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Regular Article

The longitudinal association between infant negative emotionality, childhood maltreatment, and ADHD symptoms: A secondary analysis of data from the Fragile Families and Child Wellbeing Study

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Abstract

Background: Infant temperament predicts harsh parenting, and attention deficit/ hyperactivity disorder (ADHD) symptoms. Moreover, childhood maltreatment has consistently been associated with later ADHD symptoms. We hypothesized that infant negative emotionality predicted both ADHD symptoms and maltreatment, and that there was a bidirectional association between maltreatment experiences and ADHD symptoms.

Methods: The study used secondary data from the longitudinal Fragile Families and Child Wellbeing Study ($N = 2860$). A structural equation model was conducted, using maximum likelihood with robust standard errors. Infant negative emotionality acted as a predictor. Outcome variables were childhood maltreatment and ADHD symptoms at ages 5 and 9.

Results: The model demonstrated good fit (root-mean-square error of approximation = .02, comparative fit index = .99, Tucker–Lewis index = .96). Infant negative emotionality positively predicted childhood maltreatment at ages 5 and 9, and ADHD symptoms at age 5. Age 5 maltreatment/ADHD symptoms predicted age 9 ADHD symptoms/maltreatment. Additionally, both childhood maltreatment and ADHD symptoms at age 5 mediated the association between negative emotionality and childhood maltreatment/ADHD symptoms at age 9.

Conclusions: Given the bidirectional relationship between ADHD and experiences of maltreatment, it is vital to identify early shared risk factors to prevent negative downstream effects and support families at risk. Our study showed that infant negative emotionality, poses one of these risk factors.

Keywords: Childhood maltreatment; ADHD; infant temperament; negative emotionality

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Introduction

Attention deficit/hyperactivity disorder (ADHD) is a neurodevelopmental disorder characterized by high levels of inattention and/or hyperactivity that interfere with everyday functioning. An inattentive, hyperactive, or combined subtype can be diagnosed (American Psychiatric Association, 2013)

According to meta-analytic evidence, the prevalence ranges between 6 and 7% depending on reporter (i.e., parent or teacher) with a higher prevalence for males than females (2.4:1). The inattentive subtype constitutes the most common subtype (Willcutt, 2012).

While ADHD has a high heritability (Faraone & Larsson, 2019), multiple environmental risk factors have been discussed, including experiences of childhood maltreatment (i.e., experiences of abuse or neglect) (Posner et al., 2020) to the extent that it was included into a recently published risk calculator for the development of young adult ADHD (Caye et al., 2019). A meta-analysis showed that in comparison to the general population, people with ADHD have 2.39 times higher odds of having experienced maltreatment with a maltreatment rate of 45.6% amongst people with an ADHD diagnosis (Clayton et al., 2018). The relationship between experiences of adversity, (i.e., having experienced abuse, deprivation, poverty, neglect, or trauma) and ADHD seems to be bidirectional: early maltreatment experiences seem to pose a risk factor for the development of ADHD, and ADHD seems to be a risk factor for experiencing subsequent maltreatment.

Evidence for an effect of severe maltreatment on the development of ADHD symptoms and diagnosis comes from the English and Romanian Adoptees (ERA) study. ERA is a longitudinal study that follows a group of Romanian adoptees who experienced severe institutional deprivation (i.e., severe neglect) in orphanages under the Ceausescu regime, and a comparison group of never-institutionalized UK adoptees. The study demonstrated a positive association between the time spent in the orphanage and ADHD symptoms at age 6 (Kreppner et al., 2001). Furthermore, experiences of prolonged deprivation were associated with persistently higher ADHD symptoms from childhood into young adulthood (Sonuga-Barke et al., 2017). In comparison to the general

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population, the risk of an ADHD diagnosis within the prolonged deprivation group was four times higher in adolescence (19%), and seven times higher (29%) in young adulthood (Kennedy et al., 2016). Due to the unique design of the study as a natural experiment, genetic confounding is unlikely (Rutter et al., 2012), and indeed, common genetic risk factors for neurodevelopmental disorders did not differ between Romanian adoptees who experienced prolonged or low levels of deprivation (Sonuga-Barke et al., 2017).

The effect seems to be less pronounced in general population studies with less severe but more common experiences of maltreatment. A population-based, cross-sectional, co-twin study (Dinkler et al., 2017) including more than 8000 9-year-old twins found that the risk of having more than one neurodevelopmental disorder was seven times higher in maltreated than in non-maltreated individuals. This difference was almost completely explained by shared familial factors. However, the study found a small effect of childhood maltreatment experiences on ADHD *symptoms* (Dinkler et al., 2017). This effect was replicated in a study with over 18,000 adult twins (Capusan et al., 2016), where maltreatment experiences predicted ADHD symptoms. The association was reduced when familial confounding was considered but remained significant. It is possible that familial confounding increases the risk of being maltreated for children with ADHD through gene–environment correlations (Dinkler et al., 2017; Narusyte et al., 2008). One possibility is that the risk for maltreatment by a parent could be increased through genetic influences on child temperamental traits (Dinkler et al., 2017).

A recent meta-analysis showed that ADHD is indeed predicted by various temperamental traits including activity level, negative emotionality, and self-regulation (Kostyrka-Allchorne et al., 2020). Temperamental traits in turn have been shown to predict parental stress (Saisto et al., 2008) and harsh parenting (Vitaro et al., 2006). In a sample of 1516 children, childhood temperament (negative emotionality) correlated moderately ($r = .27$) with harsh parenting at 17 months (Vitaro et al., 2006). In a longitudinal analysis of 12,474 children from the Millennium Cohort Study, high self-regulation at age 3 predicted less harsh parenting at age 5 (Baron & Malmberg, 2019). The direct link between early temperament, harsh parenting or more severe forms of adverse parenting (i.e., abuse or neglect), and ADHD symptoms has, however, not been explored, yet.

By conducting a secondary analysis of data from the longitudinal Fragile Families and Child Wellbeing Study (FFCWS) (Reichman et al., 2001), the current study aims to assess the longitudinal relationship between infant temperament and subsequent experiences of maltreatment and ADHD symptoms. As the study will focus on temperament in infancy, only negative emotionality can be included as a predictor as activity level and self-regulation were not assessed as part of the FFCWS.

1) We hypothesize that infant negative emotionality at 12 months will predict.
   a) ADHD symptoms in middle childhood (age 5 and 9 years; replication of previous findings).
   b) The extent of child maltreatment in middle childhood (age 5 and 9 years).
2) To illustrate the bidirectional relationship between the extent of childhood maltreatment and ADHD symptoms, we hypothesize that:
   a) The extent of childhood maltreatment at age 5 years will predict ADHD symptoms at age 9 years.
   b) ADHD symptoms at age 5 years will predict childhood maltreatment extent at age 9 years.
3) The association between infant negative emotionality at 12 months and ADHD symptoms at age 9 years will be mediated by the extent of child maltreatment at age 5 years.
4) The association between infant negative emotionality at 12 months and childhood maltreatment extent at age 9 years will be mediated by ADHD symptoms at age 5 years.

Method

Sample

We analyzed data from the FFCWS (Reichman et al., 2001), which follows a birth cohort of $N = 4898$ children born between 1998 and 2000. The study purposefully oversampled unmarried mothers ($n = 3600$). Participants were recruited from 75 US hospitals across 20 cities. Data is freely available from Princeton University's Office of Population Research data archive (https://opr.princeton.edu/archive/restricted/Default.aspx). The study design has been described in detail elsewhere (Reichman et al., 2001).

The current study received ethical approval for secondary data analysis from the University of Southampton Ethics Committee (ERGO: 70317), and utilized outcome data from the 1-year (median age 12 months), 5-year (median age 5.08 years), and 9-year follow-up (median age 9.17 years). The 3-year follow-up used a different measure of ADHD symptoms and was therefore not included.

Measures

Negative emotionality in infancy

Negative emotionality was assessed with three items from the Emotionality, Activity, and Sociability Temperament Survey (Mathiesen & Tambs, 1999) using a 5-point Likert scale (1= not at all like my child to 5 = very much like my child)- *Often fusses and cries, gets upset easily,* and *reacts intensely when upset*. The study authors' wording differed slightly from the original version (original: 1= not characteristic or typical of your child to 5 = very characteristic or typical of your child). Data was available from $N = 4316$ resident mothers. Cronbach's alpha for the scale was $\alpha = .60$. Inter-item correlations fell within an acceptable range (Clark & Watson, 1995) with a mean inter-item correlation of $r = .33$ (range: $r = .26$ to $r = .393$).

Childhood maltreatment in middle childhood

The FFCWS assessed childhood maltreatment with selected items from the Conflict Tactics Scale (Straus et al., 1998). This version excludes 8 items assessing severe physical maltreatment. Five items each (15 items in total) were used from the following subscales: psychological aggression (i.e., "*Called him/ her dumb or lazy or some other name like that*"), physical assault (i.e., "*Hit him/ her on the bottom with something like a belt, hairbrush, a stick or some other hard object*"), and neglect (i.e., "*Was so drunk or high that they had a problem taking care of their child*"). All items referred to the past year. The following response options were given: once, twice, 3–5 times, 6–10 times, 11–20 times, more than 20 times, not in the past year, but it happened before, this has never happened. Response options from once to over 20 times were coded 1 to 6. All other options were coded as 0. For the purpose of this study, a compound score was created by summing the ratings of all 15 items to reflect the extent of child maltreatment. Only complete data from

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Table 1. Descriptive statistics

	Time point	Mean (SD)	Median	Range	ADHD symptoms above cutoff (≥ 6)
Negative emotionality	1 year	2.81 (1.05)	2.67	1–5	
Childhood maltreatment	5 years	14.60 (9.17)	14.00	0–49	
	9 years	11.37 (9.08)	10.00	0–52	
ADHD symptoms	5 years	2.79 (2.73)	2.00	0–17	14.64%
	9 years	3.01 (3.24)	2.00	0–22	18.74%

Note. SD = standard deviation.

the primary caregiver was included (age 5 years: $N = 2874$, $\alpha = .74$; age 9 years: $N = 2878$, $\alpha = .79$).

ADHD symptoms at ages 5 and 9 years

ADHD symptoms at ages 5 and 9 years were assessed with the 11-item Attention Problems subscale of the Child Behavior Checklist (Achenbach, 1992) (i.e., "*Can't concentrate, can't pay attention for long*"; Age 5 years: $N = 2758$, $\alpha = .73$, age 9 years: $N = 3244$, $\alpha = .82$). The age 5 assessment included four items in the mother survey while 7 additional items were asked during the primary caregiver survey. At age 9 all items were assessed as part of the primary caregiver survey. The percentage of children above the cutoff (≥6, Skarphedinsson et al., 2021) is provided in Table 1.

Covariates

We controlled for the influence of the following covariates on all outcome variables: sex (1 = male, 2 = female), low birthweight of under 2500 g (0 = no, 1 = yes), presence of physical disabilities (1 = yes, 2 = no), mother's age in years, child age at time of mother interview in months, maternal depression (0 = no, 1 = yes) diagnosed with the Composite International Diagnostic Interview–short form (Kessler et al., 1998), and family income as a measure of socioeconomic status. We also accounted for the correlation between childhood maltreatment and ADHD symptoms at each time point.

Statistical analysis

A structural equation model was created using MPlus version 8 (Muthén & Muthén, 2017). To account for non-normal distribution of data, the model used maximum likelihood estimation with robust standard errors (MLR). MLR estimates missing data on outcome variables using maximum likelihood estimation with robust standard errors under the missing at random assumption and requires listwise deletion of missing data on predictor variables. Model fit was established via the root-mean-square error of approximation (RMSEA < .05 indicates good fit), comparative fit index (CFI), and Tucker–Lewis index (TLI; CFI/ TLI > .95 indicate good fit) (Geiser, 2012). All model coefficients represent standardized estimates (STDYX for continuous and STDY for categorical variables).

Results

Mean, standard deviation, median, and range for all variables of interest are reported in Table 1. As the estimator requires listwise deletion for predictor variables (including covariates), data was available from 2860 participants. The overall model fit was good (RMSEA = .02, CFI = .99, TLI = .96). The model explained 8.4% of variance for ADHD symptoms at age 5 years, 25.3% for ADHD symptoms at age 9 years, 4.5% of childhood maltreatment at age 5 years, and 31.5% of variance for childhood maltreatment at age 9 years. The complete model with standardized estimates (STDYX) can be found in Figure 1 and Table 2. The model specification and output can be found in Supplement 1.

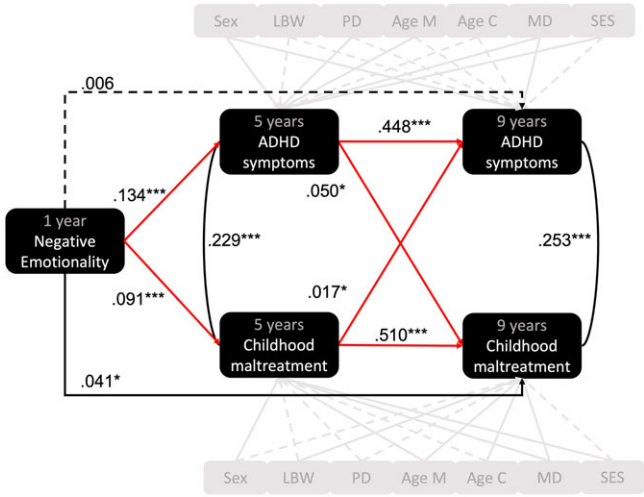

Fig. 1 Coefficients represent standardized estimates (STDYX; * $p < .05$, ** $p < .01$, *** $p < .001$). Significant direct effects are represented by solid lines, insignificant effects are represented by dashed lines. Red lines represent significant indirect effects. Acronyms: ADHD symptoms: attention deficit/hyperactivity symptoms, Age C = Child age; Age M = Age of the mother; LBW = Low birth weight; MD = Maternal depression; PD = Physical disability; SES = Socio-economic status.

Direct effects

Negative emotionality at age 12 months was associated with an increased likelihood for higher rates of childhood maltreatment at both ages 5 and 9. It was also significantly associated with increased ADHD symptoms at age 5 years, but not 9 years.

The extent of childhood maltreatment at age 5 years was associated with increased ADHD symptoms at age 9 years, and higher ADHD symptoms at age 5 years predicted higher likelihood for maltreatment at age 9 years.

In addition to cross-lagged effects, we also observed stability effects. ADHD symptoms at age 5 years predicted ADHD symptoms at age 9 years. The extent of childhood maltreatment at age 5 years predicted childhood maltreatment extent at age 9 years. It is worth noting that the stability effects were relatively larger than the cross-lagged effects.

Higher ADHD symptoms at both assessment points were associated with male sex and the presence of maternal depression. ADHD symptoms at age 5 years were additionally associated with the presence of a physical disability, lower maternal age, and lower socioeconomic status.

Across both assessment points, higher rates of maltreatment were associated with lower maternal age and presence of maternal depression. Maltreatment extent at age 5 years were additionally associated with male sex and lower socioeconomic status. Maltreatment extent at age 9 years was additionally associated with the absence of low birth weight and lower child age (see Table 2).

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Table 2. Direct effects and correlations of variables of interests and covariates

	ADHD symptoms		Maltreatment	
	5 years	9 years	5 years	9 years
Direct effects variables of interest				
Negative emotionality	**$\beta = .134^{***}$** **SE = .021**	$\beta = .006$ SE = .018	**$\beta = .091^{***}$** **SE = .021**	**$\beta = .041^{*}$** **SE = .019**
ADHD symptoms	–	**$\beta = .448^{***}$** **SE = .023**	–	**$\beta = .050^{*}$** **SE = .022**
Maltreatment	–	**$\beta = .017^{*}$** **SE = .007**	–	**$\beta = .510^{***}$** **SE = .023**
Direct effects of covariates				
Sex	**$\beta = -.223^{***}$** **SE = .039**	**$\beta = -.231^{***}$** **SE = .035**	**$\beta = -.148^{***}$** **SE = .040**	$\beta = -.033$ SE = .036
Low birth weight	$\beta = .051$ SE = .077	$\beta = .028$ SE = .062	$\beta = -.046$ SE = .068	**$\beta = -.126^{*}$** **SE = .058**
Physical disability	**$\beta = -.493^{**}$** **SE = .171**	$\beta = .104$ SE = .106	$\beta = .142$ SE = .152	$\beta = .107$ SE = .130
Age mother	**$\beta = -.061^{**}$** **SE = .022**	$\beta = -.012$ SE = .018	**$\beta = -.100^{***}$** **SE = .021**	**$\beta = -.038^{*}$** **SE = .018**
Age child	$\beta = -.027$ SE = .023	$\beta = .006$ SE = .018	$\beta = -.005$ SE = .022	**$\beta = -.049^{**}$** **SE = .018**
Socioeconomic status	**$\beta = -.058^{*}$** **SE = .023**	$\beta = -.014$ SE = .018	**$\beta = -.072^{***}$** **SE = .018**	$\beta = .003$ SE = .015
Maternal depression	**$\beta = .508^{***}$** **SE = .078**	**$\beta = .219^{***}$** **SE = .059**	**$\beta = .235^{***}$** **SE = .064**	**$\beta = .299^{***}$** **SE = .060**
Correlations				
ADHD symptoms	–	–	**$\beta = .229^{***}$** **SE = .021**	**$\beta = .253^{***}$** **SE = .026**
Maltreatment	**$\beta = .229^{***}$** **SE = .021**	**$\beta = .253^{***}$** **SE = .026**	–	–

Note. Maternal age, depression, socioeconomic status and child age were measured at the same time as the outcome variables. Correlations are between variables assessed at the same time point. Continuous predictors have been STDYX standardized, categorical predictors have been STDY standardized. SE = standard error, $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

Table 3. Indirect effects

Predictor age 12 months	Mediator age 5 years	Outcome age 9 years	Estimator (SE) (STDYX standardization)	*p*-value
Negative emotionality	Childhood maltreatment	ADHD symptoms	.004 (.002)	.030
Negative emotionality	ADHD symptoms	ADHD symptoms	.060 (.010)	<.001
Negative emotionality	Childhood maltreatment	Childhood maltreatment	.047 (.011)	<.001
Negative emotionality	ADHD symptoms	Childhood maltreatment	.007 (.003)	.028

Note. SE = standard error.

Indirect effects

The effect of negative emotionality at age 12 months on ADHD symptoms at age 9 years was mediated by the extent of childhood maltreatment at age 5 years. The effect of negative emotionality at age 12 months on childhood maltreatment extent at age 9 years was mediated by ADHD symptoms at age 5 years.

Negative emotionality at age 12 months further had an indirect effect on ADHD symptoms at age 9 years via ADHD symptoms at age 5 years and an indirect effect on the extent of childhood maltreatment at age 9 years via childhood maltreatment at age 5 years. Indirect effects are shown in Figure 1 and reported in Table 3.

Discussion

We hypothesized a direct effect of negative emotionality on the extent of childhood maltreatment and ADHD symptoms, a bidirectional relationship between childhood maltreatment extent and ADHD symptoms, and indirect effects between negative emotionality and i) ADHD symptoms and ii) the extent of childhood maltreatment via i) childhood maltreatment extent and ii) ADHD symptoms. All our hypotheses were confirmed, apart from hypothesis 1a. Negative emotionality did predict ADHD symptoms at age 5, but not 9 years. However, the effect of negative emotionality on ADHD symptoms at 9 years was partially mediated by ADHD symptoms at 5 years.

The main finding from this study is that negative emotionality at age 12 months has an indirect effect on ADHD symptoms at age 9 that is mediated by the extent of maltreatment at age 5, i.e., children who show higher negative emotionality at age 12 months are more likely to experience higher rates of maltreatment at age 5, which in turn increases ADHD symptoms at age 9.

Moreover, infant negative emotionality predicted both ADHD symptoms and child maltreatment extent at age 5 directly,

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i.e., children with high negative emotionality have a higher risk of experiencing higher rates of maltreatment. Dinkler and colleagues (2017) suggested that higher maltreatment rates in children with neurodevelopmental disorders could be explained by genetically influenced traits that increase a child's risk of maltreatment by a parent. Negative emotionality shares genetic risk with ADHD (Singh & Waldman, 2010) and might be an early sign or form of externalizing disorder, such as ADHD (Healey et al., 2011). Parent mental ill-health (Ayers et al., 2019) and emotion regulation difficulties (Wang, 2022) are associated with childhood maltreatment. It is possible that parents with ADHD (or at least high impulsivity) are more likely to use harmful conflict tactics, especially in response to a child with behavioral and emotional difficulties (e.g., negative emotionality), and their children are likely to inherit an increased vulnerability to negative emotionality and to later ADHD symptoms (Faraone et al., 2021; Faraone & Larsson, 2019). However, while genetic risk and childhood maltreatment both increase the risk of developing ADHD independently, no interaction between the two has been found, i.e., having a high genetic risk for ADHD and experiencing childhood maltreatment does not increase the risk to develop ADHD over and above the risk posed by each of these factors (He & Li, 2022). The recently proposed double-jeopardy model argues that both, experiences of maltreatment and the presence of a neurodevelopmental disorder such as ADHD, increase the risk for adverse health outcomes, potentially via changes to the stress system – a shared risk pathway (Gajwani & Minnis, 2022). While the effect is small, we were able to show that infant negative emotionality has an enduring effect on childhood maltreatment extent and ADHD symptoms in middle childhood.

The cross-lagged findings show that a small, mutual influence between ADHD symptoms and maltreatment rates over time can be assumed, i.e., controlling for important other risk factors, having higher ADHD symptoms at age 5 increases the risk for a child to be maltreated at age 9 and being maltreated at age 5 leads to higher ADHD symptoms at age 9. Associations between maltreatment and a later, increased risk of ADHD have been shown repeatedly (Craig et al., 2020; Kreppner et al., 2001; Sanderud et al., 2016; Sonuga-Barke et al., 2017).

Our finding regarding ADHD as a risk factor for maltreatment is consistent with results from other studies. For instance, a large longitudinal study (Lugo-Candelas et al., 2020) on 5–15-year-old Puerto Rican children ($N = 2{,}491$) showed that ADHD predicted subsequent adverse experiences, particularly parental maladjustment – an effect which was driven by inattentive symptoms. A recent follow-up from the ERA Study found that experiences of profound early neglect predicted symptoms of ADHD which in turn predicted bullying victimization (Rizeq et al., 2022). Taken together, it seems as if ADHD can set children up for adverse experiences within and outside of the family context.

Our results show that the relationship is mutual. The bidirectional relationship between maltreatment experiences and ADHD symptoms might pose a vicious cycle where the severity of ADHD symptoms is maintained through recent adverse experiences.

Not unexpectedly, the largest effects we found in our cross-lagged path model were that ADHD symptoms at age 5 predicted ADHD symptoms at age 9, and the same was true for the extent of maltreatment. This is in line with previous literature and the size of the effects is comparable to results from other cohort studies (Bowling et al., 2018; Wang et al., 2021). Previous studies have shown that at least a subset of children with ADHD symptoms has a consistent trajectory of either stable or increasing ADHD symptoms across development (Murray et al., 2019; Walton et al., 2017). High vulnerability and stability regarding ADHD have been linked to genetic (Thapar, 2018), epigenetic (Walton et al., 2017), and environmental factors (Langberg et al., 2008; Sasser et al., 2016). It is therefore not surprising that ADHD scores are correlated substantially across development.

In a similar manner, parenting styles are relatively consistent over time (Dallaire & Weinraub, 2005; Wittig & Rodriguez, 2019), and parents who experienced abuse in their upbringing are more likely to show abusive or neglectful behavior (Greene et al., 2020; van IJzendoorn et al., 2020). Our results show that rates of maltreatment practices also remained stable over time. This may not be surprising, considering that a parent would have to change their approach to conflict and would have to learn and apply a different strategy to solve the conflict.

It should also be noted that the contemporaneous association between the extent of maltreatment experiences and ADHD symptoms was larger than the cross-lagged association over time. This finding is consistent with a recency model where more proximal adverse experiences are thought to have a larger impact on development (Gabard-Durnam & McLaughlin, 2019). This assumption has been examined on a large sample from the Avon Longitudinal Study ($N = 7476$). The authors tested how well different theoretical models explained the association between different types of adversity and emotional and behavioral problems. The association between abuse and psychopathology was best accounted for by a recency model rather than a sensitive developmental period model (Dunn et al., 2018).

Some of the included covariates seem to pose additional robust risk factors as they increased either maltreatment or ADHD risk across *both* time points. For ADHD, those risk factors were maternal depression and male sex. Both factors have been included in a risk calculator for adult ADHD (Caye et al., 2019). Our data showed that these factors already predict ADHD symptom load across childhood.

In line with previous findings, younger maternal age (Dixon et al., 2005; de Paúl & Domenech, 2000) and maternal depression diagnosis (Choi et al., 2019; Stith et al., 2009) increased the risk for maltreatment across both time points.

It would therefore be vital not only to focus on risk calculators for psychopathology (Caye et al., 2019; Meehan et al., 2020), but on risk calculators for transdiagnostic risk factors, such as childhood maltreatment. We were able to show that negative emotionality in infancy, ADHD symptoms in middle childhood, maternal depression, and age should be included in such a risk calculator.

Some of the included risk factors may be correlated. A study using data from the Avon Longitudinal Study showed that the presence of maternal depression was associated with the presence of other risk factors including younger maternal age and domestic violence. Maternal depression may hence increase the child's cumulative risk exposure, i.e., maternal depression increases the vulnerability of a child to develop a mental health problem including ADHD (Barker et al., 2012).

The current policies react to childhood maltreatment by temporarily or permanently placing children into out-of-home care (Department of Education, 2021; Drake et al., 2022; Hong et al., 2022). In addition, it would be desirable to also focus efforts on the prevention of childhood maltreatment in the first place as this would considerably reduce the global mental health burden. A meta-analysis of prospective longitudinal studies, for instance, was able to demonstrate that a reduction of maltreatment by

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25% could reduce global cases of anxiety and depression by 80 million (Li et al., 2016). Therefore, a variety of prevention and treatment policies and programs might be needed to address the issue more effectively (Magruder et al., 2017).

The results from our study could inform health professionals who regularly visit new parents at home (i.e., health visitors in the UK) about potential additional support needs of parents from social, educational, or health services.

For instance, screening parents for depressive symptoms and stress levels (i.e., in reaction to an infant's temperament) might be helpful for identifying parents in need of support. Whether or not this would have an actual impact on parent behavior and/or potential risks for children would need to be evaluated in future studies though.

Our findings further highlight the bivariate relationship between maltreatment and ADHD symptoms. This supports previous findings that found an effect of childhood maltreatment on ADHD symptoms (Capusan et al., 2016; Dinkler et al., 2017; Kennedy et al., 2016; Sonuga-Barke et al., 2017), and findings that children with ADHD are at a higher risk for maltreatment (Hellstrom, 2019; Stern et al., 2018). Overall, the results are in line with recommendations for early identification of ADHD and parenting support in maltreated children (Minnis, 2013) or assessments of adverse experiences as part of ADHD assessments (Sonuga-Barke et al., 2017). It should be emphasized however that ADHD symptoms are represented on a continuum (McLennan, 2016; Sonuga-Barke et al., 2022) and that higher rates of these symptoms do not equal a clinical presentation. Symptoms similar to ADHD can further be observed in trauma-related conditions such as post-traumatic stress disorder including restlessness or hyperactivity (Cohen, 2010).

Strengths and limitations

While this study had clear strengths including the longitudinal design, large sample size, and control for relevant confounders, it had a few limitations. The FFCWS did not assess ADHD symptoms or maltreatment at the 12 months follow-up, nor did it assess ADHD symptoms or diagnoses in caregivers at any time point. Hence, it was not possible to control for these influences at the 12 months timepoint.

It stands to question however whether ADHD symptoms can be reliably assessed in infancy. Whereas a previous study reported acceptable psychometric properties in 2-year-old children (Brown & Harvey, 2019), comparable data on 12 months olds is missing. While it is possible to assess maltreatment in infants, the prevalence of maltreatment in children below 12 months is with 0.2% very low (Shanahan et al., 2022). Given that the FFCWS study includes quite substantive assessments, it is understandable that less priority was given to the assessment of maltreatment in infancy.

Given the high heritability of ADHD (Faraone & Larsson, 2019) it is further likely that parental ADHD affects ADHD related temperament dimensions in their offspring. Indeed, it has been shown that ADHD symptoms in mothers (Sullivan et al., 2015) and fathers (Auerbach et al., 2008) are associated with temperamental traits in infants. We therefore recommend that future birth cohort studies assess parental ADHD symptoms at baseline. In conjunction with that, maltreatment experiences of parents should be assessed as those have been identified as an antecedent of offspring maltreatment (van IJzendoorn et al., 2020).

Conclusion

The bidirectional relationship between ADHD and experiences of maltreatment highlights the need to identify early shared risk factors to prevent negative downstream effects of maltreatment and ADHD symptoms. Understanding these risk factors would enable social and clinical services to better support families at risk. Our study on a large longitudinal sample showed that infant negative emotionality, poses one of these shared risk factors.

Supplementary material. The supplementary material for this article can be found at https://doi.org/10.1017/S0954579423000457

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Conflicts of interest. The authors declare none.

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