

Sex-Specific Developmental Patterns of Early Trauma: Evidence from a Bayesian Study in Czechia

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Abstract

Background: Early trauma significantly affects child development; however, inconsistent terminology and fragmented research hinder a comprehensive understanding of their combined and recurrent effects.

Objective: We captured the effects of individual and combined trauma on children's cognitive, language, socio-emotional, and psychopathological development while controlling for recurrence, sex, and age.

Participants and Setting: Data from 181 children (47% female) aged 5–10 years were retrospectively analyzed. All participants were assessed at the LOCIKA Center in Prague, a facility providing care for children exposed to trauma.

Methods: Bayesian statistical methods were used to examine the impact of trauma (psychological abuse, physical abuse, witnessing domestic violence, and family problems) and recurrence on the Intelligence and Development Scales (IDS) and Trauma Symptom Checklist for Young Children (TSCYC) scores.

Results: No significant sex-related differences were presented in trauma prevalence. The results indicate a high recurrence of physical abuse (odds ratio [OR] = 7.4) and witnessing domestic violence (OR = 7.3). Girls scored higher on several TSCYC subscales, including emotion regulation and expressive language, as well as on the socio-emotional index. Age is negatively correlated with emotion regulation. Specific trauma types or recurrence did not consistently predict clinically significant TSCYC scores or significantly affect IDS scores.

Conclusions: Specific trauma types did not significantly predict scores on IDS or TSCYC. However, meaningful patterns in trauma recurrence and age- and sex-related differences in this sample are highlighted. These results underscore the importance of considering developmental and sex-specific factors when assessing the psychological effects of early trauma.

Introduction

For many years, researchers have been interested in the profound role of early traumatic events and their impact on child development (e.g., Ogle et al., 2024). Despite extensive work, the field faces marked limitations, primarily due to inconsistent terminology and diverse classification approaches. The effects of traumatic events are often analyzed within individual categories, which hinders a comprehensive understanding of co-occurring traumatic events in real-life conditions.

Defining and Classifying Early Trauma

A unified understanding of early trauma is crucial for scientific and clinical discourse. Diagnostic manuals like the International Classification of Diseases 11th Revision (ICD-11; World Health Organization, 2019) and the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-5;

American Psychiatric Association, 2013) offer general definitions of traumatic events, primarily within the context of posttraumatic stress disorder (PTSD). These definitions describe exposure to events of an “extremely threatening or horrific nature,” encompassing direct personal experiences, witnessing events, or learning about traumatic events affecting close individuals. The World Health Organization (2020) defines adverse childhood experiences as various forms of abuse, neglect, and severe household dysfunction. However, these frameworks may not capture the entire spectrum of symptoms and effects associated with traumatic childhood events (D'Andrea et al., 2012).

While diverse approaches and terminologies exist, common types frequently discussed in literature include physical abuse, psychological abuse, sexual abuse, neglect, and witnessing domestic violence. Some researchers further categorize specific traumatic events into subcategories such as emotional, social, or psychological neglect (Gander et al., 2020; Majer et al., 2010). This distinction could enhance our understanding of whether their unique impacts have been empirically validated. Unfortunately, differences in terminology also extend to the near-duplication of critical terms such as “complex trauma” (Lewis et al., 2021), which substantially overlaps with “chronic trauma” found in other studies (Wamser, 2023).

Beyond the specific type of event, traumatic experiences can be classified based on their characteristics. Interpersonal trauma involves confrontation with an aggressor or witnessing such an event (e.g., violence, neglect, sexual abuse). Conversely, non-interpersonal trauma refers to situations without direct confrontation (e.g., natural disasters and serious accidents; see Borrelli et al., 2024; Maharaj et al., 2022; Sparta, 2003; Thomas et al., 2021; Wamser, 2023). Research suggests a more pronounced impact of interpersonal traumatic events on children’s cognition and psychopathology than non-interpersonal events (e.g., Baker et al., 2021).

Impact of Early Trauma on Child Development

Specific types of traumatic events are associated with distinct cognitive and behavioral impairment. Neglect has been associated with lower general intelligence and difficulties with abstract thinking, attention, working memory, and fine motor skills. Physical neglect may affect cognitive flexibility, spatial working memory, and pattern recognition tasks (Aas et al., 2012; Gould et al., 2012; Kavanaugh et al., 2016; Majer et al., 2010; Spann et al., 2012; Viezel et al., 2014). Sexual violence is associated with impairments in autobiographical memory of childhood events, often manifesting as memory loss (Wolf & Nochajski, 2022); problem-solving and cognitive flexibility; language comprehension, receptive vocabulary, and naming; working memory, and perceptual–visuospatial skills (Aas et al., 2012; Gould et al., 2012; Kavanaugh et al., 2016; Viezel et al., 2014; Wolf & Nochajski, 2022). Psychological abuse is linked to deficits in spatial working memory and pattern recognition tasks as well as attention, emotional processing, empathy, and difficulties with intimacy (Aas et al., 2012; Gander et al., 2020; Gould et al., 2012; Kavanaugh et al., 2016; Majer et al., 2010). Physical abuse is linked to difficulties in cognitive flexibility, problem-solving, working memory, and perceptual, visuospatial, and verbal skills (Aas et al., 2012; Gould et al., 2012; Kavanaugh et al., 2016; Spann et al., 2012). While the impact may not be

specifically tied to different types of violence, a younger age at exposure appears to be a factor contributing to its severity (Sylvestre et al., 2015).

The impact of early trauma extends into the psychopathological domain and manifests as a range of symptoms and disorders. Beyond PTSD, early trauma has been consistently linked to depression and anxiety (e.g., O'Mahen et al., 2015). Mentalizing, also known as theory of mind, and regulatory strategies also play a role in PTSD symptomatology; greater cumulative trauma is associated with lower mentalizing ability (Doba et al., 2022). Consequently, maladaptive cognitive strategies should also be considered as key drivers of these outcomes. Specifically, behavioral avoidance mediates the association between childhood emotional neglect and depressive symptoms, while rumination partially mediates the association between childhood emotional abuse and depressive symptoms (O'Mahen et al., 2015). Some empirical evidence indicates that within posttraumatic growth, greater severity of trauma may be positively associated with elevated empathy, which could function as a protective factor mitigating the outcomes linked to adverse childhood experiences (Greenberg et al., 2018).

Present Czech and Foreign Studies

Despite growing public interest and empirical work on early trauma in Czechia, studies in Central Europe remain comparatively limited. A meta-analysis of global Childhood Trauma Questionnaire (CTQ, Bernstein et al., 1994) data (Viola et al., 2016) found that European samples report lower average trauma scores than other regions, and that higher GDP per capita predicts lower physical neglect. Across 28 European countries, adverse childhood experiences have been linked to sizable shares of adult outcomes, such as interpersonal violence and substance use, with incremental contributions to anxiety and cardiometabolic conditions (Hughes et al., 2021). Despite growing research interest, routine trauma-informed practices in European childcare and frontline services remain uneven. Most settings lack formal trauma-informed care training and protocols; therefore, implementation lags behind evidence (Dierickx et al., 2023). Notably, a study directly comparing the link between child abuse/neglect and later exposure to physical and sexual violence found no evidence of cross-cultural differences between representative samples from the US and Czechia (Johnson & Vazsonyi, 2024).

Some of the very few contemporary Czech studies have primarily focused on prevalence, specific themes, and health effects. Studies mapping the breadth of the early trauma types in children are scarce. For example, Velemínský et al. (2020) reported that 37.8% of respondents experienced no childhood traumatic events, 24.9% one, 27.4% two to three, and 9.9% four or more. The prevalence estimates for psychological, physical, and sexual violence in Europe (Stoltenborgh et al., 2014) are slightly higher than those reported in Czech population-focused studies. This lack of research highlights substantial gaps in Czech research, underscoring the need for methodologically consistent, population-based studies that map the full spectrum of early trauma in Czech children using standardized categories and definitions.

This study aimed to examine how individual and combined forms of early trauma (*Psychological Abuse, Physical Abuse, Witnessing Domestic Violence, or Family Problems*) relate to children's cognitive and

executive functioning, language abilities, and socio-emotional development in Czechia. The analyses further accounted for potential moderating effects of trauma *recurrence*, *sex*, and *age* to understand better the complex pathways linking early adversity to developmental outcomes.

Methodology

Participants and Dataset

The study sample consisted of child clients from the LOCIKA Center in Prague, Czechia, a nongovernmental organization providing comprehensive care for children exposed to early trauma, often referred to by social services or police. From a broad group of roughly 3,000 children the LOCIKA Center has been in contact since 2016 until the beginning of 2024; approximately 220 underwent complex psychological evaluations and thus met the initial criteria for inclusion in a retrospective analysis. These criteria specified an age range of 5–10 years and completion of a psychodiagnostic assessment at the LOCIKA Center. These assessments were conducted by qualified child psychologists who administered either the Intelligence and Development Scales (IDS; Grob et al., 2013) and/or the Trauma Symptom Checklist for Young Children (TSCYC; Briere et al., 2001). For the planned Bayesian analysis, children who had undergone testing using only selected IDS subtests were also included in the initial pool.

The subsequent step involved identifying specific types of traumatic events. While the initial plan was to classify *Neglect*, *Psychological Abuse*, *Physical Abuse*, *Sexual Abuse*, and *Witnessing Domestic Violence*, the sample frequently included children experiencing challenging family situations related to divorce proceedings or associated conflicts (e.g., parental arguments, shared custody disputes, and manipulation)—labeled *Family Problems*. Given their challenging and potentially traumatic nature (Borrelli et al., 2024), these situations were included in the dataset. Other types of traumatic events or suspicion of exposure to such events, which were not specified in detail or where the child was referred to the LOCIKA Center primarily because of poor school performance, were excluded from the study. Additionally, children with invalid TSCYC protocols who lacked IDS records were excluded from the study. The final sample consisted of 181 children aged 5–10 years, specifically, 94 boys (age $M = 7.7$, $SD = 1.48$) and 87 girls (age $M = 7.5$, $SD = 1.63$). In all cases, a perpetrator of abuse was a family member or a close relative. The age at which the first traumatic event occurred was reported in only 13 children (eight boys and five girls) and was therefore excluded from the analysis. The reported ages differed considerably from the participants' ages at data collection (age at first exposure: $M = 1.7$, $SD = 2.32$). All participants underwent psychological assessment at the LOCIKA Center between 2016 and 2024, and their records contained the necessary demographic and anamnestic information along with results from IDS and/or TSCYC.

Measuring Instruments

IDS. It is a comprehensive diagnostic tool for assessing cognitive function and overall development in children aged 5–10 years (Grob et al., 2013). The Czech version of the IDS, adapted in 2013, is praised for its comprehensiveness and current relevance compared to older scales, such as the Wechsler Intelligence Scale for Children, 3rd edition (Krejčová, 2014).

TSCYC. It is a 90-item parent- or caregiver-report questionnaire designed to assess trauma-related symptoms in children aged 3–12 years (Briere & Hrdličková, 2018). It provides eight clinical scales for Posttraumatic Stress–Intrusion (*PTS-I*), avoidance (*PTS-AV*), arousal (*PTS-AR*), Sexual Concerns (*SC*), dissociation (*DIS*), anxiety (*ANX*), depression (*DEP*), and anger/aggression (*ANG*)—and a summary Posttraumatic Stress–Total (*PTS-TOT*) scale that aggregates the three PTSD subscales. While TSCYC demonstrates good psychometric properties (Briere et al., 2001; Moner et al., 2021), some contemporary psychometric reviews note potential limitations, as Stanley and Stanley (2020) do.

A related instrument, the Trauma Symptom Checklist for Children (TSCC) has been used in Czechia since 2022 (Briere & Hrdličková, 2022). While sharing most scales, the key difference is that TSCC is child-reported, unlike TSCYC, which is parent-reported. Wamser-Nanney and Campbell (2020) reported discrepancies between parent and child reports, with parents often overestimating symptoms, particularly for girls. TSCYC was favored in this study because of its frequent administration.

At least one parent, often across multiple visits, typically completed the TSCYC protocols at the LOCIKA Center. In this study, the oldest available record was used if multiple records were available for a single parent. If both parents completed TSCYC, the records of the parent who accompanied the child on the day of assessment were selected. In instances where TSCYC was completed by a parent documented as perpetrating violence against the child, records from the other parent or caregiver were prioritized. Patients with invalid protocols were excluded from the analyses. Clinical scales were treated as dichotomous variables based on a cut-off score of 70 or more points, indicating a clinically significant manifestation of the symptom following Briere and Hrdličková (2018). A notable strength of the TSCYC data available from the LOCIKA Center is its timeliness, focusing on observable symptoms reported by parents or caregivers within weeks prior to administration (Briere & Hrdličková, 2018). This offers an advantage over studies that rely solely on retrospective reporting (da Silva et al., 2024). Table 1 provides an overview of the methods used and the trauma-related variables.

[Place Table 1 about here]

Procedure

Strategies for variable selection, handling possible missing variables, and preparing materials (online storage and transcription instructions) were implemented during the initial step, along with dataset exploration. Subsequently, seven psychology and medical students or graduates participated in the data extraction and transcription, which occurred continuously from June 2024 to March 2025. Comprehensive training and detailed transcription instructions were provided to each participant in a

checklist. Subsequently, all transcribers processed three identical records to assess instruction clarity and inter-rater agreement. After minor initial classification ambiguities were addressed and any inattention was corrected, 100% inter-rater agreement was achieved among all transcribers, with each file taking 15–45 minutes to transcribe.

Statistical Analysis, Aims, and Models

This study prioritizes the Bayesian approach, which differs from the frequentist approach widely used in similar studies. The Bayesian approach enables the iterative adjustment of assumptions and models throughout the analysis, allowing for refinement based on theoretical assumptions and data insights. Given this approach, the study focuses on general objectives rather than on specific hypotheses. The analysis was conducted in accordance with the recommended principles (Alter et al., 2024; Kruschke, 2021; ven de Schoot & Depaoli, 2014). The analytical process aimed to develop predictive models for the impact of early trauma on child development, considering cognitive/executive, language, and socio-emotional competencies, along with observed symptoms. The data were analyzed in three consecutive analyses, which were further divided into individual steps, as described in the following paragraphs. Note that due to limited observations of *Neglect* and *Sexual Abuse*, we only included *Psychological Abuse*, *Physical Abuse*, *Witnessing Domestic Violence*, or *Family Problems* in the following analyses.

Analysis 1: Testing Basic Assumptions. This initial analysis tested several fundamental assumptions derived from existing literature or explored relationships within a dataset that were not clearly predicted. These assumptions are crucial for subsequently informing more complex models.

1. *Prevalence of Trauma Types by Sex*: The analysis aimed to determine whether differences existed in the prevalence of various traumatic event types between boys and girls. Table 2 shows detailed results.

[Place Table 2 about here]

2. *Recurrence of Trauma Types*: This section explored whether certain types of traumatic events were more likely to recur or tended to be single occurrences. Previous research has indicated a greater impact of repeated trauma (Baker et al., 2021; Cisler et al., 2012; Finkelhor et al., 2007; Fischer et al., 2016; Gustafsson et al., 2009; Hong et al., 2023; Hughesdon et al., 2021; Kira et al., 2013; Showalter et al., 2019), but type-specific recurrence probabilities are unclear. The results are presented in Table 2.

3. *Trauma Symptoms (TSCYC) by Sex*: The objective was to investigate whether traumatic events (collectively) manifested differently in “trauma symptoms” as measured by the TSCYC scales for boys and girls separately. Although we anticipated sex differences in the symptoms (Fischer et al., 2016; Mauritz et al., 2013), we made no specific predictions. See Table 2 for additional results.

4. *Cognitive/Executive, Language, and Socio-Emotional Domains (IDS) by Sex*: This analysis aimed to determine whether boys and girls differed in their scores on cognitive/executive, language, and socio-emotional domains as measured by IDS subtests (*Emotion Recognition*, *Emotion Regulation*,

Understanding Social Situations, Socially Competent Behavior, Receptive Language, Expressive Language) and overall *Intelligence* and Social-emotional index (*SEI*). Table 3 shows the detailed results.

[Place Table 3 about here]

5. *Role of Age*: The final goal of this initial analysis was to assess whether *age* at assessment was a relevant variable for subsequent analytical steps. Namely, whether it could predict resilience or symptom manifestation, based on the assumption that older children might process trauma better because of their more developed competencies (Gander et al., 2020; Hutchison et al., 2020; Levy et al., 2019; Narvey et al., 2020). Table 4 shows these results.

[Place Table 4 about here]

Analysis 2: Impact of Traumatic Events on TSCYC Scale Scores. This analysis aimed to determine whether specific types of traumatic events, including *recurrence*, could predict clinically significant scores on various TSCYC symptom scales. The TSCYC manual (Briere et al., 2001) describes some expected relationships between traumatic events and TSCYC scale scores, and no other assumptions were made.

Analysis 3: Impact of Traumatic Events on IDS Subtests. This analysis examined the associations between the different types of traumatic events and IDS outcomes (as shown in *Analysis 1*). Additionally, it accounted for the potential *recurrence* of these events and the influence of all TSCYC scales. While the literature suggests a negative impact on overall intelligence and cognition, this analysis aimed to explore more specific effects on the less-studied socio-emotional and language domains. The primary objective was to determine whether these specific trauma types, *recurrence*, and symptoms influenced the selected IDS outcomes.

Models' Robustness, Setting Up Priors, Running the Models, Models' Diagnostics. We performed the necessary steps to ensure robustness for each model. The first step was to determine multicollinearity using the Variance Inflation Factor function, which revealed strong multicollinearity for sex in almost all models. Based on this finding, we divided the dataset according to sex and created separate models for boys and girls. Next, we considered the assumptions/priors in the models, which we stated only in the cases of *Intelligence* and *SEI*, where we integrated an average intelligence quotient (*IQ*) of 100 points and a standard deviation of 15 points into the priors as (100, 15). For *SEI*, we adopted the mean from the norms and manually calculated the standard deviation (40, 8.28). In all other cases, we used the priors of (0, 2) for the *Intercept*. Each model simulated four chains with 10,000 simulations each, of which 2,500 were used for "warm-up." For all models, we performed their diagnostics, specifically checking "posterior prediction," model convergence, effective sample size, and other parameters to verify model correctness. In all cases, these assumptions were met; therefore, we did not detail them for individual models. In all cases, the "non-null" models demonstrated the contributions of the selected predictors. We do not specify the individual metrics here. For each model, we reported the 95% Highest Density Interval (HDI).

Operationalization of Variables. The variables *sex*, *trauma recurrence*, *Psychological Abuse*, *Physical Abuse*, *Witnessing Domestic Violence*, or *Family Problems*, and individual TSCYC scales were converted into dichotomous variables. For these, 0 represented no/insignificant values and 1 represented yes/significant values. For *sex*, 0 represented boys and 1 represented girls. *Age* at assessment was represented in years (e.g., 5 years and 6 months = 5.5), and individual IDS subtests were represented by weighted scores. Furthermore, *SEI* was represented by a weighted score and *Intelligence* by an *IQ* score.

Software. The analysis was conducted using R (version 4.2.2; R Core Team, 2022) and Bayesian statistics-related packages, mainly *brms* (Bürkner, 2025). See the

Supplementary material for more details.

Results

In *Analysis 1*, we found no statistically significant evidence for differences in the prevalence of *Psychological Abuse*, *Physical Abuse*, *Witnessing Domestic Violence*, or *Family Problems* between boys and girls. While the literature suggests a higher *Sexual Abuse* prevalence in girls (Stoltenborgh et al., 2014), we were unable to include this type of event and *Neglected* children in the analysis because of the lack of data.

The *recurrence* of trauma types revealed statistically significant findings regarding a higher likelihood of *recurrence* for *Physical Abuse*, with an OR of 7.4, 95% HDI [1.6, 38.1], and for *Witnessing Domestic Violence*, with an OR of 7.3, 95% HDI [3.1, 17.6] compared to a single event. *Psychological Abuse* consistently recurred in all observed cases; therefore, it was excluded from this step.

When examining trauma symptoms (TSCYC) by sex, girls generally showed a higher probability of clinically significant symptoms across several TSCYC scales: *ANX*—OR = 3.8, 95% HDI [1.8, 7.8], *DEP*—OR = 2.7, 95% HDI [1.3, 5.7], *PTS-I*—OR = 3.5, 95% HDI [1.7, 7.2], *PTS-AV*—OR = 3.3, 95% HDI [1.6, 7.0], and *PTS-TOT*—OR = 2.1, 95% HDI [1.1, 4.4]. Although girls also exhibited a higher likelihood for *SC* (OR = 4.1, 95% HDI [1.0, 17.3]), *ANG*—OR = 2.0, 95% HDI [0.95, 4.2], *PTS-AR*—OR = 2.1, 95% HDI [1.0, 4.4], and *DIS*—OR = 1.4, 95% HDI [0.60, 3.2], the 95% HDI includes 1.0, indicating there might be no discernible difference between girls and boys for these specific scales, suggesting that the observed trends, while potentially present, did not reach statistical significance within the given model. For the complete results of these three steps, see Table 3.

In terms of the cognitive/executive, language, and socio-emotional domains (IDS) by sex, girls generally scored higher than boys in *Emotion Regulation*, *Expressive Language*, and *SEI*. No significant sex differences were found in overall *IQ* or other IDS subtests. Specifically, for *IQ*, the mean score for boys was 98.36, 95% HDI [94.45, 102.15] and for girls was approximately 98.55 IQ points. For *Emotion Regulation*, the mean score for boys was 8.41, 95% HDI [7.59, 9.26] and for girls was approximately 9.98. For *Expressive Language*, the mean score for boys was 8.57, 95% HDI [7.73, 9.40], and for girls, it was approximately 10.09. For *SEI*, the mean score for boys was 38.22, 95% HDI [30.15, 40.32] and for girls

was approximately 41.51. For reference, the general population average score was 10 points for the IDS subtests (scaled score) and 40 points for *SEI*. Notably, while these differences in specific domains were observed, the mean scores for both boys and girls generally remained within the average range of a healthy population, suggesting that while sex-specific patterns exist, they do not necessarily indicate widespread clinical impairment relative to normative data. For the complete results, see Table 4.

Finally, *age* at assessment did not predict the occurrence of specific trauma types or trauma symptoms. However, *age* showed a significant negative relationship with *Emotion Regulation* ($\beta = -0.59$, 95% HDI [-1.03, -0.16], *Intercept* = 13.53, 95% HDI [10.21, 16.84]), and with *SEI*, where older children tended to exhibit lower scores ($\beta = -0.44$, 95% HDI [-2.34, -0.15], *Intercept* = 48.87, 95% HDI [40.44, 57.17]). For the complete results, see Table 4.

Analysis 2 aimed to predict clinically significant scores on the TSCYC scales based on specific trauma types and their *recurrence*. We found no strong evidence to suggest that any particular type of traumatic event in combination with its *recurrence* consistently predicted clinically significant symptom levels across the TSCYC scales for either boys or girls.

Analysis 3 examined the association between traumatic events and IDS outcomes. We found no strong evidence that trauma type or its *recurrence* was significantly associated with *IQ*, *SEI*, or the selected IDS subtests in either boys or girls. Similarly, the individual TSCYC symptom scales did not significantly influence IDS outcomes in the models. These results were consistent across the sexes.

Discussion

This study primarily aimed to improve understanding of how different types of early traumatic experiences affect child development, with a focus on the cognitive/executive, socio-emotional, and language domains, while considering the symptoms exhibited by children who experienced traumatic events. This study aimed to examine not only the direct relationships between traumatic events and developmental outcomes but also the potential interactions among these variables. Utilizing a retrospective dataset from the LOCIKA Center in Prague and Bayesian statistical methods, we found no strong evidence suggesting a difference in the prevalence of *Psychological Abuse*, *Physical Abuse*, *Witnessing Domestic Violence*, or *Family Problems* between boys and girls. However, this analysis revealed the crucial dynamics regarding trauma *recurrence*. This finding offers new information for a more nuanced understanding of “polyvictimization” and “polytraumatization” (Finkelhor et al., 2007; Gustafsson et al., 2009), as it highlights that for certain trauma types, a single exposure might be atypical. Because of a striking low prevalence of *Sexual Abuse* of 2.2%, especially when compared to Velemínský et al.’s (2020) Czech study which predicts a prevalence of 6.4% and European’s average of 9.6% (Stoltenborgh et al., 2014), and even lower prevalence of *Neglect* of 1.7% within our dataset, we were unable to conduct respective analyses. Low numbers of observations can be partially attributed to the LOCIKA Center’s primary focus on families where domestic violence occurs, and/or to

inconsistencies in diagnostic approach, likely due to various approaches to anamnestic information collection (P. Wünschová, Director of LOCIKA Center, personal communication, June, 2024).

Furthermore, we found significant sex differences in the manifestation of trauma symptoms and in certain cognitive domains. Girls showed a higher probability of clinically significant symptoms across several trauma scales including *ANX*, *DEP*, *PTS-I*, *PTS-AV*, and *PTS-TOT*. For *SC*, girls also exhibited a higher likelihood, though with wider confidence intervals; again, due to the lack of *Sexual Abuse* observations, we are unable to explain these results fully. In terms of the cognitive and socio-emotional domains, girls scored higher than boys in *Emotion Regulation*, *Expressive Language*, and the *SEI*. We found no significant sex differences in overall *IQ* or in other selected IDS subtests. Although these differences were observed in specific cognitive domains, it is essential to note that the mean scores for both boys and girls remained within the general population's average range. To our knowledge, literature on sex differences in the cognitive domain of abused children is rather scarce; our results call for a sex-sensitive approach, as numerous sex differences are described here. The literature mainly focuses on behavioral and symptomatic aspects (e.g., Fischer et al., 2016; Mauritz et al., 2013; Stoltenborgh et al., 2014).

The analysis also indicated the potential role of *age*, as older children tended to exhibit lower scores in *Emotion Regulation* and *SEI*. We believe that this could suggest that the cumulative impact of trauma might lead to a gradual decline in specific socio-emotional competencies, or it could reflect selection biases within the sample, where older children presenting at the center might belong to a subgroup of those with more challenging difficulties. Although the literature suggests the role of a specific age (Sylvestre et al., 2015; Wolf & Nochajski, 2022) or developmental phase (Cowell, et al., 2015) in mediating the severity of the impact of traumatic events, we failed to find an explanation in literature for these results.

Next, we modeled the associations of specific traumatic events and their *recurrence* with TSCYC symptoms and IDS outcomes, respectively, which did not yield strong evidence of effects. Specifically, no strong evidence was found that any particular type of traumatic event, even when considering *recurrence*, consistently predicted clinically significant symptom levels across the TSCYC scale for either boys or girls. Similarly, the analysis did not reveal that trauma type (with *recurrence*) or TSCYC symptoms significantly affected *IQ*, *SEI*, or selected IDS subtests. These results were consistent across the sexes. A factor contributing to these nonsignificant findings could be related to measurement limitations. While IDS and TSCYC are established instruments, administration of IDS sometimes involves selected subtests rather than the entire battery. Although accommodated by the Bayesian approach, this variability could introduce measurement noise. More importantly, TSCYC relies on parent/caregiver reports, which, although valuable for observable symptoms, are subject to reporter bias. Discrepancies between parent and child reports are well-documented (Wamser-Nanney & Campbell, 2020), and direct child-reported measures are not consistently available for this age group. Moreover, existing clinical records may vary in detail and completeness, potentially introducing information bias.

The absence of a direct, statistically significant predictive relationship between specific trauma types and developmental outcomes, although initially surprising given the extensive literature on the impact of trauma, must be interpreted within the context of the study design and constraints. As detailed in the methodology, the sample consisted of clients from the LOCIKA Center, an institution that supports traumatized children. While this provides a rich clinical dataset, it might only represent a specific segment of the traumatized child population (e.g., not psychiatric inpatients or children in detention centers). Specifically, the sample was drawn exclusively from children attending the LOCIKA Center, primarily from Prague (46%) and the Central Bohemian Region (15%; P. Wünschová, director of the LOCIKA Center, personal communication, June 2024). This poses a significant limitation on the generalizability of our findings to the broader Czech clinical or general population, as the sample was recruited from an urbanized area. Moreover, it is plausible that children attending such centers, particularly those whose families actively seek support, may possess certain protective factors that were not fully captured by our retrospective data. For instance, the presence of at least one nurturing parent could serve as a significant buffer against more severe developmental impacts of trauma. Literature supports the moderating role of secure attachment (Gander et al., 2020) and strong family relationships in mitigating trauma's effects (e.g., Hutchison et al., 2020; Levy et al., 2019; Narvey et al., 2020). The existing data do not allow for a detailed exploration of these family dynamics or other resilience factors, which could have masked the direct effects of specific trauma types.

Implications, Limitations, Future Directions, and Conclusions

Our study aimed to systematically map the differential impacts of distinct types of traumatic events across multiple developmental domains. While some previous studies have adopted a summary approach to trauma (e.g., Berthelot et al., 2015; Danese et al., 2017; Lewis et al., 2021), obscuring specific effects, our approach could contribute to a more precise understanding of how varied traumatic experiences uniquely shape children's development. The emphasis on cumulative and recurrent trauma exposure underscores the need for comprehensive trauma history assessment. Translating these patterns into practice requires systems that can deliver consistent trauma-informed screening, referral, and intervention. At present, European implementation is uneven, because training, protocols, and service coverage remain bottlenecks (Dierickx et al., 2023; Kazlauskas et al., 2016). Sex- and age-specific symptom presentations also advocate for tailored interventions. The identified mediating roles of factors such as mentalization (Doba et al., 2022) and attachment (Humphrey et al., 2022) suggest promising avenues for therapeutic targeting, reinforcing the idea that interventions should not only address symptoms but also the underlying cognitive and relational processes, as described throughout this study.

Despite its contributions, this study has several limitations warranting consideration. The retrospective nature of data collection posed a significant challenge. Key variables such as the child's age at first exposure to trauma or the duration of exposure (Cowell et al., 2015; Sylvestre et al., 2015; Wolf & Nochajski, 2022), were often missing. This lack of information is a frequently cited limitation in trauma research, because the timing and chronicity of trauma influence developmental outcomes (Finkelhor et

al., 2007; Gustafsson et al., 2009). Without this temporal context, it is challenging to discern the precise mechanisms by which different trauma types relate to outcomes. Additionally, the inherent complexity of real-world traumatic experiences challenges comprehensive classification; retrospective clinical notes rarely encode timing, recurrence, or co-occurrence with precision. Therefore, distinctions between “single or repeated” exposure and “isolated or combined” trauma are hard to recover and can blur finer associations. Since the seminal work on “polyvictimization” (Finkelhor et al., 2007), researchers increasingly use newer operationalization (Ogle et al., 2024) such as person-centered methods (latent class analyses) to identify subgroups with distinct exposure patterns and track symptom change (e.g., Ayer et al., 2019), and datasets that combine self- and/or caregiver-report with administrative records to reduce common-method bias and sharpen classification (e.g., Stover et al., 2019). Together, these approaches complement type-by-type and count-based models, better capturing co-occurrence and chronicity, and enabling more nuanced tests on how exposure frequency and multiplicity relate to outcomes.

Future and follow-up studies can build on our approach while broadening the list of variables not included in our dataset, such as *Sexual Abuse* or *Neglect*. The following recommendations aim to address the limitations of contemporary knowledge and approaches and are consistent with the approaches of several articles this study draws upon (e.g., Lewis et al., 2021; O’Mahen et al., 2015). Based on the outcomes and limitations stated previously, we recommend the following:

1. Approach early trauma with unified terminology and classification. Until such a unified approach exists, it is necessary to thoroughly describe the types of traumatic events and criteria by which they are categorized. This enhances comparability across studies and reduces ambiguity in interpreting the findings. For Czechia specifically, this can be partially achieved by adopting methods such as CTQ, which is frequently used in foreign studies (e.g., Aas et al., 2012; Gould et al., 2012; Spann et al., 2012). Given the constraints of the real-world service data from the LOCIKA Center, we did not attempt to introduce a new taxonomy; instead, we provided explicit operational definitions for the terms used.
2. Thoroughly distinguish between individual types of traumatic events and, if possible, isolate them into separate groups during analysis, and/or purposefully combine them and examine their interactions. This approach was implemented in this study and may allow for a more granular understanding of the specific effects and complex interplay of co-occurring traumatic experiences.
3. Gather the broadest possible spectrum of information about traumatic events, especially regarding the type, proximity of the perpetrator, age at which the child was exposed to trauma, and its recurrence. Comprehensive data collection is vital for the robust analysis and identification of nuanced impact patterns (as discussed in Cowell et al., 2015; Finkelhor et al., 2007; Gustafsson et al., 2009; Sylvestre et al., 2015; or Wolf & Nochajski, 2022).
4. Consider the role of the time interval between the assessment and the moment of exposure to the traumatic event. This includes accounting for excessively long intervals, which can distort individual responses (due to not being able to recall the event as they happened a long time ago, e.g., da Silva et

al., 2024), or, conversely, overly short proximity, where specific impacts may not yet manifest (e.g., diagnosis of PTSD with delayed expression, which can be diagnosed only after 6 months after exposure; American Psychiatric Association, 2013).

5. Adopt a sex-sensitive approach when obtaining and analyzing the data. As our study demonstrated, sex differences are prevalent not only across trauma-related symptoms (e.g., Fischer et al., 2016; Mauritz et al., 2013), but also in cognitive/executive domains; moreover, although not demonstrated in our study, a higher probability of specific traumatic event exposures might also differ between boys and girls (Stoltenborgh et al., 2014).

6. Do not collect data solely using retrospective interviewing or by taking data from psychiatric facilities. Such methods may not sufficiently represent the entire population of children exposed to traumatic events but might only capture a subset, which is likely the most severely affected. In this sense, it may be beneficial to utilize and process data from sources such as the LOCIKA Center.

7. Focus on and consider other factors that may play a protective role, such as attachment (Borrelli et al., 2024; Gander et al., 2020) or socioeconomic status (Danese et al., 2017). Furthermore, future studies may explore qualitative factors not included in this study, such as the child's background in kindergarten/school, hobbies, leisure activities, and relationships with siblings and others.

This study contributes to the understanding of early trauma. Integrating data from the LOCIKA Center provides insights into the clinical presentation of trauma in a specific high-risk population in Czechia. The results indicated no significant sex-related differences in the prevalence of trauma. *Physical Abuse* (OR = 7.4) and *Witnessing Domestic Violence* (OR = 7.3) were associated with high *recurrence*. Girls showed higher symptom scores on several TSCYC scales and higher scores on *Emotion Regulation*, *Expressive Language*, and *SEI*. Age negatively correlated with *Emotion Regulation*. Specific trauma types or recurrence did not consistently predict clinically significant trauma symptoms or significantly impact IDS scores. Although we did not identify a direct, statistically significant, predictive relationship between specific trauma types and developmental outcomes, our study offers insights into trauma recurrence patterns and sex-specific symptom probabilities in a Czech sample.

Declarations

CRedit authorship contribution statement

Jáchym Valeš: Conceptualization, Data curation, Formal analysis, Methodology, Project administration, Resources, Software, Visualization, Writing – original draft; Julie Weissová: Writing – original draft; Jean Decety: Supervision, Writing – review & editing; Jiří Lukavský: Formal analysis, Methodology, Software, Writing – review & editing; David Adam: Conceptualization, Writing – review & editing; Marek Páv: Conceptualization, Data curation, Funding acquisition, Methodology, Supervision, Writing – review & editing. All authors agreed on the finalized manuscript.

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Declaration of competing interest

The authors declare that they have no competing interests.

Declaration of use of Artificial Intelligence in the writing process

Artificial Intelligence (Grammarly, ChatGPT, and Gemini) was utilized to enhance the readability and language of this work; the original text was authored by humans, who thoroughly supervised and evaluated all recommended changes.

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Data availability

Due to a sensitive nature of data and LOCIKA Centre's policy, raw data remains confidential; an anonymized and cleaned-up dataset might be available upon agreement with corresponding author.

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Tables

Table 1 *Frequencies of Administered Measures and Trauma Variables by Sex*

Variable	N (%) ^a		
	Boys	Girls	Total
IDS ^b	58 (32.0)	55 (30.4)	113 (62.4)
TSCYC	72 (39.8)	63 (34.8)	135 (74.6)
Combination of Trauma Types	40 (22.1)	39 (21.5)	79 (43.6)
Recurrence of Trauma	76 (42.0)	73 (40.3)	149 (82.3)
Neglect	0 (0.0)	3 (1.7)	3 (1.7)
Psychological Abuse	29 (16.0)	24 (13.3)	53 (29.3)
Physical Abuse	19 (10.5)	25 (13.8)	44 (24.3)
Sexual Abuse	0 (0.0)	4 (2.2)	4 (2.2)
Witnessing Domestic Violence	74 (40.9)	73 (40.3)	147 (81.2)
Family Problems	40 (22.1)	29 (16.0)	69 (38.1)

Note. IDS = Intelligence and Development Scales. TSCYC = Trauma Symptom Checklist for Young Children.

^a Overall sample size consisted of 181 children.

^b Only records including the overall intelligence score, counts of administration vary among individual IDS subtests.

Table 2 *Results for Prevalence of Trauma Types, Recurrence of Trauma Types, and Expression of Trauma Symptoms for Boys and Girls*

Variable	OR [95% HDI]
Psychological Violence by Sex ^a	1.15 [0.64, 2.11]
Physical Violence by Sex ^a	0.66 [0.35, 1.26]
Witnessing Domestic Violence by Sex ^a	0.75 [0.37, 1.52]
Family Problems by Sex ^a	1.43 [0.80, 2.53]
Physical Violence by Recurrence ^b	7.4 [1.6, 38.1]*
Witnessing Domestic Violence by Recurrence ^b	7.3 [3.1, 17.6]*
Family Problems by Recurrence ^b	1.0 [0.47, 2.31]
Anxiety by Sex ^c	3.8 [1.8, 7.8]*
Depression by Sex ^c	2.7 [1.3, 5.7]*
Anger/Aggression by Sex ^c	2.0 [0.95, 4.2]
Post-Traumatic Stress – Intrusion by Sex ^c	3.5 [1.7, 7.2]*
Post-Traumatic Stress – Avoidance by Sex ^c	3.3 [1.6, 7.0]*
Post-Traumatic Stress – Arousal by Sex ^c	2.1 [1.0, 4.4]
Post-Traumatic Stress – Total by Sex ^c	2.1 [1.1, 4.4]*
Dissociation by Sex ^c	1.4 [0.60, 3.2]
Sexual Concerns by Sex ^c	4.1 [1.0, 17.3]

Note. OR = Odds ratio. HDI = Highest density interval. For a result to be considered *significant, a 95% HDI cannot include a value of 1.

^a OR higher than 1 indicates a higher probability of specific trauma type occurrence in boys, OR equal to 1, or not considered significant, indicates no differences.

^b OR higher than 1 indicates higher probability of specific trauma type recurrence, OR equal to 1, or not considered significant, indicates no differences.

^c OR higher than 1 indicates a higher probability of specific trauma symptom expression in girls, OR equal to 1, or not considered significant, indicates no differences.

Table 3 Results for Cognitive, Socio-emotional, and Language Domains by Sex

Variable	β [95% HDI]	Intercept [95% HDI]
Intelligence by Sex ^a	0.19 [-5.42, 5.84]	98.36 [94.45, 102.15]
Emotion Recognition by Sex ^a	0.34 [-0.66, 1.33]	10.29 [9.63, 10.97]
Emotion Regulation by Sex ^a	1.57 [0.27, 2.74]*	8.41 [7.59, 9.26]
Understanding Social Situations by Sex ^a	0.24 [-0.71, 1.20]	10.30 [9.56, 10.94]
Socially Competent Behavior by Sex ^a	1.09 [-0.18, 2.33]	8.91 [8.01, 9.74]
Social-emotional index by Sex ^a	3.29 [0.24, 6.39]*	38.22 [30.15, 40.32]
Receptive Language by Sex ^a	0.64 [-0.67, 1.94]	8.81 [7.92, 9.71]
Expressive Language by Sex ^a	1.52 [0.28, 2.69]*	8.57 [7.73, 9.40]

Note. HDI = Highest density index. For a result to be considered *significant, a β 95% HDI cannot include a value of 0.

^a Regression coefficient β describes number of points girls have received in the respective fields in comparison to boys, positive values indicate that girls scored higher, β equal to 0, or not considered significant, indicates no differences.

Table 4 Results for the Role of Age

Variable	β [95% HDI]	Intercept [95% HDI]
Psychological Violence by Age	-0.02 [-0.23, 0.19]	-0.76 [-2.39, 0.83]
Physical Violence by Age	-0.05 [-0.27, 0.17]	-0.75 [-2.42, 0.98]
Witnessing Domestic Violence by Age	0.08 [-0.16, 0.33]	0.90 [-0.97, 2.77]
Family Problems by Age	0.06 [-0.14, 0.55]	-0.96 [-2.47, 0.55]
Anxiety by Age	-0.11 [-0.34, 0.13]	0.14 [-1.66, 1.98]
Depression by Age	0.19 [-0.06, 0.43]	-2.20 [-4.16, -0.30]
Anger/Aggression by Age	-0.07 [-0.31, 0.18]	-0.33 [-2.20, 1.54]
Traumatic Stress – Intrusion by Age	-0.11 [-0.35, 2.34]	0.58 [-0.35, 0.11]
Post-Traumatic Stress – Avoidance by Age	0.06 [-0.17, 0.28]	-0.74 [-2.47, 1.02]
Post-Traumatic Stress – Arousal by Age	0.22 [-0.02, 0.46]	-2.36 [-4.27, -0.52]
Post-Traumatic Stress – Total by Age	0.00 [-0.22, 0.22]	-0.15 [-1.88, 1.60]
Dissociation by Age	0.02 [-0.23, 0.30]	-1.53 [-3.61, 0.57]
Sexual Concerns by Age	0.24 [-0.17, 0.63]	-4.22 [-7.56, -1.06]
Intelligence by Age	-0.44 [-2.45, 1.59]	101.61 [86.36, 116.90]
Emotion Recognition by Age	-0.33 [-0.67, 0.02]	12.85 [10.30, 15.57]
Emotion Regulation by Age	-0.59 [-1.03, -0.16]*	13.53 [10.21, 16.84]
Understanding Social Situations by Age	-0.26 [-0.59, 0.10]	12.29 [9.66, 14.88]
Socially Competent Behavior by Age	-0.07 [-0.51, 0.38]	9.94 [6.56, 13.34]
Social-emotional index by Age	-1.24 [-2.34, -0.15]*	48.87 [40.44, 57.17]
Receptive Language by Age	-0.21 [-0.66, 0.26]	10.67 [7.15, 14.03]
Expressive Language by Age	0.18 [-0.26, 0.60]	7.91 [4.56, 11.13]

Note. HDI = Highest density index. For a result to be considered *significant, a β 95% HDI cannot include a value of 0. Positive regression coefficient β describes a recurrence of trauma types and expression of trauma symptoms, and/or a number of expected points a child would score with each additional year of his/her age, β equal to 0, or not considered significant, indicates no differences.