Objective: to determine whether there is an independent association between physical abuse during pregnancy or stress because of emotional, sexual, or physical abuse during pregnancy and birthweight after adjusting for behavioral, psychosocial, demographic, and medical variables.

Methods: We conducted a cross-sectional study of 808 low-income women, age 18 years or older, who delivered single infants from pregnancies of 20 weeks or longer. Abuse during the current pregnancy was measured as reported events of physical abuse and stress because of emotional, sexual, or physical abuse. Multiple regression models were developed to estimate the association of low birthweight (LBW) and mean birthweight with abuse during pregnancy, adjusting for behavioral, psychosocial, demographic, and medical variables.

Results: Physical abuse during pregnancy was not associated with LBW or with mean birthweight. Women who reported stress because of abuse had 2.1 times higher odds of LBW (95% CI 1.2, 3.6) than those who did not, and the mean birthweight of their infants was 236 g lower (95% CI -371, -102) than those of women who reported no stress in the adjusted regression models. Furthermore, the adjusted mean birthweight for LBW infants of women reporting stress because of abuse was significantly lower (-372, 95% CI 595, -149) than for LBW infants of women reporting no stress.

Conclusions: Stress because of abuse during pregnancy was associated with both LBW and lower mean birthweight after adjusting for behavioral, psychosocial, demographic, and medical variables. (JAMWA. 2002; 57:208-214)

During the past two decades, abuse of women and its consequences have been recognized as a prominent public health problem in the United States, regardless of the women’s socioeconomic status, race, education, or place of residence.1-3 For most women, the greatest risk of physical, emotional, or sexual abuse comes from someone they know and trust, most often their current or former intimate partners.1,4,5 Approximately 1.5 to 4 million women in the United States are assaulted by partners or spouses each year.5,6,10 Conservative estimates suggest that 20% to 30% of US women experi-

911 eligible women were invited to participate in the study.

Women were eligible and invited to participate if they were age 18 or older, pregnant for at least 20 weeks, and:
- positive for drug use (all invited),
- had had no or 1 prenatal visit (all invited),
- had no drug use and had had more than 1 prenatal visit (2 out of 3 invited).

Women were ineligible and excluded if they:
- transferred to Johns Hopkins Hospital for delivery,
- received prenatal care from private doctors,
- delivered newborns weighing less than 500 g.

90% of those invited to participate completed interviews (824).

Interviews were not completed for 87 women.
- 72 women refused to participate.
- 4 women broke off the interview once it had started.
- Interviewers missed 8 eligible women.
- Interviewers judged 3 women incapable of completing the questionnaire.

16 women were excluded from analysis.
- 12 had multiple births.
- 4 had no birthweight available.

808 women were included in the sample for the analysis.

Inclusion and exclusion criteria and sampling procedure.
ence physical abuse from their partners at least once in their lifetimes.3,11-16

Women who experience abuse have significant sequelae, including physical trauma; somatic symptoms; chronic abdominal, pelvic, or other pain; headaches; negative health behaviors;11,18 higher rates of depression;2,9,18,19 decreased self-esteem; and poor self-image.19 Many who need health care do not have access to it,20 and those who do use more medical services for longer periods of time than women who are not abused.17,21-25

Delayed entry into prenatal care has also been reported.26

A comprehensive review of 13 studies estimated the prevalence of violence during pregnancy to be as high as 20%,27 although the majority of the studies in that review and several others reported prevalences between 4% and 8%.28-31 Between 23% and 70% of previously abused women experience abuse during pregnancy.32-36 Abuse during pregnancy affects more women than gestational diabetes, hypertension, placenta previa, preeclampsia, or most other antepartum complications for which pregnant women are routinely screened and evaluated.37

The effects of abuse among pregnant women are not fully understood, but may include short interpregnancy interval,38 inadequate prenatal care,19 unintended pregnancy,39,40 preterm birth,39,37 abortion, and infant death.37 The evidence of an association between abuse and low birthweight (LBW) or mean birthweight is mixed. The study reported here examines this association, adjusting for women’s behavioral, psychosocial, demographic, and medical characteristics. We hypothesized that the experience of both physical abuse and stress because of abuse would be associated with lower birthweight.

Methods

Study Sample. Data for the study came from cross-sectional research conducted at Johns Hopkins Hospital (JHH) that examined barriers to prenatal care, particularly with regard to drug use, among low-income women. Although primary objectives of the original study and the study described here differed, this study was conceptualized before data analysis for the original study began.

The study sample included 808 low-income women who delivered at JHH between February 1995 and May 1996. Women were eligible for the study if they had had one or no prenatal care visits or received prenatal care through 4 clinics associated with the Johns Hopkins Health System. The figure details the study inclusion and exclusion criteria and sampling procedures.

Data were collected from several sources: a 1-hour postpartum interview with the mother, medical records, laboratory results, and the labor and delivery log. A long-established and experienced survey research firm was hired to identify study participants, conduct the interviews, and abstract medical records data.

Women were invited to participate in the study after leaving the recovery room and being moved to the postpartum unit. The vast majority of interviews were conducted within 48 hours of delivery. The compensation was $10. A Certificate of Confidentiality was obtained from the National Institute on Drug Abuse, and the study was approved by the Johns Hopkins Joint Committee on Clinical Investigations.

Measures. Birthweight was abstracted from medical records. LBW, defined as birthweight of less than 2500 g, was a dichotomous variable. Birthweight was also treated as a continuous variable.

Abuse was defined as all acts intended to control or harm inflicted on study women during their current pregnancies. It was measured directly by events of physical abuse reported on the 8-item violence subscale of the Conflict Tactics Scale (CTS).31 The subscale was administered twice, once for members inside and once for those outside the woman’s household. Experience of physical abuse during the current pregnancy was defined as a dichotomous variable indicating any and no physical abuse. From this point on, the term “physical abuse” relates to this variable.

Stress because of sexual, emotional, or physical abuse was an indirect measure of abuse during pregnancy, as reported on the Stress Scale, a Prenatal Psychosocial Profile subscale.42,43 A single item on this scale asked women to report the level of “hassle” they experienced during their current pregnancies because of sexual, emotional, or physical abuse. Any level of reported stress (some, moderate, severe) was defined as stress because of abuse during pregnancy. From here on, “stress because of abuse” refers to this variable.

Behavioral variables during the current pregnancy included smoking and drug and alcohol use. Evidence of drug use came from the questionnaire, medical records, and toxicology screens; if any one source was positive, women were considered to have used drugs. Smoking was similarly measured, as determined from the questionnaire and medical record. Because of possible interaction between drug use and smoking, women were combined into three categories: neither smoking nor drug use, either drug use or smoking, or both. Alcohol use, determined from the questionnaire, was defined as no use and any use.

Psychosocial variables during the current pregnancy included: depression, measured by the Center for Epidemiologic Studies Depression Scale (CES-D)44; stress, measured by the Stress Scale42,43; and mastery, measured by the Mastery Scale.45 The scales’ sums were used as continuous variables. The stress because of abuse item was excluded from the Stress Scale. Cronbach α reliability coefficients for these scales were within the ranges previously reported; all were at least .8, the value indicating high internal consistency. Childhood history of sexual abuse questions assessed any negative sexual experiences before age 18.46 It was defined as no and any negative experience.

Demographic variables included mother’s age at delivery, race, education, money and time resources,47 employment, and relationship with the father of the baby. Medical variables were gravidity, prior LBW baby, prior pregnancy complications, hypertension disorder (chronic hypertension, pregnancy-induced hypertension, preeclampsia, and eclampsia), and vaginal bleeding. Other medical variables that showed no association with LBW at the bivariate level were excluded from further analyses.

Missing observations were noted for a few dichotomous variables (7 or fewer cases). Study subjects with missing values were included in the reference group.
The study results were similar when the cases with missing data were excluded.

**Analysis.** Logistic regression was used for modeling the association of abuse and the adjustment variables with LBW. Linear regression models were used for mean birthweight. Initially, all adjustment variables were entered into the full regression models. Variables that were not significantly related to birthweight (p<.05) were removed one by one to obtain a parsimonious reduced model. The final reduced model had the best fit, as assessed by the \( \chi^2 \) statistic. Regression diagnostic techniques were used to assess the appropriateness of the final reduced regression models.\(^4\) The Statistical Package for the Social Sciences, version 10.0, was used for data analyses.\(^5\)

**Results**

Table 1 shows the characteristics of all study participants and women who reported physical abuse and stress because of abuse. The study women were predominantly black (94%), consistent with the population of inner-city Baltimore. One-third of the sample used drugs during pregnancy; this high percentage is due in part to the study design. Forty-one percent reported smoking cigarettes, and a third reported drinking alcohol.

The mean score for the CES-D was 19.7, higher than 16, the score generally used to identify symptoms of depression. The mean score on the Stress Scale without the abuse item was 19.4 and with the abuse item was 20.6. The mean score on the Mastery Scale was 20.2.

Almost equal numbers of women reported either physical abuse (n=111) or stress because of abuse (n=110) during pregnancy (14%), but only 38 (5%) reported both. Surprisingly, 66% (73) of the women reporting physical abuse indicated no stress because of abuse. Sixty-five percent of the women reporting stress because of abuse (72) reported no physical abuse.

About 17% (137) of the study women delivered LBW infants. Physical abuse showed no association with LBW and no difference in mean birthweight compared to no physical abuse (Table 2). Conversely, women reporting stress because of abuse had a 2.4 times higher odds ratio (OR) of having LBW infants, and their infants were significantly lighter (344 g lighter; 95% confidence interval [-204, -484]) than infants of women with no stress. To understand these disparate findings, we estimated

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total, n (%)</th>
<th>Physical Abuse, n (%)</th>
<th>Stress Because of Abuse, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;35</td>
<td>740 (91.6)</td>
<td>102 (91.9)</td>
<td>99 (90.0)</td>
</tr>
<tr>
<td>≥35</td>
<td>68 (8.4)</td>
<td>9 (8.1)</td>
<td>11 (10.0)</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>756 (93.6)</td>
<td>101 (91.0)</td>
<td>100 (90.9)</td>
</tr>
<tr>
<td>Other than black</td>
<td>52 (6.4)</td>
<td>10 (9.0)</td>
<td>10 (9.1)</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No high school diploma or GED</td>
<td>361 (44.7)</td>
<td>55 (49.5)</td>
<td>45 (40.9)</td>
</tr>
<tr>
<td>High school diploma or GED</td>
<td>47 (55.3)</td>
<td>56 (50.5)</td>
<td>65 (59.1)</td>
</tr>
</tbody>
</table>

Table 2. Abuse and Birthweight (BW): Unadjusted Odds Ratios (OR) and Difference in Mean Birthweight

<table>
<thead>
<tr>
<th>Variable</th>
<th>Low BW, ( \geq 2500 ) g, n (%)</th>
<th>OR</th>
<th>95% Confidence Interval</th>
<th>Mean BW, g</th>
<th>95% Confidence Interval</th>
<th>Range, g</th>
<th>t (df)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical abuse</td>
<td>16 (14)</td>
<td>95 (86)</td>
<td>0.80</td>
<td>(0.46, 1.41)</td>
<td>3019</td>
<td>(2889, 3150)</td>
<td>590-4362</td>
</tr>
<tr>
<td>No physical abuse</td>
<td>121 (17)</td>
<td>576 (83)</td>
<td>...</td>
<td>...</td>
<td>3024</td>
<td>(2972, 3076)</td>
<td>515-4492</td>
</tr>
<tr>
<td>Stress because of sexual, physical, or emotional abuse</td>
<td>33 (30)</td>
<td>77 (70)</td>
<td>2.45*</td>
<td>(1.55, 3.87)</td>
<td>2727</td>
<td>(2562, 2892)</td>
<td>515-4362</td>
</tr>
<tr>
<td>No stress because of sexual, physical, or emotional abuse</td>
<td>104 (15)</td>
<td>594 (85)</td>
<td>...</td>
<td>...</td>
<td>3070</td>
<td>(3021, 3120)</td>
<td>573-4492</td>
</tr>
</tbody>
</table>

*\( p < .001 \)  

\(^1\) The Statistical Package for the Social Sciences, version 10.0, was used for data analyses. \(^5\)
separate multivariate models for each measure of abuse and a third model with dummy variables: stress because of abuse only (72), physical abuse only (73), stress and physical abuse (38), and no abuse (625) as the reference.

Physical abuse had no significant association with LBW in any regression model (Table 3). The adjusted ORs of LBW for women who reported stress because of abuse were 2.10 (95% CI 1.24, 3.55) in the “alone” model and 2.66 (1.45, 4.87) in the combined abuse measures model. Women who smoked and used drugs or alcohol, were 35 years old or older, were in their first pregnancies, and had limited money and time resources had increased ORs of LBW, ranging from 1.4 to 2.1. The medical variables had stronger associations with LBW, with ORs ranging from 2.8 to 4.6. Regression diagnostic procedures indicated no outlying values or observations with high values of deviance, leverage, or influence.

Similar findings for the abuse variables were noted in the linear regression models (Table 4). Physical abuse was not significantly associated with birthweight in either model. In the reduced models, the adjusted mean birthweight was 236 g lower for infants of women who reported stress because of abuse than for infants of women reporting no stress in the alone model and 276 g lower in the combined abuse model. Women who smoked and used drugs, had high stress scores, were in their first pregnancies, had had prior LBW infants, and experienced hypertension disorder and vaginal bleeding during pregnancy had lighter babies. Women with higher mastery had heavier babies. Analysis of residuals showed no observations requiring further investigation.

We also examined whether the decrease in mean birthweight occurred across the continuum of birthweights by estimating linear regression models separately for LBW and normal birthweight infants. LBW infants of women reporting stress because of abuse were, on average, 372 g lighter (95% CI -595, -149) than those of women reporting no stress, after adjusting for drug use and smoking, first pregnancy, prior LBW baby, and vaginal bleeding. Stress because of abuse was not significantly associated with birthweight (-65; 95% CI -162, 33) among women with normal birthweight infants. Regression models are not shown, but may be requested from the authors.

Discussion

Reported physical abuse during pregnancy was not associated with LBW or mean birthweight in our study. This result is consistent with the findings of several authors who reported no significant difference at the bivariate level in LBW or mean birthweight between infants of women who did and did not experience violence during pregnancy.51-56 Amaro et al also reported no association between birthweight and physical or sexual violence during pregnancy in their multivariate model; no bivariate results were presented.57 Other studies have reported mixed evidence of an association between birthweight and abuse during pregnancy. Dye et al and Schei et al found no significant difference in LBW between women who did and did not experience violence, although mean birthweight was significantly lower in women experiencing violence. Conversely, Curry and Harvey found an association of abuse...
with LBW, but not with mean birthweight. Webster et al\(^6\) found a lower mean birthweight among abused women, but no significant association after adjusting for other variables. Campbell et al\(^6\) reported a significant association between physical and nonphysical abuse with LBW at the bivariate level among mothers of full-term, but not preterm, infants. The association was not significant in multivariate models. The results of the latter 2 studies suggest that there may be pathways by which abuse affects birthweight that include some of the adjustment variables.

Several investigators have reported a significant association between physical abuse and birthweight.\(^3\) They reported a crude OR for LBW of 1.9 and a mean birthweight 247 g lower for infants of women reporting abuse; however, an adjusted OR and mean birthweight cannot be discerned from their results. Our results are remarkably similar to those of Curry and Harvey, despite the differences in the racial composition of the samples.

A third important finding was the differential association between stress because of abuse during pregnancy and birthweight. The adjusted mean birthweight for LBW infants of women reporting stress because of abuse was 372 g lower than for LBW infants of women reporting no stress. This difference is also clinically significant. The single best predictor of mortality for LBW infants is their weight,\(^6\) and the strong association between stress because of abuse and mean birthweight for these infants deserves further examination.

Our puzzling finding of the limited overlap between the 2 variables used to measure abuse may be due to the inclusion of emotional and sexual abuse in addition to physical abuse in the stress variable. Although we were surprised by the finding that two-thirds of women reporting physical abuse on the CTS did not report stress because of abuse, it is not unique. Curry also found little overlap between stress because of abuse and Abuse Assessment Screen questions.\(^6\)

The 2 abuse variables in our study appear to measure different constructs. Some women may not consider a particular physical abuse event stressful, possibly because they witnessed physical events during childhood or because they experience it on an ongoing basis. It may, however, be that stress because of

### Table 4. Unstandardized Regression Coefficients and 95% Confidence Intervals (CI) from the Reduced Adjusted Multiple Linear Regression Models of Birthweight

<table>
<thead>
<tr>
<th></th>
<th>Physical Abuse and Birthweight Model, (\beta) (95% CI)</th>
<th>Stress Because of Abuse and Birthweight Model, (\beta) (95% CI)</th>
<th>Combined Abuse Measures and Birthweight Model, (\beta) (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>3275.1 (2954.9, 3595.3)</td>
<td>3229.2 (2910.6, 3547.8)</td>
<td>3235.8 (2917.2, 3554.3)</td>
</tr>
<tr>
<td>Physical abuse</td>
<td>57.2 (-73.8, 188.2)</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Stress because of sexual, physical, or emotional abuse</td>
<td>...</td>
<td>-236.4 (-371.3, -101.5)</td>
<td>...</td>
</tr>
<tr>
<td>Stress because of sexual, physical, or emotional abuse only</td>
<td>...</td>
<td>...</td>
<td>-276.0 (-438.4, -113.7)</td>
</tr>
<tr>
<td>Physical abuse only</td>
<td>...</td>
<td>...</td>
<td>94.2 (-62.7, 251.1)</td>
</tr>
<tr>
<td>Both stress because of sexual, physical, or emotional abuse and physical abuse</td>
<td>...</td>
<td>...</td>
<td>-126.9 (-339.9, 86.1)</td>
</tr>
<tr>
<td>Smoking and drug use</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illicit drug use or smoking</td>
<td>-15.5 (-133.2, 102.2)</td>
<td>-2.7 (-119.8, 114.4)</td>
<td>-0.6 (-117.6, 116.5)</td>
</tr>
<tr>
<td>Illicit drug use and smoking</td>
<td>-341.1 (-460.3, -222.0)</td>
<td>-334.9 (-453.2, -216.6)</td>
<td>-336.1 (-454.6, -217.6)</td>
</tr>
<tr>
<td>Mastery</td>
<td>11.9 (1.0, 22.8)</td>
<td>11.9 (1.1, 22.7)</td>
<td>11.6 (0.8, 22.4)</td>
</tr>
<tr>
<td>Stress (abuse item excluded)</td>
<td>-13.7 (-22.2, -5.2)</td>
<td>-9.4 (-18.0, -0.8)</td>
<td>-10.0 (-18.6, -1.3)</td>
</tr>
<tr>
<td>First pregnancy</td>
<td>-136.7 (-265.1, -8.3)</td>
<td>-134.1 (-261.4, -6.8)</td>
<td>-139.4 (-267.0, -11.8)</td>
</tr>
<tr>
<td>Prior LBW</td>
<td>-337.6 (-457.1, -218.1)</td>
<td>-347.7 (-466.4, -229.0)</td>
<td>-349.0 (-467.1, -226.7)</td>
</tr>
<tr>
<td>Hypertension disorder</td>
<td>-264.4 (-410.4, -118.4)</td>
<td>-252.5 (-397.6, -107.4)</td>
<td>-247.7 (-392.9, -102.5)</td>
</tr>
<tr>
<td>Vaginal bleeding</td>
<td>-324.6 (-479.7, -169.4)</td>
<td>-330.4 (-484.5, -176.2)</td>
<td>-330.3 (-484.4, -176.3)</td>
</tr>
<tr>
<td>Goodness of fit, F (df) p value</td>
<td>19.11(9, 798) (p&lt;.001)</td>
<td>20.61(9, 798) (p&lt;.001)</td>
<td>17.12 (11, 796) (p&lt;.001)</td>
</tr>
</tbody>
</table>
abuse is the important factor in determining the health consequences to infants of abused women. To further understand our findings, as well as those of Curry and Harvey, future research that includes separate measures of each form of abuse in the stress scale and of events of emotional and sexual abuse in addition to physical abuse is necessary.

A major limitation of our study is that the data were collected for a different purpose. Several variables that might explain the association between abuse and birthweight were included, but more extensive measures of abuse could have been obtained if the study had been planned before data collection began. For example, there are no measures of events of sexual or emotional abuse. Furthermore, we cannot determine which aspect of abuse—sexual, emotional, physical, or a combination—caused the woman to report stress. Moreover, the validity of the stress because of abuse variable is yet to be determined. Finally, the CT's summary or severity score could not be used in analyses because most study women (86%) reported no physical, or a combination—caused the woman to report stress. Moreover, the validity of the stress because of abuse variable is yet to be determined. Finally, the CT's summary or severity score could not be used in analyses because most study women (86%) reported no physical abuse.

It is also impossible to infer any causal relationships from our cross-sectional study. Nevertheless, associations reported here are important to address in future longitudinal studies. Generalizability is also limited to the geographical area and population from which the sample was drawn. The results may be applicable to low-income, high-risk black women in other urban areas, particularly in the Northeast and mid-Atlantic states.

Women in our study were interviewed postpartum, at which time their pregnancy outcomes were known, raising the possibility that those with smaller babies may have viewed and reported events during pregnancy differently than women with heavier babies. There is little empirical support for recall bias in women with heavier babies. There is little empirical support for recall bias in women with heavier babies. There is little empirical support for recall bias in women with heavier babies. Therefore, we must be cautious when generalizing our findings to this population.

Our study is one of the few to examine the relationship between abuse and pregnancy outcomes among high-risk women. In summary, although further research is needed, our findings suggest that LBW prevention efforts may benefit from including questions about stress because of abuse during pregnancy in order to identify women at risk. Several screening tools and guidelines assess abuse; none of them, however, include questions about stress because of abuse.

Our findings suggest that stressful responses to experiences of abuse may be associated with LBW, but this area of research is new, and one study is not enough to establish a true association. Our hypotheses were exploratory; we hope the results presented herein will stimulate future research.

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References
