

# Child and Adolescent Abuse in Relation to Obesity in Adulthood: The Black Women's Health Study

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## KEY WORDS

obesity, violence, adversity, child abuse, African American

## ABBREVIATIONS

BWHS—Black Women's Health Study

CI—confidence interval

CES-D—Center for Epidemiologic Depression

RR—risk ratio

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**WHAT'S KNOWN ON THIS SUBJECT:** Childhood abuse has been associated with obesity risk in adulthood. Little is known regarding the impact of abuse severity on risk, potential mechanisms are poorly understood, and few studies have been conducted among minority populations.



**WHAT THIS STUDY ADDS:** Severity of child/teenager physical and sexual abuse is associated with increased risk for adult obesity and/or central adiposity in adulthood. These are the first such findings in a large cohort of US black women.

## abstract



**OBJECTIVE:** To investigate the association of physical and sexual abuse in childhood and adolescence with risk of adult obesity among black women in the United States.

**METHODS:** Participants were women enrolled in the Black Women's Health Study, an ongoing prospective cohort study begun in 1995. In 2005, 33 298 participants completed a self-administered questionnaire on early life experiences of abuse. Log-binomial regression models were used to derive risk ratios (RRs) and 95% confidence intervals (CIs) for the relation of child/teenager abuse with obesity (BMI  $\geq 30$ ) and central adiposity (waist circumference  $>35$  inches) reported in 2005.

**RESULTS:** The RR for BMI  $\geq 30$ , a measure of overall obesity, was 1.29 (95% CI 1.20–1.38) for the highest severity of exposure to child/teenager physical and sexual abuse relative to no abuse. After controlling for postulated intermediates, including reproductive history, diet, physical activity, depressive symptoms, and socioeconomic status, the RR was 1.14 (95% CI 1.08–1.21). The RR for waist circumference  $>35$  inches, which measures central obesity, for severe physical and sexual abuse relative to no abuse was 1.29 (95% CI 1.19–1.38) before adjustment for intermediates and 1.18 (95% CI 1.10–1.27) after adjustment.

**CONCLUSIONS:** Early life sexual and physical abuse was associated with an increased risk of overall and central obesity in adulthood. Although the association between abuse and obesity was explained to some extent by health behaviors, reproductive history, and mental health, these factors did not fully account for the associations. Our data suggest that early life adversity is related to adult body size and weight distribution. *Pediatrics* 2012;130:245–253

Obesity is the second leading cause of preventable death. This growing public health epidemic is unequally distributed by sex, race/ethnicity, and socioeconomic status, and is most pronounced among blacks, Hispanics, and those of lower socioeconomic status.<sup>1</sup> The alarming rise in obesity prevalence suggests that environmental and behavioral influences may fuel the present epidemic.<sup>2</sup>

Childhood abuse is now recognized as a life course social determinant of health.<sup>3,4</sup> Although there is an extensive literature on the psychological impact of abuse in childhood, research on the physical health consequences of childhood abuse is still in its infancy. During recent years, new research evidence has emerged, highlighting the long-term impacts of child maltreatment on morbidity and mortality in adulthood<sup>5</sup> and physical and mental health risks.<sup>6</sup> Childhood physical, psychological, and sexual abuse and parental neglect have been associated with increased risk for obesity in adulthood.<sup>7–16</sup> Few of these studies have been among racially/ethnically diverse populations or larger cohorts. Moreover, mechanisms linking childhood adversities and adult health outcomes are poorly understood.

An association of childhood abuse with obesity may be explained by several plausible pathways. Researchers hypothesize that behavioral changes, including inactivity, emotional eating, and overeating as a means of coping with the psychological impact of abuse may lead to disruption of metabolic systems and hormonal changes.<sup>10</sup> However, although several studies have found that child abuse is a risk factor for disordered eating,<sup>17–24</sup> others have found an inconsistent association.<sup>25,26</sup>

Psychosocial stressors may impact responsiveness of the hypothalamic-pituitary-adrenal axis and neuroendocrine functioning.<sup>27</sup> Moreover, empirical research consistently documents that

racial/ethnic minorities and those residing in urban cities are at increased risk for witnessing violence and direct victimization.<sup>28</sup> Therefore, it is plausible that exposure to violence is 1 pathway through which social inequalities in weight status are produced and maintained.

By the use of data collected from the Black Women's Health Study (BWHS), a national cohort study of 59 000 black women, we investigated the association of early life abuse (occurring in childhood or adolescence) with obesity in adulthood; we considered adult BMI  $\geq 30$  to be a marker of overall obesity and an adult waist circumference exceeding 35 inches to be a marker of central obesity. We tested the following hypotheses: (1) severity of early life abuse is associated with risk for adult overall and central obesity; (2) type of abuse is associated with risk for adult overall and central obesity; (3) health behaviors, socio-demographics, and reproductive factors in adulthood partially explain the associations.

## METHODS

### Study Sample

The BWHS is a prospective cohort study of ~59 000 self-identified black women ages 21 to 69 years at baseline in 1995. Respondents are from all parts of the United States, mainly California, New York, New Jersey, Illinois, Michigan, and Georgia, recruited through the *Essence* magazine subscriber list, professional organization rosters, and friends and relatives of early respondents.<sup>29</sup> Cohort members are surveyed biennially. The retention rate was ~80% of the baseline cohort in 2007 (12 years after study initiation). The cohort establishment and data collection were approved by the institutional review board of Boston University Medical Center.

We excluded women who did not complete the 2005 questionnaire ( $n = 15$

888), did not complete the questions on abuse as a child or teenager on the 2005 follow-up questionnaire ( $n = 6618$ ), did not provide adequate information to calculate BMI in 2005 ( $n = 786$ ), were currently pregnant in 2005 ( $n = 314$ ), had gastric bypass surgery ( $n = 112$ ), or had a previous diagnosis of cancer ( $n = 2046$ ), leaving 33 298 women for analysis.

Women who completed the abuse questions were similar to those who did not with respect to mean waist circumference (32.1 vs 32.1 inches), waist to hip ratio (0.80 vs 0.79), education (14.9 vs 14.5 years), BMI in 2005 (30.2 vs 30.1), and age (39.0 vs 40.2 years). Women who completed the 2005 questionnaire were similar to those who did not with respect to mean waist circumference (32.1 vs 32.1 inches), waist to hip ratio (0.80 vs 0.79), education (14.8 vs 14.4 years), BMI at baseline (27.9 vs 28.1), and age (39.2 vs 38.7 years). Women who provided BMI information in 2005 were similar to those who did not with respect to mean waist circumference (32.1 vs 32.1 inches), waist to hip ratio (0.80 vs 0.79), baseline education (14.8 vs 14.5 years), BMI at baseline (27.9 vs 28.3), and age (39.2 vs 39.0 years).

## Measures

### Assessment of Outcome

BMI was calculated as weight in kilograms divided by meters squared ( $\text{kg}/\text{m}^2$ ) based on height reported on the baseline questionnaire (1995) and weight reported on the 2005 questionnaire. Women reported their waist circumference at the level of the umbilicus (in inches) on the 2005 questionnaire. In a validation study conducted among 115 BWHS participants residing in or near Washington, DC, correlation coefficients for self-reported height, weight, and waist circumference with technician measurements were 0.93, 0.97, and 0.75, respectively.<sup>30</sup>

### Assessment of Exposure

Based on questions from the Conflict Tactics Scale<sup>31</sup> and the Pregnancy Abuse Assessment Screen,<sup>32</sup> a 9-item instrument was included on the 2005 follow-up questionnaire to assess exposure to abuse in childhood (up to age 11 years) or as a teenager (from age 12 to 18 years). Frequency of exposure to abuse was assessed for all items by using the following response categories: “never,” “1 to 3 times,” or “ $\geq 4$  times.” As has been previously described, a principal components factor analysis of the childhood physical and sexual abuse data was conducted and confirmed 2 domains for the abuse questions: sexual and physical abuse.<sup>33</sup> Participants were classified as having experienced sexual abuse as a child or teenager if they reported a perpetrator having “exposed genitals against my will”  $\geq 4$  times or any frequency of sexual assault, queried as being “sexual with me against my will.” We also created a summary measure of the frequency of sexual assault (none, 1–3 incidents, and  $\geq 4$  incidents).

Physical abuse as a child or teenager was based on witnessed violence and direct victimization and defined as report of  $\geq 4$  incidents of a perpetrator having: “pushed, grabbed, or shoved me,” “threw something at me that could hurt me,” “kicked, bit, or punched me,” “hit me with something including hand or fist,” or “physically attacked me in some other way,” and any frequency of being “choked or burned” or “seriously harmed someone I loved.” We created a summary score for child/teenager physical abuse by assigning

respondents 1 point for each report of a physical abuse item that occurred  $\geq 4$  times, with the exception of “choked or burned” or “seriously harmed someone I loved” for which we assigned 1 point if they occurred 1 to 3 times and 2 points if they occurred  $\geq 4$  times, because we considered these events to be more severe. The resulting score, which ranged from 0 to 18, was categorized as low (score = 1–2), intermediate (score = 3–5), and high (score  $\geq 6$ ).

Based on the principal components analysis and informed by theory and empirical data, we derived a measure of severity of child/teenager abuse that incorporated both summary variables for physical and sexual abuse frequency (Table 1). Mild abuse was defined as low physical abuse score (1–2) and no sexual abuse. Moderate abuse included intermediate physical abuse score (3–5) and/or sexual abuse 1 to 3 times. Severe physical or sexual abuse included high physical abuse score ( $\geq 6$ ) or sexual abuse  $\geq 4$  times. Severe physical and sexual abuse included both high physical abuse score ( $\geq 6$ ) and sexual abuse  $\geq 4$  times.

### Covariates

Education was reported on the 1995 questionnaire and updated in 2003. Information on birth weight and age at menarche was collected on the baseline survey. Information on marital status, smoking status, alcohol consumption, vigorous physical activity, contraceptive use, menopausal status, and reproductive history was collected at baseline and on follow-up questionnaires. Total daily energy in-

take (converted to kilocalories) and percentage of calories from fat (converted to grams) were derived from food frequency questionnaires,<sup>34</sup> that were included in the 1995 and 2001 questionnaires; weekly restaurant food consumption and soda consumption were also ascertained on those questionnaires. The 1995 food frequency questionnaire was validated among 408 members of the cohort.<sup>35</sup> Current household income was assessed on the 2003 questionnaire. Whether the participant was born within or outside the United States, geographic region of residence at birth, and depressive symptoms (as measured by the Center for Epidemiologic Depression [CES-D] Scale)<sup>36</sup> were assessed on the 2005 questionnaire.

### Statistical Analysis

Log-binomial regression models were conducted by using PROC GENMOD in SAS (SAS Institute Inc, Cary, NC) to estimate risk ratios (RRs) and 95% confidence intervals (CIs) for abuse in relation to risk of overall obesity (BMI  $\geq 30$ ) and central obesity (waist circumference  $> 35$  inches) in 2005.<sup>37</sup> Multivariable models controlled for age (years, 5-year categorical), years of education ( $< 12$ , 13–15, 16,  $\geq 17$  years), household income ( $< \$25\,000$ ,  $\$25\,001$ – $\$50\,000$ ,  $\$50\,001$ – $\$100\,000$ ,  $> \$100\,000$ ), marital status (married or partnered, single, divorced/separated/widowed), foreign-born status (born in the United States or abroad), birth weight ( $< 4$  lbs, 4–5 lbs 8 oz,  $> 5$  lbs 8 oz), age at menarche ( $\leq 10$ , 11, 12, 13, 14,  $\geq 15$  years), alcohol consumption

**TABLE 1** Study Definition of Abuse in Childhood or Adolescence

Severity of Abuse	Sexual Abuse	Physical Abuse
Mild physical abuse	None	Low physical abuse score (1–2)
Moderate physical or sexual abuse	1–3 incidents of sexual abuse	Intermediate physical abuse score (3–5)
Severe physical or sexual abuse	$\geq 4$ incidents of sexual abuse or	High physical abuse score ( $\geq 6$ )
Severe physical and sexual abuse	$\geq 4$ incidents of sexual abuse and	High physical abuse score ( $\geq 6$ )

Abuse may occur as child and/or teenager.

(none, 1–6,  $\geq 7$  drinks per week), television viewing (none, 1–2, 3–4,  $\geq 5$  hours per week), vigorous physical activity ( $< 5$ ,  $\geq 5$  hours per week), current smoking (none,  $< 15$ ,  $\geq 15$  cigarettes/day), energy intake (500–1000, 1000–2000, 2000–3800 kcal/day), fast food consumption ( $< 2$ , 2 to  $< 4$  times per month, 1 to  $< 2$ , 2 to  $< 4$ ,  $\geq 4$  times per week), soda consumption (none, 1–4/month, 2–6/week,  $\geq 1$ /day), and depressive symptoms ( $< 15$ ,  $\geq 16$  CES-D score). The variable values used were those ascertained in 2005 or the closest preceding questionnaire. The reference category for all analyses was no abuse as a child or teenager. Missing covariate data were modeled by using missing indicator variables.

We stratified our analyses by smoking history and age at baseline ( $< 40$ ,  $\geq 40$  years). We used the likelihood ratio test to assess interaction by age, comparing models with and without interaction terms between abuse variables and age. A 2-sided *P* value of

$< 0.05$  was considered significant. All analyses were performed by using SAS statistical software (version 9.1).

## RESULTS

The median age of participants in 2005 was 49 years. The mean weight was 82 kg. Nearly 58% of women reported at least 1 instance of abuse as a child or teenager. Frequency distributions for severity of abuse were as follows: 18% with mild physical abuse, 27% with moderate physical and/or sexual abuse, 11% with severe physical or sexual abuse, and 2% with severe physical and sexual abuse. Severe abuse was positively associated with depressive symptoms, smoking, and body weight, and inversely associated with being married and household income (Table 2).

Table 3 present the results from the multivariable log-binomial regression models for child/teenager abuse and obesity. In comparison with those reporting no abuse, those reporting severe physical or sexual abuse and

severe physical and sexual abuse had the highest RRs, 1.17 (95% CI 1.12–1.28) and 1.29 (95% CI 1.20–1.38), respectively. RRs were attenuated after controlling for potential causal intermediates, with the greatest reduction due to control for reproductive history, health behaviors, and depressive symptoms; in fully adjusted models, the RRs for the 2 highest categories of abuse were 1.09 (95% CI 1.05–1.14) and 1.14 (95% CI 1.08–1.21), respectively.

In a parallel analysis for waist circumference (Table 4), relative to no abuse, adjusted RRs for waist circumference  $> 35$  inches were 1.12 (95% CI 1.05–1.12) for severe physical or sexual abuse and 1.18 (95% CI 1.10–1.27) for severe physical and sexual abuse. Because of the strong association between smoking and waist circumference, we repeated the analyses for waist circumference after the exclusion of 3156 women who reported smoking. The results were weaker among the nonsmokers; RRs were 1.08 (95% CI 1.03–1.13) and 1.09 (95%

**TABLE 2** Distribution of Baseline Characteristics by Abuse as a Child or Teenager: BWHS, 2005 (*N* = 33 298)

	No Abuse	Mild Physical Abuse	Moderate Physical and/or Sexual Abuse	Severe Physical or Sexual Abuse	Severe Physical and Sexual Abuse
Number of women	14,126	5882	8973	3513	804
Age, y, mean (SD)	49 (10)	48 (10)	48 (10)	47 (10)	47 (9)
Weight, kg, mean (SD)	81 (19)	82 (20)	83 (21)	85 (21)	88 (22)
BMI, mean (SD)	30 (7)	30 (7)	31 (7)	31 (8)	32 (8)
Waist circ, inches, mean (SD)	35 (6)	35 (6)	35 (6)	36 (6)	36 (7)
Education, <i>n</i> (%)					
$\leq 12$ y	2583 (18)	881 (15)	1391 (16)	541 (15)	138 (17)
13–15 y	4596 (33)	1914 (33)	3268 (36)	1402 (40)	338 (42)
16 y	3549 (25)	1581 (27)	2248 (25)	823 (24)	165 (21)
$\geq 17$ y	3383 (24)	1505 (26)	2063 (23)	744 (21)	163 (20)
Income, <i>n</i> (%)					
$< 25$ K	1579 (11)	607 (10)	1008 (11)	443 (12)	129 (16)
25–49K	4085 (29)	1608 (27)	2563 (28)	1042 (30)	256 (32)
$\geq 50$ K	7232 (51)	3251 (55)	4807 (54)	1794 (51)	366 (45)
Missing	1230 (9)	416 (8)	595 (7)	234 (7)	53 (7)
Marital status married, <i>n</i> (%)	6106 (46)	2540 (46)	3756 (44)	1382 (42)	281 (38)
Foreign born, <i>n</i> (%)	648 (5)	279 (5)	479 (5)	204 (6)	44 (6)
Nulliparous, <i>n</i> (%)	3870 (28)	1689 (29)	2470 (28)	957 (27)	199 (25)
Alcohol intake 7+/wk, <i>n</i> (%)	451 (3)	212 (4)	354 (4)	176 (5)	43 (5)
Vigorous exercise none, <i>n</i> (%)	6270 (52)	2565 (50)	3868 (49)	1509 (49)	379 (55)
Premenopausal, <i>n</i> (%)	6213 (52)	2927 (58)	4684 (62)	1908 (65)	418 (64)
Current smoker, <i>n</i> (%)	1382 (10)	609 (10)	1076 (12)	465 (13)	151 (19)
Depressive symptoms (CES-D $\geq 16$ ), <i>n</i> (%)	2366 (20)	1245 (24)	2361 (30)	1127 (36)	308 (43)

Columns display the number, mean, or percent with characteristic for each level of abuse as a child or teenager. Those with missing data for education (*n* = 22) are not listed. circ, circumference.



**TABLE 3** Relative Risk of Adult BMI  $\geq 30$  According to Severity of Exposure to Abuse in Childhood and Adolescence: BWHS (2005)

Abuse as Child and/or Teenager	BMI $<30$ , <i>n</i> (%)	BMI $\geq 30$ , <i>n</i> (%)	Model 1, <sup>a</sup> RR (95% CI)	Model 2, <sup>b</sup> RR (95% CI)	Model 3, <sup>c</sup> RR (95% CI)
No abuse	8303 (44)	5823 (40)	1.00 (referent)	1.00 (referent)	1.00 (referent)
Mild physical abuse	3383 (18)	2499 (17)	1.02 (0.99–1.06)	1.04 (1.00–1.07)	1.03 (0.99–1.06)
Moderate physical and/or sexual	4964 (26)	4009 (28)	1.07 (1.04–1.11)	1.07 (1.04–1.10)	1.07 (1.04–1.10)
Severe physical or sexual abuse	1854 (10)	1659 (12)	1.17 (1.12–1.28)	1.13 (1.08–1.17)	1.09 (1.05–1.14)
Severe physical and sexual abuse	376 (2)	428 (3)	1.29 (1.20–1.38)	1.25 (1.17–1.33)	1.14 (1.08–1.21)
<i>P</i> <sub>Trend</sub>			<.0001	<.0001	<.0001

BMI (*N* = 33 298).

<sup>a</sup> Model 1 age-adjusted.

<sup>b</sup> Model 2 controls for all variables in model 1 and marital status, education, birth weight, foreign born, and menopause.

<sup>c</sup> Model 3 controls for all variables in model 2 and parity, alcohol use, smoking status, energy intake, soda consumption, fast food, TV viewing, vigorous physical activity, and depressive symptoms.

**TABLE 4** Relative Risk of Adult Waist Circumference  $>35$  Inches According to Severity of Exposure to Abuse in Childhood and Adolescence: BWHS (2005)

Abuse as Child and/or Teen	WC $\leq 35$ , <i>n</i> (%)	WC $>35$ , <i>n</i> (%)	Model 1, <sup>a</sup> RR (95% CI)	Model 2, <sup>b</sup> RR (95% CI)	Model 3, <sup>c</sup> RR (95% CI)
No abuse	6426 (43)	4683 (40)	1.00 (referent)	1.00 (referent)	1.00 (referent)
Mild physical abuse	2709 (18)	2002 (17)	1.02 (0.97–1.06)	1.02 (0.98–1.06)	1.01 (0.97–1.05)
Moderate physical and/or sexual	4029 (27)	3239 (28)	1.07 (1.03–1.10)	1.07 (1.03–1.10)	1.05 (1.02–1.08)
Severe physical or sexual abuse	1485 (10)	1383 (12)	1.17 (1.11–1.21)	1.15 (1.11–1.20)	1.12 (1.05–1.12)
Severe physical and sexual abuse	305 (2)	349 (3)	1.29 (1.19–1.38)	1.27 (1.18–1.36)	1.18 (1.10–1.27)
<i>P</i> <sub>Trend</sub>			<.0001	<.0001	<.0001

Waist circumference (*N* = 26 610). WC, waist circumference.

<sup>a</sup> Model 1 age-adjusted.

<sup>b</sup> Model 2 controls for all variables in model 1 and marital status, education, birth weight, foreign born, and menopause.

<sup>c</sup> Model 3 controls for all variables in model 2 and parity, alcohol use, smoking status, energy intake, soda consumption, fast food, TV viewing, vigorous physical activity, and depressive symptoms.

CI 0.99–1.20) for severe physical or sexual abuse and severe physical and sexual abuse relative to no abuse, respectively.

Associations of abuse with obesity and waist circumference were present within strata of age ( $<40$  and  $\geq 40$  years) and there was no evidence of effect modification (*P* interaction = 0.25).

We evaluated the association of child/teenager abuse with waist circumference  $>35$  inches among nonobese women, those with a BMI  $<30$ . Those who reported a higher severity of child/teenager abuse had a higher risk of waist circumference  $>35$  inches; adjusted RRs for elevated waist circumference were 1.03 (95% CI 0.94–1.12) for mild physical abuse, 1.08 (95% CI 1.00–1.17) for moderate physical and/or sexual, 1.14 (95% CI 1.03–1.27) for severe physical or sexual abuse, and 1.34 (95% CI 1.09–1.63) for severe physical and sexual abuse relative to no abuse (*P*<sub>Trend</sub> = .0006).

We also evaluated the relation of abuse to overall obesity among women with a waist circumference of  $<35$  inches. Adjusted RRs for obesity were 1.03 (95% CI 0.93–1.13) for mild physical abuse, 1.02 (95% CI 0.94–1.11) for moderate physical and/or sexual, 1.09 (95% CI 0.96–1.22) for severe physical or sexual abuse, and 1.38 (95% CI 1.13–1.70) for severe physical and sexual abuse relative to those with no abuse (*P*<sub>Trend</sub> = .03).

Tables 5 and 6 present the results for BMI  $\geq 30$  and waist circumference  $>35$  inches by type of child/teenager abuse. The risks of both outcomes were greatest for women who experienced the greatest abuse severity or multiple types of abuse.

## DISCUSSION

In this large cohort study of US black women, we found a modest, statistically significant association between higher severity of abuse in early life

and adult overall and central obesity. Associations were dampened by controlling for reproductive history, health behaviors, and depressive symptoms that might have been causal intermediates. However, these lifestyle and behavioral and mental health factors did not fully account for the observed associations.

Our findings are consistent with previous research that has investigated the association between early life abuse and obesity risk in adulthood<sup>10,12,14,38</sup> and are the first such findings in a large group of US black women. Rates of exposure to abuse as a child or teenager in the BWHS were comparable to those in other retrospective reports.<sup>39</sup> The present findings add to the literature in demonstrating a graded association of a measure of physical and sexual abuse severity with obesity risk. Many of the previous analyses assessed only 1 type of abuse or did not consider the impact of severity of abuse on outcomes.

**TABLE 5** Relative Risk of Adult BMI  $\geq 30$  According to Type of Abuse in Childhood and Adolescence: BWHS (2005)

	BMI <30, n (%)	BMI $\geq 30$ , n (%)	Model 1, <sup>a</sup> RR (95% CI)	Model 2, <sup>b</sup> RR (95% CI)
Type of abuse (N = 33 298)				
None	8303 (44)	5823 (40)	1.00 (referent)	1.00 (referent)
Physical only	5240 (28)	4013 (28)	1.05 (1.02–1.08)	1.04 (1.01–1.07)
Sexual only	1791 (10)	1394 (10)	1.06 (1.02–1.10)	1.05 (1.01–1.09)
Physical and sexual	3546 (18)	3188 (22)	1.14 (1.11–1.18)	1.10 (1.06–1.13)
<i>P</i> <sub>Trend</sub>			<.0001	<.001
Physical abuse (N = 30 113) excluding sexual abuse only				
None	8303 (49)	5823 (45)	1.00 (referent)	1.00 (referent)
Low (score 1–2)	5049 (30)	3896 (30)	1.05 (1.02–1.08)	1.05 (1.02–1.07)
Intermediate (score 3–5)	2406 (14)	2043 (16)	1.10 (1.06–1.14)	1.07 (1.03–1.11)
High (score $\geq 6$ )	1331 (8)	1262 (10)	1.14 (1.09–1.20)	1.08 (1.04–1.13)
<i>P</i> <sub>Trend</sub>			<.0001	<.0001
Sexual abuse (N = 24 045) excluding physical abuse only				
None	8303 (61)	5823 (56)	1.00 (referent)	1.00 (referent)
1–3 times	4062 (30)	3329 (32)	1.06 (1.02–1.09)	1.07 (1.03–1.10)
$\geq 4$ times	1275 (9)	1253 (12)	1.14 (1.08–1.19)	1.10 (1.05–1.16)
<i>P</i> <sub>Trend</sub>			<.0001	<.0001

<sup>a</sup> Model 1 age-adjusted and mutually adjusted for both types of abuse.

<sup>b</sup> Model 2 controls for all variables in model 1 and marital status, education, birth weight, foreign born, parity, menopause, alcohol use, smoking status, energy intake, soda consumption, fast food, TV viewing, vigorous physical activity, and depressive symptoms.

**TABLE 6** Relative Risk of Adult Waist Circumference  $>35$  Inches According to Type of Abuse in Childhood and Adolescence: BWHS (2005)

	WC $\leq 35$ inches, n (%)	WC $>35$ inches, n (%)	Model 1, <sup>a</sup> RR (95% CI)	Model 2, <sup>b</sup> RR (95% CI)
Type of abuse (N = 26 610)				
None	6426 (43)	4683 (40)	1.00 (referent)	1.00 (referent)
Physical only	4231 (28)	3218 (28)	1.04 (1.02–1.08)	1.03 (1.01–1.08)
Sexual only	1414 (10)	1141 (10)	1.07 (1.02–1.10)	1.06 (1.01–1.10)
Physical and sexual	2883 (19)	2614 (22)	1.15 (1.11–1.18)	1.11 (1.07–1.14)
<i>P</i> <sub>Trend</sub>			<.0001	<.0001
Physical abuse (N = 24 055) excluding sexual abuse only				
None	6426 (48)	4683 (45)	1.00 (referent)	1.00 (referent)
Low (score 1–2)	4057 (30)	3154 (30)	1.04 (1.01–1.08)	1.02 (0.99–1.06)
Intermediate (score 3–5)	1981 (15)	1636 (16)	1.07 (1.03–1.12)	1.04 (1.00–1.08)
High (score $\geq 6$ )	1076 (8)	1042 (10)	1.14 (1.09–1.21)	1.08 (1.03–1.13)
<i>P</i> <sub>Trend</sub>			.004	.0017
Sexual abuse (N = 19 161) excluding physical abuse only				
None	6426 (60)	4683 (56)	1.00 (referent)	1.00 (referent)
1–3 times	3278 (31)	2716 (32)	1.06 (1.02–1.10)	1.04 (1.00–1.08)
$\geq 4$ times	1019 (10)	1039 (12)	1.15 (1.08–1.21)	1.12 (1.06–1.16)
<i>P</i> <sub>Trend</sub>			<.0001	<.0001

WC, waist circumference.

<sup>a</sup> Model 1 age-adjusted and mutually adjusted for both types of abuse.

<sup>b</sup> Model 2 controls for all variables in model 1 and marital status, education, birth weight, foreign born, parity, menopause, alcohol use, smoking status, energy intake, soda consumption, fast food, TV viewing, vigorous physical activity, and depressive symptoms.

There are several potential mechanisms that may explain the observed associations. First, social adversities may shape lifestyles and health behaviors. Research has demonstrated that

psychobehavioral responses to childhood violence include the use of food in response to stress in adulthood.<sup>7</sup> Emotion-focused coping strategies include eating more in general and eating

more of certain type of “comfort foods” in response to stress.<sup>40</sup> Social adversities may influence mood and mental health and therefore increase risk for sedentary behaviors and low physical activity.

Next, psychobiological conditions resulting from adversities may contribute to the development of obesity. Child sexual abuse has been associated with disordered eating patterns,<sup>23,24,41</sup> extreme weight control practices,<sup>22</sup> and bulimia,<sup>18</sup> in addition to obesity.<sup>9,12</sup> Stress may induce neuroadaptation of the reward system, in particular, serotonin levels that are known to influence regulation of satiety, and thereby lead to affective dysregulation, decreased impulse control, and compulsive eating.<sup>40</sup> Stress may lead to elevation of glucocorticoids and thereby stimulate insulin release and appetite, leading to elevated desire to eat and altered eating patterns. Positive neuroendocrine feedback associated with intake of certain foods may reduce feelings of stress and ultimately reinforce unhealthy eating patterns.<sup>40</sup> Finally, allostatic load is associated with hypothalamic-pituitary-adrenal dysregulation, increased blood levels of insulin, insulin resistance, and visceral fat accumulation.<sup>40,42</sup> Metabolic and hormonal disruption due to stress may impact adipocyte quantity and hyperplasia, ultimately influencing insulin levels and risk for insulin resistance.<sup>43,44</sup>

This study has several limitations. First, we assessed history of childhood abuse, BMI, and waist circumference at the same point in time. Several studies comparing retrospective reporting of child abuse as an adult with documented child abuse by social services have found substantial underreporting of abuse; however, self-report measures have strong discriminant validity for identifying those with a history of abuse.<sup>45</sup> Inaccuracy of recall of child abuse may be associated with

social pressures<sup>45</sup>; moreover, accurate recall of traumatic events may be difficult.<sup>46</sup> If present in our cohort, then underreporting of child/teenager abuse would likely cause underestimation of the association between child/teenager abuse and obesity. Alternatively, if women who are obese are more likely to recall negative experiences in early life, or appraise early life events as abusive, then it is possible to have overestimated associations between child/teenager abuse and obesity. The Conflict Tactics Scale questions we used had modified frequency categories; however, these questions have been associated with other outcomes in the BWHS, including age at menarche<sup>33</sup> and breast cancer.<sup>47</sup> The instruments on which our abuse questions were based have been widely used in different populations and demonstrate high reproducibility both within our cohort and in other studies.<sup>32,31</sup> Our measures did not assess who the perpetrator was. In addition, our measure of physical abuse included both direct victimization and witnessed violence. In subanalyses excluding witnessed abuse, our results did not change appreciably.

Our study does not control for other childhood hardships or social stressors. The co-occurrence of early life adversities is well appreciated.<sup>5</sup> Children in families with neglect, parental substance abuse, marital violence, and housing insecurity are also more likely to experience victimization in childhood.<sup>48</sup> Chronicity, duration, and

frequency of abuse have been associated with multiple forms of household dysfunction and neglect in a graded fashion.<sup>49,50</sup> If early life abuse is associated with other unmeasured adversities or social stressors in childhood, the association between child/teenager abuse and adult obesity may be driven by the cumulative impact of these adversities. Next, early life abuse may be a proxy for these other adversities and psychosocial stressors that may have a direct effect on obesity risk in adulthood.

Our measure of BMI is based on self-report. Because self-reported weight may tend to be lower than actual weight, we may have underestimated associations between child/teenager abuse and obesity, and our effect sizes may be relatively conservative.

## CONCLUSIONS

Our findings suggest that higher frequency of abuse in childhood or adolescence was associated with overall and central obesity in adulthood in a cohort of black women residing in the United States. Overall and abdominal obesity have been associated with all-cause mortality among women in this cohort<sup>51</sup> and others.<sup>52</sup> Childhood adversities have been linked to cardiovascular risk and poorer cardiovascular outcomes in adulthood. Early life abuse may have an enduring impact on risk for chronic illness and mortality in adulthood. Although there is no debate as to whether pediatric

providers should routinely screen for child abuse,<sup>53,54</sup> many are inconsistent in their practice.<sup>55</sup> Our findings suggest that efforts to prevent child abuse have implications for current and future health. Moreover, for survivors of abuse, behavioral patterns associated with cardiovascular risk may emerge in childhood and require tailored interventions that address trauma history in addition to modification of health behaviors. Pediatricians are uniquely poised to lead the translation of these scientific advances into practice and policy to improve child health. Trauma-informed models of pediatric preventive care may have particular significance for the prevention of cardiovascular disease. Future studies with prospective measurement of violence exposure as well as assessment of additional adversities in childhood, including poverty, material hardship, neglect, and turbulent life circumstances are needed to establish a temporal association between abuse in early life and adult overall and/or central obesity. Future studies should investigate alternative mechanisms through which early life exposures influence adult obesity, including: critical period, latent effect, or cumulative risk models.

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**PAYING TO PLAY:** *“Can I have a check for \$40?” My daughter had just come home from lacrosse practice with yet another team sweatshirt in her hands, and was asking for money to pay the team manager. The sweatshirt looked great, and she clearly liked it, but I could not help feeling that we had purchased far too much team paraphernalia over the years. She has played for three high school varsity teams, a travel soccer team and, intermittently, travel lacrosse teams. Each season, all raise money, team spirits, and camaraderie by selling shirts, sweatshirts, sweatpants, caps, and even blankets (in Vermont, parents on the sidelines can get quite cold indeed). With four children, our house seems stuffed with team gear. The expenses associated with youth sports teams grow each year and, as reported in The New York Times (Sports: April 24, 2012), no sport seems immune to the phenomenon. Even baseball and softball have become quite expensive. I sound curmudgeonly, but when I played youth baseball, there was no initiation fee. The local parks and recreation department ran the program. Fathers of the players volunteered their time. I had one uniform (donated by the local electrician’s union) for four years. Broken bats were glued and then screwed back together. Now, joining a baseball league can cost hundreds - if not thousands - of dollars. In most places, the local parks and recreation department, crushed by budget cuts, is no longer involved in youth sports. Youth sports leagues and teams are independent with their own budgets. Teams hire coaches and young athletes are equipped with the best equipment available. “Good” baseball bats now cost more than \$200. Add in a glove, batting glove, helmet, cleats, team uniform, practice outfit, and travel, and the cost can be staggering. My daughter’s travel soccer team offers scholarships, but I know for sure that a few players on her lacrosse team cannot or should not spend \$40 on a new sweatshirt. Parents can just say no, but this can be difficult. The professionalization and increased economic cost to youth sports seems inexorable. I have been part of it, but I do miss what seem now like simpler times. Anyway, my daughter did not quite understand my concerns. I eventually gave her the check and the sweatshirt was added to our collection.*

*Noted by WVR, MD*

## Child and Adolescent Abuse in Relation to Obesity in Adulthood: The Black Women's Health Study

Renée Boynton-Jarrett, Lynn Rosenberg, Julie R Palmer, Deborah A. Boggs and  
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