Abuse Victimization in Childhood or Adolescence and Risk of Food Addiction in Adult Women

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Objective: Child abuse appears to increase obesity risk in adulthood, but the mechanisms are unclear. This study examined the association between child abuse victimization and food addiction, a measure of stress-related overeating, in 57,321 adult participants in the Nurses’ Health Study II (NHSII).

Design and Methods: The NHSII ascertained physical and sexual child abuse histories in 2001 and current food addiction in 2009. Food addiction was defined as ≥3 clinically significant symptoms on a modified version of the Yale Food Addiction Scale. Confounder-adjusted risk ratios (RRs) and 95% confidence intervals (CIs) were estimated using modified Poisson regression.

Results: Over 8% of the sample reported severe physical abuse in childhood, while 5.3% reported severe sexual abuse. Eight percent met the criteria for food addiction. Women with food addiction were 6 U of BMI heavier than women without food addiction. Severe physical and severe sexual abuse were associated with roughly 90% increases in food addiction risk (physical abuse RR = 1.92; 95% CI: 1.76, 2.09; sexual abuse RR = 1.87; 95% CI: 1.69, 2.05). The RR for combined severe physical abuse and sexual abuse was 2.40 (95% CI: 2.16, 2.67).

Conclusions: A history of child abuse is strongly associated with food addiction in this population.

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Introduction

National survey results suggest that more than a third of girls in the United States experience some form of physical or sexual child abuse by the time they turn 18 years old (1,2). Published studies indicate that child abuse is related to adult obesity (3–7), with potentially serious consequences for long-term health. In our own work, we have found that child abuse is associated with substantial increases in obesity-related disease risk in adulthood, including risks of hypertension (8), type 2 diabetes (9), and cardiovascular events (10). The mechanisms linking abuse to weight gain remain largely unexplored.

A compelling body of animal and clinical evidence suggests that stress can dysregulate eating, promoting a preference for highly palatable (high fat/high sugar) foods and disrupting homeostasis of body weight (11,12). Laboratory research has used social stressors to induce consumption of palatable foods in humans (13), and studies have demonstrated a dose-response relationship between exogenous administration of glucocorticoid stress hormones and food intake in both animals (14,15) and humans (16). Studies further suggest that stress-related overeating has important similarities to drug addiction. Palatable food ingestion and drug use both stimulate reward systems in the brain (17) that dampen the physiologic stress response (18). Rats exposed to stressors seek palatable food in much the same way that they seek cocaine (19,20). Over time, exposure to both palatable foods and addictive drugs appears to disrupt brain reward function, resulting in withdrawal symptoms when the foods or drugs are removed (21), and encouraging continued consumption even in the face of adverse stimuli (21); brain imaging studies have highlighted neurological overlaps between uncontrolled eating and drug use (22–24).

These and other findings have motivated recent calls to define certain eating behaviors as “food addiction” (25,26). The push to define food addiction as a psychiatric disorder is controversial, but regardless of its status as a diagnosis, the food addiction construct...
may be useful for identifying uncontrolled eating in response to distress. We hypothesized that addiction-like eating behaviors may be one potential pathway from child abuse to obesity. There are currently no published studies on child abuse as a risk factor for food addiction. In this study, we examined the association between history of child physical or sexual abuse and food addiction among women in the Nurses’ Health Study II.

Methods

Data sources

The Nurses’ Health Study II (NHSII) follows 116,430 female registered nurses recruited at ages 25–42 in 1989. Biennial questionnaires gather sociodemographic, behavioral, and medical data. In 2001, a supplemental Violence Questionnaire asking about experiences of physical and sexual abuse in childhood 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 the supplemental questionnaire recipients. Violence Questionnaire respondents were more likely to be white than the NHSII cohort as a whole, but had similar childhood socioeconomic status and childhood body size. The 2009 biennial questionnaire included a modified version of the Yale Food Addiction Scale (27), which ascertains the extent to which participants’ eating behavior can be characterized as a dependency. The Institutional Review Board of Partners Health Care System (Boston, MA) approved this study.

Variables and variable definitions

Exposures. Our main exposures were physical and sexual abuse experienced in childhood or adolescence (up to and including age 17). Child and/or adolescent physical abuse was assessed using questions from the Revised Conflict Tactics Scale (28), which asked participants to report the frequency 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 when they were children (age 0-10) and when they were adolescents (age 11-17). As in previous analyses (9,10), we categorized physical abuse into the following four categories: none, mild (being pushed, grabbed, or shoved at any frequency or being kicked, bitten, or punched once or hit with something once), moderate (being hit with something more than once or physically attacked once), and severe (being kicked, bitten, or punched or physically attacked more than once or ever choked or burned).

Child and/or adolescent sexual abuse was ascertained by asking participants (1) whether and how often, as a child (age 0-10) or adolescent (age 11-17), they had ever been touched in a sexual way by an adult or an older child or forced to touch an adult or an older child in a sexual way when they did not want to, and (2) whether an adult or older child had ever 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?” (29). We categorized sexual abuse into the following four categories (9): none, sexual touching only, one experience of forced sexual activity, and more than one experience of forced sexual activity.

Outcome. Food addiction was assessed in 2009 using a modified version of the Yale Food Addiction Scale (YFAS) (27), which parallels measures of drug and alcohol addiction. The original YFAS uses 25 questionnaire items to assess seven diagnostic criteria for food addiction, and has been shown to have adequate internal reliability, high convergent validity with other eating pathology constructs, and discriminant validity with related but distinct disorders such as alcohol abuse (27) in a nonclinical sample of undergraduate students. The modified Yale Food Addiction Scale (mYFAS) uses a core of nine questionnaire items, with one question for each of the symptom groups included in the seven diagnostic criteria, plus two items assessing clinically significant impairment and distress. In an application of the mYFAS to the validation data for the YFAS, 9% of participants met the criteria for food addiction using the mYFAS, while 11% met the criteria in the original YFAS validation (30). The mYFAS shows good construct validity and reasonably high sensitivity (79%), providing a valid, though conservative, measure of food addiction.

The mYFAS defines food addiction as three or more of the following seven symptoms plus clinically significant impairment or distress: (a) eating when no longer hungry four or more times per week, (b) worrying about eating two or more times per week, (c) feeling sluggish or fatigued from overeating two or more times per week, (d) experiencing negative feelings from overeating that interfere with other activities two or more times per week, (e) having physical withdrawal symptoms when cutting down on certain foods two or more times per week, (f) continuing to consume the same amount of food despite significant emotional or physical problems due to overeating at any frequency, and (g) feeling the need to eat an increasing amount of food to reduce distress at any frequency. The mYFAS defines clinically significant impairment or distress as either (a) experiencing significant distress related to eating behavior two or more times per week or (b) experiencing a decrease in ability to function due to issues related to food two or more times per week.

The frequency with which symptoms were reported by women meeting the criteria for food addiction ranged from 23% to 88%. Most symptoms were endorsed by at least 70% of women with food addiction, except for needing to eat an increasing amount of food to reduce distress (reported by 62%) and experiencing physical withdrawal symptoms when cutting down on certain foods (reported by 23%). We use the term “food addiction” throughout the manuscript, as shorthand for this set of uncontrolled eating behaviors, but we caution the reader that the extent to which this reflects a physical dependency on certain foods has not been fully established.

Covariates. We included the following covariates, plausible predictors of both child abuse and food addiction, as potential confounders in adjusted models: age at baseline (continuous with a squared term), race (indicators for African American, Asian, Hispanic, and other, with non-Hispanic white as the referent), mother’s and father’s educational attainment when participant was an infant (indicators for <9, 9-11, 12, and 13-15 years, with 16+ as the referent), indicators for mother in professional occupation and father in professional occupation, indicator for parental home ownership when participant was an infant, recalled body size at age 5 (continuous; the participant could choose one of nine female figures ranging from very lean, a score of 1, to very obese, a score of 9, that best represented her body type at age 5 years (31)), and parental lifetime history of depression (indicator if either parent had depression history).

Data analysis

We used modified Poisson regression (Poisson regression with robust standard error estimation (32)) to estimate risk ratios for food
| Variable                        | Child and/or adolescent physical abuse | Child and/or adolescent sexual abuse |
|--------------------------------|----------------------------------------|--------------------------------------|
|                                | None  (n = 26,676) | Mild  (n = 10,593) | Moderate  (n = 15,024) | Severe  (n = 4,852) | None  (n = 37,936) | Touch only  (n = 12,731) | Forced sex once  (n = 3,290) | Forced sex >once  (n = 2,990) |
| Continuous                     | Mean (SD) | Mean (SD) | Mean (SD) | Mean (SD) | Mean (SD) | Mean (SD) | Mean (SD) | Mean (SD) |
| Age in 1989$^a$                | 35.1 (4.7) | 35.1 (4.6) | 35.2 (4.5) | 35.6 (4.5) | 35.1 (4.7) | 35.5 (4.6) | 35.2 (4.5) | 35.4 (4.5) |
| Mother’s education             | 12.5 (2.0) | 12.4 (2.0) | 12.2 (2.0) | 12.1 (2.0) | 12.4 (1.9) | 12.2 (2.0) | 12.1 (2.0) | 12.1 (2.1) |
| Father’s education             | 12.6 (2.5) | 12.5 (2.4) | 12.3 (2.5) | 12.2 (2.5) | 12.6 (2.4) | 12.3 (2.5) | 12.3 (2.5) | 12.1 (2.5) |
| Somatogram at age 5            | 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) | 2.6 (1.3) |
| Sex in 1990$^a$                | % | % | % | % | % | % | % | % |
| Race                           | None | Touch only | Forced sex once | Forced sex >once |
| African-American               | 0.7 | 0.7 | 1.9 | 0.9 | 0.8 | 1.4 | 1.2 | 1.7 |
| Latina                         | 0.9 | 1.2 | 1.7 | 1.7 | 0.9 | 1.8 | 1.6 | 2.0 |
| Asian                          | 1.2 | 1.0 | 1.7 | 1.7 | 1.3 | 1.6 | 1.2 | 1.2 |
| Caucasian                      | 94.3 | 94.4 | 91.9 | 92.4 | 94.0 | 92.6 | 93.1 | 92.0 |
| Other                          | 1.5 | 1.5 | 1.5 | 2.0 | 1.6 | 1.4 | 1.7 | 1.7 |
| Mother in professional occupation | 11.8 | 11.6 | 10.3 | 10.1 | 11.4 | 10.9 | 10.2 | 11.5 |
| Father in professional occupation | 29.9 | 27.9 | 24.1 | 22.0 | 28.8 | 25.1 | 23.9 | 21.6 |
| Parents owned home             | 52.9 | 50.3 | 48.4 | 44.9 | 51.5 | 49.4 | 48.1 | 47.7 |
| Mother or father with history of depression | 11.5 | 14.9 | 16.2 | 24.5 | 12.9 | 16.0 | 19.6 | 21.4 |

$^a$Value is not age-standardized.
addiction comparing women with histories of abuse to women without histories of abuse. Analyses included those women who responded to both the 2001 Violence Questionnaire, on which abuse was ascertained, and the 2009 biennial questionnaire, on which food addiction was assessed (n = 63,002). Women who left three or more food addiction symptom questions blank were excluded (n = 5,344), as were 337 additional women missing information on clinical significance of symptoms, leaving 57,321 participants for our analyses. To assess the sensitivity of our results to these exclusions, we re-ran our models in datasets recreated under various assumptions about the value of the missing outcome data; results were unchanged, indicating that our findings are robust to a variety of missingness patterns.

For each of our abuse exposures, we ran an age-adjusted model and a model adjusted for additional potential confounders. Physical abuse and sexual abuse were first modeled separately. We then examined physical abuse–food addiction associations with and without any sexual abuse exposure, and sexual abuse–food addiction associations with and without any physical abuse exposure. Women missing physical abuse data were excluded from physical abuse analyses (n = 176), and women missing sexual abuse data were excluded from sexual abuse analyses (n = 374). Analyses of combined physical and sexual abuse excluded women missing either physical or sexual abuse (n = 428).

We examined the possibility of a multiplicative interaction between physical abuse and sexual abuse by running a modified Poisson model with a physical abuse indicator, a sexual abuse indicator, and a physical-by-sexual abuse interaction term. We used a Wald test to assess the impact of the interaction term on model fit. Likewise, we assessed the potential additive interaction between physical and sexual abuse with a Wald test of the interaction term in a Poisson model with an identity link.

To determine whether food addiction risk varies with abuse timing and duration, we estimated the effects of abuse in childhood only, adolescence only, and in childhood and adolescence relative to no abuse in either period.

Finally, to estimate absolute age-adjusted food addiction risks at each level of physical and sexual abuse severity, we ran a Poisson model with an identity link, including indicator variables for each of the 16 cross-classifications of the four physical and four sexual abuse severity levels, plus age, centered at the baseline mean (35 years), coded as a continuous variable with a squared term. Food addiction risks for each level of physical and sexual abuse severity were calculated by adding the intercept of this model to the parameter estimates for each physical and sexual abuse category.

Table 2 shows risk ratios (RRs) and 95% confidence intervals (CIs) for food addiction as a function of physical and sexual child abuse severity. Women meeting the criteria for food addiction were 6.0 U of BMI heavier in 2009 than women not meeting the food addiction criteria; almost two thirds of women with food addiction were obese (BMI >30 kg m⁻²) in 2009, compared to a quarter of women without food addiction.

Table 2 shows risk ratios (RRs) and 95% confidence intervals (CIs) for food addiction as a function of physical and sexual child abuse severity. With sexual abuse exposureb

### TABLE 2 Risk ratios for food addiction by physical child abuse severity in all women and by exposure to sexual child abuse: Nurses’ Health Study 2

| Physical abuse severitya | All women | By sexual abuse exposure |
|--------------------------|-----------|--------------------------|
|                          | N (cases) | RR (95% CI) | RR (95% CI) | N (cases) | RR (95% CI) |
| None                    | 26,676 (1,749) | 1.00 | - | 1.00 | - |
| Mild                    | 10,593 (874) | 1.26 (1.16, 1.36) | 1.24 (1.14, 1.34) | 19,732 (1,156) | 1.23 (1.11, 1.35) |
| Moderate                | 15,024 (1,401) | 1.42 (1.33, 1.52) | 1.39 (1.30, 1.49) | 6,849 (581) | 1.41 (1.28, 1.55) |
| Severe                  | 4,852 (657) | 2.06 (1.90, 2.25) | 1.92 (1.76, 2.09) | 2,088 (236) | 1.82 (1.59, 2.08) |

|                        | N (cases) | RR (95% CI) |
|------------------------|-----------|-------------|
| No sexual abuse exposureb | 19,732 (1,156) | 1.00 | - |
| With sexual abuse exposureb | 6,849 (581) | 1.41 (1.28, 1.55) |
1.92 (95% CI: 1.76, 2.09) for mild, moderate, and severe physical abuse, compared to no physical abuse. The relationship of sexual abuse severity to food addiction was similar (Table 3), with an RR for the most severe category of sexual abuse, repeated forced sex, of 1.87 (95% CI: 1.69, 2.05).

Combined exposure to both types of abuse imparted greater risk for food addiction than either type alone. For example, compared to women with neither physical nor sexual abuse histories, the RR associated with severe physical abuse when sexual abuse was also present was 2.40 (95% CI: 2.16, 2.67; Table 2). Likewise, women with repeated experiences of forced sex in addition to a history of physical abuse had an RR for food addiction of 2.32 (95% CI: 2.07, 2.59; Table 3). There was no evidence of a multiplicative interaction between any physical abuse and any sexual abuse (Wald test $P$ value = 0.68). A test of additive interaction approached statistical significance ($P = 0.06$).

We estimated similar effects of abuse occurring in childhood only and abuse occurring in adolescence only (Table 4), with RRs of 1.21 (95% CI: 1.12, 1.30) and 1.29 (95% CI: 1.13, 1.47) for physical abuse and comparable RRs for sexual abuse. Longer duration of abuse conferred a greater food addiction risk: when experienced in both childhood and adolescence, physical abuse was associated with an RR of 1.61 (95% CI: 1.51, 1.71) and sexual abuse was associated with an RR of 1.79 (95% CI: 1.65, 1.94).

The age-adjusted risks of food addiction by cross-classifications of child physical and sexual abuse severity ranged from 6.1% among women with no history of physical or sexual abuse to 16.1% among women with a history of both severe physical and severe sexual abuse (Figure 1).

### TABLE 3 Risk ratios for food addiction by sexual child abuse severity in all women and stratified by exposure to physical child abuse: Nurses’ Health Study 2

| Sexual abuse severity | All women | Confounder-adjusted$^c$ | By physical abuse exposure | No physical abuse exposure | With physical abuse exposure$^a$ |
|-----------------------|-----------|-------------------------|----------------------------|---------------------------|-------------------------------|
|                       | N (cases) | RR (95% CI)             | N (cases)                  | RR (95% CI)               | N (cases)                    | RR (95% CI) |
| None                  | 37,936 (2,658) | 1.00 -                    | 19,732 (1,156)           | 1.00 -                     | 18,165 (1,498)              | 1.38 (1.28, 1.48) |
| Touch only            | 12,731 (1,237) | 1.39 (1.30, 1.48) | 5,179 (427)            | 1.38 (1.24, 1.53)       | 7,538 (809)                | 1.76 (1.61, 1.92) |
| Forced sex once       | 3,290 (341) | 1.48 (1.33, 1.64) | 1,025 (80)             | 1.28 (1.03, 1.59)       | 2,263 (261)                | 1.86 (1.64, 2.11) |
| Forced sex ›once      | 2,990 (423) | 2.02 (1.83, 2.22) | 645 (74)               | 1.85 (1.48, 2.31)        | 2,344 (349)                | 2.32 (2.07, 2.59) |

$^a$Adjusted for age in 1989, race, mother’s educational attainment, father’s educational attainment, mother in professional occupation, father in professional occupation, parental home ownership, parental history of depression.

$^b$Any physical abuse, including mild, moderate, or severe.

### TABLE 4 Risk ratios for food addiction by timing of child and adolescent physical and sexual abuse: Nurses’ Health Study 2

| Abuse timing          | Physical abuse | Confounder-adjusted$^b$ | Sexual abuse | Confounder-adjusted$^b$ |
|-----------------------|----------------|-------------------------|--------------|-------------------------|
|                       | N (cases)      | RR (95% CI)             | N (cases)    | RR (95% CI)             |
| None                  | 26,676 (1,749) | 1.00 -                   | 37,936 (2,658) | 1.00 -                   |
| Childhood (age 0-10) only | 12,051 (971) | 1.23 (1.14, 1.32) | 6,994 (662)    | 1.35 (1.25, 1.47)       |
| Adolescence (age 11-17) only | 2,588 (227) | 1.33 (1.16, 1.52) | 7,123 (678)    | 1.36 (1.25, 1.47)       |
| Childhood and adolescence | 15,820 (1,734) | 1.67 (1.57, 1.78) | 4,894 (661)    | 1.93 (1.78, 2.09)       |

$^a$Adjusted for age in 1989, race, mother’s educational attainment, father’s educational attainment, mother in professional occupation, father in professional occupation, parental home ownership, parental history of depression.
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nervosa (33-35). A small number of studies provide suggestive evidence for an association between child abuse and binge eating disorder (36,37), which captures a distinct but related (38) uncontrolled eating phenotype that affects an estimated 2-3% of the US population (39). In general, studies of child abuse and eating behaviors have relied on small sample sizes, and have been unable to distinguish different types of eating disorder outcomes; few have examined eating behaviors prevalent enough to contribute importantly to obesity rates. One exception is an examination of childhood abuse and “using food in response to stress” among 1,650 adult respondents in the National Survey of Midlife in the US. The authors reported that childhood exposure to frequent physical and psychological abuse was associated with using food in response to stress, which partially explained a 40% increase in obesity incidence in adults reporting child abuse (7). The use of food in response to stress was ascertained with two questionnaire items and was associated with a two-fold increase in obesity prevalence.

Our large cohort allowed us to conduct in-depth examinations of the associations between the type and timing of child abuse and food addiction, a measure of uncontrolled eating reported by 8% of our sample. Nearly two thirds of women meeting the food addiction criteria were obese in 2009, compared to a quarter of women without food addiction. While cross-sectional, this association suggests that food addiction may contribute significantly to obesity rates. The NHSSII has rich data on possible confounders, including childhood socioeconomic status and family history of depression, allowing us to adjust for common causes of abuse and eating behaviors that are frequently overlooked.

Despite these strengths, our study has several important limitations. First, we were unable to date the onset of food addiction symptoms, and were therefore unable to establish with certainty that child abuse occurred prior to food addiction. While we believe that a mechanism from child abuse to food addiction is more plausible than one from food addiction to child abuse, this study would have been strengthened by data on timing of food addiction symptoms, which would have allowed us to identify periods of vulnerability to food addiction. Second, the degree to which food addiction represents a valid eating disorder phenotype—and in particular the extent to which the food addiction construct reflects a physical dependency—remains in question; the potential application of these study results will depend in part on whether food addiction is ultimately seen as physical or behavioral in nature and whether effective treatments are identified. Third, the NHSSII is comprised primarily of white women, and thus our findings may not be generalizable to the US population as a whole. Future studies in more diverse populations will enrich our understanding of eating behavior sequelae of child abuse. Finally, as with many studies of child abuse, we relied on women’s self-report of child abuse, which could not be validated. Because child abuse goes underreported (40), it is unclear what gold standard should be used to validate self-reports of child abuse. Using reported and substantiated cases of child abuse would identify only the most severe cases of abuse and would miss the majority of the exposed population. While we could not validate self-reports of child abuse, the prevalence in our study is very similar to the child abuse prevalence self-reported on national surveys (1,2).

Our finding that child abuse victimization is associated with food addiction adds to accumulating evidence of the importance of stress in the etiology of some obesity phenotypes (12), and may help to inform the development of weight-loss regimens for women with abuse histories. Our study also contributes to a growing body of literature documenting widespread and long-lasting mental and physical health repercussions of child abuse, which help to clarify the true societal costs of child maltreatment and lend urgency to abuse prevention efforts.

The epidemic prevalence of obesity and its toll on health call for focused efforts to understand widespread obesity risk factors that may be modified to improve public health. A better understanding of the mechanisms by which child abuse, experienced by over a third of girls (1,2), influences weight gain is likely to be important in addressing obesity risk in women. Our study suggests that uncontrolled eating in response to stress may be one important element of this pathway. Future work should further articulate the pathways from abuse to weight gain, to identify critical periods of vulnerability and targets for intervention that can inform prevention and treatment efforts.

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