Short communication

Childhood maltreatment in patients with mental illness as a risk factor for obesity

Inga Schalinski [a,b,*], Thomas Jozefiak [c], Nikola Stenzel [d], Susanne Breinlinger [e,f], Martin H. Teicher [g,h,1], Brigitte Rockstroh [b,d,1]

[a] Universität der Bundeswehr München, Department of Human Sciences, Neubiberg, Germany
[b] Non-Governmental Organization Vivo International e.V., Konstanz, Germany
[c] Regional Centre for Child and Youth Mental Health and Child Welfare (RKBU Central Norway), Department of Mental Health, Norwegian University of Science and Technology, Trondheim, Norway
[d] Psychologische Hochschule Berlin, Germany
[e] Department of Psychology, Clinical Psychology and Psychotherapy, University of Konstanz, Germany
[f] Center of Psychiatry, Reichenau, Germany
[g] Department of Psychiatry, Harvard Medical School, Boston, MA, USA
[h] Developmental Biopsychiatry Research Program, McLean Hospital, Belmont, MA, USA

ARTICLE INFO

ABSTRACT

Mental illness increases risk for obesity which is often attributed to medications. We assessed the impact of childhood maltreatment on body-mass-index (BMI) and obesity in $N = 261$ adult psychiatric inpatients and $N = 81$ controls. There was an increased risk for obesity in psychiatric inpatients compared to controls. Conditioned random forest regression revealed parental abuse at ages 4–5 and peer-related violence at 7–13 as crucial factors in BMI elevation among individuals with mental illness, while type of psychiatric diagnoses, and use of psychotropics were not. Recognizing this link may aid in understanding the mechanisms and the development of strategies to mitigate the risk.

1. Introduction

Individuals with psychiatric disorders are three times more likely to have obesity (Afzal et al., 2021), a condition that also increases the likelihood of disability, disease, and early death. This escalated risk is ascribed to psychotropic medications, lifestyle, socioeconomic and psychological factors, metabolic changes, sleep disturbances, and genetic factors (Avila et al., 2015). However, the influence of childhood maltreatment (CM), a known risk factor for both psychiatric disorders and population-level obesity (Felitti et al., 1998; Danese and Tan, 2014), on this increased obesity risk remains underexplored.

CM is a complex construct that involves exposure to different types of adversity across childhood from an array of perpetrators. Meta-analyses indicate that maltreatment, in general, is a risk factor for obesity, particularly caregiver physical and sexual abuse and peer bullying (Danese and Tan, 2014; Midei and Matthews, 2011). Timing of exposure may be critical (Schalinski et al., 2019a) and a few studies have outlined vulnerability windows to CM, including infancy (McKelvey et al., 2019) and early teenage years (D'Argenio et al. 2009), and to peer violence between ages 7–11 (Takizawa et al., 2015). However, a comprehensive analysis of type and time risk factors has not been reported.

The aims of this study were to identify the most important type and time risk factors for increased BMI and obesity and to ascertain how well these specific experiences compared to global maltreatment measures, and other risk factors including psychotropic medications and psychopathology.

---

* Corresponding author at: University of the Bundeswehr Munich, Institute for Psychology, Clinical Psychology and Traumatherapy, Werner-Heisenberg-Weg 39, 85577 Neubiberg, Germany.
E-mail addresses: inga.schalinski@unibw.de (I. Schalinski), thomas.jozefiak@ntnu.no (T. Jozefiak), n.stenzel@phb.de (N. Stenzel), Susanne.breinlinger@uni-konstanz.de (S. Breinlinger), martin_teicher@hms.harvard.edu (M.H. Teicher), brigitte.rockstroh@uni-konstanz.de (B. Rockstroh).
[1] These authors jointly share the last authorship

2. Methods

2.1. Study sample, procedure, and setting

Psychiatric inpatients aged 18 to 40 with proficiency in German were recruited from the Center for Psychiatry Reichenau. All had at least one major ICD-10 diagnosis. Controls ($N = 81$) had no current or past psychiatric history (confirmed by Mini International Neuropsychiatric Interview, Ackenheil et al., 1999), and were selectively recruited from the community to closely match patients in age, sex, and education. See eTable 1 and 2 for demographic and descriptive data.

The study was reviewed and approved by the Ethics Committee of the University of Konstanz. In accordance with the Declaration of Helsinki 2008, all participants were informed by written and verbal information about this study and provided written informed consent. All methods were performed based on the relevant guidelines.

As part of a larger project investigating the relationship between CM and various outcomes, we previously reported CM data in a different methodological context, based on a data subset of the larger project ($n = 167$ patients, $n = 75$ controls; Schalinski et al., 2019b).

2.2. Instruments

Severity and timing of exposure to ten types of CM was assessed retrospectively using the Maltreatment and Abuse Chronology of Exposure scale (MACE-X; Isele et al., 2014; see supplement).

Exposure to other potentially traumatic events across the life span was assessed with the Life Events Checklist (Gray et al., 2004). Trauma load was calculated as the sum of all event types, potentially ranging between 0 and 17.

Individuals with mental illness were weighed weekly during hospitalization and provided their weight and height during interviews. Controls reported their weight and height. BMI was calculated as weight (kg) divided by height (m^2).

2.3. Statistical analysis

Adjusted odds ratios (OR) for BMI$\geq$25 and BMI$\geq$30 were calculated using logistic regression to describe group differences between individuals with psychiatric disorders and controls. For cases only, random forest regression with conditional inference trees (Breiman, 2001; Strobl et al., 2007, 2009) was implemented using the R package 'party' as a predictive analytical strategy to identify the most important risk factors for BMI, effectively addressing collinearity between predictor variables. Potential risk factors included parental abuse and neglect (ages 1–18), peer-related and sexual abuse (ages 4–18), global measures of severity, multiplicity, duration of CM and trauma load. Age, years of education and sex were covariates, along with binary variables for diagnostic categories and the use of antipsychotics and antidepressants (see supplement for more information). Logistic regression was used to calculate adjusted odds ratios for risk factors identified by random forest regression within cases. Due to psychological stress during CM assessment, one individual with mental illness lacked CM data, leading to partial exclusion from the analysis.

3. Results

3.1. Replication of the increased risk for overweight and obesity for individuals with mental illness compared to controls

Psychiatric inpatients had an OR of 1.86 (95 %-CI 1.05–3.31) for having overweight (BMI$\geq$25), and an OR of 3.43 (95 %-CI 1.18–9.96) for having obesity (see eTable 3 and 4) compared to controls.
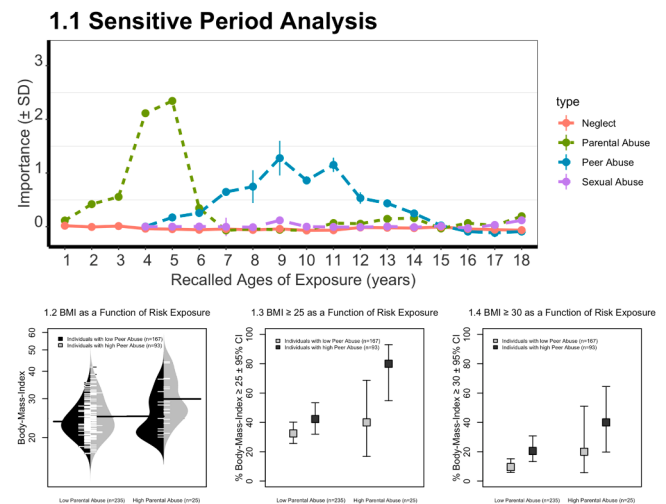
3.2. Parental abuse at ages 4–5 and peer abuse at ages 7–13 are relevant risk factors for BMI

The most important risk factors for increased BMI were parental abuse at ages 4–5 and peer abuse at ages 7–13 (Fig. 1). As indicated in eTable 5, none of the diagnostic categories emerged as significant risk factors (all $p\geq$.22), nor did the use of antipsychotics (p=.20) or antidepressants (p=.17). None of the global MACE scores contributed significantly to BMI (all p>.48), nor was trauma load (p=.65) or sex (p=.49) significant risk factors in the random forest regression.

We partitioned inpatients into those with high or low levels of parental abuse and peer abuse at these ages using k-means clustering. There were significant main effects of parental abuse (F(1255)=8.57, p=.004, η^2=0.03) and peer abuse (F(1255)=10.39, p=.001, η^2=0.04) on BMI, and a significant interaction between these main effects (F(1255)= 4.06, p=.045, η^2=0.02; Figure 1.2; see eTable10 and eTable11). Parental abuse had an OR 2.71 (95 %-CI 1.10–6.70), and peer abuse had an OR of 1.66-fold (95 %-CI 0.96–2.86) of having overweight. Individuals with high exposure to parental abuse had an OR of 2.12 (95 %-CI 0.81–5.55), while peer abuse had an OR of 2.31 for having obesity (95 %-CI 1.13–4.72; see eTable 6 and 7; Figure 1.3–1.4). While parental abuse and peer abuse were independent risk factors, participants with both types of maltreatment had the most elevated BMIs, and the combined effect appeared to be more than additive, as indicated by their significant interaction.

3.3. CM is a relevant risk factor for having overweight and obesity across individuals with and without psychiatric disorders

Due to low exposure rates to CM in the control group, we partitioned subjects into individuals with exposure to either parental or peer abuse during these time periods ($n = 112$; including $n = 9$ controls) and those without this exposure ($n = 229$; including $n = 72$ controls). Across all participants there was a significant main effect of any exposure of

Fig. 1. Variable importance $\pm$ SD of neglect, parental abuse, peer abuse and sexual abuse across age as risk factors for increased body-mass-index (BMI) in individuals with mental illness as determined by random forest regression with conditional inference trees. Figure 1.2–1.4: BMI as a function of risk exposure: low versus high exposure to parental abuse at ages 4–5 and low versus high exposure to peer abuse at ages 7–13 on 1.2: BMI (Distribution of BMI as a function of risk exposure ($n = 157$ with low peer and parental abuse; $n = 78$ with high peer risk exposure and low parental abuse; $n = 10$ with high parental abuse and low peer abuse; $n = 15$ with high parental and high peer abuse); small white lines show individual observations, while the long black lines represents the mean of the respective group); 1.3: Prevalence of BMI $\geq$ 25 $\pm$ 95 % confidence interval and 1.4: Prevalence of BMI $\geq$ 30 $\pm$ 95 % confidence interval.

parental and peer abuse ($F(1336)=4.46$, $p=.036$, $\eta^2=0.01$) on BMI, but no significant main effect of mental illness ($F(1336)=0.84$, $p=.360$, $\eta^2<0.01$), nor a significant exposure by mental illness interaction ($F(1336)=0.02$, $p=.888$, $\eta^2<0.01$). Exposure had an OR of 1.84 for having overweight (95 % CI 1.11–3.03, $p=.018$) and an OR of 2.57 for having obesity (95 % CI 1.29–5.10, $p=.007$), respectively. When exposure to maltreatment was included as a regressor, there was no longer a significant association between mental illness and risk for having overweight (adjusted OR=1.57, 95 %-CI 0.87–2.85, $p=.135$) or obesity (adjusted OR=2.41, 95 %-CI 0.81–7.2, $p=.115$) (see eTable 8 and 9 in the supplement).

4. Discussion

This study identified three key findings. First, the main risk factors for higher BMI were early parental abuse and violence from peers during ages 4–5 and 7–13, respectively. Second, these risk factors applied to both inpatients and controls. Third, global measures of maltreatment, current use of psychotropic drugs, or history of mental illness were not significant risk factors when more specific type-time risk factors were included in the analysis. The importance of both parental abuse and peer bullying is consistent with Midei and Matthews (2011) but differs from reports emphasizing the importance of sexual abuse (Danese and Tan, 2014), despite enough cases with a history of sexual abuse. Other studies, however, have failed to find an association between sexual abuse and obesity (Bentley and Widom, 2009) and most studies reporting strong associations with sexual abuse do not control for exposure to other CM types. Finally, the specific windows of vulnerability identified are consistent with McKelvey et al. (2019) observation of the importance of early developmental exposure to parental abuse and Takizawa et al. (2015) prospective finding on the importance of peer bullying between ages 7–11. Discrepancies may result from sample selection (general populations versus psychiatric inpatients), maltreatment measures, and statistical approaches.

These findings support the ecophenotype hypothesis, suggesting that maltreated individuals with psychiatric disorders differ clinically and neurobiologically from their non-maltreated counterparts (Teicher et al., 2022). The increased obesity risk in maltreated individuals is consistent with other ecophenotype characteristics, such as higher inflammatory markers (Danese et al., 2008) and alterations in stress-susceptible brain regions (Teicher et al., 2016). Maltreatment-associated alterations in biological systems, including metabolism and immune system dynamics (Baldwin and Danese, 2019; Wiss and Brewerton, 2020), reward system sensitivity (Opel et al., 2019), and cognitive or behavioral control systems (Luo et al., 2020), or types of weight control behaviors (Ruiz and Font, 2020) may underlie the increased risk in the ecophenotype.

The study's limitations include reliance on self-reported data for weight and height, its cross-sectional nature, and retrospective CM assessments, hindering causal inferences. However, similar associations between CM and both self-reported and directly measured weights are noted in meta-analyses (Danese and Tan, 2014). Detailed data on specific past and current medication usage were lacking, and a wide range of antidepressants and atypical antipsychotics were prescribed. Since only two cases received mood stabilizers, we were unable to include this as a covariate. Furthermore, the inpatient setting may limit the generalizability of the present results to individuals in outpatient settings or the general population. Additionally, the control group had an insufficient number of participants for independent analysis of vulnerable periods.

The study suggests that CM may play a major role in psychiatric patients' risk for obesity, highlighting the potential importance of considering this factor in exploring mechanisms and interventions.

CRediT authorship contribution statement

Inga Schalinski: Writing – original draft, Project administration, Investigation, Funding acquisition, Data curation, Conceptualization. **Thomas Jozefiak:** Writing – review & editing, Writing – original draft, Conceptualization. **Nikola Stenzel:** Writing – review & editing. **Susanne Breinlinger:** Writing – review & editing, Validation, Investigation. **Martin H. Teicher:** Writing – review & editing, Methodology, Formal analysis, Conceptualization. **Brigitte Rockstroh:** Writing – review & editing, Supervision, Resources, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.psychres.2024.116264.

References

Ackenheil, M., Stotz-Ingenlath, G., Dietz-Bauer, R., et al., 1999. MINI Mini International Neuropsychiatric Interview, German Version 5.0. 0 DSM IV. Psychiatric University Clinic, Munich, Germany.

Afzal, M., Siddiqi, N., Ahmad, B., et al., 2021. Prevalence of overweight and obesity in people with severe mental illness: systematic review and meta-analysis. Front. Endocrinol. 12, 769309. https://doi.org/10.3389/fendo.2021.769309.

Avila, C., Holloway, A.C., Hahn, M.K., et al., 2015. An overview of links between obesity and mental health. Curr. Obes. Rep. 4 (3), 303–310. https://doi.org/10.1007/s13679-015-0164-9.

Baldwin, J.R., Danese, A., 2019. Pathways from childhood maltreatment to cardiometabolic disease: a research review. Adopt. Foster. 43 (3), 329–339. https://doi.org/10.1177/0308575919856175.

Bentley, T., Widom, C.S., 2009. A 30-year follow-up of the effects of child abuse and neglect on obesity in adulthood. Obesity. (Silver. Spring) 17, 1900–1905. https://doi.org/10.1038/oby.2009.160.

Breiman, L., 2001. Random forests. Mach. Learn. 45 (1), 5–32. https://doi.org/10.1023/A:1010933404324.

Danese, A., Moffitt, T.E., Pariante, C.M., et al., 2008. Elevated inflammation levels in depressed adults with a history of childhood maltreatment. Arch. Gen. Psychiatry 65 (4), 409–415. https://doi.org/10.1001/archpsyc.65.4.409.

Danese, A., Tan, M., 2014. Childhood maltreatment and obesity: systematic review and meta-analysis. Mol. Psychiatry 19, 544–554. https://doi.org/10.1038/mp.2013.54.

D'Argenio, A., Mazzi, C., Pecchioli, L., et al., 2009. Early trauma and adult obesity: is psychological dysfunction the mediating mechanism? Physiol. Behav. 98 (5), 543–546. https://doi.org/10.1016/j.physbeh.2009.08.010.

Felitti, V.J., Anda, R.F., Nordenberg, D., et al., 1998. 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. 56 (6), 774–786. https://doi.org/10.1016/j.amepre.2019.04.001.

Gray, M.J., Litz, B.T., Hsu, J.L., et al., 2004. Psychometric properties of the life events checklist. Assessment. 11 (4), 330–341. https://doi.org/10.1177/1073191195002001001.

Isele, D., Teicher, M.H., Ruf-Leuschner, M., et al., 2014. KERF–ein Instrument zur umfassenden Ermittlung belastender Kindheitserfahrungen. [KERF–An instrument for measuring adverse childhood experiences: construction and psychometric evaluation of the German MACE (Maltreatment and Abuse Chronology of Exposure) scale]. Z Klin. Psych. Psychoth. 43 (2), 121–130. https://doi.org/10.1026/1616-3443/a000257.

Luo, Q., Zhang, L., Huang, C.C., et al., 2020. Association between childhood trauma and risk for obesity: a putative neurocognitive developmental pathway. BMC. Med. 18, 1–14. https://doi.org/10.1186/s12916-020-01743-2.

McKelvey, L.M., Saccente, J.E., Swindle, T.M., 2019. Adverse childhood experiences in infancy and toddlerhood predict obesity and health outcomes in middle childhood. Child Obes. 15 (3), 206–215. https://doi.org/10.1089/chi.2018.0225, 2019.

Midei, A.J., Matthews, K.A., 2011. Interpersonal violence in childhood as a risk factor for obesity: a systematic review of the literature and proposed pathways. Obesity Rev. 12 (5), e159–e172. https://doi.org/10.1111/j.1467-789X.2010.00823.x.

Opel, N., Redlich, R., Repple, J., et al., 2019. Childhood maltreatment moderates the influence of genetic load for obesity on reward related brain structure and function in major depression. Psychoneuroendocrinology. 100, 18–26. https://doi.org/10.1016/j.psyneuen.2018.09.027.

Ruiz, A.L., Font, S.A., 2020. Role of childhood maltreatment on weight and weight-related behaviors in adulthood. Health Psychol. 39 (11), 986. https://doi.org/10.1037/hea0001027.

Schalinski, I., Breinlinger, S., Hirt, V., et al., 2019a. Environmental adversities and psychotic symptoms: the impact of timing of trauma, abuse, and neglect. Schizophr. Res. 205, 4–9. https://doi.org/10.1016/j.schres.2017.10.034.

Schalinski, I., Teicher, M.H., Rockstroh, B., 2019b. Early neglect is a key determinant of adult hair cortisol concentration and is associated with increased vulnerability to trauma in a transdiagnostic sample. Psychoneuroendocrinology. 108, 35–42. https://doi.org/10.1016/j.psyneuen.2019.06.007.

Strobl, C., Boulesteix, A.L., Zeileis, A., et al., 2007. Bias in random forest variable importance measures: illustrations, sources and a solution. BMC. Bioinformatics. 8 (1), 1–21. https://doi.org/10.1186/1471-2105-8-25.

Strobl, C., Hothorn, T., Zeileis, A., 2009. Party on!. Department of Statistics. Munich, Germany.

Takizawa, R., Danese, A., Maughan, B., et al., 2015. Bullying victimization in childhood predicts inflammation and obesity at mid-life: a five-decade birth cohort study. Psychol. Med. 45 (13), 2705–2715. https://doi.org/10.1017/S0033291715000653.

Teicher, M.H., Gordon, J.B., Nemeroff, C.B., 2022. Recognizing the importance of childhood maltreatment as a critical factor in psychiatric diagnoses, treatment, research, prevention, and education. Mol. Psychiatry 27, 1331–1338. https://doi.org/10.1038/s41380-021-01367-9.

Teicher, M.H., Samson, J.A., Anderson, C.M., et al., 2016. The effects of childhood maltreatment on brain structure, function and connectivity. Nat. Rev. Neurosci. 17 (10), 652–666. https://doi.org/10.1038/nrn.2016.111.

Wiss, D.A., Brewerton, T.D., 2020. Adverse childhood experiences and adult obesity: a systematic review of plausible mechanisms and meta-analysis of cross-sectional studies. Physiol. Behav. 223, 112964. https://doi.org/10.1016/j.physbeh.2020.112964.