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Early life adversity and/or posttraumatic stress disorder severity are associated with poor diet quality, including consumption of trans fatty acids, and fewer hours of resting or sleeping in a US middle-aged population: A cross-sectional and prospective study

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Abstract

Background—Early life adversity (ELA) and post-traumatic stress disorder (PTSD) are associated with poorer psychological and physical health. Potential underlying mechanisms and mediators remain to be elucidated, and the lifestyle habits and characteristics of individuals with ELA and/or PTSD have not been fully explored. We investigated whether the presence of ELA and/or PTSD are associated with nutrition, physical activity, resting and sleeping and smoking.

Methods—A cross-sectional sample of 151 males and females (age: 45.6±3.5 y, BMI: 30.0±7.1kg/m²) underwent anthropometric measurements, as well as detailed questionnaires for dietary assessment, physical activity, resting and sleeping, smoking habits and psychosocial assessments. A prospective follow-up visit of 49 individuals was performed 2.5 years later and the same outcomes were assessed. ELA and PTSD were evaluated as predictors, in addition to a

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Conflicts of interest

The authors have nothing to disclose

Author contributions

CM developed the concept for the study, AG analyzed the data, AG and OF wrote the manuscript. All authors interpreted and critically reviewed the data and manuscript

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variable assessing the combined presence/severity of ELA–PTSD. Data were analyzed using analysis of covariance after adjusting for several socioeconomic, psychosocial and anthropometric characteristics.

Results—Individuals with higher ELA or PTSD severity were found to have a poorer diet quality (DASH score: $p=0.006$ and $p=0.003$, respectively; aHEI-2010 score: ELA $p=0.009$), including further consumption of trans fatty acids (ELA $p=0.003$); the differences were significantly attenuated null after adjusting mainly for education or income and/or race. Further, individuals with higher ELA severity reported less hours of resting and sleeping ($p=0.043$) compared to those with zero/lower ELA severity, and the difference remained significant in the fully adjusted model indicating independence from potential confounders. When ELA and PTSD were combined, an additive effect was observed on resting and sleeping ($p=0.001$); results remained significant in the fully adjusted model. They also consumed more energy from trans fatty acids ($p=0.017$) tended to smoke more ($p=0.008$), and have less physical activity (PTSD $p=0.024$) compared to those with no or lower ELA and PTSD severity. Adjustments for sociodemographic factors and/or BMI rendered results of the above life style parameters non-significant. The analysis of the prospective data showed similar trends to the cross-sectional analysis, further supporting the conclusions, although statistical significance of results was lower due to the lower number of participants.

Conclusion—Fewer hours of resting and sleeping and poorer diet quality are linked to ELA and/or PTSD, indicating that these pathways might underlie the development of several metabolic abnormalities in individuals with ELA and/or PTSD. Differences in terms of diet quality are significantly attenuated by race and/or education and/or income, whereas differences in other lifestyle habits of individuals with and without ELA and/or PTSD, such as physical activity, are mostly explained by confounding sociodemographic variables and/or body mass index.

Keywords

PTSD; early life adversity; diet quality; physical activity; resting and sleeping

Introduction

Early life adversity (ELA) and posttraumatic stress disorder (PTSD) are both triggered by traumatic and stressful events that can negatively impact adult mental and physical health [1, 2]. ELA is associated with adverse childhood experiences including neglect, stressful living conditions, maltreatment and abuse [3]. An estimated one child out of every 58 experienced at least one type of adversity in the United States during the year of 2005–2006, although actual numbers of children impacted by ELA are probably underestimated [4]. PTSD, with a prevalence of 7.8% among the general US population [5], can be triggered by events such as physical assault and natural disasters or by traumatic experiences such as war or persistent sexual abuse at any age [6]. Recently, both ELA and PTSD have been linked to poor psychological health and have been associated with increased risk for cardiovascular and metabolic diseases and disorders such as coronary heart disease, hypertension, type 2 diabetes mellitus, and obesity [7–11].

Although accumulating evidence suggests adverse physical health consequences of these conditions, less is known about the lifestyle habits developed which may lead to or contribute to these negative health outcomes. Individuals with PTSD have been found to exercise less frequently, develop eating disorders more often, engage in smoking more frequently, and experience more sleep disturbances [12]. Few studies have explored how the diets of individuals with PTSD may differ, and they found that individuals with PTSD consume more soda and fast food [13] and less fruits [14] compared to individuals without PTSD. However, both of these studies assessed nutritional intake through a limited number of questions, instead of validated instruments designed for assessing dietary intake. Furthermore, a negative association between PTSD number of symptoms and alternative Healthy Eating Index (aHEI) has been observed in the Nurses' Health Study II [15]. Since available data are very limited, further studies with more detailed information are needed.

Similar to PTSD, ELA shows behavioral impacts which may lead to adverse metabolic consequences. Maltreatment before the age of 18 is associated with higher cigarette use during adolescence [16]. Adults reporting more adverse childhood experiences have poorer sleep quality and increased smoking rates compared to those having less or no adverse experiences [17]. Furthermore, an indication of a poorer diet quality, assessed with the alternate Healthy Eating Index-2010 (aHEI-2010), among people with ELA has also been suggested previously from our group but the analysis was limited to a simple correlation analysis instead of a multivariate analysis [18]. So far, data regarding certain behavioral health habits among people with ELA or PTSD are derived from a limited number of studies which have raised many questions. Thus, the purpose of the current study was to investigate in both a cross-sectional and prospective manner associations between ELA and PTSD with lifestyle habits including nutrition, physical activity, resting and sleeping and smoking. We then focused on ELA types, i.e. neglect, abuse to explore the same questions. Since our study is the first to use validated questionnaires and a cross-sectional and prospective study design to answer these questions, we believe that our data provides clarification and validity to currently available knowledge.

Methods

This prospective study was designed to investigate psychosocial influences on physical and mental health in midlife. Please refer to prior publications for a detailed description of the study protocol [18, 19].

Study sample

Two hundred and twelve European Americans and African Americans of both sexes were recruited primarily through advertisements from the greater Boston area. For the current analysis, complete data from 151 participants were available. Participants with metabolic diseases (history of stroke or myocardial infarction, diabetes mellitus, hepatitis, cirrhosis), dialysis, long-term steroid use, active intravenous drug use, current treatment for cancer and/or or active infection (other than brief antibiotic therapies) were excluded from participation. All participants provided written informed consent during their screening visit and the protocol was approved by the BIDMC Committee on Clinical Investigations and

Institutional Review Board as well as the Institutional Review Board of JBCC. Participants came to the Clinical Research Center (CRC) of Beth Israel Deaconess Medical Center (BIDMC) early in the morning after an overnight fast for physiological measurements and then went to Judge Baker Children's Center (JBCC) for in-depth psychosocial assessments.

Among 151 participants, a total of 49 returned for a follow up visit 2.5 years after the cross-sectional visit. Procedures at the follow-up visit were identical to the cross-sectional visit, as described below.

Lifestyle measurements

Nutritional information—The validated, self-administered Block food frequency questionnaire (FFQ) (NutritionQuest, Berkeley, CA, USA) [20] was used for the assessment of dietary intake over the past year. The questionnaire assesses the frequency and quantity of consumption of 110 food items with the aid of pictures. Intake of each food item was calculated by multiplying the item's reported frequency by the selected pre-specified serving size. Total energy and macronutrient intake was then computed, including the percentage of energy coming from total lipids, saturated fatty acids (SFA) and trans fatty acids. Foods with similar nutrition properties and culinary usage were further categorized into food groups. The Dietary Approach to Stop Hypertension (DASH) score and the aHEI-2010 were calculated as previously described [21, 22]. Briefly, DASH diet score was computed based on the following eight food components: fruits, vegetables, nuts and legumes, low-fat dairy products, whole grains, sugar sweetened beverages, red and processed meat, and sodium [23]. The aHEI-2010 was calculated based on the following 11 food components: vegetables, fruits, nuts and legumes, red meat and processed meats, sugar sweetened beverages and fruit juices, alcohol, polyunsaturated fat, trans fat, ω -3 fat (eicosapentaenoic acid and docosahexaenoic acid), whole grains, and sodium intake [22]. A total score for each index was calculated based on the individual component scores. The higher the total score, the better the adherence. The total DASH diet score ranged from 8 to 40 (perfect adherence) and the total aHEI-2010 score ranged from 0 to 110 (perfect adherence).

Smoking, physical activity and sleep information—Smoking, physical activity and sleep were assessed through a self-report physical health questionnaire. The questionnaire is divided in three sections, one for each category. The first section evaluates past and current smoking habits. The second section assesses present and habitual exercise habits over the past 3 months (duration, intensity, type of exercise) as well as sedentary activities including the continuous variable of "resting and sleeping." Based on the reported duration, intensity and type of exercise, and with the aid of the metabolic equivalents, the daily and annual physical activity of each participant was calculated. The third and last section of the questionnaire evaluates sleep quantity over a 24h period in a categorical manner: (a) 5 h/d, (b) 5–6 h/d, (c) 6–7 h/d, (d) 7–8 h/d, (e) 8–9 h/d and (f) 10 h/d.

Psychological measurements

Detailed psychological information was obtained through validated interviews and questionnaires. ELA was assessed using a) the Evaluation of Lifetime Stressors interview assessing trauma [24], b) the Structured Clinical Interview for Diagnoses Diagnostic and

Statistical Manual (DSM) IV-R Non-Patient Version Axis 1 including the Post Traumatic Stress Disorder module [25], and c) the Adult Attachment Interview yielding narrative descriptions of childhood adversities [26] and the detailed procedure has been described elsewhere [18]. Briefly, an overall score was calculated by multiplying the number of ELA times the overall severity of each ELA times the overall chronicity of ELA (whether chronic or acute) as described previously. The types of ELA neglect, physical abuse, sexual abuse and emotional abuse were, also, assessed as dichotomous variables (yes/no). Probable presence of posttraumatic stress disorder (PTSD in the manuscript) and PTSD severity was assessed through the University of California, Los Angeles (UCLA) PTSD scale, as described previously [19, 27]. Depression continues scores were evaluated with the Beck Depression Inventory (BDI) II [28]. Other psychological and medical information, including psychiatric medication, was collected through detailed medical and psychological histories.

Sociodemographic, anthropometric and body composition measurements

Sociodemographic data was collected through self-administered questionnaires. Body weight and height were measured to the nearest 0.1 kg and 0.1 cm with the use of a calibrated digital electric scale and a wall-mounted stadiometer, accordingly, with participants wearing their standard clothing and being barefoot. BMI was calculated as weight divided by height squared. The smallest waist circumference was measured, as well. Body composition was measured through bioelectrical impedance analysis with the use of a Quantum II bioelectrical impedance analyzer (RJL Systems, Clinton Township, MI, USA) while participants lying in a supine position. All measurements were taken in the fasted state.

Statistical analysis

All analyses were performed with the Statistical Package for Social Sciences (SPSS), v.21. Data are presented as mean $\pm$ standard deviation, unless otherwise described. Normality was assessed with pp-plots and histograms. Data not normally distributed were log transformed or were ranked. Both ELA and PTSD severity variables were analyzed as a continuous overall score but also as quartiles across all participants. The first two quartiles of the PTSD severity and ELA variables were collapsed per standard epidemiology practices to correct for the skewedness of the data while still representing the distribution of the scores. A combined variable of ELA and PTSD was created based on the highest tertile point of the two variables, creating the following groups: (a) LL: low ELA (scores: 0–18)-low PTSD (scores: 0–10), (b) LH: low ELA-high PTSD (scores: 11–57), (c) HL: high ELA (scores: 19–156)-low PTSD and (d) HH: high ELA -high PTSD. Continuous variables following the normal distribution were compared among ELA quartiles, PTSD quartiles and ELA-PTSD combined categories with univariate analysis of variance (ANOVA). Subsequent post-hoc Bonferroni's corrections were used for comparing one quartile or category to another. Normally distributed continuous variables were compared among types of ELA with independent samples t-test. Non-normally distributed variables, even after transformation, were compared with the Kruskal-Wallis test. Categorical variables were compared with chi-square test. Spearman correlation coefficients were used to identify correlations among ELA and PTSD as continuous variables and anthropometric, lifestyle and psychosocial continuous characteristics. The unadjusted analyses (ANOVAs and t-tests) followed the

univariate ANCOVAs after adjusting for the following covariates: Model 1: unadjusted, Model 2: adjustment for age and gender, Model 3: adjustment for age, gender and race, Model 4: adjustment for age, gender and education, Model 5: adjustment for age, gender, race, education and income, Model 6: adjustment for age, gender, race, education, income, BMI, Model 7: adjustment for age, gender, race, education, income, BMI, energy intake, Model 8: adjustment for age, gender, race, education, income, BMI, energy intake, psychiatric medication, depression. Each covariate was tested individually before building the models. Prospective data were analyzed in the same way by using ELA and PTSD information from the first visit and lifestyle variables from the follow-up visit. Significance level was set for $p = 0.05$.

Results

Our sample consisted of 151 middle aged individuals (35–55 y; 50% females, 50% African Americans, 50% European Americans), of all BMI categories (18.2–50.5 kg/m²). Those who returned for the follow-up visit were 59.2% females, 49.0 % African Americans and had a mean age of 47.8 ± 2.9 years and a mean BMI of 31.2 ± 8.5 kg/m².

Cross-Sectional data

Sample Characteristics—Table 1 presents the descriptive characteristics of the overall study sample as well as the unadjusted comparisons of these characteristics among ELA and PTSD severity quartiles, with the first two quartiles collapsed for each variable. Less participants were European-American ($p=0.001$) and more reported fewer years of education in the higher ELA quartiles (Q3 and Q4 vs. Q1+Q2, $p = 0.001$). Furthermore, individuals with higher ELA severity presented higher BMI (Q3 and Q4 vs. Q1+Q2, $p=0.023$), waist circumference (Q3 and Q4 vs. Q1+Q2, $p=0.048$) and percentage body fat (Q3 and Q4 vs. Q1+Q2, $p=0.025$) compared to those with zero/lower ELA severity. In addition, individuals in the higher ELA quartiles were more likely to be current smokers ($p=0.007$), and have higher severity scores for both depression and PTSD ($p=0.001$ in both cases) compared with those in the lower ELA quartiles. ELA was positively correlated with BMI ($p=0.013$), waist circumference ($p=0.025$), body fat mass ($p=0.012$), depression ($p=0.001$) and PTSD ($p = 0.001$; Table 2).

The percentage of European-American and married individuals was lower among those with higher PTSD severity compared to those with zero/lower PTSD severity ($p=0.019$ and $p = 0.001$, respectively; Table 1). Furthermore, those in the highest PTSD severity quartile reported fewer years of education (Q4 vs. Q1+Q2 and Q3, $p=0.008$) and had a greater percentage of body fat mass (Q4 vs. Q1+Q2, $p=0.012$) compared to those in the lower PTSD quartiles. In addition, individuals with higher PTSD severity were more likely to be smokers ($p=0.001$), have higher levels of depression ($p = 0.001$) and greater severity of ELA ($p=0.002$) compared to those in the lower quartiles. Spearman correlations (Table 2) revealed a positive correlation between PTSD severity and BMI ($p=0.035$), body fat mass ($p=0.002$), depression ($p = 0.001$) and ELA ($p = 0.001$).

Energy Intake and percentage of energy from total lipids, SFA and trans fatty acids—ELA quartiles did not differ among each other regarding energy intake or the

percentage of energy coming from total lipids and SFA in the unadjusted model (Table 1). Furthermore, no correlation was found between ELA severity and energy intake (Table 2) or the percentage of energy coming from total lipids and SFA (data not shown). However, the percentage of energy coming from trans fatty acids differ significantly among ELA quartiles (Q1+Q2: 1.05 ± 0.44 , Q3: 1.20 ± 0.30 , Q4: 1.29 ± 0.49 , $F=6.111$, $p=0.003$) with individuals in Q1+Q2 having a lower percentage compared to those in Q4 ($p=0.005$). Results remained significant when age and gender, and/or race, and/or education were inserted in the model but was lost when race, education and income were combined in one model. Results remain non-significant with further adjustments. In addition, the percentage of energy coming from trans fatty acids was positively correlated with ELA severity (Spearman $\rho=+0.235$, $p=0.004$).

Energy intake did not differ significantly between PTSD severity quartiles in the unadjusted model (Table 1). Furthermore, no significant correlation was found between PTSD severity and energy intake (Table 2). The same was true for the percentage of energy coming from total lipids, SFA and trans fatty acids (data not shown).

Regarding ELA-PTSD combined, no significant differences were found between ELA-PTSD categories and energy intake or the percentage of energy coming from total lipids and SFA (data not shown). However, the percentage of energy coming from trans fatty acids was significantly different among ELA-PTSD categories LL: 1.09 ± 0.43 kcal/d vs. HL: 1.16 ± 0.32 kcal/d; vs. LH: 1.09 ± 0.37 kcal/d; vs. HH: 1.41 ± 0.50 kcal/d, $F=3.488$, $p=0.017$). Specifically, individuals with low ELA and with low or high PTSD reported a significantly lower percentage of energy coming from trans fatty acids compared to those in the combined high ELA/PTSD category ($p=0.002$ and $p=0.018$, respectively). However, when education was inserted in the model significance was lost (data not shown).

Diet quality

DASH score: A significant difference was found among ELA severity quartiles regarding DASH score ($F=5.332$, $p=0.006$; Table 1). Specifically those in Q3 and Q4 presented a lower score compared to those in the Q1+Q2 ($p=0.007$ and $p=0.011$, respectively). Significance remained when age and gender were included in the model but was lost when further adjustment for race and/or education was made and results remained non-significant for any further adjustments (Table 3a). A negative association was also found between ELA severity and DASH score ($p=0.018$; Table 2).

As for PTSD, a significant difference among PTSD quartiles was revealed regarding DASH score ($F=6.132$, $p=0.003$; Table 1). Individuals in the highest PTSD severity quartile presented a significantly lower DASH score compared to those in the lowest PTSD quartile (Q4 vs. Q1+Q2, $p=0.001$). Significance was lost when education was inserted to the model and all models built with it inside remained non-significant (Table 3a). Furthermore, PTSD severity was negatively correlated with DASH ($p=0.003$; Table 2).

When ELA and PTSD were combined, a significant difference between categories and DASH was found when no adjustments were made ($F=2.978$, $p=0.034$; Table 4). Individuals in the LL category presented a significantly higher score compared to those in the LH and

HH categories ($p=0.028$ and $p=0.022$, respectively). Differences remained significant when adjustments for age and gender were made but were lost in any further adjustment (Table 4).

aHEI-2010 score: ELA quartiles were significantly different among each other in the unadjusted analysis regarding aHEI-2010 score ($F=4.907$, $p=0.009$; Table 1), with individuals in Q1+Q2 having a higher aHEI-2010 score compared to those in the Q3 ($p=0.002$). Significance remained when age and gender and/or race, and/or education, and/or income were included as covariates but was lost when BMI was inserted in the model (Table 3a). ELA severity did not present any significant correlation with aHEI-2010 score (Table 2).

PTSD severity quartiles did not differ among each other in relation to aHEI-2010 score when no adjustments were made (Table 1). However, when age and gender were included in the analysis this became significant ($F= 3.107$, $p=0.048$; Table 3a). Specifically, those in the highest PTSD severity quartile presented a significantly lower aHEI-2010 score compared to those in the lower PTSD severity quartiles (Q1+Q2 vs. Q4, $p=0.016$). However, significance disappeared when further adjustments were made (Table 3a), i.e. for race, education, income, BMI, energy intake, psychiatric medication and depression. In addition, Spearman correlation showed no correlation between PTSD severity and aHEI-2010 score (Table 2). Furthermore, aHEI-2010 score was not significantly different between categories for combined ELA-PTSD (Table 4).

Physical activity—ELA quartiles did not differ significantly among each other regarding annual physical activity in the unadjusted analysis (Table 1) or when further adjustments were made (Table 3a). No significant associations were also observed between ELA severity and annual physical activity (Table 2).

On the other hand, a significant difference between PTSD severity quartiles was observed in the unadjusted analysis regarding annual physical activity ($F=3.580$, $p=0.031$; Table 1). Individuals in Q1+Q2 were engaged in more physical activity per year compared to those in Q3 and Q4 ($p=0.022$ and $p=0.015$, respectively). However, significance disappeared when adjustments for potential confounders were made (Table 3a) including age and gender. Furthermore, a negative association between annual physical activity and PTSD severity was found ($p=0.012$; Table 2). No significant differences were found between categories of the combined variable ELA-PTSD (Table 4).

Resting and Sleeping—Resting and sleeping were significantly different among ELA quartiles ($F=3.228$, $p=0.043$; Table 1) where individuals with higher ELA severity were resting and sleeping fewer hours compared to those with zero/lower ELA severity (Q4 vs. Q1+Q2, $p=0.013$). The difference remained significant after adjusting for age and gender, became marginally significant when race was inserted in the model, and reappeared in all further adjustments (Table 3a). Furthermore, a significant negative correlation between ELA severity and sleeping and resting was found ($p=0.008$; Table 2).

As per PTSD severity, PTSD quartiles presented a marginally significant in relation to resting and sleeping ($F=2.582$, $p=0.079$; Table 1). Adjustment for potential confounders did

not render results significant (Table 3a). On the other hand, resting and sleeping were negatively associated with PTSD severity ($p=0.047$; Table 2).

ELA-PTSD combined showed a significant difference in resting and sleeping among categories in an unadjusted model ($F=6.159$, $p=0.001$; Table 4). Individuals in the LL category reported significantly more hours of resting and sleeping compared to those in the HL, LH and HH categories ($p=0.010$, $p=0.002$ and $p=0.002$, respectively). The association remained significant after all further adjustments.

Smoking—A greater percentage of individuals with higher ELA severity was smokers compared to those in the lower quartiles ($p=0.007$; Table 1), and this was also the case regarding PTSD quartiles ($p=0.001$; Table 1). Furthermore, individuals having either ELA and/or PTSD were more likely to be current smokers, as compared to those having neither ELA nor PTSD (HL:43.5%, LH:46.2%, HH:45.5% vs. LL:19.0%, $p=0.008$).

Types of ELA—Individuals having experienced neglect had a lower DASH score compared to those that had not in the unadjusted model (20.40 ± 5.21 vs. 23.93 ± 5.42 , $F=3.958$, $p=0.049$; Supplementary Table 1). Significance remained when adjustments for age and gender were made but disappeared after further adjustments. No significant differences were observed between those with neglect and those without regarding aHEI-2010 score, energy intake, percentage of energy coming from total lipids, SFA or trans fatty acids, annual physical activity, sleep, resting and sleeping or smoking.

Individuals with experiences of physical abuse presented a lower DASH score as compared to those that have not experienced physical abuse (21.98 ± 5.04 vs. 24.64 ± 5.5 , $F=8.176$, $p=0.005$; Supplementary Table 1). Significance remained after adjustment for age and gender, and/or race but was lost when education was inserted in the analysis. Furthermore, physically abused participants presented a lower score of aHEI-2010 compared to those without physical abuse (50.30 ± 12.93 vs. 56.25 ± 14.98 , $F=5.693$, $p=0.018$; Supplementary Table 1). However, the association was lost when race was included in the models. They also had a higher percentage of energy coming from trans fatty acids compared to non-physically abused individuals (1.29 ± 0.42 % kcal/d vs. 1.09 ± 0.42 % kcal/d, $F=9.675$, $p=0.002$; Supplementary Table 1). The association remained significant when adjustment for age and gender, and/or race, and/or education was made but was lost when age, gender, race, education and income were combined in the models. Any further adjustment remained non-significant. Physically abused individuals were also resting and sleeping fewer hours than those haven't experienced such abuse (6.57 ± 1.26 h/d vs. 7.35 ± 1.55 h/d, $F=8.667$, $p=0.004$; Supplementary Table 1). This difference remained significant after all adjustments were made. Furthermore, a greater percentage were sleeping less than 7h per day and more than 9h per day compared to those with no such experiences (59.2 % vs. 35.1 % and 4.1 % vs. 3.1 %, respectively, $p=0.016$; Supplementary Table 1). In addition, a greater percentage were current smokers compared to those haven't experienced such abuse (46.9% vs. 23.7%, $p=0.005$; Supplementary Table 1). No significant differences were observed between groups regarding energy intake, percentage of energy coming from total lipids and SFA and annual physical activity.

Individuals who had experienced sexual abuse were engaged in less physical activity during the year compared to those that had not experienced sexual abuse (452.2 (103.2, 857.4) met*h vs. 869.4 (429.0, 1512.0) met*h, $F=6.073$, $p=0.015$; Supplementary Table 1). The effect disappeared when gender and age were inserted as covariates and remained non-significant after further adjustments. Furthermore, a greater percentage of them were sleeping less than 7h per day compared to those with no such experiences (65.8 % vs. 35.2 %, $p=0.005$; Supplementary Table 1). Additionally, they were more likely to be current smokers compared to those have not experienced such abuse (47.4% vs. 25.9%, $p=0.009$; Supplementary Table 1). No significant differences were observed between groups regarding DASH score, aHEI-2010 score, energy intake, percentage of energy coming from total lipids, SFA and trans fatty acids and resting and sleeping.

Participants with emotional abuse had a lower DASH score compared to those without emotional abuse (21.77 ± 4.83 vs. 24.31 ± 5.52 , $F=6.069$, $p=0.015$; Supplementary Table 1). The difference remained significant when adjustments for age and gender, and/or race were made but was lost when education was included as covariate. Furthermore, these individuals were consuming significantly more energy compared to those who have not experienced emotional abuse (2682 ± 1363 kcal/d vs. 2019 ± 959 kcal/d, $F=7.212$, $p=0.008$; Supplementary Table 1). The association remained significant after adjustment for socioeconomic covariates and BMI but became marginally significant when depression and psychiatric medication were included in the last model ($F=3.524$, $p=0.063$). Furthermore, emotionally abused individuals presented a higher percentage of energy coming from trans fatty acids compared to those without emotional abuse (1.31 ± 0.50 % kcal/d vs. 1.10 ± 0.40 % kcal/d, $F=5.508$, $p=0.020$; Supplementary Table 1), however the association was lost when education was inserted in the model. No significant differences were observed between groups regarding aHEI-2010, percentage of energy coming from total lipids and SFA, annual physical activity, sleep, resting and sleeping and smoking.

Prospective data—We found that individuals with higher PTSD severity had a lower DASH score ($F=3.886$, $p=0.028$; Q1+Q2 vs. Q4, $p=0.008$), less annual physical activity when age and gender ($F=3.347$, $p=0.052$; Q1+Q2 vs. Q3, $p=0.016$) and/or race ($F=3.301$, $p=0.054$; Q1+Q2 vs. Q3, $p=0.017$) were used as covariates and fewer hours of resting and sleeping ($F=4.048$, $p=0.024$; Q1+Q2 vs Q4, $p=0.012$; Q3 vs. Q4, $p=0.015$) compared to individuals with zero/lower PTSD severity (Table 3b). Significant differences were lost when race and/or education were inserted into the models.

Individuals who had been physically abused presented with fewer hours of resting and sleeping compared to those with no physical abuse (6.37 ± 1.42 h/d vs. 7.39 ± 1.49 h/d, $F=5.580$, $p=0.023$) that persisted even with a fully adjusted model (data not shown). Furthermore, individuals who had been emotionally abused had a greater percentage of energy coming from trans fatty acids compared to those with no history of emotional abuse (1.31 ± 0.40 % kcal/d vs. $1.04\pm0.40\%$ kcal/d, $F=4.483$, $p=0.040$; data not shown). Significance was lost when education was included in the model. Although differences found in the cross-sectional analysis did not remain in the prospective analysis due to the small sample size and the lack of power, the trends for means are the same and support the cross-sectional findings.

Discussion

Here, we demonstrate that middle-aged individuals with greater ELA and/or PTSD severity appear to have poorer behavioral outcomes including decreased diet quality, more energy coming from trans fatty acids, less rest and sleep, and less physical activity as well as a greater percentage of smokers, obesity and depression. Sociodemographic factors seem to explain most of these outcomes, with education and/or race rendering most of the significant associations with poor lifestyle quality null. On the other hand, fewer hours of resting and sleeping seem to be directly and independently related to these conditions. Although future in-depth studies would be needed to confirm these data, these risk factors may relate or contribute to findings of increased obesity, insulin resistance, and cardiometabolic dysfunction in these populations and health care providers like psychiatrists and metabolic medicine doctors, should be aware of potential worse lifestyle habits when they screen individuals with these disorders.

Nutritional outcomes with ELA and PTSD

Higher levels of ELA are associated with poorer diet quality as measured by DASH, but these associations lose significance with race, suggesting differences by race, or correlates of race such as education and/or income, which may confound the effects of ELA on diet quality. Indeed, other studies have observed changes in dietary quality and patterns across different races [29–31], and these underlying differences may contribute to the relationship between ELA and diet quality. On the other hand, ELA displayed a significant relationship with aHEI-2010 scores, where higher levels of ELA displayed poorer aHEI-2010 and this remained significant with adjustments for race and other potential socioeconomic confounders including education and income but was lost when adjustment for BMI was made. Other studies have also observed differences between aHEI-2010 and DASH measures [31, 32], and while all diet quality measures are related (e.g. all people who have high scores in one type will have high scores in others), there are key differences in how food scores are calculated that may make aHEI-2010 but not DASH remain significant with higher ELA despite corrections for race [32]. Thus, altogether, many aspects of diet quality are decreased with higher levels of ELA severity.

PTSD has been suggested to demonstrate altered consumptive behaviors, which may lead to obesity and other metabolic dysfunctions [33]. Here, we observe that increased PTSD severity is related to a less nutritious diet (DASH score). Indeed, this poorer diet quality may lead to obesity, which has been observed in individuals with PTSD [19]. On the other hand, some studies have shown that PTSD posttraumatic stress disorder (PTSD) a higher risk for obesity which is not modulated by binge eating, suggesting other mechanisms for the link between PTSD and obesity [34]. However, individuals with PTSD have reported less nutritious consumptive behaviors and increased emotional eating in addition to guilt and increased episodes of overeating [14, 35]. Regardless, the association between PTSD and DASH scores disappears when we add education into the model. This may suggest that education mediates diet quality in individuals with PTSD. Higher dietary quality has been shown to be associated with educational level in many community populations without PTSD [36–38]. Education has also been shown to improve diet quality in men over time

[39]. Since dietary quality and PTSD seem to be confounded with educational, these results suggest that increasing education for individuals with PTSD may improve adverse metabolic outcomes. Notably, combined ELA and PTSD have an additive effect on diet quality, where higher levels of combined ELA and PTSD severity decrease DASH score (but not aHEI-2010 score), but this difference, also, disappears with corrections for race and/or education, likely for similar reasons as above.

The energy coming from trans fatty acids was also significantly higher among people with greater ELA or ELA-PTSD combined but significance was lost when socioeconomic variables, particularly education, were used as covariates. Low socioeconomic status has been previously shown to be negatively associated with trans fatty acid consumption [40]. Furthermore, trans fatty acid consumption is associated with adverse cardiometabolic variables, all cause mortality, total CHD, and CHD mortality [41, 42] which might indicate a path between ELA and/or PTSD negative health outcomes in individuals with low socioeconomic status.

Cigarette use with ELA and PTSD

We observe a relationship between smoking status with ELA and PTSD. Individuals with ELA or PTSD are more likely to be current or past smokers consistent with the literature. For instance, a previous study has observed higher levels of cigarette smoking with childhood adversity in a midlife African American population [43]. In another study, greater numbers of ELA events showed heightened use of cigarettes in adulthood [44]. Thus, there are clear relationships between adversities and smoking that should be explored more deeply with targeted studies. Similar findings have been shown with PTSD. Higher levels of cigarette smoking and nicotine addiction have been repeatedly observed in individuals with PTSD [45–49]. Higher levels of PTSD also demonstrate higher levels of nicotine withdrawal and addiction resilience [45]. Furthermore, individuals with PTSD show greater negative reinforcement motives, such as the removal of negative affect/anxiety, for smoking [46, 49]. Individuals with PTSD reported a greater difficulty in tobacco cessation [50] which might also account for the increased risk for CVD these individuals exhibit [51], although risk for CVD remains elevated even after adjustment for smoking [52].

Physical activity changes with ELA and PTSD

We observe decreased physical activity with PTSD but no differences in physical activity were observed with ELA severity or ELA and PTSD combined. However, this difference disappears when adjusting for age and gender, suggesting that these confounders may prevent us from observing any further relationships. Despite the previously observed negative association between PTSD and physical activity, physical activity has shown to benefit PTSD symptom severity as well as to improve associated central obesity [53–56]. According to a study of an animal model of PTSD, these beneficial effects of exercise on PTSD symptoms may occur through an increased expression of the brain-derived neurotrophic factor, neuropeptide Y and delta opioid receptor signaling in the brain [57]. Thus, physical activity may be an additional therapeutic option for people with PTSD.

Sleep changes with ELA and PTSD

We also observe less hours of reported rest and sleep with both ELA and PTSD. Differences in ELA with rest and sleep remain significant when controlling for age and gender and in models with additional factors, such as socioeconomic variables, BMI and depression but disappeared when race was used as the only covariate. The effects of PTSD on amount of rest and sleep remain significant with age, gender, and education controlled in the model but disappear when adding race as a covariate. ELA has been previously associated with sleep disturbances in adulthood [58] and the same is true for PTSD [59]. Race has been previously shown to be associated with sleep duration, with African Americans to be more likely to report fewer hours of sleep compared to European Americans [60]. When ELA and PTSD were combined an additive effect was found and significance remained after all adjustments made. Insufficient sleep has been linked to poor dietary habits and weight gain in past studies [61] as well as to metabolic abnormalities [62–64] and CVD [65], indicating a potential link between these disorders and their poorer health outcomes. Furthermore, PTSD has been associated with shorter sleep duration and higher metabolic risk, while sleep duration has been associated with metabolic risks in PTSD, although it does not fully explain the association between PTSD and metabolic measures [66]. On the other hand, it has been demonstrated that perceived stress is associated with poorer sleep quality and modulation of the autonomic nervous system which might provide a link between stress and CVD [67]. The later may suggest poor sleep as a potential mediator of ELA and/or PTSD associated cardiometabolic risk and a greater attention to sleep habits of individuals with ELA and/or PTSD should be paid for both CVD prevention or support to therapeutic efforts if CVD already present.

Types of ELA and lifestyle habits

When we looked into the specific types of ELA we, also, observed poorer lifestyle habits for each specific type, and especially for those with physical abuse, compared to those with no such experiences. However, most differences were lost when adjustment for race and/or education were made. Although specific types of abuse, particularly physical abuse during childhood, have been associated with an increased risk for obesity and metabolic syndrome in adult life [68, 69], low physical activity and an unhealthy dietary pattern were not related to a history of abuse/neglect in a population of midlife women [70]. In addition, individuals with sexual and physical abuse during childhood did not report infrequent breakfast consumption, binge drinking or abnormal hours of sleep compared to individuals with no history of childhood abuse [71]. Although the latter is in contrast with our findings of fewer hours of resting and sleeping among individuals with and without physical abuse and abnormal hours of sleep between those with and without sexual abuse, other studies have found decreased sleep quantity and/or quality among abused (either type) individuals [72, 73]. Furthermore, previous studies have reported mixed results for a greater incidence of smoking among people with or without neglect or abuse [70, 74–76]. Although, the evidence about specific types of ELA and certain lifestyle habits are not plenty, it seems that most of the unhealthy behaviors these individuals were found to develop are not related to ELA, per se, but other factors mediate these findings; in our study, these were sociodemographic differences. Increased levels of education in these individuals might resolve part of the problem, but more research is required to identify other modifiable

factors that may mediate these observations. Furthermore, targeted interventions should be developed for improving sleeping habits among individuals who had experienced early life abuse.

Strengths and limitations

This is the first study, to our knowledge, that has examined the relationship between ELA and/or PTSD and several important lifestyle factors including nutrition, physical activity, resting and sleeping and smoking. These data emphasize the importance for health care professionals to take this novel information into account when examining individuals with a history of ELA and/or PTSD. We examined ELA and PTSD as both continuous and categorical variables in order to capture different types of associations, and we also examined combined ELA and PTSD in order to explore potential additive effects. The cross-sectional sample size was adequate enough to identify significant differences across genders and races. However, we cannot generalize findings to all races and outside of the mid-life age spectrum. The small sample size of the prospective data could be considered a limitation of the study, however the trends observed supported the cross-sectional data and provide the time sequence criterion for causality of the relationships studied. Nevertheless, findings need to be replicated by future larger prospective studies, which can explore these interactions in similar or different populations. Furthermore, as in every epidemiological study, we controlled for covariates known to affect the variables of interest; however, there may be other potential, unknown mediators for which we cannot control. Although, validated instruments by blinded observers enhance the quality of the study, some measurements, like self-reported sleep/rest could be sometimes inaccurate. Future studies with and without objective sleep measurements are necessary to confirm the evidence provided by the current study. Random error in measurements, such as misclassification of self-reported sleep, could have occurred but would have only created suppression of effect estimates and resultant p-values without affecting the significance of statistically significant data we have presented herein.

Conclusions

With this study we showed that the nutrition, physical activity and resting and sleeping habits of the individuals with ELA and/or PTSD differ from those without ELA and/or PTSD. Sociodemographic factors and/or BMI explained the observed differences for diet quality and physical activity. However, none adjustment explained the observed differences for resting and sleeping indicating that fewer hours of rest and sleep might be a path linking ELA and/or PTSD with the several metabolic abnormalities associated with these conditions. More studies are needed to confirm and expand our findings as well as to elucidate potential mechanisms between associations. Prospective studies of greater sample sizes would provide a broader understanding of potential associations, as well as clearer cause and effect relations and are needed to set the stage for interventional studies. Given the negative health outcomes ELA and/or PTSD are related with, as well as the mediating effect of socioeconomic status on lifestyle habits of individuals with high ELA and/or PTSD severity, modifiable risk factors need to be elucidated so that appropriate interventions to be designed and implemented. Further clinical practitioners may find it useful to assess lifestyle

habits in relation to history of ELA and/or PTSD when examining individuals with ELA and/or PTSD, so that they could detect and target potential unhealthy lifestyle behaviors.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations

ELA	Early life adversity
PTSD	Post-traumatic stress disorder
BMI	Body Mass Index
SFA	Saturated fatty acids
CRC	Clinical Research Center
BIDMC	Beth Israel Deaconess Medical Center
JBCC	Judge Baker Children's Center
FFQ	food frequency questionnaire
aHEI-2010	alternate Healthy Eating Index-2010
DASH	Dietary Approach to Stop Hypertension
UCLA	University of California, Los Angeles
BDI	Beck Depression Inventory
ANOVA	Analysis of variance

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Table 1

Baseline characteristics of the study sample and unadjusted comparisons between ELA and PTSD quartiles

Characteristic	Overall sample (n=151)	ELA severity			P- value	PTSD severity			P- value
		Q1+Q2 0-4 (n=76)	Q3 5-24 (n=39)	Q4 25-156 (n=36)		Q1+Q2 0 (n=77)	Q3 1-22 (n=37)	Q4 22-57 (n=37)	
Demographic Characteristics									
Age (y)	45.62±3.49	45.47±3.22	46.18±3.66	45.31±3.86	0.493	45.88±3.68	45.89±2.92	44.78±3.57	0.250
Gender (% females) *	50.30	48.70	43.60	61.10	0.292	45.50	45.90	64.90	0.126
Race (% European Americans) *	49.70	65.30	34.20	33.30	0.001	55.30	58.30	27.90	0.019
Marital status (% married) *	30.70	36.80	21.10	27.80	0.206	42.10	21.60	16.20	0.008
Education (y)	14.49±2.46	15.38±2.41 ^a	13.69±2.31 ^b	13.45±2.00 ^b	0.001	15.07±2.48 ^a	14.78±2.32 ^a	12.91±1.83 ^b	0.001
Income *									
\$ 25,000/y (%)	50.40	41.50	52.90	66.70	0.096	40.00	58.30	64.50	0.245
>\$ 45,000/y (%)	23.20	37.00	11.70	6.00		37.10	14.00	3.20	
Anthropometric Characteristics									
Weight (kg)	87.95±21.56	84.07±21.92	92.86±22.79	90.81±18.18	0.077	85.92±20.67	88.14±24.29	91.97±20.47	0.375
BMI (kg/m ²)	30.03±7.06	28.49±6.62 ^a	31.19±7.71 ^b	32.03±6.87 ^b	0.023	28.99±6.61	30.31±7.68	31.90±7.29	0.119
Waist circumference (cm)	95.32±15.84	92.13±16.61 ^a	98.82±15.02 ^b	98.44±13.82	0.048	93.45±15.93	96.15±17.43	98.45±13.60	0.297
Body fat mass (%)	29.99±11.18	27.53±11.14 ^a	31.92±11.15 ^b	33.19±10.34 ^b	0.025	27.92±10.60 ^a	29.51±10.99 ^{a,b}	34.69±11.43 ^b	0.012
Lifestyle Characteristics									
Annual physical activity (met [*] h) [‡]	715.20 (388.00–1550.40)	1146.60 (450.90–1638.00)	594.00 (240.00–1188.00)	528.00 (244.80–1569.60)	0.287	1125.00 (7438.00–1778.00) ^a	528.00 (250.00–1626.00) ^b	594.00 (139.20–1056.00) ^b	0.024
Smoking status [*]									
Never smoker (%)	53.30	65.80	50.00	30.60	0.007	66.20	43.20	36.10	0.001
Current smoker (%)	31.30	21.10	39.50	44.40		19.50	32.40	55.60	
Sleeping (7–9h/24h; %) [*]	54.00	67.10	44.70	36.10	0.083	59.80	59.40	36.10	0.090
Resting & sleeping (h/d)	7.09±1.49	7.32±1.32 ^a	7.16±1.84 ^{ab}	6.55±1.36 ^b	0.043	7.3±1.3	7.1±1.6	6.6±1.7	0.079
Sedentary activities (h/d) [‡]	3.96 (2.00–6.00)	3.28 (2.00–5.57)	4.43 (2.45–6.43)	4.14 (1.14–6.00)	0.389	3.96 (2.00–5.93)	3.29 (1.54–4.71)	5.00 (3.00–6.28)	0.078
Nutritional Characteristics									

Characteristic	Overall sample (n=151)	ELA severity			P-value	PTSD severity			P-value
		Q1+Q2 0-4 (n=76)	Q3 5-24 (n=39)	Q4 25-156 (n=36)		Q1+Q2 0 (n=77)	Q3 1-22 (n=37)	Q4 22-57 (n=37)	
Energy intake (kcal/d)	2154.17±1100.66	2097.53±1182.91	2053.81±795.12	2382.49±1198.04	0.357	2017.84±1030.24	2255.53±1105.10	2336.55±1225.25	0.287
aHEI-2010	54.21±14.51	57.49±15.37 ^a	48.90±13.43 ^b	53.05±11.98 ^{ab}	0.009	55.93±15.72	55.08±12.17	49.77±13.42	0.095
DASH score	23.83±5.49	25.24±5.67 ^a	22.34±4.79 ^b	22.44±5.17 ^b	0.006	25.09±5.69 ^a	23.65±4.95 ^{ab}	21.38±4.82 ^b	0.003
Psychosocial Characteristics									
Depression score [‡]	8.00 (3.00–16.00)	5.00 (0.00–13.50)	10.50 (5.00–21.50)	10.00 (4.50–16.50)	0.001	5.00 (0.00–10.00)	8.00 (4.75–13.25)	17.00 (9.00–27.50)	0.001
Early life adversity score [‡]	4.00 (0.00–24.00)	-	-	-	-	2.00 (0.00–15.00)	6.00 (0.00–24.80)	20.00 (0.80–58.50)	0.002
Post-traumatic stress disorder score [‡]	0.00 (0.00–22.00)	0.00 (0.00–9.30)	4.00 (0.00–29.00)	10.00 (0.00–36.75)	0.001	-	-	-	-
Psychiatric medication (% of participants taking psychiatric medication) [*]	20.90	15.30	21.20	32.40	0.130	20.60	22.20	20.00	0.971

Normally distributed continues data were compared with one-way ANOVA and are presented as mean ± SD.

Q1-Q4 indicate quartiles 1 to 4

[‡]If logarithmic transformation of non-normally distributed variables rendered variables normally distributed, then those values were compared using one-way ANOVA. Variables for transformed data are presented as median (1st-3rd quartile).

[‡]Non-normally continues distributed data were compared with the independent-samples Kruskal-Wallis test and are presented as median (1st-3rd quartile).

^{*} Categorical data were compared with X² test and are presented as percentages (%).

Different letters inside each condition (PTSD or ELA) indicate statistically significant difference between quartiles, P 0.05.

Abbreviations: early life adversity (ELA); post-traumatic stress disorder (PTSD); Dietary Approach to Stop Hypertension (DASH); alternate Healthy Eating Index-2010 (aHEI-2010); Body mass index (BMI)

Table 2

Spearman correlation coefficients (*rho*) and corresponding p-values among ELA and PTSD severity and anthropometric, lifestyle including nutritional, and psychosocial characteristics

	ELA severity		PTSD severity	
	rho	p-value	rho	p-value
Anthropometric characteristics				
Age (y)	0.08	0.359	−0.06	0.432
Weight (kg)	0.14	0.089	0.12	0.150
BMI (kg/m ²)	0.20	0.013	0.17	0.035
Waist circumference (cm)	0.19	0.025	0.15	0.066
Body fat mass (%)	0.21	0.012	0.26	0.002
Lifestyle characteristics				
Annual physical activity (met*h)	−0.14	0.157	−0.24	0.012
Resting and sleeping (h/d)	−0.22	0.008	−0.16	0.053
Sedentary activities (h/d)	0.08	0.359	0.07	0.406
Nutritional characteristics				
Energy intake (kcal/d)	0.12	0.134	0.11	0.170
aHEI_2010	−0.12	0.139	−0.11	0.194
DASH score	−0.21	0.009	−0.24	0.003
Psychosocial characteristics				
Depression score	0.29	0.001	0.45	0.001
ELA score	-	-	0.29	0.001
PTSD score	0.29	0.001	-	-

Abbreviations: early life adversity (ELA); post-traumatic stress disorder (PTSD); Dietary Approach to Stop Hypertension (DASH); alternate Healthy Eating Index-2010 (aHEI-2010); Body mass index (BMI).

Table 3a

Cross sectional associations between PTSD severity or ELA severity and lifestyle characteristics

	ELA severity				PTSD severity			
	Q1+Q2 0 (n=76)	Q3 1-22 (n=39)	Q4 22-57 (n=36)	P-value	Q1+Q2 0-4 (n=77)	Q3 5-24 (n=37)	Q4 25-156 (n=37)	P-value
DASH score								
Model 1	25.24±0.61	22.36±0.86	22.44±0.89	0.006	25.09±0.61	23.65±0.87	21.38±0.87	0.003
Model 2	25.25±0.62	22.30±0.86	22.46±0.90	0.005	25.10±0.61	23.66±0.88	21.35±0.89	0.003
Model 3	24.77±0.62	22.62±0.87	22.83±0.89	0.080	24.86±0.60	23.38±0.87	21.84±0.88	0.019
Model 4	24.57±0.62	22.83±0.83	23.25±0.92	0.223	24.59±0.60	23.41±0.84	22.51±0.94	0.166
Model 5	24.07±0.62	22.84±0.88	23.68±0.89	0.543	24.10±0.61	23.55±0.84	22.83±0.97	0.555
Model 6	23.79±0.61	23.12±0.85	23.97±0.86	0.742	24.04±0.58	23.56±0.80	22.96±0.93	0.628
Model 7	23.80±0.61	23.11±0.86	23.97±0.86	0.743	24.04±0.59	23.56±0.81	22.96±0.93	0.631
Model 8	23.77±0.66	23.50±0.95	24.32±1.02	0.828	24.11±0.66	24.09±0.90	22.89±1.10	0.652
aHEL-2010 score								
Model 1	57.49±1.62	48.90±2.27	53.05±2.36	0.009	55.93±1.64	55.08±2.36	49.77±2.36	0.095
Model 2	57.56±1.62	49.09±2.27	52.69±2.37	0.009	56.17±1.63	55.29±2.35	49.06±2.39	0.048
Model 3	56.63±1.66	49.57±2.32	53.21±2.37	0.053	55.54±1.63	55.02±2.36	49.84±2.39	0.141
Model 4	57.45±1.71	49.45±2.30	53.11±2.53	0.025	56.09±1.69	55.04±2.36	49.69±2.65	0.144
Model 5	56.98±1.77	48.54±2.48	53.38±2.51	0.032	54.94±1.75	55.77±2.41	49.91±2.79	0.253
Model 6	56.17±1.70	49.40±2.38	54.24±2.41	0.086	54.74±1.66	55.81±2.29	50.31±2.65	0.278
Model 7	55.67±1.58	50.62±2.22	54.03±2.23	0.210	54.88±1.52	55.48±2.10	50.39±2.43	0.247
Model 8	55.45±1.75	51.15±2.53	54.00±2.71	0.413	54.62±1.77	56.09±2.40	50.57±2.93	0.374
Annual physical activity (met*h)								
Model 1	1125.88±123.37	998.56±177.67	861.70±181.05	0.096	1255.06±122.55	883.53±170.19	737.12±173.31	0.031
Model 2	1127.87±117.25	938.78±170.92	919.49±174.89	0.083	1207.18±119.10	887.12±163.58	829.17±170.09	0.092
Model 3	1054.03±120.47	972.41±170.54	967.84±175.25	0.483	1152.29±119.25	887.89±160.74	868.84±170.01	0.288
Model 4	1116.17±126.33	965.91±177.08	990.46±191.98	0.291	1206.52±126.72	890.03±166.84	894.71±198.12	0.277
Model 5	1058.85±137.91	973.93±200.61	977.75±196.94	0.470	1169.66±139.10	868.98±174.24	895.25±214.10	0.424
Model 6	999.43±135.24	1006.21±194.40	1074.66±193.93	0.682	1173.01±134.06	838.69±168.41	926.80±205.84	0.351

	ELA severity				PTSD severity			
	Q1+Q2 0 (n=76)	Q3 1-22 (n=39)	Q4 22-57 (n=36)	P-value	Q1+Q2 0-4 (n=77)	Q3 5-24 (n=37)	Q4 25-156 (n=37)	P-value
Model 7	991.98±136.14	1031.94±198.84	1065.11±195.08	0.825	1173.49±134.52	847.60±169.55	914.45±207.43	0.362
Model 8	926.38±151.62	1157.14±217.43	1174.29±237.50	0.985	1190.93±148.05	807.06±189.66	1001.29±232.36	0.351
Resting and sleeping (h/d)								
Model 1	7.32±0.17	7.16±0.25	6.55±0.25	0.043	7.32±0.17	7.076±0.25	6.624±0.25	0.079
Model 2	7.31±0.17	7.17±0.25	6.56±0.25	0.051	7.32±0.17	7.08±0.25	6.611±0.26	0.080
Model 3	7.26±0.18	7.23±0.26	6.60±0.26	0.098	7.30±0.18	7.08±0.26	6.663±0.26	0.143
Model 4	7.28±0.18	7.18±0.25	6.46±0.27	0.041	7.31±0.18	7.08±0.25	6.513±0.29	0.081
Model 5	7.20±0.19	7.52±0.28	6.53±0.28	0.033	7.25±0.19	7.17±0.27	6.728±0.32	0.389
Model 6	7.24±0.19	7.47±0.28	6.49±0.28	0.027	7.28±0.19	7.16±0.26	6.689±0.32	0.309
Model 7	7.26±0.19	7.45±0.28	6.49±0.28	0.028	7.28±0.19	7.16±0.26	6.685±0.31	0.302
Model 8	7.37±0.18	7.38±0.27	6.25±0.28	0.003	7.17±0.19	7.28±0.26	6.859±0.33	0.617

Data are presented as adjusted mean±SE

Q1-Q4 indicate quartiles 1 to 4

Abbreviations: early life adversity (ELA); post-traumatic stress disorder (PTSD); Dietary Approach to Stop Hypertension (DASH); alternate Healthy Eating Index-2010 (aHEI-2010); Body mass index (BMI)

Model 1: unadjusted

Model 2: adjustment for age and gender

Model 3: adjustment for age, gender and race

Model 4: adjustment for age, gender and education

Model 5: adjustment for age, gender, race, education and income

Model 6: adjustment for age, gender, race, education, income, BMI

Model 7: adjustment for age, gender, race, education, income, BMI, energy intake

Model 8: adjustment for age, gender, race, education, income, BMI, energy intake, psychiatric medication, depression

Table 3b

Associations between ELA severity or PTSD severity with lifestyle characteristics evaluated prospectively

	ELA severity				P-value	PTSD severity				P-value
	Q1+Q2 0 (n=29)	Q3 1-22 (n=7)	Q4 22-57 (n=13)	Q4 22-57 (n=13)		Q1+Q2 0-4 (n=29)	Q3 5-24 (n=10)	Q4 25-156 (n=10)		
DASH score										
Model 1	24.62±0.93	24.43±1.90	22.31±1.40	22.31±1.50	0.382	25.14±0.88	24.30±1.50	20.30±1.50		0.028
Model 2	24.84±0.94	24.34±1.91	21.86±1.42	21.86±1.50	0.231	25.20±0.89	24.28±1.50	20.13±1.53		0.024
Model 3	24.70±0.92	25.07±1.91	21.79±1.39	21.79±1.54	0.200	25.13±0.90	24.03±1.54	20.60±1.64		0.072
Model 4	24.33±0.92	25.25±1.87	22.80±1.44	22.80±1.76	0.534	24.70±0.93	24.64±1.51	21.47±1.76		0.276
Model 5	24.31±0.94	24.41±2.02	22.07±1.46	22.07±1.74	0.434	24.32±0.95	24.40±1.55	21.26±1.74		0.306
Model 6	23.97±0.94	24.94±1.10	22.59±1.46	22.59±1.72	0.586	24.17±0.93	24.38±1.51	21.73±1.72		0.443
Model 7	24.01±0.96	24.82±2.10	22.57±1.48	22.57±1.74	0.606	24.12±0.96	24.50±1.58	21.77±1.74		0.453
Model 8	23.89±0.99	24.83±2.14	22.85±1.53	22.85±1.88	0.715	24.07±1.10	24.28±1.63	22.15±1.88		0.651
aHEL-2010 score										
Model 1	57.72±2.63	58.79±5.35	53.69±3.93	53.69±4.26	0.644	59.81±2.50	56.91±4.26	48.00±4.26		0.068
Model 2	58.00±2.70	58.85±5.50	53.05±4.10	53.05±4.42	0.569	60.02±2.56	56.87±4.33	47.43±4.42		0.061
Model 3	57.72±2.70	60.27±5.61	52.92±4.09	52.92±4.77	0.510	59.94±2.60	56.61±4.46	47.93±4.77		0.108
Model 4	57.34±2.77	60.04±5.62	55.07±4.35	55.07±5.20	0.774	59.97±2.76	56.87±4.46	48.47±5.20		0.196
Model 5	57.65±2.88	56.31±6.21	53.28±4.50	53.28±5.21	0.740	59.21±2.86	56.06±4.64	48.01±5.21		0.216
Model 6	56.95±2.93	57.41±6.26	54.38±4.58	54.38±5.27	0.883	58.93±2.87	56.02±4.64	48.89±5.27		0.300
Model 7	56.52±2.99	58.88±6.51	54.66±4.61	54.66±5.27	0.856	59.58±2.91	54.66±4.78	48.46±5.27		0.231
Model 8	56.14±3.09	59.12±6.70	55.41±4.79	55.41±5.69	0.892	59.71±3.01	54.20±4.93	48.60±5.69		0.271
Annual physical activity (met*h)										
Model 1	1750.13±288.01	874.80±610.96	668.00±432.01	668.00±458.45	0.155	1716.37±1311.43	572.11±445.93	1324.40±1525.68		0.070
Model 2	1770.03±280.19	715.99±607.25	702.68±422.07	702.68±458.45	0.126	1670.80±311.87	454.86±458.45	1512.45±438.63		0.052
Model 3	1821.58±273.40	595.06±593.21	647.11±410.47	647.11±458.54	0.125	1808.27±327.76	538.70±458.54	1181.33±509.22		0.054
Model 4	1817.13±299.28	672.56±634.76	600.37±483.57	600.37±555.44	0.238	1689.84±361.50	464.24±481.18	1571.93±555.44		0.122
Model 5	1628.44±284.12	430.59±679.08	681.37±445.35	681.37±540.51	0.397	1450.82±361.03	546.62±453.21	1579.68±540.51		0.260
Model 6	1542.94±313.58	681.16±778.33	781.62±474.36	781.62±510.78	0.577	1377.69±337.66	500.02±422.01	1762.11±510.78		0.237

	ELA severity				PTSD severity			
	Q1+Q2 0 (n=29)	Q3 1-22 (n=7)	Q4 22-57 (n=13)	P-value	Q1+Q2 0-4 (n=29)	Q3 5-24 (n=10)	Q4 25-156 (n=10)	P-value
Model 7	1531.02±320.14	820.96±828.45	750.66±486.21	0.562	1584.31±365.08	323.54±433.84	1554.86±523.66	0.130
Model 8	1532.83±317.40	958.83±808.76	687.17±492.40	0.536	1692.79±362.73	387.91±429.90	1289.02±542.02	0.159
Resting and sleeping (h/d)								
Model 1	7.13±1.28	6.17±0.57	7.07±0.42	0.253	7.19±0.26	7.436±0.45	5.78±0.47	0.024
Model 2	7.13±1.29	6.13±0.58	7.10±0.44	0.216	7.19±0.27	7.435±0.46	5.77±0.49	0.031
Model 3	7.07±1.29	6.46±0.58	7.05±0.42	0.223	7.23±0.29	7.396±0.48	5.64±0.57	0.180
Model 4	7.13±1.31	6.14±0.62	7.18±0.47	0.215	7.17±0.27	7.251±0.47	6.06±0.53	0.040
Model 5	7.25±1.30	6.33±0.66	6.91±0.46	0.339	7.36±0.29	7.060±0.49	5.91±0.56	0.099
Model 6	7.25±1.31	6.33±0.67	6.90±0.47	0.337	7.37±0.30	7.051±0.50	5.90±0.57	0.105
Model 7	7.17±1.31	6.61±0.69	6.95±0.46	0.462	7.49±0.29	6.690±0.50	5.94±0.55	0.059
Model 8	7.24±1.30	6.34±0.66	6.94±0.44	0.563	7.42±0.29	6.743±0.50	6.11±0.56	0.143

Data are presented as adjusted mean±SE

Q1-Q4 indicate quartiles 1 to 4

Abbreviations: early life adversity (ELA); post-traumatic stress disorder (PTSD); Dietary Approach to Stop Hypertension (DASH); alternate Healthy Eating Index-2010 (aHEI-2010); Body mass index (BMI)

Model 1: unadjusted

Model 2: adjustment for age and gender

Model 3: adjustment for age, gender and race

Model 4: adjustment for age, gender and education

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Model 7: adjustment for age, gender, race, education, income, BMI, energy intake

Model 8: adjustment for age, gender, race, education, income, BMI, energy intake, psychiatric medication, depression

Table 4

ELA-PTSD combined groups in relation to lifestyle characteristics

		ELA-PTSD categories				
		Low ELA (T1+T2)-Low PTSD (T1+T2), n=79	High ELA (T3)-Low PTSD (T1+T2), n=23	Low ELA (T1+T2)-High PTSD (T3), n=26	High ELA (T3)-High PTSD (T3), n=23	P-value
DASH score						
Model 1		25.05±0.61	23.04±1.12	22.35±1.06	22.09±1.12	0.034
Model 2		25.11±0.61	22.90±1.14	22.27±1.06	22.10±1.14	0.028
Model 3		24.73±0.61	23.18±1.11	22.19±1.05	22.70±1.12	0.128
Model 4		24.36±0.62	23.68±1.10	22.57±1.01	23.44±1.21	0.521
Model 5		23.80±0.62	24.01±1.07	22.85±1.04	23.74±1.19	0.854
Model 6		23.71±0.59	24.02±1.03	22.90±1.00	23.99±1.14	0.848
Model 7		23.71±0.59	24.02±1.03	22.90±1.01	23.99±1.15	0.851
Model 8		23.84±0.65	23.99±1.18	23.04±1.11	24.59±1.36	0.829
aHEL-2010 score						
Model 1		55.67±1.64	54.05±3.03	52.32±2.85	51.49±3.03	0.566
Model 2		56.05±1.64	53.75±3.05	51.99±2.85	50.87±3.05	0.391
Model 3		55.16±1.65	54.24±3.01	52.09±2.86	51.90±3.05	0.709
Model 4		55.60±1.74	54.58±3.09	52.33±2.85	51.77±3.41	0.689
Model 5		54.68±1.78	54.48±3.10	53.19±3.02	52.05±3.44	0.912
Model 6		54.39±1.69	54.52±2.94	53.36±2.87	52.86±3.28	0.969
Model 7		54.56±1.55	55.06±2.70	52.31±2.63	52.83±3.00	0.840
Model 8		54.58±1.76	54.07±3.18	52.26±2.99	54.51±3.65	0.929
Annual physical activity (met*h)						
Model 1		1189.33±121.54	956.45±236.93	797.15±200.24	845.98±229.40	0.167
Model 2		1178.47±117.15	875.61±228.04	815.72±190.70	936.11±221.98	0.168
Model 3		1115.19±118.04	922.36±226.19	814.13±187.26	1000.50±222.90	0.505
Model 4		1173.30±126.60	894.65±235.38	827.74±194.67	1061.47±261.86	0.420
Model 5		1129.09±138.22	888.43±242.19	830.69±208.86	1030.48±267.90	0.600
Model 6		1094.26±134.20	937.17±234.74	810.77±201.96	1134.65±261.79	0.633

	ELA-PTSD categories				P-value
	Low ELA (T1+T2)-Low PTSD (T1+T2), n=79	High ELA (T3)-Low PTSD (T1+T2), n=23	Low ELA (T1+T2)-High PTSD (T3), n=26	High ELA (T3)-High PTSD (T3), n=23	
Model 7	1102.43±134.98	945.89±235.62	796.98±203.31	1113.95±263.90	0.601
Model 8	1078.51±152.14	1074.38±281.84	839.42±223.18	1175.74±304.86	0.887
Resting and sleeping (h/d)					
Model 1	7.58±0.17	6.69±0.30	6.56±0.28	6.45±0.31	0.001
Model 2	7.57±0.17	6.72±0.31	6.57±0.29	6.42±0.32	0.001
Model 3	7.55±0.17	6.74±0.31	6.57±0.29	6.47±0.32	0.003
Model 4	7.60±0.18	6.68±0.31	6.55±0.28	6.13±0.35	0.001
Model 5	7.60±0.19	6.71±0.32	6.67±0.31	6.30±0.37	0.005
Model 6	7.61±0.18	6.73±0.32	6.64±0.31	6.25±0.37	0.003
Model 7	7.60±0.18	6.72±0.32	6.69±0.31	6.24±0.37	0.004
Model 8	7.54±0.18	6.46±0.33	7.05±0.31	6.38±0.38	0.010

Data are presented as adjusted mean±SE

T1-T3 indicate tertiles 1 to3

Abbreviations: early life adversity (ELA); post-traumatic stress disorder (PTSD); Dietary Approach to Stop Hypertension (DASH); alternate Healthy Eating Index-2010 (aHEI-2010); Body mass index (BMI)

Model 1: unadjusted

Model 2: adjustment for age and gender

Model 3: adjustment for age, gender and race

Model 4: adjustment for age, gender and education

Model 5: adjustment for age, gender, race, education and income

Model 6: adjustment for age, gender, race, education, income, BMI

Model 7: adjustment for age, gender, race, education, income, BMI, energy intake

Model 8: adjustment for age, gender, race, education, income, BMI, energy intake, psychiatric medication, depression