

# An observational study of type, timing, and severity of childhood maltreatment and preterm birth

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## ABSTRACT

**Background** Childhood maltreatment has been linked to preterm birth (<37 weeks gestation) in some studies, but these findings have been inconsistent, and it remains unclear whether type, timing or severity of maltreatment are associated with risk of preterm birth. The aim of this observational study was to explore type of maltreatment (child and adolescent physical and sexual abuse and harsh parenting) as risk factors for preterm birth.

**Methods** We examined these associations in a cross-sectional analysis of the Nurses' Health Study II cohort of female nurses. Women completed a questionnaire about experiences of sexual abuse, physical abuse or harsh parenting, along with pregnancy outcomes. Logistic regression models adjusted for relevant covariates including age, race, alcohol and cigarette use during pregnancy, age at menarche, marital status, adult income, body mass index (kg/m<sup>2</sup>) at age 18, physical abuse in pregnancy, and childhood socioeconomic position.

**Results** Among 51 434 first births, 4110 were preterm (8% of births). Forced sexual activity in childhood or adolescence was associated with a 22% increased odds of preterm birth (OR=1.22, 95% CI 1.10 to 1.35). Maltreatment involving sexual touch, physical abuse or harsh parenting was not associated with preterm birth in this sample.

**Conclusions** Women who experience forced sexual activity in childhood or adolescence may have an increased likelihood of delivering preterm in adulthood.

## INTRODUCTION

Preterm birth (PTB) is a leading cause of infant morbidity and mortality with a higher incidence in the USA (12–13%) compared with other developed nations (5–9%).<sup>1</sup> Literature reviews support maternal stress exposure, including violence, as a risk factor for PTB.<sup>2–3</sup> PTB is hypothesised to act like a chronic disease, where activation of neuroendocrine responses from psychosocial stress causing physiological 'wear and tear' across the life course.<sup>2</sup> In particular, child and adolescent maltreatment may be a potential risk factor for PTB.<sup>4–12</sup> Findings to date are contradictory, possibly reflecting the inconsistencies in measurement of maltreatment, with variations in type, timing, frequency and severity of maltreatment reported. To date, no large studies have simultaneously considered all of these factors. This paper examines early life exposure to maltreatment across these dimensions and adulthood risk of PTB.

Maltreatment in childhood is common. In a given year, one in seven children will experience some form of maltreatment,<sup>13</sup> including physical,

sexual, emotional abuse or neglect. Growing evidence also links exposure to childhood abuse with negative behaviours and problems in adulthood including drug and alcohol use,<sup>14–16</sup> obesity,<sup>17</sup> mental health problems,<sup>18–19</sup> sexual risk taking,<sup>20–21</sup> and revictimisation,<sup>22–23</sup> along with health conditions such as hypertension, and diabetes,<sup>24–27</sup> which may increase risk for PTB.<sup>17–28–29</sup>

Stressful life events and intimate partner violence during pregnancy are associated with PTB.<sup>3–30</sup> However, whether childhood maltreatment is associated with pregnancy complications is unclear.<sup>4–12</sup> Much of the literature focuses on childhood sexual abuse (CSA). Fewer studies have considered physical abuse, emotional abuse or neglect, though these experiences co-occur. A handful of studies find associations of CSA or family violence with prematurity.<sup>4–7</sup> Two suggest that alcohol and smoking among women with an abuse history explain associations of abuse with PTB.<sup>4–7</sup> By contrast, other studies have not found associations between CSA and PTB<sup>9–10</sup> or low birth weight.<sup>11–12</sup>

Few data sets allow consideration of type of maltreatment (physical, sexual, emotional), timing of maltreatment (childhood or adolescence) and severity of maltreatment. The goal of our study is to test the hypothesis that all forms of maltreatment are associated with PTB with increased severity and earlier exposure to maltreatment having a stronger association with the outcome. The current study used data from a unique data set that allowed for an investigation of the role of type of maltreatment (physical abuse, sexual abuse and harsh parenting), timing of maltreatment (<10 or 11–17) and severity of maltreatment as they relate to PTB. This data set also includes a wealth of information across a number of social, demographic and health outcomes alongside the exposure and outcome variables.

## METHODS

### Study population

The Nurses' Health Study II (NHS II) is a questionnaire-based longitudinal cohort begun in 1989 with 116 430 registered nurses between 25 and 42 years old. Participants complete biennial 'main' questionnaires and occasional 'supplemental' questionnaires. The supplemental 2001 violence questionnaire included retrospective measures of abuse and violence histories, as well as a reproductive history, including details on up to five pregnancies lasting longer than 12 weeks. The survey was mailed to the 91 297 respondents of the 2001 main questionnaire who did not request a short form questionnaire and took less than four mailings



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## Other topics

to complete the most recent biennial questionnaire. The response rate was 75% (n=65 852). More details on the cohort can be obtained online.<sup>31</sup>

### Exclusions

The sample included women completing the 2001 survey, who reported that their first pregnancy, lasting longer than 12 weeks, ended in a live birth. Those delivering before age 18, were excluded to ensure maltreatment exposure occurred prior to pregnancy (n=867). The final analytic sample included 51 434 participants.

### Exposure variables

#### Harsh parenting

The short form of the Childhood Trauma Questionnaire (CTQ) measured harsh parenting, with domains of emotional abuse, neglect and/or physical abuse in childhood up to age 11.<sup>32</sup> Respondents answered six CTQ questions on a scale ranging from 1 (never) to 5 (all the time) about whether they were 'hit with hard objects', hit hard enough to cause 'bruises and marks', someone in their family 'yelled or screamed', said 'hurtful or insulting things', punishments seemed 'cruel', and if they felt 'important or special' (reverse coded). Item scores were summed, and ranged from 6 to 30, with high scores indicating the highest level of harsh parenting. Internal consistency was high with an  $\alpha$  of 0.86. We also created a six category variable to consider the possibility of threshold effects (ie, 6, 7–10, 11–15, 16–20, 21–25, 26–30).

#### Physical abuse

The measure of physical abuse included items from the Revised Conflict Tactics Scale (CTS), a widely used instrument with strong validity and reliability.<sup>33</sup> Five questions from the CTS are included in the NHS II questionnaire and asked about abuse in early childhood (0–11 years) and late childhood/adolescence (11–17 years). Respondents report frequency with which a parent, step-parent or adult guardian would 'push, grab or shove you', 'kick, bite or punch you', 'hit you with something that hurt your body', 'choke or burn you', or 'physically attack you in some other way'. Spanking for discipline was queried, but not included. Responses were combined to create a four-category variable of physical abuse with categories of (1) no abuse, (2) mild, (3) moderate or (4) severe physical abuse in childhood and adolescence. Mild violence included being 'hit with something' or 'kicked, bitten or punched' once, or being 'pushed, grabbed or shoved' once or a few times or more. Moderate violence included being 'physically attacked' once, or being 'hit with something' a few or more times. Severe violence included being 'kicked, bitten or punched' a few or more times, 'choked or burned' ever, or being 'physically attacked' a few or more times.

#### Sexual abuse

Sexual abuse refers to unwanted sexual contact between a minor (under age 18) with an older child or adult. The sexual abuse measure was derived from the survey by Finkelhor *et al.*<sup>34</sup> Each item asked respondents to report sexual abuse experiences occurring either in early childhood (<11 years) or late childhood (11–17 years). The two items were: 'Were you ever touched in a sexual way by an adult or an older child or were you forced to touch an adult or an older child in a sexual way when you did not want to?' and 'Did an adult or older child ever force you or attempt to force you into sexual activity by

threatening you, holding you down, or hurting you in some way when you did not want to?'

Respondents reported on frequency of experiences in relation to each of these items as: never, once or more than once. We created three mutually exclusive categories of sexual abuse history across childhood and adolescence: never sexually abused, sexually touched at least once (but not forced sexual activity) and forced sexual activity at least once. Women who experienced both types of sexual abuse were placed in the forced sexual activity category.

#### Combined severe physical and sexual abuse

This measure combines information from the physical and sexual abuse variables and includes categories of (1) no severe physical abuse or forced sexual activity, (2) severe physical abuse but no forced sexual activity, (3) forced sexual activity but no severe physical abuse, (4) those who have both severe physical abuse and forced sexual activity. Those women who experienced mild or moderate physical abuse, or women who experienced sexual touch, but not forced sexual activity were put into the no severe abuse group for this variable.

### Outcome variable

#### Preterm birth

Gestational length of first, live birth reported in the 2001 survey was captured with a self-reported, categorical variable with categories of 12 to <20, 20 to <24, 24 to <28, 28 to <32, 32 to <37, 37 to 42 (term) and 43+ weeks. Live births included pregnancies lasting at least 20 weeks, with PTB defined as delivery between 20 and 37 weeks. Several studies confirm that retrospective maternal recall of gestational age at delivery is moderately to highly accurate,  $r=0.76$ – $0.93$ .<sup>35 36</sup>

### Covariates

#### Demographic and behavioural covariates

Covariates were chosen based on theoretical and empirical evidence. Covariates came from the baseline survey (1989), demographic factors from the 2001 and 2005 main questionnaires and 2001 violence questionnaire, and health questions from the 2001 and 2003 surveys. Basic demographic measures included maternal race (Caucasian, African-American, other), baseline marital status (married, not married), adult income (<\$30 000, \$30–\$49 999, \$50–\$74 999, \$75–\$99 999, \$100–\$149 999 and \$150 000 or more), child socioeconomic position (SEP) as measured by parental home ownership at respondent's birth (yes/no) and highest parental education from either parent at the time of the respondent's birth (<9 years, 1–3 years of high school, 4 years of high school, 1–3 years of college, or 4 or more years of college). Maternal age was used as a continuous variable. Behavioural risk factors including quantity of cigarette use (none, 1–4, 5–14, and 15 or more cigarettes per day) and alcohol use (0, 1–4, 5 or more drinks per week) during pregnancy, physical abuse during pregnancy (yes/no), body mass index (BMI) at age 18 (occurring after abuse, but prior or concurrent with pregnancy), and age at menarche (<11, 11–14 and  $\geq 15$  years). Other potential physical and mental health sequelae such as diagnosis of heart disease, diabetes, gestational diabetes and depression were coded as dichotomous (yes/no) responses.

### Statistical analysis

Analyses were conducted using SAS V9.2 (Cary, North Carolina, USA). Descriptive statistics of independent and dependent variables and covariates were examined, followed by associations between variables using  $\chi^2$  tests. Covariates were

**Table 1** Distribution of participant sociodemographic and behavioural characteristics by childhood and adolescent abuse exposures

Variable	N (%)	Sexual abuse in childhood or adolescence*			Childhood trauma questionnaire score*		Physical abuse in childhood or adolescence*			
		No sexual abuse (%)	Touch only (%)	Forced sex (%)	6–20 (%)	21–30 (%)	None (%)	Mild (%)	Moderate (%)	Severe (%)
Total	51 434 (100)	34 144 (67)	11 403 (22)	5570 (11)	47 376 (92)	4049 (8)	23 752 (46)	9669 (19)	13 615 (27)	4250 (8)
Maternal age	27 (5)	27 (5)	27 (5)	26 (5)	27 (5)	26 (5)	27 (5)	27 (5)	27 (5)	26 (5)
Maternal race										
Non-Hispanic white	48 006 (95)	95	94	94	95	93	96	95	93	94
Other race	2676 (5)	5	6	6	5	7	4	5	7	6
Highest parental education†‡										
Less than high school	4845 (11)	9	13	14	10	15	9	10	12	15
4 years high school	19 144 (42)	41	42	43	41	44	40	41	44	43
1–3 years college	11 316 (25)	25	24	24	25	23	25	25	24	24
4+ years college	10 700 (23)	25	21	19	24	18	26	24	20	18
Parents home owner†‡										
Owned home	24 947 (54)	55	53	52	55	49	57	54	52	49
Age at menarche (years)										
Before 11	3749 (7)	7	8	10	7	9	7	7	7	9
11–14	43 780 (85)	86	86	82	86	83	86	85	85	83
15 or more	3761 (7)	8	6	8	7	8	7	8	8	8
Body mass index at age 18										
Underweight (<18.5)	7539 (15)	16	13	14	15	14	15	15	15	15
Normal weight (18.5–24.9)	39 326 (77)	77	78	76	77	75	78	77	76	75
Overweight (25–29.9)	3361 (7)	6	7	8	6	8	6	7	7	8
Obese (over 30)	817 (2)	1	2	2	2	2	1	1	2	2
Physical abuse in pregnancy										
No abuse	50 018 (97)	98	97	95	98	93	99	97	97	93
Weekly prenatal alcohol use										
0 drinks	44 070 (86)	86	85	84	86	85	87	83	85	84
1–4 drinks	6935 (14)	13	14	14	13	14	12	16	14	15
5 or more drinks	353 (1)	0.6	0.7	1	1	1	0.5	0.7	0.9	1
Daily prenatal cigarette use										
None	45 086 (88)	89	87	83	88	83	90	86	87	82
Less than 1 up to 4	2110 (4)	4	5	5	4	5	3	5	4	6
5–14 cigarettes	2098 (4)	4	4	6	4	5	3	4	4	6
15+ cigarettes	2080 (4)	3	5	7	4	7	3	5	5	7
Baseline marital status										
Married	44 315 (86)	87	86	83	87	82	87	87	86	83
Family income 2005‡										
<50 000	6121 (15)	14	15	19	14	19	14	14	15	19
50 000–74 000	11 100 (26)	26	27	29	26	26	27	25	27	27
75 000–99 000	9249 (22)	22	22	21	22	21	22	22	22	20
100 000–149 000	9999 (24)	25	23	21	24	22	24	24	24	22
150 000+	5552 (13)	14	12	10	13	12	13	15	13	12

\*Values are means (SDs) or percentages.

†At participant's birth.

‡Not all participants returned this questionnaire.

## Other topics

evaluated by relevance (association with the exposure or outcome), as well as evidence of confounding (using a 10% or greater change in the effect estimate for the abuse exposure).<sup>37</sup> Using logistic regression models, we examined associations between each type of maltreatment (physical, sexual and harsh parenting) and PTB in the first pregnancy—the pregnancy closest chronologically to the abuse exposure. Adjustment for potential confounders (model 1) were added, and then potentially mediating covariates (model 2). A final model was run that considered potential mental and physical health sequelae of abuse (results not shown). Timing and frequency of physical and sexual abuse on PTB by time period of early or late childhood, and frequency by which abuse occurred were then considered. Finally, the relationship between PTB and the combined severe physical and sexual abuse variable was considered. Statistical significance was set using two-tailed tests of association of 0.05 with 95% CIs. Missing indicator analysis, where missing data are included as a dummy variable, was used as is standard with this data set. This study was approved by the Institutional Review Board of Brigham and Women's Hospital. Return of the questionnaire via US mail constituted implied consent.

### Sample description

Table 1 describes characteristics of the sample. Women who reported more severe abuse tended to have lower childhood SEP, were more likely to be overweight or obese at age 18, smoke and drink during pregnancy, earn less income, experience violence during pregnancy, and not be married at baseline (table 1). Relationships between childhood abuse and covariates were similar for all types of abuse. More than half of the women (54%) reported experiencing physical abuse exposure prior to age 18 (table 1). A third of the sample (33%) reported experiencing sexual abuse with 11% reporting forced sexual activity. Eight per cent of the cohort experienced CTQ scores >20, which typically represent high levels of harsh and punitive parenting. Different forms of abuse commonly co-occurred. For example, more than a third of the women who reported physical abuse, 40%, also reported sexual abuse.

### Childhood abuse and PTB

Harsh parenting as measured by the CTQ was unassociated with PTB in either minimally or fully adjusted models (table 2). A small (~10%) increased odds of PTB among women with severe physical abuse in childhood was not statistically significant in either minimally or fully adjusted models. Unwanted sexual touching was not associated with likelihood of PTB, but forced sexual activity predicted a modest increase in odds of PTB (OR 1.22, CI 1.10 to 1.35; table 2). Placing physical abuse and sexual abuse in the same model, or controlling for physical and mental health variables, did not alter effect estimates (data not shown). Forced sexual activity was associated with increased odds of PTB in both childhood and adolescence (table 3). However, there was no evidence that forced sex on multiple occasions (table 4) further increased the odds of PTB. Looking at the subset of women with a history of both forced sexual activity and severe physical abuse did show a significant increased odds of PTB with an OR of 1.35 and CI from 1.13 to 1.62 (table 5). This suggests additional risk for women experiencing both forced sexual activity and severe physical abuse.

### DISCUSSION

Among 52 000 women, participants who experienced forced sex in childhood or adolescence had a 22% increased odds of delivering preterm in their first pregnancy lasting 12 weeks or

**Table 2** ORs and 95% CIs for combined child and adolescent abuse and odds of preterm birth with separate models being run for each type of abuse

Variable	Cases of preterm/total N	Model 1* OR (95% CI)	Model 2† OR (95% CI)
CTQ Score (0–11 years)			
6	305/3889	1.00	1.00
7–10	1675/20 608	1.04 (0.92 to 1.18)	1.04 (0.92 to 1.19)
11–15	1269/15 933	1.02 (0.89 to 1.16)	1.01 (0.89 to 1.16)
16–20	515/6946	0.94 (0.81 to 1.09)	0.93 (0.80 to 1.08)
21–25	263/2966	1.16 (0.98 to 1.38)	1.14 (0.96 to 1.35)
26–30	83/1083	1.00 (0.78 to 1.29)	0.96 (0.75 to 1.24)
Combined time periods for abuse variables (0–17 years)			
Physical abuse			
None	1919/23 752	1.00	1.00
Mild	780/9669	1.00 (0.92 to 1.09)	1.00 (0.92 to 1.09)
Moderate	1033/13 615	0.94 (0.87 to 1.02)	0.93 (0.86 to 1.01)
Severe	371/4250	1.11 (0.99 to 1.25)	1.08 (0.96 to 1.22)
Sexual abuse			
None	2666/34 144	1.00	1.00
Unwanted sexual touch only	908/11 403	1.03 (0.95 to 1.11)	1.03 (0.95 to 1.11)
Forced sexual activity	518/5570	1.24 (1.13 to 1.37)	1.22 (1.10 to 1.35)

\*Adjusted for maternal age, childhood socioeconomic position, and maternal race.

†Adjusted for maternal age, childhood socioeconomic position, and maternal race, prenatal alcohol use, prenatal cigarette use, age at menarche, marital status at baseline, reported income 2001, BMI at 18, and physical abuse in pregnancy.

longer. However, childhood physical abuse, sexual touch and harsh parenting (as measured by the CTQ score) were not associated with risk of PTB. The experience of forced sexual activity may have unique adverse outcomes not present with other forms of abuse (including sexual touching), despite abuse types co-occurring.

This study contributes to the literature by providing evidence that forced sexual activity in childhood is associated with increased odds of PTB. These findings are congruent with research that suggests CSA increases odds of PTB.<sup>4–7 38</sup> However, it goes beyond prior research, when we compare the effects of different forms of maltreatment, and assess timing and severity of abuse, which did not appear to influence results.

There are a number of plausible mechanisms to explain a relationship between CSA and PTB including: alterations in neuroendocrine and stress response systems<sup>39</sup>; maladaptive health behaviours, such as drug and alcohol use<sup>4 7</sup>; physical damage from abuse, such as sexually transmitted infections (STIs)<sup>21</sup>; or impaired health and chronic diseases, such as obesity and diabetes, putting women at risk of medically indicated PTB.<sup>17 24 27 28</sup> Previous research suggests alcohol use during pregnancy may mediate the association of CSA with PTB.<sup>4</sup> However, maternal cigarette and alcohol use did not appear to attenuate the relationship between forced sexual activity and PTB in this analysis.

CSA may also activate and alter biological responses to stress causing hyperactivation of the neuroendocrine system and release of corticotrophin releasing hormone, leading to PTB.<sup>39</sup> However, stress reactivity as a mechanism would only be consistent with our data if specific to forced sexual activity. Perhaps stress response alterations are more likely to occur among those

**Table 3** ORs and 95% CIs for child and adolescent abuse with preterm birth with separate models being run for each type of abuse

Variable	Cases of preterm/total N	Model 1* OR (95% CI)	Model 2† OR (95% CI)
<i>Childhood (0–10 years)</i>			
Physical abuse			
None	2097/26 067	1.00	1.00
Mild	682/8478	1.00 (0.92 to 1.10)	1.00 (0.92 to 1.10)
Moderate	1022/13 349	0.95 (0.88 to 1.03)	0.95 (0.88 to 1.02)
Severe	303/3406	1.14 (1.00 to 1.29)	1.11 (0.97 to 1.26)
Sexual abuse			
None	3196/40 615	1.00	1.00
Touched	626/7594	1.06 (0.96 to 1.15)	1.05 (0.96 to 1.15)
Forced sex	274/2985	1.22 (1.07 to 1.38)	1.19 (1.04 to 1.36)
<i>Adolescence (11–17 years)</i>			
Physical abuse			
None	2797/34 631	1.00	1.00
Mild	600/7594	0.98 (0.90 to 1.08)	0.98 (0.89 to 1.07)
Moderate	425/5858	0.90 (0.81 to 1.00)	0.89 (0.80 to 0.99)
Severe	282/3217	1.12 (0.98 to 1.27)	1.09 (0.95 to 1.24)
Sexual abuse			
None	3220/40 440	1.00	1.00
Unwanted sexual touch only	517/6831	0.95 (0.87 to 1.05)	0.95 (0.87 to 1.05)
Forced sexual activity	362/3944	1.20 (1.07 to 1.35)	1.18 (1.05 to 1.32)

\*Adjusted for maternal age, childhood socioeconomic position and maternal race.

†Adjusted for maternal age, childhood socioeconomic position, and maternal race, prenatal alcohol use, prenatal cigarette use, age at menarche, marital status at baseline, reported income 2001, body mass index at 18, and physical abuse in pregnancy.

who experienced forced sexual activity. Coping behaviours may mitigate effects of other forms of abuse, rendering their associations with PTB less consistent, which are less effective for forced sexual activity, especially when compounded by exposure to severe physical abuse.

Sexually abused children are also at risk for STIs related to their abuse, and increased sexual risk behaviours after the sexual abuse.<sup>20 21</sup> However, STIs have been found to be related to multiple forms of child maltreatment, not only CSA.<sup>20</sup> Unfortunately, we lacked data on infection or inflammation during pregnancy, as well as sexual history, so this hypothesis could not be explored further.

Several limitations of this study require consideration. Although the NHS II cohort is prospective, this analysis was based on retrospective abuse and pregnancy history collected on the same questionnaire, risking recall bias. If women with PTB report more negative past experiences because of reporting their pregnancy history, this could bias the results in support of our hypothesis. However, such a bias would also presumably produce associations of PTB with physical abuse and harsh parenting.

As with most epidemiological studies of childhood abuse, we relied on self-report measures. The survey instruments were from well-established surveys focusing on specific acts of violence rather than more subjective terms such as 'abuse' or 'rape'.<sup>33–35</sup> Alternatively, relying on data of 'reported' abuse cases would be limiting as most abuse is never reported. The rates of abuse in our sample are slightly higher than those in the

**Table 4** ORs and 95% CIs for the association of child and adolescent sexual abuse with preterm birth by the severity, timing and frequency of sexual abuse

Variable	Cases of preterm/total N	Model 1* OR (95% CI)	Model 2† OR (95% CI)
Childhood sexual abuse: timing and severity			
None	2666/34 144	1.00	1.00
Touched only (child only)	428/4982	1.11 (1.00 to 1.24)	1.11 (1.00 to 1.23)
Touched only (adolescent only)	344/4471	0.99 (0.88 to 1.12)	1.00 (0.89 to 1.12)
Touched only (both periods)	141/2020	0.89 (0.75 to 1.07)	0.89 (0.74 to 1.06)
Forced sexual activity (child only)	157/1651	1.27 (1.07 to 1.50)	1.25 (1.05 to 1.48)
Forced sexual activity (adolescent only)	245/2613	1.25 (1.09 to 1.44)	1.23 (1.08 to 1.42)
Forced sexual activity (both periods)	117/1335	1.18 (0.97 to 1.43)	1.14 (0.94 to 1.39)
Forced sexual activity: frequency			
None	3580/45 629	1.00	1.00
Forced sexual activity (once)	271/2932	1.22 (1.07 to 1.39)	1.20 (1.06 to 1.37)
Forced sexual activity (more than once)	248/2667	1.25 (1.09 to 1.43)	1.22 (1.06 to 1.39)

\*Adjusted for maternal age, childhood socioeconomic position and maternal race.

†Adjusted for maternal age, childhood socioeconomic position, and maternal race, prenatal alcohol use, prenatal cigarette use, age at menarche, marital status at baseline, reported income 2001, body mass index at 18, and physical abuse in pregnancy.

more representative sample of the National Violence Against Women Survey (40% experienced physical abuse compared with 54% in this study and 9% experienced rape compared with 11% with forced sexual activity in this study).<sup>40</sup>

The self-reported pregnancy outcome raises the possibility of misclassification bias. However, if the bias were non-differential, or random, the impact would bias to the null. Use of women's self-report of PTB has good accuracy, which decreases this concern.<sup>36 37</sup> The prevalence of PTB in this sample (8%) is appropriate for a largely white, employed sample of singleton

**Table 5** ORs and 95% CIs for severe physical abuse and forced sexual activity during childhood or adolescence and preterm birth

Variables	Cases of preterm/total N	Model 1* OR (95% CI)	Model 2† OR (95% CI)
Combined abuse			
No severe abuse	3343/42 640	1.00	1.00
Severe physical only	232/2897	1.03 (0.90 to 1.19)	1.02 (0.88 to 1.17)
Forced sex only	379/4217	1.19 (1.06 to 1.33)	1.17 (1.05 to 1.31)
Experienced both severe abuse types	139/1353	1.40 (1.17 to 1.68)	1.35 (1.13 to 1.62)

\*Adjusted for maternal age, childhood socioeconomic position and maternal race.

†Adjusted for maternal age, childhood socioeconomic position, and maternal race, prenatal alcohol use, prenatal cigarette use, age at menarche, marital status at baseline, reported income 2001, body mass index at 18, and physical abuse in pregnancy.

## Other topics

pregnancies.<sup>1</sup> Additionally, a sample of nurses is likely to have equal or better recall of gestational age than the community sample from the validity studies. Another concern is that spontaneous preterm labour, preterm premature rupture of membranes, and inductions for medical reasons or patient preferences were combined. This heterogeneity could attenuate associations of abuse with certain subtypes of PTB, as etiological underpinnings between indicated and spontaneous PTBs may differ. Using a data set of health professionals may mean that respondents have higher resiliency than a general population sample. However, even in this potentially resilient sample, an association was found. In addition, other important risk factors, such as pre-eclampsia or somatic risk factors, were not available. More information on these factors might have contributed to elucidating the mechanisms underlying the association found.

This study also has a number of unique strengths. The large sample size ensured excellent statistical power to detect even relatively small associations of PTB with child abuse history. Another strength was the inclusion of various types of maltreatment, not only CSA. Additionally, the survey includes information about frequency and timing of maltreatment, which adds insight into etiological windows of vulnerability and impacts of abuse.

The specificity of the association between forced sexual activity and PTB may suggest a discrete biological or psychological mechanism through which early forced sexual activity influences pregnancy outcomes. Future studies with detail on physical and psychological sequelae of childhood maltreatment may clarify mechanisms between CSA and PTB. Providing better strategies for the treatment of girls with a history of forced sexual activity to improve future reproductive health.

### What is already known on this subject

- There is strong evidence that adverse childhood experiences are correlated with a host of negative health sequelae in adulthood.
- What is less clear is whether certain adverse events, such as childhood maltreatment, may have an independent association with health outcomes, including reproductive outcomes.
- Despite a number of negative risk factors being more common in survivors of abuse, the link between childhood abuse and adulthood reproductive health is mixed in the literature.

### What this study adds

- This study was able to utilise rich level of detail on childhood abuse that includes the type, timing and severity of abuse experienced during childhood and preterm birth in adulthood.
- This study found that most forms of abuse were not associated with the outcome of preterm birth in this cohort.
- However, those who experienced forced sexual activity in childhood did have a small increased odds of preterm birth.

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**Data sharing statement** The Nurses' Health Studies (NHS and NHS II) have a proud history of successful collaborations with investigators external to the Brigham and Women's Hospital and Harvard School of Public Health community. For more information visit: [http://www.channing.harvard.edu/nhs/?page\\_id=471](http://www.channing.harvard.edu/nhs/?page_id=471); if you have questions after reading these guidelines, please send an email to: [nhspermission@channing.harvard.edu](mailto:nhspermission@channing.harvard.edu).

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