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# Physical and sexual abuse in childhood as predictors of early onset cardiovascular events in women

**J.W. Rich-Edwards, ScD**[1,2], **S. Mason, PhD**[1], **K. Rexrode, MD**[3], **D. Spiegelman, ScD**[1,4], **E. Hibert, MS**[5], **I. Kawachi, PhD**[6], **H.J. Jun, ScD**[5,6], and **R.J. Wright, MD**[5,7]

[1]Connors Center for Women's Health and Gender Biology, Department of Medicine, Brigham and Women's Hospital and Harvard Medical School, Boston, MA

[2]Department of Epidemiology, Harvard School of Public Health, Boston MA

[3]Division of Preventive Medicine, Department of Medicine, Brigham and Women's Hospital and Harvard Medical School, Boston, MA

[4]Department of Biostatistics, Harvard School of Public Health

[5]Channing Laboratory, Brigham and Women's Hospital/Harvard Medical School

[6]Department of Society, Human Development and Health, Harvard School of Public Health

[7]Department of Environmental Health, Harvard School of Public Health

## Abstract

**Background—**Although child abuse is widespread and has been associated with cardiovascular disease (CVD) risk factors, its association with CVD events is not established.

**Methods and Results—**We examined associations of child abuse with CVD events among 66,798 women in the Nurses' Health Study 2. Proportional hazards models estimated hazard ratios (HR) and 95% confidence intervals (CI) for myocardial infarction (n=262), stroke (n=251), and total CVD (n=513). Severe physical abuse was reported by 9% and forced sex by 11% of participants. Adjusting for age, race, childhood body type, parental education and family CVD history, the HR for CVD events was 0.91 (95% CI: 0.70–1.17) for mild physical abuse, 1.02 (0.82–1.26) for moderate physical abuse, and 1.46 (1.11–1.92) for severe physical abuse compared to none. Compared to women without childhood sexual abuse, the HR was 1.10 (0.88–1.35) for unwanted sexual touching, and 1.56 (1.23–1.99) for forced sex. After adjustment for adult lifestyle and medical risk factors, the HR for severe physical abuse was 1.13 (0.85–1.51) and that for forced sex was 1.25 (0.98–1.60); these intermediates accounted for much of the association of severe child abuse with CVD. Associations were similar for retrospectively and prospectively reported events. Women with abuse were less likely to release medical records. The associations were stronger for unconfirmed self-reported events than endpoints which were corroborated with additional information or medical record review.

**Conclusions—**Severe child abuse is a prevalent risk for early adult CVD that is partially mediated by preventable risk factors.

### Keywords

myocardial infarction; stroke; women; epidemiology; violence

Address: 1620 Tremont Street, Boston, MA 02120. Phone: 617-525-8264; Fax: 617-525-7746; jr33@partners.org.

Conflict of Interest. None.

Cardiovascular disease (CVD) remains the leading cause of death and disability among women in the United States, despite advances in treatment and secondary prevention.[1] Recognizing that CVD has roots in early life, the American Academy of Pediatrics now recommends that cardiovascular screening, prevention, and treatment begin in childhood.[2] Interventions to alter CVD risk in childhood require an understanding of the early social contexts that shape risk trajectories.[3]

Physical and sexual abuse are widespread and understudied early exposures that have been associated with adult obesity, hypertension, and diabetes.[4–7] The National Violence Against Women (NVAWS) survey by the National Institute of Justice and the Centers for Disease Control and Prevention reported that 40% of women had been physically assaulted by an adult caretaker and 9% raped before age 18 years.[8] Women and men surveyed by the Adverse Childhood Experiences (ACE) Study reported 45% prevalence of physical and 21% prevalence of sexual abuse. Abuse of children by adults has remained stable over time.[9]

With one exception,[10] existing studies examining child abuse and CVD risk have been limited by modest samples,[11–13] retrospective design,[11–15] and self-reported outcomes without medical record confirmation,[11–15] making them susceptible to misclassification and recall bias. The two largest studies suggest that sexual abuse is associated with heart disease risk;[14–15] one of them also reported an association of physical abuse with heart disease.[14] The exceptional study that examined childhood adversity as a predictor of incident, confirmed CVD cases included 23,916 Finns. Although ‘serious conflicts in the family and ‘fear of a family member’ were considered, it is not clear the extent to which these exposures reflect child abuse.[10]

We tested whether early physical or sexual abuse are associated with CVD cases of varying levels of confirmation. We compared the association in retrospectively vs. prospectively reported data. We hypothesized that associations of early abuse with adult CVD would be partially mediated by adult lifestyle and medical risk factors. We utilized data from the Nurses’ Health Study 2 (NHS2), a longitudinal cohort of women from whom we collected data on lifetime abuse history in 2001, and for whom medical record-confirmed CVD events were available from 1989 through 2007.

## METHODS

### Sample

The NHSII cohort includes 116,430 registered nurses aged 25–42 years at 1989 baseline. Participants are followed by biennial questionnaires regarding risk factors and disease incidence. In 2001, a Violence Questionnaire was mailed to 91,297 participants, excluding those who had requested short questionnaires or required more than four mailings of the 1999 biennial questionnaire. Participants returned 68,376 Violence Questionnaires. The institutional review board of Partners Health Care System (Boston, Massachusetts) approved this study and accepted the return of the questionnaire as implied consent.

Participants contributed person-time from 1989 until their last returned questionnaire, CVD event, or the end of follow-up. Data were analyzed in 2011, after the 2007 questionnaire cycle was closed in 2009, and medical records for CVD events were obtained, reviewed and coded. For the main analysis, we examined 513 cases of myocardial infarction (MI) and stroke that accrued from 1989–2007, the follow-up period during which self-reported cases were confirmed by the process described below. To assess potential recall bias, we examined subsets of 363 events that occurred before and 150 events that occurred after the Violence Questionnaire was collected.

## Exclusions

For the main analysis from 1989–2007, we excluded women who reported MI (n=272) or stroke (n=184) prior to the 1989 baseline questionnaire, as events that occurred before baseline were not confirmed. At baseline (n=606) and throughout follow-up, women were censored at the report of cancer (except non-melanoma skin cancer). We excluded 516 women missing data on childhood abuse, yielding 66,798 women in the main analysis.

## Exposure Assessment

The Violence Questionnaire covers three time periods: up to age 11 years, 11–17 years, and adulthood. We combined abuse before age 18 as childhood abuse. Adult experiences of abuse[16] were used to exclude women for analysis of abuse that was limited to childhood. The derivation of abuse categories is described elsewhere,[17] and explained briefly here.

Physical abuse was assessed by the revised Conflict Tactics Scale, which queried specific acts of a parent, step-parent, or adult guardian.[18] We created categories of physical abuse severity based on item factor loadings from principle components factor analysis, as well as the reported frequency of each abuse item.[17] Physical abuse was categorized into four groups: no physical abuse (none); being “pushed, grabbed, or shoved” at any frequency or being “kicked, bitten, or punched” once or “hit with something” once (mild); being “hit with something” more than once or “physically attacked” once (moderate); being “kicked, bitten, or punched” or “physically attacked” more than once or ever “choked or burned” (severe).

Sexual abuse was measured by questions adapted from Finkelhor, Moore, and Hamby:[19–20] “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 any sexual activity by threatening you, holding you down, or hurting you in some way when you did not want to?” Exposure was categorized as: no sexual abuse; unwanted sexual touching only; and forced sexual activity.

## Cardiovascular Endpoint Assessment

On the 1989 baseline questionnaire participants indicated whether they had ever experienced physician-diagnosed “MI or angina” and “Stroke (CVA) or TIA”. These baseline self-reports constituted exclusion criteria for the main analysis. For each biennial follow-up, participants were asked if they were diagnosed by a physician in the past two years with “Myocardial infarction (heart attack)” or “Stroke (CVA) or TIA”; separate questions were posed regarding angina pectoris and coronary revascularization. Permission was requested from participants (or next of kin, in the case of death) to review medical records after report of CVD events. Medical records were reviewed by physicians blinded to exposure status. Myocardial infarction was confirmed if it met the criteria of the World Health Organization based on symptoms plus diagnostic electrocardiographic changes or elevated cardiac enzyme concentrations.[21] Stroke was classified by National Survey of Stroke criteria, as a neurologic deficit with sudden or rapid onset that persisted for >24 hours or until death.[22] Cerebrovascular pathology due to infection, trauma, or malignancy was excluded, as were “silent” strokes discovered only by radiology.

We attempted to confirm self-reported CVD cases reported during study follow-up, from 1989 to 2007. Events confirmed by medical records were designated as ‘definite’ (n=340). Events for which confirmatory information was obtained by interview or letter, but for which medical records could not be reviewed, were designated as ‘probable’ (n=173). We examined three levels of case confirmation: 1) the 2,836 self-reported CVD events, regardless of confirmation status or whether they occurred before or after 1989 baseline (to

replicate the extant literature that has employed unconfirmed self-reports); 2) the 513 'probable' or 'definite' CVD cases occurring from 1989–2007 (combined to maximize statistical power as our main analysis); and 3) the 340 'definite' CVD cases occurring from 1989–2007 that were confirmed by blinded medical record review.

### Covariates

Factors in early childhood were evaluated as potential confounders, including race/ethnicity (white, non-white), birthweight (five categories), and maternal and paternal history of MI or stroke before age 60, maternal and paternal occupation (three categories each), maternal and paternal education at the participant's birth (years), home ownership when the participant was an infant, and aspects of high school diet (glycemic load, glycemic index, animal and vegetable fat consumption).[23] A somatogram scale at age 5 was used to estimate early childhood adiposity.[24] Recall of child somatogram scores is sufficiently accurate for epidemiologic studies.[25]

Cardiovascular risk factors arising after childhood were considered potential mediators, as these factors may have been influenced by earlier abuse. Except where otherwise noted, these time-varying covariates were updated biennially, including adult body mass index (continuous BMI, $kg/m^2$), cigarette smoking (current, past, never), alcohol use (none, <15g daily, ≥15g daily), physical activity (five categories, updated every 4 years), hypertension, type 2 diabetes mellitus, parity (0,1), oral contraceptive use (current, past, never), hormone replacement therapy (premenopausal use; postmenopausal use; pre- and post-menopausal use); and aspects of diet (animal fat intake, vegetable fat intake, glycemic load and glycemic index, updated every 4 years). Lifetime depression status was first measured on the 2001 questionnaire as positive response to both: "In your lifetime, have you ever had 2 weeks or longer when nearly every day you felt sad, blue or depressed for most of the day?" and "Did you ever tell a doctor or mental health specialist that you were feeling depressed?". From the 2003 questionnaire onward, we considered depression to be an endorsement of 'clinician diagnosed depression'.

### Statistical Analysis

We used Cox proportional hazards models to estimate hazard ratios and 95% confidence intervals (CI).[26] Global tests of the association of physical and sexual abuse were conducted by likelihood ratio test comparing nested models with and without abuse parameters. Factors which preceded childhood abuse and were theoretically or empirically associated with abuse and cardiovascular risk were retained in the models, including race, parental education at the time of the participant's birth, age 5 somatotype, and parental CVD history. This model including potential confounders that preceded the exposure is our main model. Lifestyle and CVD risk factors arising in adulthood were tested as potential mediators of the childhood abuse and CVD associations, by examining the extent to which their inclusion in models diminished the abuse effect estimates. The proportion of the abuse association potentially explained by adult covariates was estimated using the SAS macro of Spiegelman as the mediation proportion with 95% CI.[27–28]

## RESULTS

Table 1 summarizes characteristics by child abuse history. Overall, 65% of women reported some abuse, predominately mild physical abuse or unwanted sexual touching. However, 9% reported severe physical abuse and 11% reported forced sex; 17% experienced either severe physical or sexual abuse. A history of abuse was associated with higher adult BMI, cigarette smoking, depression, and intimate partner violence in adulthood. Parents of women reporting abuse had less education and were more likely to have suffered early CVD events.

From 1989 through 2007, there were 513 definite or probable CVD events, including 262 myocardial infarctions and 251 strokes. The details of case confirmation status are presented in Table 2 by abuse history. Increasing severity of physical abuse was associated with a lower likelihood that a CVD case was confirmed by study staff; this was driven by a tendency of participants with a history of physical abuse to deny access to medical records. Differences in case confirmation status across sexual abuse history were weak and lacked statistical significance.

Compared to women reporting no history of childhood physical abuse, those who reported experiencing physical abuse in childhood were at increased risk of CVD events (p=0.03, adjusted for childhood risk factors). This was driven by an association of severe physical abuse with CVD; women reporting mild or moderate physical abuse were not at increased CVD risk (Table 3). The 9% of women reporting severe physical abuse were at a 46% higher risk of adult CVD events after accounting for childhood risk factors (Model 2). Further adjustment for lifestyle and medical risk factors arising in adulthood, particularly adult BMI, hypertension, and diabetes, attenuated the association of severe physical abuse with CVD risk (Model 3). The estimated mediation proportion indicated that adult risk factors accounted for as much as 79% (95% CI, 25%–98%) of the association of severe childhood physical abuse and risk of CVD.

Women who had experienced sexual abuse had increased risk of CVD events (p=0.002, adjusted for childhood risk factors). This elevated risk was apparent only for the 11% of women who reported forced sex in childhood, who experienced a 56% increased risk of adult CVD after adjustment for childhood risk factors (Model 2). As with physical abuse, the association of forced sex with adult CVD was attenuated by adjustment for adult risk factors. As much as 63% (39%–82%) of the association of forced sex with CVD risk was explained by adult covariates.

Most women who reported severe physical abuse also reported sexual abuse, and vice versa (Table 1). The association of severe physical abuse with CVD events after adjustment for sexual abuse (and covariates in Model 2) was 1.30 (0.97–1.73), and the association for forced sex after adjustment for physical abuse was 1.47 (1.14–1.89).

Childhood abuse was associated with an increased likelihood of adult abuse (Table 1). For women who reported no adult abuse, among whom there were 233 CVD events, severe physical abuse in childhood was associated in Model 2 with an HR of 1.86 (1.18–2.91) and forced sexual activity in childhood was associated with an HR of 1.67 (1.09–2.53).

A comparison of the retrospective analysis (events reported before the Violence Questionnaire) and prospective analysis (events occurring after the Violence Questionnaire) in Table 4 shows similar patterns of elevated CVD risk for the more severe forms of child abuse, albeit with less statistical power in the shorter prospective follow-up period. The findings for forced sex were somewhat stronger in the prospective analysis; the findings for severe physical abuse were somewhat stronger in the retrospective analysis.

Table 5 repeats the analysis with varying levels of CVD case confirmation status. Associations of abuse with CVD events were stronger when we considered all 2,836 self-reported CVD cases. Associations were intermediate for the combined group of 513 ‘definite’ and ‘probable’ cases documented as described above. Findings were weakest when restricted to the 340 cases that we were able to confirm by record review. Notably, the analysis of all self-reported endpoints yielded associations of moderate as well as severe abuse with CVD events.

We examined associations of abuse separately for definite and probable MI (n=262) and stroke (n=251), presented in the Supplemental Table. Although physical abuse was unassociated with increased risk of MI, there was a suggestion of an increased risk of MI among women with a history of forced sex in childhood (HR 1.36 (0.96–1.93)). Severe physical and sexual abuse were each associated with increased risk of stroke, with HR's of 1.86 (1.29–2.68) for severe physical abuse and 1.82 (1.31–2.54) for forced sex.

## COMMENT

The 17% of women who experienced severe physical or sexual abuse in childhood had 46% to 56% higher risks of cardiovascular events in early adulthood, after adjustment for childhood CVD risk factors. Adult risk factors known to be associated with early abuse, including adult experiences of intimate partner violence, smoking, BMI, hypertension, diabetes, and depression, accounted for as much as 60% to 80% of the associations of severe early abuse with CVD risk. This suggests that a large portion of the association of childhood abuse with adult CVD risk could be eliminated or reduced by targeted prevention efforts that have been successful in reducing CVD incidence among U.S. women.[1]

The structure of our dataset allowed us to examine several methodological questions. Similar results of prospectively and retrospectively reported cases (Table 4) indicate that recall bias is unlikely to explain the associations. However, examination of all self-reported disease yielded considerably stronger associations than did examination of cases confirmed by additional data or medical record review. There could be several reasons for this gradient across case confirmation status. There was less statistical power to examine confirmed cases. Alternatively, the stronger estimates for the unconfirmed cases reported at baseline in 1989 could result from early, pre-baseline CVD events of women with a history of child abuse. However, such 'attrition of susceptibles' over time seems a less likely explanation than simple differences by case confirmation status, especially as we observed contrasts between 'probable and definite' versus 'definite' cases observed over the same follow-up period (1989–2007). Women with histories of childhood physical abuse tended to deny permission to review medical records (Table 2), precluding their classification as 'definite' cases. Unfortunately, it is unclear whether risk estimates based on 'probable and definite cases' or only 'definite cases' best reflect the association of abuse history with CVD risk: on the one hand, restriction to women willing to release records could induce a bias to the null if that restriction eliminates the very women whose abuse history is severe enough to affect CVD risk; on the other hand, the restriction to medically confirmed cases could be an appropriate way to eliminate any tendency of abused women to over-report disease outcomes. As analyses restricted to definite, record-confirmed CVD events exposed to severe physical abuse were null, the findings for physical abuse cannot be considered robust. However, the increased risk of CVD with forced sex was consistent and statistically significant, even with the most strict case confirmation status.

Our findings are generally consistent in direction, if not magnitude, with two large studies of child abuse.[14–15] Differences between studies in assessment of abuse exposures and CVD outcomes make close comparisons problematic. The present study included 66,798 women age 43 to 60 years at the end of follow-up, of whom 0.8% experienced CVD events confirmed by corroborating medical information or records. The ACE study included 17,337 men and women of average age 56 years, of whom 10.6% reported a history of ischemic heart disease (IHD) in response to queries regarding history of heart attack, chest pain or heavy chest pressure with exertion, or use of nitroglycerine.[14] Self-reports of IHD were not confirmed. The focus of the ACE study is a 10-item childhood trauma score that includes two items on physical abuse and two on sexual abuse. Results were not stratified by gender. Our finding of a 46% increased risk of CVD events with severe physical abuse appears to

agree with the ACE report of 50% (40% to 90%) increased risk of IHD with physical abuse, although, in our data, the association of physical abuse with CVD was driven by a stronger association with stroke than with MI. The ACE study estimated a 40% (30% to 60%) increased IHD risk among individuals who experienced either sexual touching or intercourse; this appears to be intermediate between our null estimate for sexual touching and 56% increased risk of CVD with forced sex. Again, we observed stronger associations of sexual abuse with stroke than with MI.

The National Comorbidity Survey (NCS) questioned 5,877 men and women age 15–54; 0.4% of women endorsed an item regarding "heart attack or serious heart trouble" in the past 12 months.[15] There was little evidence that women who indicated that they had been 'physically abused as a child' were more likely to report heart disease; on the other hand, women who reported a history of child or adolescent 'rape or sexual molestation' were 5 times more likely to report heart disease.[15] Our estimates for sexual abuse are consistent in direction with those of the NCS, although much smaller in magnitude.

The only study to examine exclusively confirmed events in a prospective analysis, the Health and Social Support (HeSSup) study in Finland, was focused on child adversities as a whole rather than on child abuse in particular.[10] Among the roughly 14,000 women studied, there were 91 CVD events. The risk of CVD events increased with the number of childhood adversities reported. When the adversity score was dissected into its components, 'serious conflicts in the family' was associated with an age-adjusted HR for CVD of 1.71 (1.07–2.73). However, 'fear of a family member' was associated with an HR of 1.33 (0.79–2.23). As in our study, adjustment for adult CVD risk factors attenuated these estimates. While these exposures do not correspond directly to physical and sexual child abuse, they do suggest that childhood social environment is associated with adult CVD risk, and that much of this association is mediated by preventable risk factors that are elevated in women with a history of childhood adversity.

Several strengths of the present study are notable. We were able to examine CVD events variously self-reported by nurses, corroborated by additional details, and/or confirmed by medical record review. The fact that some associations were weaker when restricted to 'definite' cases suggests that the use of unconfirmed self-reports may overestimate associations of abuse with CVD risk. Previous studies have been too small to permit more fine-grained examination of severity of abuse. In contrast, the NHS2 cohort is several times larger than the next largest study; distinguished between mild, moderate and severe abuse; examined CVD events that were confirmed by medical record or other evidence; and tested whether associations were similar among cases that occurred before and after the abuse assessment, permitting evaluation of the potential role of recall bias. Another strength that distinguishes the current study is the 18 years of prospectively collected data on risk factors such as family history, socioeconomic position, smoking, BMI, hypertension, and diabetes that enabled testing of confounders and intermediates.

Like most large abuse studies, our participants self-reported their abuse history. We used instruments employed by national surveys[18–19] that reduce bias by querying specific acts of violence, rather than nominal questions regarding 'abuse' or 'rape'.[29] The alternative to self-report is police, court or other administrative records of abuse. However, only the minority of child abuse cases are reported to authorities; officially documented abuse cases are almost certainly a non-random sample of all cases; and it is impractical, if not impossible, to assemble a cohort of documented abuse cases large enough (and long ago enough) to study CVD endpoints. Given these issues, self-report is the gold standard abuse measurement for large cohort studies. The nurses in our cohort report somewhat more mild and moderate abuse than women in the NVAWS telephone survey.[8] The NHS2 abuse prevalence is similar

to that reported by ACE study, suggesting that survey methodology may explain some discrepancies.

We did not document other childhood neglect or traumas such as marital discord, mental illness or criminal activity in the home. Such factors are correlated with child abuse and are also associated with CVD risk.[10, 14–15] In this analysis, we did not consider emotional abuse. The NHS2 participants are predominately white women with at least a college degree. Our findings need to be replicated in more diverse settings to determine their generalizability. Finally, as participants were age 43–60 at the end of follow-up, these findings pertain to early CVD; further follow-up will be necessary to determine whether early abuse also predicts CVD during the peak incidence period.

Several lines of evidence suggest that abuse in early life may increase cardiovascular risk. Preclinical and clinical studies demonstrate profound and lasting effects of early stress on the hypothalamic-pituitary-adrenal and noradrenergic stress systems, including heightened glucocorticoid, norepinephrine, and autonomic stress reactivity, as well as altered dopaminergic and serotonergic function.[30–34] Survivors of childhood sexual abuse have increased heart rate and blood pressure response to cognitive and social challenges.[35] Supporting, if indirect, evidence that abuse increases cardiovascular risk can be drawn from literature on post-traumatic stress disorder, which is prevalent among abused women[36] and associated with increased risks of coronary heart disease,[37] smoking,[38–41] overweight,[42] dyslipidemia,[43] diabetes,[44] hypertension[45] and possibly inflammation.[46] This is consistent with literature that documents increased adiposity,[6–7] hypertension,[4] diabetes,[5] and smoking[38–41] with a history of child abuse.

Studies consistently document widespread physical and sexual abuse of children and adolescents. Early abuse is associated with behavioral and physiologic risk factors for CVD. The evidence is now growing that early abuse, especially sexual abuse, also predicts CVD events in adulthood. However, our findings suggest that this field may be vulnerable to differential reporting of disease endpoints by abuse status. We need to understand the complex physiological and behavioral pathways through which abuse leads to true CVD events, so that interventions that aim to alter CVD risk trajectories from childhood can be maximally effective.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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## Clinical Perspective

Women with a history of severe sexual abuse in childhood are at increased risk for cardiovascular disease as adults. Severe physical abuse may also increase risk of future CVD. Over 10% of women have a history of severe physical or sexual abuse as girls. A large proportion of the CVD risk associated with child abuse is explained by adverse lifestyle and medical risk factors for CVD in adulthood among women abused as children. This suggests that targeted prevention and treatment of risk factors would reduce CVD incidence in this high-risk population. Future research should examine whether specialized therapies can be developed to help girls and women with a history of child abuse reduce their cardiovascular risk.

## Table 1

Age-standardized[a] characteristics of the study population by history of childhood physical and sexual abuse.

| | Physical Abuse | | | | | Sexual Abuse | | | |
|---|---|---|---|---|---|---|---|---|---|
| | None n=31122 47% | Mild n=12450 19% | Moderate n=17500 26% | Severe n=5726 9% | p | None n=44517 67% | Sexual touching only n=14798 22% | Forced sexual activity n=7483 11% | p |
| **Mean (standard deviation)** | | | | | | | | | |
| Age in 1989[b] | 35 (5) | 35 (5) | 35 (5) | 35 (5) | * | 35 (5) | 35 (5) | 35 (5) | * |
| Maternal education, years[c] | 13 (2) | 12 (2) | 12 (2) | 12 (2) | * | 12 (2) | 12 (2) | 12 (2) | * |
| Paternal education, years[c] | 13 (3) | 13 (2) | 12 (3) | 12 (3) | * | 13 (2) | 12 (3) | 12 (3) | * |
| Body mass index (kg/m$^2$) at age 18 | 21 (3) | 21 (3) | 21 (3) | 22 (4) | * | 21 (3) | 21 (3) | 22 (4) | * |
| Body mass index (kg/m$^2$) in 1989 | 24 (5) | 24 (5) | 24 (5) | 25 (6) | * | 24 (5 | 24 (5) | 25 (6) | * |
| **Median (Interquartile range)** | | | | | | | | | |
| Somatotype at age 5[d] | 2 (2–3) | 2 (2–3) | 2 (2–3) | 2 (1–3) | § | 2 (2–3) | 2 (2–3) | 2 (2–3) | * |
| **Percent** | | | | | | | | | |
| Caucasian | 95 | 95 | 93 | 93 | * | 95 | 93 | 93 | * |
| Parental history of MI < age 60 | 18 | 18 | 19 | 22 | * | 18 | 19 | 22 | * |
| Parental history of stroke < age 60 | 4 | 4 | 4 | 6 | * | 4 | 5 | 5 | * |
| Daily alcohol consumption | | | | | § | | | | † |
| None | 38 | 33 | 37 | 39 | | 37 | 37 | 39 | |
| <15g alcohol daily | 59 | 63 | 59 | 57 | | 61 | 59 | 58 | |
| ≥15g alcohol daily | 3 | 3 | 3 | 4 | | 3 | 3 | 3 | |
| Cigarette smoking status | | | | | * | | | | * |
| Never smoker | 71 | 64 | 64 | 56 | | 69 | 64 | 57 | |
| Past smoker | 19 | 23 | 23 | 27 | | 20 | 23 | 26 | |
| Current smoker | 10 | 13 | 13 | 17 | | 11 | 12 | 17 | |
| **Percent** | | | | | | | | | |
| Exercise weekly | 78 | 79 | 78 | 79 | § | 79 | 77 | 79 | § |
| Ever depression[e] | 25 | 31 | 34 | 48 | * | 26 | 35 | 45 | * |
| Hypertension 1989 | 5 | 5 | 5 | 7 | * | 5 | 5 | 7 | * |
| Diabetes 1989 | <1% | <1% | <1% | <1% | § | <1% | <1% | 1 | § |

| | Physical Abuse | | | | | Sexual Abuse | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **None n=31122 47%** | **Mild n=12450 19%** | **Moderate n=17500 26%** | **Severe n=5726 9%** | **p** | **None n=44517 67%** | **Sexual touching only n=14798 22%** | **Forced sexual activity n=7483 11%** | **p** |
| Adult abuse | 36 | 48 | 53 | 67 | * | 41 | 50 | 63 | * |
| Childhood sexual abuse | 26 | 34 | 39 | 57 | * | | | | |
| Childhood physical abuse | | | | | | 48 | 59 | 74 | * |

[a] Values are standardized to the age distribution of the study population. Values do not add to 100%, due to missing values. Fewer than 2% were missing any given variable, with the exception of maternal (11.5% missing) and paternal education (12.7% missing).

[b] Value is not age adjusted

[c] Mean years of education at the time of the participant's birth, reported in 2005

[d] Mean somatogram score at age 5 years; range is 0–9

[e] Lifetime depression reported in 2001

[*] p<0.0001, by age-adjusted t-test (means), chi-square test (percentages), or Spearman correlation (medians)

[†] p=0.001, by age-adjusted t-test (means) or chi-square test (percentages), or Spearman correlation (medians)

[§] p>0.05, by age-adjusted t-test (means) or chi-square test (percentages), or Spearman correlation (medians)

**Table 2**

Percent of CVD cases with varying degrees of case confirmation status for cases reported from 1989–2007, by history of child abuse, Nurses' Health Study 2.

| | Definite Cases | Probable Cases: Upon recontact, participant or kin confirmed questionnaire report of CVD, but case was not definite because: | | | |
|---|---|---|---|---|---|
| | Confirmed by medical record review | Confirmed only by death certificate autopsy report | Medical records unavailable | Too little information from participant to retrieve records | Participant denied permission to review records |
| **Physical Abuse** | | | | | |
| None | 72% | 0% | 10% | 8% | 10% |
| Mild | 65% | 0% | 10% | 9% | 17% |
| Moderate | 66% | 0% | 9% | 9% | 16% |
| Severe | 50% | 1% | 12% | 6% | 31% |
| p-value[1] | 0.009 | 0.09 | 0.96 | 0.91 | 0.0006 |
| **Sexual Abuse** | | | | | |
| None | 66% | 0% | 12% | 8% | 15% |
| Sexual touching | 72% | 0% | 7% | 8% | 13% |
| Forced sex | 59% | 1% | 8% | 10% | 22% |
| p-value[1] | 0.14 | 0.09 | 0.23 | 0.70 | 0.22 |

[1]Chi-square test across abuse categories. (The p-value across all confirmation status categories was 0.01 for physical abuse and 0.15 for sexual abuse)

**Table 3**

Adjusted hazard ratios (95% confidence intervals) for the association of physical and sexual abuse in childhood with risk of cardiovascular events in adulthood, Nurses' Health Study 2, 1989–2007

| | Cases Person-Years | Model 1: Adjusted for age | Model 2: Adjusted for age and childhood covariates preceding abuse[1] | Model 3: Model 2 plus adult covariates[2] |
|---|---|---|---|---|
| **Physical Abuse** | | | | |
| None | 226<br>537,165 | 1.00 | 1.00 | 1.00 |
| Mild | 82<br>214,508 | 0.91<br>0.71–1.18 | 0.91<br>0.70–1.17 | 0.87<br>0.68–1.13 |
| Moderate | 137<br>301,260 | 1.06<br>0.85–1.31 | 1.02<br>0.82–1.26 | 0.93<br>0.74–1.15 |
| Severe | 68<br>97,860 | 1.59<br>1.21–2.08 | 1.46<br>1.11–1.92 | 1.13<br>0.85–1.51 |
| p-value[3] | | 0.006 | 0.03 | 0.40 |
| **Sexual Abuse** | | | | |
| None | 306<br>767,975 | 1.00 | 1.00 | 1.00 |
| Sexual touching | 119<br>254,752 | 1.13<br>0.91–1.40 | 1.10<br>0.88–1.35 | 1.02<br>0.82–1.27 |
| Forced sex | 88<br>128,066 | 1.71<br>1.35–2.17 | 1.56<br>1.23–1.99 | 1.25<br>0.98–1.60 |
| p-value[3] | | 0.0002 | 0.002 | 0.22 |

[1] Model 2 is adjusted for age, race, age 5 somatotype, parental education, and parental MI or stroke

[2] Model 3 is adjusted for variables in Model 2 plus: adult BMI, smoking, alcohol use, depression and intimate partner violence, quintiles of animal fat consumption, vegetable fat consumption, glycemic index in high school and updated throughout adulthood; oral contraceptive use; parity; menopausal status; postmenopausal hormone use; physical activity; incident hypertension and diabetes.

[3] p-value for differences across abuse categories, derived from a likelihood ratio test contrasting nested models with and without the set of abuse covariates

**Table 4**

Adjusted[1] hazard ratios (95% confidence intervals) for the association of abuse in childhood with risk of cardiovascular events in adulthood by follow-up period, Nurses' Health Study 2

| | **Total 1989–2007 513 cases** | **Retrospective[2] 1989– 2003 363 cases** | **Prospective[2] 2003– 2007 150 cases** |
|---|---|---|---|
| **Physical Abuse** | | | |
| None | 1.00 | 1.00 | 1.00 |
| Mild | 0.91 0.70–1.17 | 1.05 0.78–1.40 | 0.60 0.36–1.03 |
| Moderate | 1.02 0.82–1.26 | 1.01 0.78–1.31 | 1.04 0.71–1.52 |
| Severe | 1.46 1.11–1.92 | 1.51 1.09–2.09 | 1.35 0.81–2.24 |
| p-value[3] | 0.03 | 0.11 | 0.09 |
| **Sexual Abuse** | | | |
| None | 1.00 | 1.00 | 1.00 |
| Sexual touching | 1.10 0.88–1.35 | 1.06 0.82–1.37 | 1.19 0.80–1.75 |
| Forced sex | 1.56 1.23–1.99 | 1.53 1.14–2.03 | 1.66 1.06–2.58 |
| p-value[3] | 0.002 | 0.02 | 0.10 |

[1] Adjusted for age, race, age 5 somatotype, parental education, and parental MI or stroke.

[2] Retrospective analysis includes follow-up time through May 2003; exposures and CVD events could have preceded violence reports during this period. Prospective analysis includes follow-up time and incident events after May 2003, after all violence reports had been collected.

[3] p-value for differences across abuse categories, derived from a likelihood ratio test contrasting nested models with and without the set of abuse covariates

**Table 5**

Adjusted[1] hazard ratios (95% confidence intervals) for the association of abuse in childhood with risk of cardiovascular events in adulthood by case confirmation status, Nurses' Health Study 2

| CVD Model 2 | All lifetime self reports n=2836 cases | Probable and definite cases 1989–2007 n=513 cases | Definite cases 1989–2007 n=340 cases |
|---|---|---|---|
| **Physical Abuse** | | | |
| None | 1.00 | 1.00 | 1.00 |
| Mild | 1.08<br>0.97–1.21 | 0.91<br>0.70–1.17 | 0.81<br>0.60–1.11 |
| Moderate | 1.31<br>1.20–1.44 | 1.02<br>0.82–1.26 | 0.94<br>0.73–1.22 |
| Severe | 2.04<br>1.83–2.29 | 1.46<br>1.11–1.92 | 1.03<br>0.71–1.49 |
| p-value[2] | <0.0001 | 0.03 | 0.58 |
| **Sexual Abuse** | | | |
| None | 1.00 | 1.00 | 1.00 |
| Sexual touching | 1.26<br>1.15–1.37 | 1.10<br>0.88–1.35 | 1.19<br>0.92–1.53 |
| Forced sex | 2.07<br>1.88–2.28 | 1.56<br>1.23–1.99 | 1.44<br>1.06–1.96 |
| p-value[2] | <0.0001 | 0.002 | 0.06 |

[1] Adjusted for age, race, age 5 somatotype, parental education, and parental MI or stroke.

[2] p-value for differences across abuse categories, derived from a likelihood ratio test contrasting nested models with and without the set of abuse covariates