²	27.5 ± 6.3	28.9 ± 6.8	28.1 ± 6.6	28.4 ± 6.6
Has health insurance	92	92	93	91
Has a regular physician	87	86	87	85
Vigorous exercise ≥ 5 h/wk	9	10	8	11
Current drinker	25	29	25	29
Current smoker	15	17	15	17
Smoking among current/past smokers, pack-y	10.7 ± 11.4	12.0 ± 13.2	11.1 ± 12.2	11.2 ± 11.7
Exposure to secondhand smoke				
Ages 0-10 y	45	53	47	53
Ages 11-20 y	45	52	46	52
Ages 21-30 y	47	56	47	56
Ages 31-40 y	31	37	31	36
Mother smoked during pregnancy (2009)	8	10	8	10
Parental history of asthma (1999)	5	6	6	7

Data are presented as % or mean ± SD. Means and percentages were standardized to the age distribution of the cohort in 1997. Extreme categories of everyday and lifetime racism are shown. BWHS = Black Women's Health Study.

^aCharacteristics are percentages ascertained in 1997 unless noted otherwise.

Table 2—Everyday and Lifetime Racism Scores in 1997 and Asthma Incidence, BWHS, 1997-2011

Scores	No. of Cases (Person-y)	Age- and Period-Adjusted IRR (95% CI)	Multivariable IRR ^a (95% CI)
Everyday racism score			
Quartile 1	152 (85,334)	1.00 (Ref)	1.00 (Ref)
Quartile 2	283 (131,042)	1.23 (1.01-1.50)	1.19 (0.98-1.46)
Quartile 3	329 (129,759)	1.48 (1.21-1.79)	1.39 (1.14-1.69)
Quartile 4	304 (108,172)	1.68 (1.37-2.04)	1.45 (1.19-1.78)
P for trend	...	< .0001	< .0001
Lifetime racism score			
No to all	287 (141,354)	1.00 (Ref)	1.00 (Ref)
Yes to 1	342 (152,788)	1.09 (0.93-1.27)	1.07 (0.91-1.25)
Yes to 2	282 (111,719)	1.20 (1.02-1.42)	1.18 (1.00-1.39)
Yes to 3	157 (48,446)	1.52 (1.25-1.84)	1.44 (1.18-1.75)
P for trend	...	< .0001	.0004

IRR = incidence rate ratio; Ref = reference. See Table 1 legend for expansion of other abbreviation.

^aAdjusted for age, time period, BMI (< 25.0, 25.0-29.9, 30.0-34.9, 35.0-39.9, ≥ 40.0 kg/m², missing), current smoker (yes, no), pack-y of smoking (0, 1-4, 5-14, 15-24, ≥ 25, missing), secondhand smoke exposure (ages 0-10 y at home, 11-20 y at home, 21-30 y at home or work, 31-40 y at home or work, and currently at home or work) (yes, no, missing), vigorous exercise in h/wk (0, < 5, ≥ 5, missing), alcohol use in drinks/wk (never, past any amount, current 1-3, 4-6, 7-13, ≥ 14, missing), female hormone use (never, < 5 y, ≥ 5 y, missing), parental history of asthma (yes, no, unknown), mother's smoking status (yes, no, unknown), education in years (≤ 12, 13-15, 16, ≥ 17, missing), and household income (≤ \$25,000, \$25,001-50,000, \$50,001-100,000, > \$100,000, missing).

1.56 (95% CI, 1.12-2.18) for a high relative to a low level of violence.²⁹ Several prospective studies suggest a role for stress in the development of adult-onset asthma.¹¹⁻¹³ The first was a study of the effects of war-related stress on older adults (aged 50-69 years) in Kuwait following the 1990 Iraqi invasion.¹¹ Using a war-related stress score, the authors found that subjects at the highest level were more than twice as likely to report incident asthma over 13 years of follow-up than were those reporting no stressors (OR = 2.3; 95% CI, 1.3-3.9). In a recent Danish study, participants who reported high levels of stress in 1981 had more than twice the risk of adult-onset asthma over

the next decade than did those reporting low stress levels (OR = 2.32; 95% CI, 1.47-3.65).¹² Finally, in previous analyses in the BWHS, childhood physical abuse, a source of stress that may persist into adulthood,³¹ was positively associated with adult-onset asthma: The IRR was 1.26 (95% CI, 1.07-1.49) for childhood physical abuse relative to no abuse.¹³ Although the biologic pathways linking stress to asthma onset have yet to be described definitively, evidence suggests that stress effects on the immune³²⁻³⁴ and autonomic nervous systems^{24,35} may increase airway inflammation and hyperresponsiveness²⁵ and thereby contribute to the development of asthma.

Table 3—Everyday and Lifetime Racism Scores in 1997 and 2009 and Asthma Incidence Among Women With Unchanged Scores in Both Years, BWHS, 1997-2011

Scores	No. of Cases (Person-y)	Age- and Period-Adjusted IRR (95% CI)	Multivariable IRR ^a (95% CI)
Everyday racism score ^b			
Quartile 1	74 (45,758)	1.00 (Ref)	1.00 (Ref)
Quartile 2	93 (43,059)	1.33 (0.98-1.81)	1.30 (0.95-1.77)
Quartile 3	83 (34,389)	1.49 (1.08-2.05)	1.45 (1.05-2.01)
Quartile 4	100 (26,581)	2.39 (1.75-3.25)	2.12 (1.55-2.91)
P for trend	...	< .0001	< .0001
Lifetime racism score ^c			
No to all	135 (75,369)	1.00 (Ref)	1.00 (Ref)
Yes to 1	112 (48,819)	1.24 (0.97-1.60)	1.25 (0.97-1.62)
Yes to 2	82 (33,145)	1.32 (1.00-1.74)	1.36 (1.03-1.81)
Yes to 3	55 (17,066)	1.65 (1.20-2.26)	1.66 (1.20-2.30)
P for trend	...	.0015	.0012

See Table 1 and 2 legends for expansion of abbreviations.

^aAdjusted for age, time period, BMI (< 25.0, 25.0-29.9, 30.0-34.9, 35.0-39.9, ≥ 40.0 kg/m², missing), current smoker (yes, no), pack-y of smoking (0, 1-4, 5-14, 15-24, ≥ 25, missing), secondhand smoke exposure (ages 0-10 y at home, 11-20 y at home, 21-30 y at home or work, 31-40 y at home or work, and currently at home or work) (yes, no, missing), vigorous exercise in h/wk (0, < 5, ≥ 5, missing), alcohol use in drinks/wk (never, past any amount, current 1-3, 4-6, 7-13, ≥ 14, missing), female hormone use (never, < 5 y, ≥ 5 y, missing), parental history of asthma (yes, no, unknown), mother's smoking status (yes, no, unknown), education in years (≤ 12, 13-15, 16, ≥ 17, missing), and household income (≤ \$25,000, \$25,001-50,000, \$50,001-100,000, > \$100,000, missing).

^bIncludes 11,256 women who stayed in the same quartile of everyday racism in 1997 and 2009.

^cIncludes 13,083 women who stayed in the same category of lifetime racism in 1997 and 2009.

In the current study, experiences of racism in 1997 were reported before the diagnoses of asthma during subsequent follow-up, obviating recall bias. The large sample size produced stable estimates, and we controlled for a range of potentially confounding factors, including known and suspected risk factors for adult-onset asthma. However, it was not possible to control for environmental factors that may have been confounders, including indoor allergens and outdoor air pollution. Misclassification may have affected our measures of experiences of everyday and lifetime racism. However, the measures used were similar to those used previously in other studies of racism.^{16,36-38} The racism questions have shown good reproducibility in other studies.^{16,39} Reproducibility was also good in our cohort: Among 1,172 women in the BWHS who returned duplicate questionnaires in 1997, weighted κ values for agreement between questionnaires ranged from 0.54 to 0.73.⁴⁰ Finally, in the current study, the associations were stronger based on women whose racism scores in 1997 and 2009 were similar, and these may have been less affected by misclassification than the associations that relied only on the 1997 measure.

We relied on self-reported physician-diagnosed asthma. Self-report is the standard method of identifying asthma cases in large national cohort studies^{5,41-44} because it is not feasible to examine all cases to verify asthma or to examine all noncases to identify undiagnosed asthma. In a validation study among 43 women in the BWHS who met our case definition and who gave us permission to contact their physicians, 39 (91%) were confirmed by their physicians as having asthma. In addition, the overall results were consistent when we used a less-strict case definition (physician-diagnosed asthma regardless of medication use).

CONCLUSIONS

Experiences of racism were positively associated with adult-onset asthma in this large cohort of black women, suggesting that the chronic stress associated with such racism contributes to the onset of asthma in adults. Given the high prevalence of this stressor in the lives of black women,⁴⁵ the association is of significant public health importance. Our observations contribute to a growing body of evidence indicating that experiences of racism can have adverse health effects. School- and community-based programs to combat racism, if successful, may have benefits in terms of health. Furthermore, interventions to reduce racism-related stress may be an important component of any comprehensive strategy for primary asthma prevention, especially in communities with a high proportion of minority residents and a high prevalence of asthma. Brief stress-reduction interventions that have been developed to address stress from other

sources (eg, stress related to intimate partner violence⁴⁶ and military service⁴⁷) may hold promise for ameliorating racism-related stress.

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Dr Coogan: contributed to the idea for this study, study design conceptualization, analysis and interpretation of the data, and writing of the manuscript.

Mr Yu: contributed to the study design conceptualization, analysis and interpretation of the data, and critical rewriting and approval of the final version of the manuscript.

Dr O'Connor: contributed to the study design conceptualization, analysis and interpretation of the data, and critical rewriting and approval of the final version of the manuscript.

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Dr Rosenberg: contributed to the idea for this study, study design conceptualization, designing of the BWHS, supervision of the data collection, analysis and interpretation of the data, and critical rewriting and approval of the final version of the manuscript.

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