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Abuse in Childhood or Adolescence and Gestational Diabetes:

A Retrospective Cohort Study

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Abstract

Introduction—Early life abuse has been linked to later Type 2 diabetes, but its association with gestational diabetes has not been examined. The aim of this study was to examine the association between childhood and adolescent abuse victimization and risk of gestational diabetes in the Nurses' Health Study II.

Methods—Participants were asked about experiences of physical and sexual abuse in childhood or adolescence in 2001 and about history of pregnancy complications in 2009. Mothers of singleton live births who provided information on their abuse history comprised the study sample. Modified Poisson regression was used to estimate risk ratios and 95% CIs for gestational diabetes as a function of physical and sexual abuse victimization. Analyses were conducted in 2014–2015.

Results—Of 45,550 women in the analysis, 8% reported severe physical abuse and 11% reported forced sexual activity in childhood or adolescence. Approximately 3% (*n*=3,181) of pregnancies were complicated by gestational diabetes. In adjusted models, severe physical abuse was associated with a 42% greater gestational diabetes risk (risk ratio=1.42, 95% CI=1.21, 1.66) relative to no physical abuse and forced sexual activity was associated with a 30% greater risk

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(95% CI=1.14, 1.49). Women with histories of both physical and sexual abuse were at higher risk than women exposed to a single type of abuse. These associations were not explained by overweight status in early adulthood or prior to pregnancy.

Conclusions—Childhood and adolescent victimization is associated with increased risk of gestational diabetes in adult women.

Introduction

Gestational diabetes mellitus (GDM) is a metabolic condition in which impaired glucose tolerance emerges or is first recognized during pregnancy.[1] GDM increases incidence of perinatal complications such as caesarean section and macrosomia,[2,3] thus its prevention is an important public health goal. GDM risk factors include overweight/obesity[4] and sociodemographic factors such as minority race and low SES.[5] Psychosocial factors, such as stress[6] and prenatal depression,[7,8] may also contribute to GDM.

Abuse victimization in early life (childhood or adolescence) is a prevalent psychosocial exposure affecting more than 20% of U.S. women.[9,10] There are several reasons that early abuse may be a GDM risk factor. First, abuse victimization is associated with Type 2 diabetes in midlife,[11] which is strongly correlated with GDM[12]; it is possible that the metabolic risk associated with abuse emerges first in pregnancy. Second, women with abuse histories are more likely to be obese in young adulthood,[13–19] and obesity is a major contributor to GDM risk.[4] Third, other plausible biological mechanisms could link abuse to GDM, including abuse-related elevations in stress hormones that may trigger insulin resistance.[20–22] To the authors' knowledge, the association between early abuse and GDM has not been investigated.

Understanding the relationship between early life abuse and GDM can inform theories of GDM etiology and guide prevention approaches. This study therefore examined the hypotheses that:

1. Early life physical or sexual abuse exposure is associated with increased GDM risk.
2. This association is explained by early adult and prepregnancy weight status. Analyses were conducted in the Nurses' Health Study II (NHSII) longitudinal cohort in 2014–2015.

Methods

Study Population

The NHSII is a longitudinal cohort of 116,430 female registered nurses recruited from 14 states at age 25–42 years in 1989. Biennial questionnaires ascertain sociodemographic, behavioral, and medical information. In 2001, a supplemental Violence Questionnaire asking about physical and sexual abuse in childhood or adolescence was sent to 91,297 NHSII participants who had responded to the previous biennial questionnaire within three mailings. Questionnaires were returned by 68,376 (75%) of recipients. The 2009 biennial questionnaire included a comprehensive reproductive history, and was returned by 57,580 Violence Questionnaire responders; these women were similar to 2001 questionnaire

responders overall (data not shown). Women were excluded if they had had no live births (*n*=10,236), did not report the year of the birth (*n*=4), had their first birth prior to age 18 years (*n*=1,126) owing to overlap with the window of abuse exposure, or had a twin or triplet first birth (*n*=664) given potentially unique GDM etiologies in these pregnancies; women with singleton first births who had a subsequent twin or triplet pregnancy contributed singleton pregnancy observations until the twin or triplet birth, when their subsequent pregnancies were excluded. This left 45,550 women with 103,370 pregnancies for analyses. Of these, women missing physical abuse data were excluded from physical abuse analyses (*n*=135), and women missing sexual abuse data were excluded from sexual abuse analyses (*n*=278). Analyses of combined physical and sexual abuse excluded women missing either physical or sexual abuse (*n*=319). This study was approved by the IRB of Brigham and Women's Hospital.

Measures

Child and adolescent physical abuse were assessed using questions from the Revised Conflict Tactics Scales,[23] which ascertained the frequency in childhood (age 0–10 years) and adolescence (age 11–17 years) with which a parent, step parent, or adult guardian: pushed, grabbed, or shoved; kicked, bit, or punched; hit with something that hurt; choked or burned; or physically attacked the participant. As in previous analyses,[11,24] this study used the most severe event in either childhood or adolescence to categorize physical abuse as:

1. none;
2. mild (pushed/grabbed/shoved at any frequency **or** kicked/bitten/punched once **or** hit with something once);
3. moderate (hit with something more than once **or** physically attacked once); and
4. severe (kicked/bitten/punched more than once **or** physically attacked more than once **or** choked/burned at any frequency).

In analyses of the mediating role of prepregnancy overweight, which were conducted in the subset of the sample with a pregnancy after the 1989 baseline, moderate and severe abuse were combined into a single category to maintain adequate cell sizes. Preliminary analyses indicated that associations were similar for moderate and severe abuse.

Child and adolescent sexual abuse was ascertained by asking participants whether and how often as a child (age 0–10 years) or adolescent (age 11–17 years) the following occurred:

1. They had been touched in a sexual way by an adult or an older child or were forced to touch an adult or an older child in a sexual way when they did not want to.
2. An adult or older child had forced or attempted to force them into any sexual activity by "*threatening you, holding you down, or hurting you in some way when you did not want to?*"[25]

Sexual abuse was categorized into the following three categories based on the most severe event[24]: none, sexual touching only, and forced sexual activity.

To assess whether exposure to both physical and sexual abuse conferred additional risk, two composite variables were also examined: an eight-category variable for physical abuse severity with and without any sexual abuse, and a six-category variable for sexual abuse severity with and without any physical abuse. The ref for both composite variables was no physical or sexual abuse.

The 2009 questionnaire included a reproductive history that asked participants to report diagnosis of GDM in each pregnancy. A previous validation study of self-reported GDM on earlier biennial questionnaires confirmed 94% of self-reported GDM cases against medical record of GDM diagnosis, suggesting that participants tend to report GDM accurately.[26]

The following shared risk factors for abuse and GDM were included as potential confounders in adjusted models: age at pregnancy (continuous), nurse participant's year of birth (continuous), race/ethnicity (indicator for nonwhite, with white as the ref), participant's mother's and father's educational attainment (indicators for <9 years, 9–11 years, 12 years, 13–15 years, with ≥16 years as the ref), participant's mother in professional occupation (yes/no), participant's father in professional occupation (yes/no), participant's parents' home ownership (yes/no), recalled body size at age 5 years (each participant indicated the image of the female figure that best approximated her body type at age 5 years, ranging from 1=very lean to 9=very obese[27]; ordinal), and participant's parents' history of diabetes (yes/no).

Because abuse is associated with weight status,[15,17,18] which predicts GDM,[4] overweight status was examined at two time points as potential mediators of the abuse–GDM relationship. First, the study examined mediation by overweight at age 18 years, defined as BMI >25 kg/m^2, based on weight at age 18 years reported by nurse participants at NHSII baseline; comparisons to recorded weights on nursing school entry health exams indicate reasonable validity of this measure.[28] Second, prepregnancy overweight was examined as a mediator. Prepregnancy overweight was defined as BMI>25 kg/m^2 on the biennial questionnaire prior to each pregnancy. This analysis was restricted to the subset of the analytic sample that had at least one pregnancy after the 1989 NHSII baseline (i.e., those for whom prepregnancy overweight was measured). The potential mediating role of weight trajectories was examined in a supplemental analysis examining weight change from age 18 years to prepregnancy. Finally, the authors ran a supplemental analysis of mediation by prepregnancy smoking, which is common after abuse[29] and may be associated with GDM[30,31]; prepregnancy smoking was defined as current smoking reported on the biennial questionnaire prior to the pregnancy.

Statistical Analysis

Modified Poisson regression[32] was used to estimate risk ratios (RRs) for GDM as a function of abuse, using generalized estimating equations to handle repeated outcomes.[33] For each abuse exposure, the authors ran a crude model and a model adjusted for potential confounders. Missing covariate data were handled with complete case analyses; fewer than 10% of participants were missing covariates. Because the main analyses relied on GDM reports on the 2009 cumulative pregnancy questionnaire, which have not been validated, the authors ran a sensitivity analysis using GDM reported on the previous biennial

questionnaires, which performed well in a validation study.[26] They also ran supplemental analyses of GDM as a function of:

1. timing of abuse (childhood only, adolescence only, or both); and
2. sexual abuse by frequency.

All analyses were conducted in SAS, version 9.3.

To examine BMI at age 18 years as a potential mediator of the abuse–GDM association, associations were estimated between:

1. abuse and risk of overweight at age 18 years;
2. overweight status at age 18 years and GDM risk; and
3. abuse and GDM risk adjusted for overweight at age 18 years.

Models adjusting for a mediator can provide an estimate of the direct effect of the exposure on the outcome, independent of the mediator, under several assumptions including no interaction between the exposure and mediator.[34] The authors therefore tested for an interaction between categorical abuse and overweight at age 18 years, using a Wald test with a cutoff of $p<0.05$; a significant interaction term implies different direct effects of abuse on GDM depending on overweight status.[34]

For the subset of the analytic sample that had at least one pregnancy after the 1989 NHSII baseline (n=14,643), the authors also assessed the mediating role of prepregnancy overweight (approximated by overweight status at the biennial questionnaire prior to each pregnancy). The association was estimated between abuse and prepregnancy overweight, and between prepregnancy overweight and GDM. The authors then ran abuse–GDM models adjusted for overweight status, after testing for an abuse–overweight interaction. They ran a supplemental analysis adjusting for weight change from age 18 years to prepregnancy.

Results

Approximately one third (34%) of the 45,550 women included in the analysis reported moderate or severe physical abuse in childhood or adolescence, with 8% (n=3,684) reporting severe abuse. Thirty-three percent reported sexual abuse, with approximately 11% (n=4,806) reporting forced sexual activity (Table 1). Approximately 3% of the 103,370 pregnancies were complicated by GDM and 5% of women had experienced a GDM pregnancy. The incidence of GDM ranged from 5% among women with no history of physical abuse to 7% for women with a history of severe physical abuse. Women with histories of physical or sexual abuse were slightly younger at pregnancy than their non-abused counterparts, were less likely to have fathers who worked professional jobs, and were more likely to have a parental history of diabetes (Table 1).

In crude analyses, physical abuse severity was associated with elevated GDM risk in a dose–response manner (Table 2). Mild, moderate, and severe physical abuse were associated with GDM RRs, relative to no physical abuse, of 1.13 (95% CI=1.01, 1.27), 1.16 (95% CI=1.05, 1.29), and 1.50 (95% CI=1.30, 1.73), respectively. Adjustment for covariates attenuated

these RRs to 1.08 (95% CI=0.96, 1.22), 1.16 (95% CI=1.04, 1.29), and 1.42 (95% CI=1.21, 1.66), respectively. The adjusted RR for forced sex was 1.30 (95% CI=1.14, 1.49, Table 2). Exposure to unwanted sexual touching was unassociated with GDM risk (RR=1.08, 95% CI=0.96, 1.22, Table 2), except when experienced more than once (data not shown); forced sex had similar associations with GDM regardless of frequency. Sensitivity analyses using reports of GDM on prior biennial questionnaires, rather than reports from the 2009 pregnancy survey, generally found similar results (data not shown), with a slightly stronger association for unwanted sexual touching.

When modeled as a composite variable, severe physical abuse in combination with sexual abuse was associated with a 68% higher GDM risk (RR=1.68, 95% CI=1.38, 2.04) relative to no physical or sexual abuse. When combined with physical abuse, forced sexual activity was associated with a 40% higher GDM risk (RR=1.42, 95% CI=1.20, 1.67) compared with no sexual or physical abuse (Table 2). Supplemental analyses of the timing of abuse suggested that physical abuse was more strongly associated with GDM if it occurred in adolescence (versus childhood), whereas the opposite was true for sexual abuse (data not shown).

Moderate and severe physical abuse and forced sex were associated with modestly higher risks of overweight at age 18 years (moderate physical abuse, RR=1.15, 95% CI=1.06, 1.24; severe physical abuse, RR=1.20, 95% CI=1.07, 1.35; forced sex, RR=1.10, 95% CI=1.00, 1.22, data not shown). Being overweight at age 18 years was associated with a 43% higher risk of GDM (RR=1.43, 95% CI=1.24, 1.66) relative to not being overweight (data not shown). However, adjustment for overweight at age 18 years made no difference to the estimated association between either physical or sexual abuse and GDM (Table 3). A physical abuse–age 18 years overweight interaction term was statistically significant (Wald $p<0.05$), with severe physical abuse associated with an RR for GDM of 1.74 (95% CI=1.09, 2.78) among the small number (8%) of women who were overweight at age 18 years versus 1.40 (95% CI=1.19, 1.66) among those who were not overweight. Stratified analyses for sexual abuse are presented to parallel the physical abuse results, but the sexual abuse–overweight interaction was not significant.

In the subsample of women with at least one pregnancy after study baseline (n=14,643), moderate to severe physical abuse (combined for this smaller subsample) was associated with an adjusted 15% higher risk of being overweight in prepregnancy (RR=1.15, 95% CI=1.08, 1.23), and forced sex was associated with a 26% higher risk (RR=1.26, 95% CI=1.16, 1.38, data not shown). Prepregnancy overweight was in turn associated with a doubling of GDM risk (RR=2.25, 95% CI=1.98, 2.55, data not shown). Abuse–GDM associations in this subsample were similar to those in the main analysis (moderate to severe physical abuse, RR=1.30, 95% CI=1.12, 1.51; forced sex, RR=1.34, 95% CI=1.09, 1.65, Table 4). Adjustment for prepregnancy overweight attenuated these associations slightly, to 1.25 (95% CI=1.08, 1.45) for moderate to severe physical abuse and 1.25 (95% CI=1.01, 1.53) for forced sex. Adjustment for continuous prepregnancy BMI and change in BMI from age 18 years to prepregnancy produced similar results. Interactions between abuse and prepregnancy overweight were not significant. Adjustment for prepregnancy smoking did not have an important impact on effect estimates (data not shown).

Discussion

Early life physical or sexual abuse was associated with elevated risk of GDM. Severity of physical abuse was related to GDM in a dose–response manner, with moderate physical abuse associated with a 16% greater GDM risk and severe physical abuse associated with a 42% greater risk, compared with no physical abuse. Forced sex was associated with a 30% greater risk compared with no sexual abuse. Experiencing sexual abuse in addition to physical abuse elevated the risks further, with the approximately 5% of women who experienced severe physical abuse in addition to sexual abuse having an almost 70% greater risk of GDM than their non-abused counterparts.

Only a handful of studies to date have examined early life abuse exposure as a risk factor for poor pregnancy health; these have found early life abuse to predict prenatal depression,[35] preterm birth,[36,37] low birth weight,[37] and cesarean section.[38] To the authors' knowledge, this is the first study to examine GDM risk in relation to early life abuse.

These findings build upon previous results in this cohort showing that early life abuse exposure predicts Type 2 diabetes in middle age—a metabolic condition that is strongly correlated with GDM.[12] Current findings suggest that metabolic risk in abused and non-abused women diverges by reproductive age, consistent with previous prospective work documenting abuse-related divergence in weight status by late adolescence.[15]

As abuse has been associated with heavier adult weight status in several studies,[13–18,39] the authors hypothesized that weight status might explain the elevated risk of GDM in abused women. However, they did not find that adjustment for either being overweight at age 18 years or at prepregnancy attenuated the associations between physical and sexual abuse and GDM risk, indicating that weight at these time points is not a driving factor. This suggests that other abuse–GDM pathways may be important; for example, chronic elevation in stress hormones in response to abuse may contribute to insulin resistance even in the absence of observable weight status changes.[20–22]

Limitations

Limitations of this observational study include retrospective reports of both early life abuse and pregnancy outcomes. Because most abuse is not reported to authorities, there is no gold standard against which to validate the retrospective abuse reports in this cohort. Reassuringly, when abuse–obesity associations have been compared across self-reported and externally substantiated abuse, results are similar.[39] GDM data were also retrospectively collected in this cohort, but validation against medical records of GDM reported on previous biennial questionnaires suggests that women in this cohort report GDM with a high degree of accuracy.[26] Weight status may be also misclassified, although validation studies indicate good agreement with measured weight.[28] Prepregnancy or prenatal depression may play a role in the association between abuse and GDM, but the authors were unable to examine this owing to lack of data on these variables in the cohort. As with any observational study, the results may be influenced by residual confounding. Finally, the NHSII is a non-representative cohort of mostly white women; however, the observed associations are likely driven by mechanisms that are generalizable across population groups.

Findings indicate that highly stressful events in early life should be further explored as determinants of poor pregnancy health and might be used to more accurately identify women at increased risk for GDM. Those designing interventions to prevent GDM might explore expanding the scope of intervention strategies, which currently focus largely on nutrition, exercise, and weight control.[40] If replicated, these findings suggest that development and testing of tailored interventions that address psychological and social sequelae of early abuse exposures might be worthwhile.

Conclusions

This study finds observational evidence that abuse victimization elevates women's risk of GDM in pregnancy, and that this is not explained by previously observed links between abuse victimization and young adult weight status. Additional work is needed to further explore mechanisms and to develop and test interventions that can address the unique risks faced by women with abuse histories.

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Table 1

Distribution of Outcome and Covariates by Physical and Sexual Abuse in Childhood or Adolescence

	Childhood and adolescent physical abuse				Childhood and adolescent sexual abuse			Missing (%)
Analysis variables	**None (n=21,216)**	**Mild (n=8,532)**	**Moderate (n=11,983)**	**Severe (n=3,684)**	**None (n=30,372)**	**Touch only (n=10,094)**	**Forced sex (n=4,806)**	
Gestational diabetes in any pregnancy n (%)	1,053(5.0)	465(5.5)	685(5.7)	258(7.0)	1,561(5.1)	574(5.7)	318(6.6)	0.0
Continuous covariates (*Mean, SD*)								
Maternal year of birth	1954.4(4.8)	1954.4(4.6)	1954.3(4.6)	1953.9(4.6)	1954.4(4.7)	1954.0(4.6)	1954.1(4.5)	0.0
Age at pregnancy (years)	28.5(4.8)	28.4(4.9)	28.1(4.9)	27.7(5.2)	28.5(4.8)	28.1(4.9)	27.6(5.1)	0.0
Parity in 2009	2.3(0.9)	2.3(0.9)	2.3(0.9)	2.2(0.9)	2.3(0.9)	2.3(0.9)	2.3(0.9)	0.0
Mother's education (years)	12.5(2.0)	12.4(1.9)	12.2(1.9)	12.1(2.0)	12.4(1.9)	12.2(2.0)	12.1(2.0)	6.7
Father's education (years)	12.6(2.5)	12.5(2.4)	12.3(2.4)	12.2(2.5)	12.6(2.4)	12.3(2.5)	12.2(2.5)	7.9
Age 5 somatogram[a]	2.5(1.2)	2.5(1.2)	2.5(1.2)	2.5(1.3)	2.5(1.2)	2.5(1.2)	2.5(1.3)	1.8
Categorical covariates (column %)								
Physical abuse								0.1
None	--	--	--	--	52.0	40.5	26.8	
Mild	--	--	--	--	18.7	19.7	17.7	

Analysis variables	Childhood and adolescent physical abuse: None (n=21,216)	Mild (n=8,532)	Moderate (n=11,983)	Severe (n=3,684)	Childhood and adolescent sexual abuse: None (n=30,372)	Touch only (n=10,094)	Forced sex (n=4,806)	Missing (%)
Moderate	--	--	--	--	24.1	30.8	31.6	
Severe	--	--	--	--	5.3	9.0	23.9	
Sexual abuse								0.4
None	74.6	66.6	61.3	43.7	--	--	--	
Touch only	19.3	23.4	26.0	24.9	--	--	--	
Forced sex once	6.1	10.0	12.7	31.4	--	--	--	
Nonwhite race	5.5	5.4	7.6	7.5	5.7	6.9	7.4	0.0
Mother professional	11.8	11.1	10.0	10.1	11.3	10.6	10.3	0.0
Father professional	30.0	27.6	23.9	22.1	28.9	24.8	22.7	0.0
Parents owned home	53.2	50.3	48.6	45.0	51.7	49.5	48.2	0.0
Parental diabetes history	24.5	25.5	27.2	29.9	24.9	27.3	29.1	0.0
Overweight (BMI>25 kg/m^2) at age 18 years[b]	7.4	7.8	8.7	9.8	7.6	8.7	9.4	0.9

[a] Participants chose the image of a female figure that best approximated their body type at age 5, ranging from 1 (very lean) to 9 (obese)

[b] Nurse participants were asked to self-report their weight at age 18 on the 1989 baseline questionnaire; comparisons to recorded weights on nursing school entry health exams indicate good validity of these reports.[29]

Table 2

Early Life Physical and Sexual Abuse Associations With Gestational Diabetes

				By sexual abuse exposure[ce]			
	Crude[b]		Adjusted[cd]	No sexual abuse exposure		With sexual abuse Exposure[f]	
Physical abuse[a]	**N(cases)**	**RR (95%CI)**	**RR (95 %CI)**	**N(cases)**	**RR (95%CI)**	**N(cases)**	**RR (95%CI)**
None	21,216(1,053)	1--	1 --	15,774(751)	1 --	5,371(297)	(0.98,1.14 1.32)
Mild	8,532(465)	1.13 (1.01, 1.27)	(0.96,1.221.08)	5,662(300)	(0.92,1.07 1.24)	2,834(165)	(1.03,1.24 1.49)
Moderate	11,983(685)	1.16 (1.05, 1.29)	(1.04,1.291.16)	7,313(408)	(1.04,1.18 1.35)	4619(274)	(1.04,1.21 1.42)
Severe	3,684(258)	1.50 (1.30, 1.73)	(1.21,1.661.42)	1,597(100)	(0.98,1.24 1.57)	2,061(156)	(1.38,1.68 2.04)
				By physical a buse exposure[ci]			
	Crude[g]		Adjusted[ch]		No physical abuse exposure		With physical abuse exposure[j]
Sexual abuse	N(cases)	RR (95% CI)	RR (95% CI)	N(cases)	RR (95% CI)	N(cases	RR (95%CI))
None	30,372(1,561)	1 --	1 --	15,774 (751)	1 --	14,572(808)	(1.03,1.14 1.28)
Touch only	10,094(574)	1.1 (1.00,1 1.23)	1.1 (0.99,0 1.22)	4,083(218)	1. (0.91, 08 1.27)	5,999(356)	(1.09,1.25 1.44)
Forced sex	4,806(318)	1.(1.15,3 1.49)	1.(1.14,3 1.49)	1,288(79)	1.(1.04, 34 1.72)	3,51	(1.20,51.42 1.67)
		1	0				(239)

[a] Mild physical abuse was defined as being pushed, grabbed, or shoved at any frequency or being kicked, bitten, or punched once or hit with something once; moderate physical abuse was defined as being hit with something more than once or physically attacked once, and severe physical abuse was defined as being kicked, bitten, punched, or physically attacked more than once or ever choked or burned.

[b] n=45,415 women with 103,059 pregnancies

[c] Adjusted for maternal age at pregnancy, maternal year of birth, race, mother's educational attainment, father's educational attainment, mother in professional occupation, father in professional occupation, parental home ownership, age 5 body size (somatogram), parental history of diabetes.

[d] Complete case analysis included 41,540 women with 94,340 pregnancies

[e] Complete case analysis included 41,373 women with 93,974 pregnancies

[f] Any sexual abuse, including sexual touching only, forced sexual activity once, and forced sexual activity more than once.

[g] n=45,272 women with 102,750 pregnancies

[h] Complete case analysis included 41,408 women with 94,058 pregnancies

[i] Complete case analysis included 41,373 women with 93,974 pregnancies

[j] Any physical abuse, including mild, moderate, or severe

Table 3

Early Life Abuse Associations With Gestational Diabetes by Overweight Status (BMI>25 kg/m^2) at Age 18 Years

	Adjusted for overweight status[a] at age 18			Stratified by weight status at age 18[b]					
				Not overweight at age 18			Overweight at age 18		
Exposure	**N(cases)**	**RR[c]**	**(95%CI)**	**N(cases)**	**RR[c]**	**(95% CI)**	**N(cases)**	**RR[c]**	**(95% CI)**
Physical abuse[d]									
None	21,216(1,053)	1	--	19,468(948)	1	--	1,554(89)	1	--
Mild	8,532(465)	1.09	(0.97,1.23)	7,802(403)	1.05	(0.93,1.20)	659(59)	1.52	(1.04,2.21)
Moderate	11,983(685)	1.16	(1.04,1.29)	10,843(589)	1.10	(0.98,1.24)	1,034(89)	1.74	(1.26,2.40)
Severe	3,684(258)	1.43	(1.22,1.67)	3,293(228)	1.40	(1.19,1.66)	358(29)	1.74	(1.09,2.78)
Sexual abuse									
None	30,372(1,561)	1	--	27,834(1,396)	1	--	2,279(147)	1	--
Touch only	10,094(574)	1.10	(0.99,1.22)	9,130(492)	1.06	(0.95,1.19)	867(74)	1.40	(1.03,1.90)
Forced sex	4,806(318)	1.31	(1.15,1.50)	4,312(272)	1.30	(1.12,1.50)	449(45)	1.40	(0.97,2.03)

[a] BMI>25kg/m^2

[b] Wald *p* for interaction with physical abuse=0.045 for physical abuse; Wald *p* for interaction with sexual abuse=0.248

[c] Adjusted for maternal age at pregnancy, maternal year of birth, race, mother's educational attainment, father's educational attainment, mother in professional occupation, father in professional occupation, parental home ownership, age 5 body size (somatogram), parental history of diabetes.

[d] Mild physical abuse was defined as being pushed, grabbed, or shoved at any frequency or being kicked, bitten, or punched once or hit with something once; moderate physical abuse was defined as being hit with something more than once or physically attacked once, and severe physical abuse was defined as being kicked, bitten, punched, or physically attacked more than once or ever choked or burned.

Table 4

Early Life Abuse Associations With Gestational Diabetes, Adjusted for Pre-Pregnancy Overweight Status (BMI >25kg/m^2) [a]

		Adjusted[b]		Additionally adjusted for pre-pregnancy overweight[c]	
Exposure	**N (cases)**	**RR**	**(95% CI)**	**RR**	**(95% CI)**
Physical abuse					
None	6,035 (458)	1	--	1	--
Mild	2,413 (208)	1.20	(1.00, 1.43)	1.18	(0.99, 1.41)
Moderate or severe	3,921 (394)	1.30	(1.12, 1.51)	1.25	(1.08, 1.45)
Sexual abuse					
None	8,608 (687)	1	--	1	--
Touch only	2,611 (252)	1.13	(0.96, 1.32)	1.11	(0.95, 1.30)
Forced sex	1,126 (118)	1.34	(1.09, 1.65)	1.25	(1.01, 1.53)

[a] Among women with ≥1 pregnancy after 1989, n=14,643

[b] Adjusted for maternal age at pregnancy, maternal year of birth, race, mother's educational attainment, father's educational attainment, mother in professional occupation, father in professional occupation, parental home ownership, age 5 body size (somatogram), and parental history of diabetes.

[c] BMI >25kg/m^2 reported on questionnaire prior to pregnancy; in cases where women were pregnant during the questionnaire cycle prior to their first birth (e.g., a woman could have had her first birth in 1992 and been pregnant at the time she reported her BMI on the 1991 questionnaire), we used the reported BMI from the questionnaire prior to the one in which she reported being pregnant (e.g., for woman with her first birth in 1992, who was pregnant during report of BMI in 1991, we used BMI in 1989 as her pre-pregnancy BMI).