Original Article

Childhood Maltreatment and Body Mass Index in Older Adults With Chronic Illness

Vicki St-Arnaud, MSc,[a,b] Ann Xiuli Chicoine, BSc,[a,b] Jean-Claude Tardif, MD,[a,c]
David Busseuil, PhD,[a] and Bianca D'Antono, PhD[a,b]

[a] Research Centre, Montreal Heart Institute, Montreal, Québec, Canada
[b] Psychology Department, Université de Montréal, Montreal, Québec, Canada
[c] Department of Medicine, Université de Montréal, Montreal, Québec, Canada

ABSTRACT

Background: Childhood trauma has been associated with greater psychological and physical morbidity, including a greater risk of developing coronary artery disease (CAD). Emotional dysregulation and increased body mass index (BMI) may be involved. This study evaluated whether (1) childhood maltreatment is associated with a higher BMI at study onset and with greater increases in BMI 5 years later among older adults with CAD or other chronic illnesses; (2) sex and/or CAD status moderate these results; and (3) baseline symptoms of anxiety, depression, and perceived stress (emotional dysregulation) mediate the association between childhood maltreatment and BMI at follow-up.

Methods: A total of 1232 men and women (aged 60.86 [6.95] years) completed validated questionnaires on childhood maltreatment and symptoms of psychological distress. The weight and height of the participant were measured, and the BMI was calculated using the weight (kg)/height (m²) ratio.

RÉSUMÉ

Contexte : Les traumatismes de l'enfance sont associés à une plus grande morbidité physique et psychologique, notamment à un risque accru de maladie coronarienne. Il se peut qu'une dysrégulation émotionnelle et un indice de masse corporelle (IMC) élevé y contribuent. Cette étude visait à évaluer si 1) la maltraitance subie pendant l'enfance est associée à un IMC initial plus élevé et à une augmentation plus marquée de l'IMC après 5 ans chez des personnes âgées atteintes d'une maladie coronarienne ou d'une autre maladie chronique; 2) le sexe et/ou la présence ou l'absence d'une maladie coronarienne influent sur ces résultats; et 3) certains symptômes initiaux (anxiété, dépression et stress tel qu'il est perçu [dysrégulation émotionnelle]) sont des médiateurs de l'association entre la maltraitance subie pendant l'enfance et l'IMC calculé lors du suivi.

Méthodologie : En tout, 1 232 hommes et femmes (âgés de 60,86 ans [6,95] ans) ont rempli des questionnaires validés sur la maltraitance infantile et les symptômes de détresse psychologique. Le

Childhood maltreatment, which includes physical, psychological, and sexual abuse, as well as emotional and physical neglect, represents a serious public health issue,[1] with 9% to 33% of Canadians having reported at least 1 type of abuse and 21% to 34% neglect before the age of 15 years.[2–4] In the long term, survivors of childhood maltreatment report poorer health compared with those who have not experienced maltreatment[5–7] and are more likely to develop various physical and psychological health problems, including type 2 diabetes and cardiovascular disease.[8–15] This may result, in part, from the increased risk of becoming overweight (body mass index [BMI] 25 to ≤29.9 kg/m²) or obese (BMI ≥30) in adults having suffered maltreatment in childhood.[15–17] Indeed,

according to a meta-analysis of 41 cross-sectional and retrospective studies (N = 190,285), the lifetime risk of obesity is increased by 36% in individuals with vs without experiences of abuse and neglect before the age of 18 years, independent of socioeconomic status and health behaviours.[18] These findings are consistent with those of 2 other meta-analyses.[19,20]

Nonetheless, there is significant heterogeneity in these results, which may be explained in part by methodological differences, including sample characteristics such as sex, whether validated questionnaires were used, and whether maltreatment experiences were examined as a whole or individually.[18–20] Studies that have examined individual types of maltreatment have produced less consistent results, which may reflect the fact that nearly half of survivors have experienced multiple forms of abuse and/or neglect in childhood[21–23] and that these cumulative experiences are more predictive of later health problems than individual abuses.[24–26] In addition, most studies (>80%) have been performed in predominantly

Results: Childhood maltreatment was not significantly associated with BMI at study onset nor at follow-up. This relation did not differ as a function of sex nor CAD status. Although childhood maltreatment was associated with significantly greater psychological distress at study onset (all *P* < 0.001), there latter was not found to mediate the relation between maltreatment and change in BMI at follow-up.
Conclusions: In contrast to previous literature, childhood maltreatment was not associated with BMI nor with the change in BMI over 5 years in men and women with chronic disease. However, as psychological distress increases risk for morbidity and mortality, it may represent an important target for prevention and intervention in survivors of childhood maltreatment.

poids (kg) et la taille de ces participants ont été recueillis, et leur IMC a été calculé selon la formule suivante : poids (kg)/taille^2 (m^2).
Résultats : Il n'y avait pas d'association significative entre la maltraitance subie pendant l'enfance et les IMC calculés au départ et lors du suivi. Ni le sexe ni la présence ou l'absence d'une maladie coronarienne n'ont influé sur cette relation. Certes, la maltraitance subie pendant l'enfance était associée à une détresse psychologique significativement plus marquée au début de l'étude (*p* < 0,001 dans tous les cas), mais il a été établi que ce paramètre n'était pas un médiateur de la relation entre la maltraitance infantile et l'IMC calculé lors du suivi.
Conclusion : Contrairement à ce qu'indiquent des données publiées, il n'y avait pas d'association entre la maltraitance subie pendant l'enfance et l'IMC ou la variation de celui-ci sur 5 ans chez des femmes et des hommes atteints d'une maladie chronique. Cependant, comme la détresse psychologique accroît le risque de morbidité et de décès, elle peut constituer une cible importante des stratégies de prévention et d'intervention chez les personnes qui ont survécu à une maltraitance infantile.

female samples[18] despite high prevalence rates of childhood maltreatment[27] and overweight/obesity[28] in men. Importantly, in 3 prospective studies that included young men, little to no relationship between childhood maltreatment and BMI was observed in the men.[29–31] These findings, if replicated, could suggest important differences in how childhood maltreatment may impact boys/men and girls/women. Moreover, to this day, few studies have focused on older individuals. Indeed, an important limitation of the current literature is the under-representation of adults over 50 years of age. To our knowledge, only 3 studies have included samples with a mean age of 52-57 years.[32–35] This is surprising given the poorer prognosis associated with overweight or obesity among older individuals, including those with chronic diseases,[36] diseases that may themselves play a role in adult weight gain.[37–39] It thus seems important to evaluate the association of childhood maltreatment on the BMI trajectory among older men and women, taking into consideration their medical status.

Given the increasingly high prevalence rates of overweight and obesity worldwide,[40] and related morbidity and mortality risks, it is crucial to better understand which factors contribute to increased BMI in later adulthood.[41] It has been proposed that alterations in emotional regulation and resulting psychological distress[42–45] arising from early maltreatment experiences[46] may lead to the development of unhealthy behaviours, such as substance use, poor eating habits, and binge eating, in attempts to cope with life challenges,[47,48] thus increasing the risk for overweight and obesity.[45,49] Yet, only a few studies have focused on whether psychological distress mediates the relation between childhood maltreatment and BMI in adulthood. Two longitudinal studies[15,50] and one cross-sectional study[51] found that depressive symptoms measured during adolescence mediated the relationship between childhood maltreatment and BMI or BMI trajectory in adulthood, particularly in women. To our knowledge, however, only 1 prospective study examined whether anxiety mediated the relationship between maltreatment and BMI[52] and found that anxiety symptoms at age 29 years was a

significant mediator between childhood physical abuse and BMI at age 41 years in women but not men. Alvarez et al.,[41] for their part, reported that while perceived stress was associated with both obesity and abuse (physical and sexual) in a large cross-sectional study of women over the age of 18 years, it did not mediate the relationship between obesity and abuse. As such, little is still known regarding the potential role of psychological distress, particularly anxiety and stress, in mediating the effects of childhood maltreatment on BMI, particularly among middle-aged to older individuals with chronic medical conditions.

The purpose of this study is to replicate and extend findings regarding childhood maltreatment and BMI in an older sample of men and women with coronary artery disease (CAD) or other chronic non–cardiovascular diseases (CVD). It is of interest to know whether this relation withstands the test of time and the many divergent life experiences that occur over decades of life, and whether psychological distress factors continue to exert their effect in later age. In contrast to most previous research, the current 5-year prospective study will examine BMI as a continuous variable in primary analyses rather than the presence of (morbid) obesity to determine whether current findings are also applicable across the weight continuum. This prospective correlational investigation will seek to (1) assess whether childhood maltreatment is associated with a higher BMI at study onset and with greater increases in BMI 5 years later, (2) examine whether these relationships differ by sex or medical status of participants, and (3) evaluate the possibility of mediation by testing the direct and indirect associations of childhood maltreatment via psychological distress (anxiety, depression, and/or perceived stress) obtained at baseline, with BMI at 5-year follow-up.

Methods

This study is part of an ongoing prospective research project (BEL-AGE) examining the role of psychological burden in pathologic aging in adults with CAD and other chronic non-CVD at lower risk of mortality. It was approved by the

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Research Ethics and New Technology Development Committee of the Montreal Heart Institute. The authors confirm that patient consent forms have been obtained for this article.

Transparency and openness

Sample size was initially determined for the purposes of other BEL-AGE primary objectives. All data exclusions, manipulations, and measures are reported. Statistical significance was defined as a 2-tailed P value of < 0.05. All analyses were performed using IBM SPSS Statistics 26.0 software (IBM Corporation, Somers, NY). The moderation and mediation models were analysed using the PROCESS (version 3.5) macro for SPSS.[53] Data, analysis code, and research materials can be made available upon reasonable request but are not placed in open access given our continued analyses of the data. This study's design and its analysis were not preregistered.

Sample

A total of 1325 (60% men) participants with CAD or other non-CVD illnesses (mean age = 60.6 ± 7.3 years) were recruited into the BEL-AGE project from September 2012 to May 2017 from the participant pool of the André and France Desmarais Hospital Cohort at the Montreal Heart Institute (the MHI Cohort). Inclusion criteria for the MHI Cohort were being 18 years of age or older, working at and/or attending the MHI for any reason (including for routine blood tests, being a patient of the MHI, or being a family member of an MHI patient). For the BEL-AGE project, the inclusion criteria were: (1) to have been recruited into the Hospital Cohort ± 5 years before participation in the BEL-AGE project and to have agreed to be contacted for future studies, (2) to be between 30 and 70 years of age at the time of participation in the Hospital Cohort, (3) to be able to speak and write French or English, (4) to have received no medical diagnosis with a high risk of mortality other than coronary heart disease (eg, AIDS, cancer, and chronic obstructive pulmonary disease), and (5) had completed at least some of the psychological questionnaires at time 1. In addition, at the time of follow-up, participants also had to meet the following conditions: (6) live in the Montreal metropolitan area, (7) not suffer from a cognitive impairment or serious mental health problem (eg, bipolar disorder, schizophrenia, and dementia) that would prevent the participant from understanding or fully participating in the study, (8) not be pregnant or breastfeeding, and (9) have consented to have the data from the MHI Cohort (time 1) transmitted to BEL-AGE. CAD was confirmed by previous myocardial infarction, coronary artery bypass surgery, coronary angioplasty, and/or stenosis greater than 50% on angiography. To be included, individuals without CVD had to be free of arrhythmia, congenital heart disease, angina, heart failure, cardiomyopathy, or stroke. Participants with chronic non-CVD had to have 1 or more chronic health problems, including but not limited to arthritis, diabetes, and asthma. Healthy individuals had to be free of any chronic or acute illness at the time of recruitment.

Complete data for the main analyses were available for 1232 participants. Ninety-three participants from the original sample were excluded from the present study either because they did not meet the inclusion criteria (n = 17), had missing BMI (n = 5), or depression (n = 32) at baseline, or did not suffer from a chronic condition (n = 39). Despite our efforts (extending recruitment and purposeful sampling) to recruit age-matched healthy individuals as an additional comparison group, we were forced to exclude this group from analyses given its small sample size.

Procedure

Baseline procedure. Eligible participants were given an appointment with an MHI Cohort nurse, who measured their weight and height. A semistructured interview regarding participants' medical history was conducted, and psychological questionnaires addressing depression and sociodemographic questionnaires were completed on site. Participants could complete the remaining psychological questionnaires at home and return them by mail in a prestamped envelope. Psychological questionnaires were not returned by 204 participants. They were excluded from the parallel mediation analyses given missing anxiety and stress data (N = 1028). Participants who did and did not return the questionnaires on anxiety or stress at baseline did not differ significantly on any of the sociodemographic, medical, or psychological (depression, hostility) variables examined.

Follow-up procedure. Approximately 5 years later (57 $\pm$ 9.22 standard deviation months), participants returned for testing on a weekday between 8:00 and 10:00 AM. Participants were asked to refrain from eating, drinking (except water), and exercising 12 hours before the appointment and using recreational drugs or alcohol 24 hours before their appointment. They were allowed to take their medication as prescribed. Once the participant's consent was obtained, weight and height were measured by a trained BEL-AGE staff member. A semistructured interview involving the completion of all psychological and lifestyle questionnaires on site ensued.

Instruments

Sociodemographic and health variables. Data on sex (assigned at birth), age, ethnicity, years of schooling, marital status, personal and family income, personal and family medical history, and the participant's current list of medications were obtained. Data on the participant's health behaviours such as tobacco use, alcohol, and physical activity were also collected.

Childhood Trauma Questionnaire—Short Form (CTQ-SF). The CTQ-SF[34] was used to assess maltreatment experienced in childhood and adolescence. It consists of 25 self-report items measuring 5 different forms of maltreatment (physical, sexual, emotional abuse, and emotional and physical neglect). Each form of maltreatment is measured using a 5-point scale ranging from 1 ("never true") to 5 ("very often true"). Participants with moderate to extremely severe scores on at least 1 subscale, emotional abuse (≥ 13), physical abuse (≥ 10), sexual abuse (≥ 8), emotional neglect (≥ 15), and physical neglect (≥ 10), are classified as positive for childhood maltreatment history. The original questionnaire has high internal consistency ($\alpha = 0.89$), and temporal stability measured at 4-month intervals ranged from 0.79 to 0.86.[54] In the current sample, overall

internal consistency was excellent ($\alpha = 0.91$), as was that for subscales ($\alpha > 0.80$) except for the physical neglect subscale ($\alpha = 0.58$). The low internal consistency for the physical neglect subscale study is consistent with previous studies.[55-57]

Center for Epidemiologic Studies-Depression Scale Revised (CESD-R).

The CESD-R[58] consists of a 20-item self-report measuring 9 types of depressive symptoms over the past 2 weeks (sadness, loss of interest, appetite, sleep, thoughts/concentration, guilt, fatigue, agitation, and suicidal thoughts). Each symptom is measured using items on a Likert-type scale from 0 ("not at all or less than 1 day") to 3 ("nearly every day for 2 weeks"). The total score ranges from 0 to 60, where a score of 16 and above indicates a risk of clinical depression. This tool has very good internal consistency ($\alpha = 0.85\text{-}0.94$).[58-60] Temporal stability, measured after 3-6 months, is 0.54-0.59.[61,62]

State-Trait Anxiety Inventory (STAI)—state version.

The STAI-state[63] is a 20-item self-report questionnaire assessing the participant's current state of anxiety. Each item is measured on a 4-point Likert scale ranging from 1 ("not at all") to 4 ("very much so"). The total score ranges from 20 to 80, where a score of 40 or greater is considered clinically elevated.[63,64] Internal consistency of the STAI-state is excellent ($\alpha = 0.91$).[65] The test-retest stability coefficient for the STAI ranges from 0.65 to 0.75 over a 2-month interval.[63]

Perceived Stress Questionnaire (PSQ).

This 30-item questionnaire[66] is used to measure perceived stressful life events, circumstances, and reactions to stress. The PSQ includes 7 dimensions: harassment, overload, irritability, lack of joy, fatigue, worries, and tension. Participants rate on a 4-point scale ranging from 1 ("almost never") to 4 ("usually") how frequently they experienced each of the stress-related statements over the past 2 years. The sum of all responses was used within this study. This questionnaire has an excellent internal consistency ($\alpha = 0.85\text{-}0.92$) and a test-retest reliability over a period of 1 year of 0.82.[66,67]

We have previously demonstrated the psychometric properties for the CESD-R, STAI, and PSQ within this sample consistent with the existing literature.[68]

Anthropometric measurements.

Weight in kilograms (kg) was measured on a digital medical scale with a maximum capacity of 300 kg, and a vertical rod graduated in centimetres was used to measure the participant's height. The participant's BMI was calculated using the weight (kg)/height (m^2) ratio.

Statistical approach

Preliminary analyses.

Descriptive analyses were performed using t tests and χ^2 analyses for continuous and categorical data, respectively. Logarithmic transformations were performed for symptoms of anxiety and depression as well as for BMI to normalize their distributions. Square root transformations were performed for childhood maltreatment data. Transformed data were used for statistical analyses, though nontransformed data are presented in tables and figures for ease of interpretation.

Potential covariates were identified using the current literature on maltreatment and BMI in adults.[18-20] Pearson correlations and χ^2 analyses were performed to finalize the list of covariates, with variables reaching a P value of ≤ 0.10 retained. These included sex, age, annual family income, weekly alcohol consumption, number of hours of exercise per week, tobacco use, use of psychotropics, and presence/absence of 1 or more of hypercholesterolemia, hypertriglyceridemia, and/or essential hypertension.

Main-analyses.

Bivariate Pearson correlations assessed the nonadjusted associations between continuous measures of childhood maltreatment and BMI at study onset and 5 years later. For ease of comparison with some literature, 2 analyses of variance comparing childhood maltreatment scores between participants who did or did not meet the criteria for obesity at T1 and T2 were also performed.

Two hierarchical linear regressions were performed to assess the associations between childhood maltreatment and BMI (both as continuous variables) at study onset and 5 years later, independent of covariates. Covariates as well as sex and CAD status were forced into block 1, whereas childhood maltreatment was entered in block 2. For the analysis of BMI at a follow-up, the initial BMI and follow-up interval were added to the list of covariates in block 1.

Moderation analyses examined whether the association between childhood maltreatment and baseline BMI was moderated by sex and/or CAD status. The analysis was repeated for BMI obtained at the 5-year follow-up, with covariates as above. The 2- and 3-way interactions of childhood maltreatment with sex and/or CAD status were constructed from centered variables. Nonsignificant interaction terms were removed from the equation and the more parsimonious model retained.

To evaluate whether anxiety, depression, and/or perceived stress (entered simultaneously) mediated the association between childhood maltreatment and BMI at follow-up, a parallel mediation analysis was performed, controlling for covariates, sex, and CAD status. The indirect effects were tested using nonparametric bootstrapping, with effects considered statistically significant when 0 falls outside the 95% confidence intervals. Bootstrapping was performed using 5000 samples.

Secondary analyses.

To investigate the relation between dichotomous values of childhood maltreatment and obesity, a binomial logistic regression was performed using obesity as an outcome variable. Obesity was defined as BMI ≥ 30 kg/m^2. Covariates, childhood maltreatment, sex and CAD status, and their 2- and 3-way interactions were entered as predictors. If the interaction terms were not significant, they were removed from the equation.

Results

Participant characteristics

Table 1 presents participant characteristics. Participants with CAD were slightly older and had fewer years of formal education, as well as a lower annual family income compared with participants with non-CVD illness. They were also more

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Table 1. Participant characteristics

Characteristic	CAD men (n = 494)	Non-CVD men (n = 256)	CAD women (n = 146)	Non-CVD women (n = 336)	Full sample (N = 1232)
Demographic variables					
Age (y), mean ± SD***	61.21 ± 6.54	59.69 ± 7.29	62.89 ± 6.26	60.36 ± 7.35	60.86 ± 6.95
Race, n (%)					
Caucasian	489 (99)	248 (96.9)	144 (98.9)	332 (98.8)	1213 (98.5)
First spoken language, n (%)					
French	463 (93.7)	225 (87.9)	139 (95.2)	309 (92.0)	1136 (92.2)
Other	31 (6.3)	31 (12.1)	7 (4.8)	27 (8.0)	96 (7.8)
Civil status, n (%)***					
Single	36 (7.3)	22 (8.6)	13 (8.9)	39 (11.6)	110 (8.9)
Civil union/married	377 (76.3)	207 (80.9)	89 (61.0)	229 (68.2)	902 (73.2)
Separated/divorced/widowed	81 (16.4)	27 (10.5)	44 (30.1)	68 (20.2)	220 (17.9)
Years of education, mean ± SD***	14.07 ± 3.76	15.38 ± 3.28	12.69 ± 3.15	14.36 ± 3.43	14.26 ± 3.58
Annual family income, n (%)***					
≤$29,999	57 (11.5)	10 (3.9)	36 (24.7)	38 (11.3)	141 (11.4)
$30,000-$59,999	164 (33.2)	67 (26.2)	62 (42.5)	134 (39.9)	427 (34.7)
$60,000-$99,999	153 (31)	80 (31.3)	37 (25.3)	94 (28.0)	364 (29.5)
≥$100,000	117 (23.7)	99 (38.7)	11 (7.5)	68 (20.2)	295 (23.9)
Health behaviour					
Alcoholic beverage/wk, mean ± SD***	7.67 ± 10.20	7.54 ± 7.75	2.95 ± 5.50	4.59 ± 6.16	6.25 ± 8.44
Hours of exercise/wk, mean ± SD***	2.45 ± 2.39	2.81 ± 2.22	2.30 ± 2.49	3.09 ± 2.39	2.68 ± 2.38
Current smoker, n (%)**	61 (12.3)	16 (6.3)	16 (11.0)	21 (6.3)	114 (9.3)
Cigarettes/days for smoker, mean ± SD	17.11 ± 11.53	18.85 ± 9.45	13.55 ± 8.14	14.44 ± 7.57	16.35 ± 10.21
Psychotropic use, n (%)***	89 (18.0)	37 (14.5)	58 (39.7)	73 (21.7)	257 (20.9)
Chronic physical conditions, n (%)					
Diabetes***	97 (19.6)	29 (11.3)	34 (23.3)	17 (5.1)	177 (14.4)
Dyslipidemia***	475 (96.2)	162 (63.3)	130 (89.0)	133 (39.6)	900 (73.1)
Hypertension***	339 (68.6)	101 (39.5)	109 (74.7)	116 (34.5)	665 (54.0)
Psychological distress, mean ± SD					
Anxiety symptoms[†],***	31.35 ± 10.08	31.35 ± 10.34	36.41 ± 11.20	31.56 ± 9.23	31.98 ± 10.15
Depression symptoms***	5.22 ± 7.03	5.36 ± 7.48	9.24 ± 10.00	5.11 ± 6.40	5.69 ± 7.48
Perceived stress[†],***	54.67 ± 14.11	56.55 ± 15.85	63.53 ± 17.11	57.02 ± 14.18	56.74 ± 15.08
Body mass index (BMI) (kg/m²), mean ± SD					
Baseline***	29.47 ± 4.59	29.14 ± 4.77	28.66 ± 6.01	27.98 ± 5.36	28.90 ± 5.06
Follow-up**	29.78 ± 4.45	29.25 ± 4.89	29.20 ± 6.05	28.49 ± 5.72	29.25 ± 5.14
BMI ≥30 (obesity range), n (%)					
Baseline**	192 (38.9)	99 (38.7)	54 (37.0)	94 (28.0)	439 (35.6)
Follow-up*	212 (42.9)	90 (35.2)	59 (40.4)	109 (32.4)	470 (38.1)
Childhood maltreatment					
Total score, mean ± SD*	35.93 ± 11.98	35.24 ± 10.85	38.79 ± 16.91	36.05 ± 12.53	36.16 ± 12.62
Participants who experienced maltreatments, n (%)[‡]	159 (32.2)	74 (28.9)	55 (37.7)	106 (31.5)	394 (32.0)

CAD, coronary artery disease; non-CVD, chronic non−cardiovascular diseases; SD, standard deviation.

*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

[†] N = 1028.

[‡] Participants with moderate to extremely severe scores on at least 1 subscale of the Childhood Trauma Questionnaire.

likely to smoke, were less physically active, had a higher BMI and prevalence of obesity at baseline and follow-up compared with those without CVD, and suffered more from diabetes, hypercholesterolemia, and hypertension. Men had a higher weekly alcohol consumption compared with women, whereas women reported significantly more symptoms of anxiety, depression, and stress and were prescribed more psychotropic medication compared with men.

Univariate associations between childhood maltreatment, BMI, and obesity

Pearson correlations between childhood maltreatment and BMI at study onset ($r = 0.028$, $P = 0.323$) and at follow-up ($r = 0.036$, $P = 0.204$) were not significant.

However, individuals meeting the criteria for obesity at follow-up ($F(1, 1231) = 8.071$, $P = 0.005$) did report slightly, though significantly more childhood maltreatment compared with individuals falling within the normal to overweight range ($37.40 ± 13.78$ vs $35.39 ± 11.79$), respectively. A similar trend was observed at baseline ($F(1, 1231) = 3.723$, $P = 0.054$).

Multivariate associations between childhood maltreatment, BMI, and obesity

Associations between the continuous measures of childhood maltreatment and BMI remained nonsignificant at both time points in the linear regressions controlling for covariates (see Tables 2 and 3 for details).

The difference in childhood maltreatment scores among individuals meeting or not the criteria for obesity (at follow-up) was no longer significant after controlling for covariates ($F(1, 1226) = 3.835$, $P = 0.050$).

Table 2. Summary of the hierarchical regression analysis for baseline BMI

Characteristic	b	B	T	P	95% CI LL	95% CI UL	Semipartial r
Block 1							
Age (y)	−0.027	−0.001	−0.918	0.359	−0.002	0.001	−0.025
Male vs female sex	0.130	0.045	4.134	<0.001	0.024	0.067	0.114
CAD vs other chronic disease	−0.035	−0.012	−1.100	0.272	−0.033	0.009	−0.030
Smoker (yes vs no)	−0.090	−0.053	−3.177	0.002	−0.085	−0.020	−0.087
Exercise (h/wk)	−0.140	−0.010	−4.972	<0.001	−0.014	−0.006	−0.137
Alcoholic beverage/wk	−0.055	−0.001	−1.921	0.055	−0.002	<0.001	−0.053
Family income	−0.002	<0.001	−0.063	0.950	−0.011	0.010	−0.002
Years of education	−0.121	−0.006	−3.983	<0.001	−0.009	−0.003	−0.110
Psychotropic use (yes vs no)	0.003	0.001	0.097	0.922	−0.022	0.024	0.003
Metabolic triad (yes vs no)	0.129	0.063	4.161	<0.001	0.033	0.093	0.114
Corticosteroid use (yes vs no)	0.070	0.033	2.529	0.012	0.007	0.058	0.070
$F(11, 1214) = 9.857, P < 0.001, R^2 = 0.082, R^2_{adjusted} = 0.074$							
Block 2							
Childhood maltreatment	0.023	0.004	0.810	0.418	−0.006	0.014	0.022
$F(12, 1213) = 9.087, P < 0.001, R^2 = 0.082, R^2_{adjusted} = 0.073$							

Metabolic triad refers to the current or past diagnosis of hypercholesterolemia, diabetes, and/or hypertension.

b, unstandardized β coefficient; B, standardized β coefficient; BMI, body mass index; CAD, coronary artery disease; CI, 95% confidence interval for B; LL, lower limit; UL, upper limit.

Sex and CAD status do not moderate the relation between childhood maltreatment and BMI

The relation between childhood maltreatment and BMI was not moderated by sex ($b = 0.0106, P = 0.2764$) nor by CAD status ($b = −0.0132, P = 0.1804$) at study onset, nor at the 5-year follow-up by sex ($b = 0.0006, P = 0.8900$) and CAD status ($b = −0.0066, P = 0.4500$). No significant 3-way interactions emerged for either of the time points.

The relation between childhood maltreatment and BMI is not mediated by psychological distress

Given the potential for reverse mediation, we performed the mediation analysis despite the lack of association between childhood maltreatment and BMI. Although childhood maltreatment was associated with significantly greater symptoms of anxiety, depression, and stress at baseline (all $P < 0.001$), the latter were not found to mediate the association between childhood maltreatment and BMI at follow-up (see Fig. 1 for details).

Childhood maltreatment (categorical) does not predict a greater risk of obesity

No main or interaction effects involving childhood maltreatment emerged at study onset, nor at follow-up in the logistic regressions involving the dichotomous values of childhood maltreatment and obesity (see Tables 4 and 5).

Table 3. Summary of the hierarchical regression analysis for BMI at follow-up

Characteristic	b	B	t	P	95% CI LL	95% CI UL	Semipartial r
Block 1							
Age (y)	−0.035	−0.001	−2.434	0.015	−0.001	<0.001	−0.033
Male vs female sex	−0.021	−0.007	−1.382	0.167	−0.017	0.003	−0.018
CAD vs other chronic disease	0.019	0.006	1.204	0.229	−0.004	0.016	0.016
Initial BMI (kg/m²)	0.872	0.841	62.453	<0.001	0.814	0.867	0.835
Interval between first and second visit (y)	−0.022	<0.001	−1.624	0.105	−0.001	<0.001	−0.022
Smoker (yes vs no)	−0.005	−0.003	−0.347	0.729	−0.018	0.013	−0.005
Exercise (h/wk)	−0.061	−0.004	−4.375	<0.001	−0.006	−0.002	−0.059
Alcoholic beverage/wk	0.016	<0.001	1.134	0.257	<0.001	0.001	0.015
Family income	0.012	0.002	0.814	0.416	−0.003	0.007	0.011
Years of education	−0.022	−0.001	−1.500	0.134	−0.002	<0.001	−0.020
Psychotropic use (yes vs no)	−0.006	−0.002	−0.440	0.660	−0.013	0.008	−0.006
Metabolic triad (yes vs no)	−0.004	−0.002	−0.266	0.791	−0.016	0.012	−0.004
Corticosteroid use (yes vs no)	0.013	0.006	0.956	0.339	−0.006	0.018	0.013
$F(13, 1212) = 336.900, P < 0.001, R^2 = 0.783, R^2_{adj} = 0.781$							
Block 2							
Childhood maltreatment	0.008	0.001	0.566	0.571	−0.003	0.006	0.008
$F(14, 1211) = 312.683, P < 0.001, R^2 = 0.783, R^2_{adj} = 0.781$							

Metabolic triad refers to current or past diagnosis of hypercholesterolemia, diabetes, and/or hypertension.

b, unstandardized β coefficient; B, standardized β coefficient; BMI, body mass index; CAD, coronary artery disease; CI, 95% confidence interval for B; LL, lower limit; UL, upper limit.
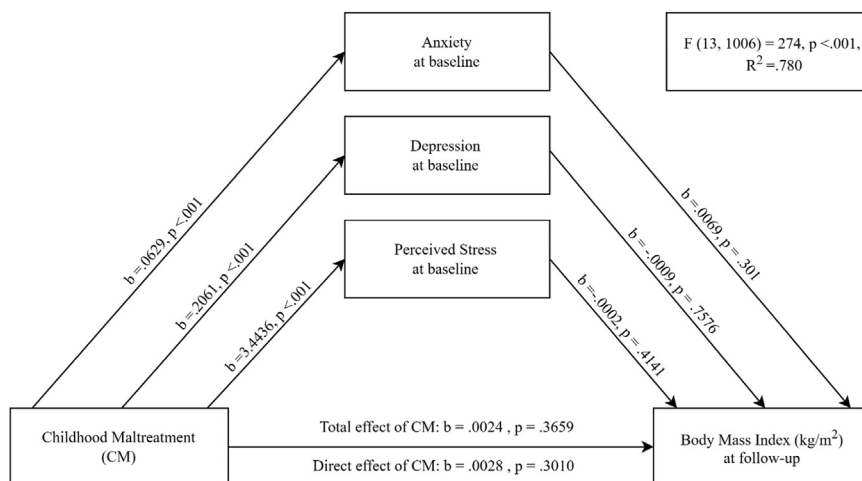
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Figure 1. Psychological distress does not mediate the relation between childhood maltreatment and body mass index (BMI) at follow-up. Although childhood maltreatment (continuous) was associated with significantly greater symptoms of anxiety, depression, and stress at study onset (all $P < 0.001$), the latter were not found to mediate the association between childhood maltreatment and BMI at follow-up. Analyses presented controlled for baseline BMI, time to follow up, and other covariates.

Discussion

The current prospective study sought to examine whether maltreatment experienced in childhood was associated with a higher BMI at baseline and 5 years later in a sample of middle-aged to older men and women with CAD or other chronic non-CVD illness. It also examined whether individual characteristics (sex and CAD status) moderated these relations and whether measures of psychological distress mediated changes in BMI over the follow-up period. Contrary to expectations, childhood maltreatment was not significantly associated with BMI at baseline nor at follow-up. This was true independently of whether these constructs were examined as continuous or dichotomous variables. Although individuals who were obese

did report significantly more childhood trauma compared with those within the normal to overweight range for BMI, this difference was very small and no longer significant when controlling for potential confounds. Finally, although childhood maltreatment was associated with significantly greater symptoms of anxiety, depression, and stress at baseline, the latter did not mediate (indirectly explain the variance between) the relationship between childhood maltreatment and BMI at follow-up.

Our results contrast those of previous studies that found childhood maltreatment to be associated with increased BMI

Table 4. Association between childhood maltreatment and obesity (BMI $\geq$30) at baseline using a binomial logistic regression

Characteristic	OR	P	95% CI LL	95% CI UL
Age (y)	0.990	0.307	0.972	1.009
Male vs female sex	1.453	0.010	1.093	1.931
CAD vs other chronic disease	0.860	0.286	0.651	1.135
Smoker (yes vs no)	0.470	0.001	0.298	0.742
Exercise (h/wk)	0.900	<0.001	0.853	0.949
Alcoholic beverage/wk	0.994	0.460	0.980	1.009
Family income	0.977	0.754	0.847	1.128
Years of education	0.914	<0.001	0.880	0.949
Psychotropic use (yes vs no)	0.931	0.645	0.685	1.264
Metabolic triad (yes vs no)	1.956	0.002	1.272	3.009
Corticosteroid use (yes vs no)	1.526	0.011	1.104	2.111
Participants who experienced maltreatment* (yes vs no)	1.010	0.940	0.777	1.312

$\chi^2(12, 1226) = 77.192$, $P < 0.001$. Pseudo-R^2: Cox and Snell = 0.061, Nagelkerke = 0.084.

Metabolic triad refers to current or past diagnosis of hypercholesterolemia, diabetes, and/or hypertension.

OR, odds ratio; BMI, body mass index; CAD, coronary artery disease; CI, 95% confidence interval for OR; LL, lower limit; UL, upper limit.

*Participants with moderate to extremely severe scores on at least 1 subscale of the Childhood Trauma Questionnaire.

Table 5. Association between childhood maltreatment and obesity (BMI $\geq$30) at follow-up using a binomial logistic regression

Characteristic	OR	P	95% CI LL	95% CI UL
Age (y)	0.976	0.065	0.952	1.002
Male vs female sex	0.778	0.211	0.524	1.154
CAD vs other chronic disease	1.503	0.043	1.014	2.229
Obesity baseline (yes vs no)	40.815	<0.001	28.662	58.120
Follow-up between first and second visit, years	0.993	0.516	0.974	1.013
Smoker (yes vs no)	0.830	0.537	0.459	1.500
Exercise (h/wk)	0.905	0.008	0.841	0.974
Alcoholic beverage/wk	0.999	0.932	0.979	1.020
Family income	1.057	0.577	0.869	1.286
Years of education	0.987	0.634	0.937	1.040
Psychotropic use (yes vs no)	0.937	0.762	0.613	1.431
Metabolic triad (yes vs no)	1.245	0.452	0.704	2.202
Corticosteroid use (yes vs no)	1.202	0.435	0.758	1.906
Participants who experienced maltreatment* (yes vs no)	1.152	0.443	0.802	1.654

$\chi^2(14, 1226) = 694.361$, $P < 0.001$. Pseudo-R^2: Cox and Snell = 0.432, Nagelkerke = 0.588.

Metabolic triad refers to current or past diagnosis of hypercholesterolemia, diabetes, and/or hypertension.

OR, odds ratio; BMI, body mass index; CAD, coronary artery disease; CI, 95% confidence interval for OR; LL, lower limit; UL, upper limit.

*Participants with moderate to extremely severe scores on at least 1 subscale of the Childhood Trauma Questionnaire.

and obesity.[18–20] Methodological differences between this vs prior investigations may partly explain these divergent results and may have contributed to our null results. Contrary to prior investigations that have focused their recruitment on adults with obesity, especially morbid obesity, the present study examined BMI as a continuous variable to assess whether reported associations apply across the weight continuum. However, Ruiz and Font[69] have recently reported that individuals who have experienced abuse and neglect are more likely to be obese than overweight. The use of a continuous measure of BMI may thus have underestimated the impact of childhood maltreatment. This said, we found no association when examining obesity either, though 32.5% of our sample met criteria for obesity and 3.1% for morbid obesity at baseline. It is also notable that the proportion of participants who experienced childhood maltreatment (32%) in our sample, while substantial, was nonetheless lower than that reported in some studies (≥51%).[14,50]

Contrary to our study, the vast majority of literature on this topic was conducted with adolescents or young adults.[18] Resilience may increase as individuals age, despite earlier maltreatment experiences,[70] and contribute to improved coping strategies and decreased focus on negative emotions.[71–73] This is consistent with a recent investigation[74] that reported that individuals older than 61 years of age showed better emotion regulation and used fewer maladaptive coping strategies such as overeating and emotional eating, as compared with those younger than 40 years. It is therefore possible that developmental improvements in emotion regulation could have countered the negative experiences of childhood maltreatment among our older participants.[75] It is also possible, given their older age and the fact that they had chronic health issues, that our null results reflect a survivor effect, with individuals in whom childhood maltreatment may have been most detrimental having already died or been too sick to participate. Individuals with chronic illness are also more likely to be followed for their weight, which may have countered any lingering effects of childhood experiences.

Limited data from a meta-analysis[18] suggested that childhood maltreatment may be more strongly associated with obesity in women compared with men, though few studies have examined this issue directly, and/or included a sufficiently large sample of men to address this issue. The current study, which did include a large sample of men, did not find any sex differences in the relation between childhood maltreatment and BMI/obesity, suggesting that the long-term weight consequences of childhood maltreatment may be similar among older men and women, at least among those with chronic somatic conditions. Notably, the results were the same independent of whether the participants were diagnosed with CAD or another chronic non-CVD, despite the greater somatic and psychological morbidity, as well as poorer health behaviours among those with CAD. To our knowledge, no other study has explored this potential moderating effect.

It has been proposed that childhood maltreatment may disrupt neuroendocrine activity and responses underlying emotional regulation,[76–78] thereby increasing the risk for psychological distress.[79,80] Indeed, in the present study, as in the previous literature,[81] childhood maltreatment was associated with significantly greater symptoms of depression, anxiety, and stress. Although a few previous investigations have shown that depression[15,50,51] and anxiety[52] but not stress[41] mediated the relation between childhood maltreatment and BMI, we found no such evidence. Further research is required to examine the longitudinal effects of childhood maltreatment on BMI and its underlying mechanisms into older age to better disentangle developmental shifts vs confounding effects of illness and its treatment.

The limitations of the present study include the fact that childhood maltreatment was based on retrospective self-report many decades after exposure. Recall and response bias[82,83] may have influenced results, though this is true of most previous investigations on the topic. The alternative, involving a large-scale prospective study from birth on to identify those subjected to maltreatment, with long-term follow-up to evaluate its impact, is too onerous for most researchers; not to mention, maltreatment would likely be grossly under-reported by parents, who are often its instigators, or are either in collusion with or unaware of maltreatment by other perpetrators. On the other hand, self-reports obtained retrospectively using standardized scales, such as the CTQ, allow us to obtain sensitive information more accurately about experiences in the past that would otherwise be difficult to obtain. Indeed, according to Hardt and Rutter,[84] memory bias has limited impact on results when using validated questionnaires that consist of objective criteria and easily defined adversity types, as is the case with CTQ. The timing and chronicity of the traumatic experiences were not examined, though recent data suggest that these may have differential effects on health outcomes in adulthood.[85,86] The research design was correlational and cannot speak to causality. Although the literature has focused on BMI to assess overweight and obesity, the actual criteria to meet these categories, as well as their prognostic significance, may change with older age.[87] This notwithstanding, the main analyses were performed on the continuous measure of BMI rather than BMI categories, limiting the extent to which this may be an issue. It is possible that a 5-year follow-up may have been insufficient to observe significant changes in BMI. In addition, our samples were almost exclusively French-speaking Caucasians, and results may not be generalizable to individuals of different races or ethnicities. Indeed, the strength of the association between childhood maltreatment and BMI may vary across different ethnic groups,[18] though research on this issue is limited. Finally, potential influences of gender were not examined in the current paper.

The strengths include the longitudinal assessment of BMI over a 5-year period, the inclusion of a large representative sample of men permitting the examination of potential sex differences, and the use of well-validated questionnaires to assess various dimensions of psychological distress and childhood maltreatment. To our knowledge, this is the first study to examine the association of childhood maltreatment and BMI among older individuals with chronic illnesses, providing insight into factors that may or may not alter their BMI trajectory. Analyses further controlled for psychotropic medication, current or previous diagnosis of hypercholesterolemia, diabetes, and/or hypertension, and sociodemographic and lifestyle habits previously associated with BMI as well as the change in BMI.

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Conclusions

Our results suggest that among older Caucasians with chronic diseases, childhood maltreatment is not associated with BMI nor with the change in BMI over 5 years. Although symptoms of anxiety, depression, and perceived stress did not appear to mediate the association between childhood maltreatment and BMI, they were nonetheless significantly more severe among those with greater maltreatment. Given that greater distress has been associated with increased risk for morbidity and mortality,[88] distress represents an important target for prevention and intervention,[38] including as concerns promoting healthier lifestyle habits.

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Ethics Statement

The authors confirm that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

Patient Consent

The authors confirm that a patient consent form(s) has been obtained for this article.

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Disclosures

The authors have no conflicts of interest to disclose.

References

1. Leeb RT. *Child Maltreatment Surveillance: Uniform Definitions for Public Health and Recommended Data Elements*. Ottawa, Ontario, Canada: Centers for Disease Control and Prevention, National Center for Injury Prevention and Control; 2008.

2. Trocmé N, Fallon B, MacLaurin B, et al. *Canadian Incidence Study of Reported Child Abuse and Neglect*. Ottawa, ON: Public Health Agency of Canada; 2008.

3. Clément M, Bérubé A, Chamberland C. Prevalence and risk factors of child neglect in the general population. *Public Health*. 2016;138:86−92.

4. Burczycka M, Conroy S. *Family violence in Canada: a statistical profile, 2015*. Statistics Canada; 2017. https://www150.statcan.gc.ca/n1/pub/85-002-x/2017001/article/14698-eng.htm. Accessed December 4, 2023.

5. Adams J, Mrug S, Knight DC. Characteristics of child physical and sexual abuse as predictors of psychopathology. *Child Abuse Negl*. 2018;86:167−177.

6. Burczycka M, Conroy S, Savage L. *Family violence in Canada: a statistical profile, 2017*. Statistics Canada; 2017. https://www150.statcan.gc.ca/n1/pub/85-002-x/2018001/article/54978-eng.htm. Accessed December 5, 2023.

7. Youngstrom EA, Prinstein MJ, Mash EJ, Barkley RA. *Assessment of Disorders in Childhood and Adolescence*. New York, New York: Guilford Publications; 2020.

8. Basu A, McLaughlin KA, Misra S, Koenen KC. Childhood maltreatment and health impact: the examples of cardiovascular disease and type 2 diabetes mellitus in adults. *Clin Psychol (New York)*. 2017;24:125.

9. Hellou R, Häuser W, Brenner I, et al. Self-reported childhood maltreatment and traumatic events among Israeli patients suffering from fibromyalgia and rheumatoid arthritis. *Pain Res Manag*. 2017;2017, 3865249.

10. Hovdestad WE, Shields M, Shaw A, Tonmyr L. Childhood maltreatment as a risk factor for cancer: findings from a population-based survey of Canadian adults. *BMC Cancer*. 2020;20:70.

11. Scott KM, Smith DA, Ellis PM. A population study of childhood maltreatment and asthma diagnosis: differential associations between child protection database versus retrospective self-reported data. *Psychosom Med*. 2012;74:817−823.

12. Bossé S, Stalder T, D'Antono B. Childhood trauma, perceived stress, and hair cortisol in adults with and without cardiovascular disease. *Psychosom Med*. 2018;80:393−402.

13. Harris KM, Udry JR. *National Longitudinal Study of Adolescent to Adult Health (Add Health), 1994-2008*; 2018. https://doi.org/10.3886/ICPSR21600.v21. Accessed December 4, 2023.

14. Li M, D'Arcy C, Meng X. Maltreatment in childhood substantially increases the risk of adult depression and anxiety in prospective cohort studies: systematic review, meta-analysis, and proportional attributable fractions. *Psychol Med*. 2016;46:717−730.

15. O'Neill A, Beck K, Chae D, Dyer T, He X, Lee S. The pathway from childhood maltreatment to adulthood obesity: the role of mediation by adolescent depressive symptoms and BMI. *J Adolesc*. 2018;67:22−30.

16. Gilbert R, Widom CS, Browne K, Fergusson D, Webb E, Janson S. Burden and consequences of child maltreatment in high-income countries. *Lancet*. 2009;373:68−81.

17. Mundi MS, Hurt RT, Phelan SM, et al. Associations between experience of early childhood trauma and impact on obesity status, health, as well as perceptions of obesity-related health care. *Mayo Clinic*. 2021;96:408−419.

18. Danese A, Tan M. Childhood maltreatment and obesity: systematic review and meta-analysis. *Mol Psychiatry*. 2014;19:544−554.

19. Hemmingsson E, Johansson K, Reynisdottir S. Effects of childhood abuse on adult obesity: a systematic review and meta-analysis. *Obes Rev*. 2014;15:882−893.

20. Hughes K, Bellis MA, Hardcastle KA, et al. The effect of multiple adverse childhood experiences on health: a systematic review and meta-analysis. *Lancet Public Health*. 2017;2:e356−e366.

21. Claussen AH, Crittenden PM. Physical and psychological maltreatment: relations among types of maltreatment. *Child Abuse Negl*. 1991;15:5−18.

22. Dong M, Anda RF, Felitti VJ, et al. The interrelatedness of multiple forms of childhood abuse, neglect, and household dysfunction. *Child Abuse Negl*. 2004;28:771−784.

23. Finkelhor D, Turner HA, Shattuck A, Hamby SL. Prevalence of childhood exposure to violence, crime, and abuse: results from the National Survey of Children's Exposure to Violence. *JAMA Pediatr*. 2015;169:746−754.

24. Felitti VJ, Anda RF, Nordenberg D, et al. Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults. The Adverse Childhood Experiences (ACE) Study. *Am J Prev Med*. 1998;14:245−258.

25. Shin SH, Miller DP. A longitudinal examination of childhood maltreatment and adolescent obesity: results from the National Longitudinal Study of Adolescent Health (AddHealth) Study. *Child Abuse Negl*. 2012;36:84−94.

26. Sokol RL, Gottfredson NC, Shanahan ME, Halpern CT. Relationship between child maltreatment and adolescent body mass index trajectories. *Child Youth Serv Rev*. 2018;93:196−202.

27. Moody G, Cannings-John R, Hood K, Kemp A, Robling M. Establishing the international prevalence of self-reported child maltreatment: a systematic review by maltreatment type and gender. *BMC Public Health*. 2018;18:1164.

28. Brauer P, Gorber SC, Shaw E, et al. Recommendations for prevention of weight gain and use of behavioural and pharmacologic interventions to manage overweight and obesity in adults in primary care. *CMAJ*. 2015;187:184−195.

29. Mamun AA, Lawlor DA, O'Callaghan MJ, Bor W, Williams GM, Najman JM. Does childhood sexual abuse predict young adult's BMI? A birth cohort study. *Obesity (Silver Spring)*. 2007;15:2103−2110.

30. Schneiderman JU, Negriff S, Peckins M, Mennen FE, Trickett PK. Body mass index trajectory throughout adolescence: a comparison of maltreated adolescents by maltreatment type to a community sample. *Pediatr Obes*. 2015;10:296−304.

31. Sokol RL, Gottfredson NC, Poti JM, et al. Sensitive periods for the association between childhood maltreatment and BMI. *Am J Prev Med*. 2019;57:495−502.

32. Greenfield EA, Marks NF. Violence from parents in childhood and obesity in adulthood: using food in response to stress as a mediator of risk. *Soc Sci Med*. 2009;68:791−798.

33. Rohde P, Ichikawa L, Simon GE, et al. Associations of child sexual and physical abuse with obesity and depression in middle-aged women. *Child Abuse Negl*. 2008;32:878−887.

34. Bernstein DP, Stein JA, Newcomb MD, et al. Development and validation of a brief screening version of the Childhood Trauma Questionnaire. *Child Abuse Negl*. 2003;27:169−190.

35. Williamson DF, Thompson TJ, Anda RF, Dietz WH, Felitti V. Body weight and obesity in adults and self-reported abuse in childhood. *Int J Obes Relat Metab Disord*. 2002;26:1075−1082.

36. Jura M, Kozak LP. Obesity and related consequences to ageing. *Age*. 2016;38:1−18.

37. Kwiatek R. Treatment of fibromyalgia. *Aust Prescr*. 2017;40:179.

38. Russ TC, Stamatakis E, Hamer M, et al. Association between psychological distress and mortality: individual participant pooled analysis of 10 prospective cohort studies. *BMJ*. 2012;345, e4933.

39. Russell-Jones D, Khan R. Insulin-associated weight gain in diabetes—causes, effects and coping strategies. *Diabetes Obes Metab*. 2007;9:799−812.

40. Blüher M. Obesity: global epidemiology and pathogenesis. *Nat Rev Endocrinol*. 2019;15:288−298.

41. Alvarez J, Pavao J, Baumrind N, Kimerling R. The relationship between child abuse and adult obesity among California women. *Am J Prev Med*. 2007;33:28−33.

42. Bowlby J. The bowlby-ainsworth attachment theory. *Behav Brain Sci*. 1979;2:637−638.

43. Gross JJ, Jazaieri H. Emotion, emotion regulation, and psychopathology: an affective science perspective. *Clin Psychol Sci*. 2014;2:387−401.

44. Thayer JF, Lane RD. A model of neurovisceral integration in emotion regulation and dysregulation. *J. Affect Disord*. 2000;61:201−216.

45. Mishra AA, Friedman EM, Mihalec-Adkins BP, et al. Childhood maltreatment exposure and physical functional limitations in late adulthood: examining subjective sleep quality in midlife as a mediator. *Psychol Health*. 2020;35:573−592.

46. Lavi I, Katz LF, Ozer EJ, Gross JJ. emotion reactivity and regulation in maltreated children: a meta-analysis. *Child Dev*. 2019;90:1503−1524.

47. Gruhn MA, Compas BE. Effects of maltreatment on coping and emotion regulation in childhood and adolescence: a meta-analytic review. *Child Abuse Negl*. 2020;103, 104446.

48. Rosenbaum DL, White KS, Artime TM. Coping with childhood maltreatment: avoidance and eating disorder symptoms. *J Health Psychol*. 2021;26:2832−2840.

49. Reffi AN, Boykin DM, Orcutt HK. Examining pathways of childhood maltreatment and emotional dysregulation using self-compassion. *J Aggression Maltreat Trauma*. 2019;28:1269−1285.

50. Sacks RM, Takemoto E, Andrea S, et al. Childhood maltreatment and BMI trajectory: the mediating role of depression. *Am J Prev Med*. 2017;53:625−633.

51. McCarthy-Jones S, McCarthy-Jones R. Body mass index and anxiety/depression as mediators of the effects of child sexual and physical abuse on physical health disorders in women. *Child Abuse Negl*. 2014;38:2007−2020.

52. Francis MM, Nikulina V, Widom CS. A prospective examination of the mechanisms linking childhood physical abuse to body mass index in adulthood. *Child Maltreat*. 2015;20:203−213.

53. Hayes AF. *THE PROCESS macro for SPSS, SAS, and R [logiciel]*; 2020. https://processmacro.org/index.html. Accessed December 4, 2023.

54. Bernstein D, Fink L. *Childhood Trauma Questionnaire: A Retrospective Self-Report: Manual*. San Antonio, TX: The Psychological Corporation; 1998.

55. Dekker JM, Girman C, Rhodes T, et al. Metabolic syndrome and 10-year cardiovascular disease risk in the Hoorn Study. *Circulation*. 2005;112:666−673.

56. Ekelund U, Brage S, Froberg K, et al. TV viewing and physical activity are independently associated with metabolic risk in children: the European Youth Heart Study. *Plos Med*. 2006;3, e488.

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57. Paquette D, Laporte L, Bigras M, Zoccolillo M. [Validation of the French version of the CTQ and prevalence of the history of maltreatment]. *Sante Ment Que*. 2004;29:201–220 [In French].

58. Eaton WW, Smith C, Ybarra M, Muntaner C, Tien A. Center for Epidemiologic Studies Depression Scale: Review and revision (CESD and CESD-R). In: Maruish ME, ed. *The Use of Psychological Testing for Treatment Planning and Outcomes Assessment*. 3rd Edition. Mahwah, NJ: Lawrence Erlbaum; 2004:363–377.

59. Van Dam NT, Earleywine M. Validation of the Center for Epidemiologic Studies Depression Scale Revised (CESD-R): pragmatic depression assessment in the general population. *Psychiatr Res*. 2011;186:128–132.

60. Carleton RN, Thibodeau MA, Teale MJ, et al. The center for epidemiologic studies depression scale: a review with a theoretical and empirical examination of item content and factor structure. *PLoS One*. 2013;8, e58067.

61. Roberts RE. Reliability of the CES-D scale in different ethnic contexts. *Psychiat Res*. 1980;2:125–134.

62. Radloff LS. The CES-D scale: a self-report depression scale for research in the general population. *Appl Psychol Meas*. 1977;1:385–401.

63. Spielberger CD, Gorsuch RL, Lushene R, Vagg PR, Jacobs GA. *Manual for the State-Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychologists Press; 1983.

64. Knight RG, Waal-Manning HJ, Spears GF. Some norms and reliability data for the State-Trait Anxiety Inventory and the Zung Self-Rating Depression scale. *Br J Clin Psychol*. 1983;22:245–249.

65. Barnes LL, Harp D, Jung WS. Reliability generalization of scores on the Spielberger state-trait anxiety inventory. *Educ Psychol Meas*. 2002;62:603–618.

66. Levenstein S, Prantera C, Varvo V, et al. Development of the Perceived Stress Questionnaire: a new tool for psychosomatic research. *J Psychosom Res*. 1993;37:19–32.

67. Fliege H, Rose M, Arck P, et al. The Perceived Stress Questionnaire (PSQ) reconsidered: validation and reference values from different clinical and healthy adult samples. *Psychosom Med*. 2005;67:78–88.

68. Vaillancourt M, Busseuil D, D'Antono B. Severity of psychological distress over five years differs as a function of sex and presence of coronary artery disease. *Aging Ment Health*. 2022;26:762–774.

69. Ruiz AL, Font SA. Role of childhood maltreatment on weight and weight-related behaviors in adulthood. *Health Psychol*. 2020;39:986–996.

70. Rodin D, Stewart DE. Resilience in elderly survivors of child maltreatment. *SAGE Open*. 2012;2, 2158244012450293.

71. Charles ST. Strength and vulnerability integration: a model of emotional well-being across adulthood. *Psychol Bull*. 2010;136:1068–1091.

72. Cohen S, Janicki-Deverts D. Who's stressed? Distributions of psychological stress in the United States in probability samples from 1983, 2006, and 2009. *J Appl Soc Psychol*. 2012;42:1320–1334.

73. Sheffler JL, Piazza JR, Quinn JM, Sachs-Ericsson NJ, Stanley IH. Adverse childhood experiences and coping strategies: identifying pathways to resiliency in adulthood. *Anxiety Stress Coping*. 2019;32:594–609.

74. Samuel L, Cohen M. Expressive suppression and emotional eating in older and younger adults: an exploratory study. *Arch Gerontol Geriatr*. 2018;78:127–131.

75. Rapsey CM, Scott KM, Patterson T. Childhood sexual abuse, polyvictimization and internalizing disorders across adulthood and older age: findings from a 25-year longitudinal study. *J Affect Disord*. 2019;244:171–179.

76. Heim C, Newport DJ, Heit S, et al. Pituitary-adrenal and autonomic responses to stress in women after sexual and physical abuse in childhood. *JAMA*. 2000;284:592–597.

77. Gunnar M, Quevedo K. The neurobiology of stress and development. *Annu Rev Psychol*. 2007;58:145–173.

78. Tarullo AR, Gunnar MR. Child maltreatment and the developing HPA axis. *Horm Behav*. 2006;50:632–639.

79. Danese A, Moffitt TE, Harrington H, et al. Adverse childhood experiences and adult risk factors for age-related disease: depression, inflammation, and clustering of metabolic risk markers. *Arch Pediatr Adolesc Med*. 2009;163:1135–1143.

80. Faravelli C, Lo Sauro C, Lelli L, et al. The role of life events and HPA axis in anxiety disorders: a review. *Curr Pharm Des*. 2012;18:5663–5674.

81. Gardner MJ, Thomas HJ, Erskine HE. The association between five forms of child maltreatment and depressive and anxiety disorders: a systematic review and meta-analysis. *Child Abuse Negl*. 2019;96, 104082.

82. MacDonald K, Thomas ML, Sciolla AF, et al. Minimization of childhood maltreatment is common and consequential: results from a large, multinational sample using the Childhood Trauma Questionnaire. *PloS One*. 2016;11, e0146058.

83. Widom CS, Morris S. Accuracy of adult recollections of childhood victimization, part 2: childhood sexual abuse. *Psychol Assess*. 1997;9:34–46.

84. Hardt J, Rutter M. Validity of adult retrospective reports of adverse childhood experiences: review of the evidence. *J Child Psychol Psychiatry*. 2004;45:260–273.

85. Ehrlich KB, Miller GE, Rogosch FA, Cicchetti D. Maltreatment exposure across childhood and low-grade inflammation: considerations of exposure type, timing, and sex differences. *Dev Psychobiol*. 2021;63:529–537.

86. Ziobrowski HN, Buka SL, Austin SB, et al. Using latent class analysis to empirically classify maltreatment according to the developmental timing, duration, and co-occurrence of abuse types. *Child Abuse Negl*. 2020;107, 104574.

87. Winter JE, MacInnis RJ, Wattanapenpaiboon N, Nowson CA. BMI and all-cause mortality in older adults: a meta-analysis. *Am J Clin Nutr*. 2014;99:875–890.

88. Barry V, Stout ME, Lynch ME, et al. The effect of psychological distress on health outcomes: a systematic review and meta-analysis of prospective studies. *J Health Psychol*. 2020;25:227–239.