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Childhood neurodevelopmental disorders and risk of coercive sexual victimization in childhood and adolescence – a population-based prospective twin study

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Background: Autism spectrum disorder (ASD), Attention-deficit/Hyperactivity disorder (ADHD), and other related neurodevelopmental disorders (NDDs) have, in some previous studies, been shown to increase the risk of being sexually victimized. However, no studies have examined whether the association is driven by a general NDD phenotype versus specific diagnoses, nor the etiology of the association. **Method:** Using a genetically informative, prospective design, we examined the association between ASD and ADHD in childhood and coercive sexual victimization up to age 18. A total of 4,500 children participating in the Child and Adolescent Twin Study in Sweden (CATSS) were rated by their parents on NDDs at age 9 or 12 years, and self-reported at age 18 on lifetime experiences of coercive sexual touching and/or coercive sex. First, we regressed sexual victimization on the NDDs. Second, we regressed sexual victimization on general and specific NDD symptoms identified via a bifactor model. Third, we decomposed the observed associations into genetic and environmental parts. **Results:** In females, ASD was associated with an almost threefolded increased risk of coercive sexual victimization, and ADHD with a doubled risk. In males, the risk associated with ASD and ADHD was of the same magnitude but not significant. When controlling for overall NDD symptom load ASD or ADHD, no longer uniquely predicted coercive sexual victimization. The association between the NDD general factor and coercive sexual victimization was due to shared genetics. **Conclusions:** General NDD symptom load, rather than specific ASD or ADHD symptoms, seems to be a moderate vulnerability factor for coercive sexual victimization. We speculate that an evocative gene–environment correlation might account for this observation, such that sexual perpetrators actively target NDD individuals. **Keywords:** Attention-deficit/Hyperactivity disorder; autism spectrum disorder; neuropsychiatric disorders; sexual abuse; twins.

Introduction

Victims of sexual abuse tend to experience a host of debilitating and adverse outcomes (Hillberg, Hamilton-Giachritsis, & Dixon, 2011; Maniglio, 2009; Paras et al., 2009). While the responsibility for abuse never lies with the victim, it is important to elucidate if specific risk factors elevate the probability of being abused. This information can be used to identify cases that have been victimized in order to prevent harmful secondary effects and re-victimization. Different psychiatric disorders and physical disabilities among children and adolescents have been associated with an increased risk of sexual victimization (Jones et al., 2012). Autism spectrum disorder (ASD), Attention-deficit/Hyperactivity disorder (ADHD), and other related neurodevelopmental disorders (NDDs) might potentially elevate the risk of being sexually abused (Sevlever, Roth, & Gillis, 2013; Snyder, 2015).

In a population-based study of 1,247 female nurses, women in the highest quintile of autistic traits were more likely to have been sexually abused in childhood compared with those in the lowest (40.1% compared to 26.7%; Roberts, Koenen, Lyall, Robinson, & Weisskopf, 2015). These results appear to be consistent also in diagnosed cases. A study of 95 individuals with a self-reported diagnoses of ASD, found that cases self-reported more sexual victimization than 117 control subjects (Brown-Lavoie, Viecili, & Weiss, 2014). One speculation is that individuals with ASD may be prone to misinterpret potentially hazardous situations as not dangerous. Indeed children with ASD struggle to recognize deceptive emotions in facial expressions (Dennis, Lockyer, & Lazenby, 2000), which might make them less able to identify potential offenders.

ADHD could also increase the risk of being sexually abused (White & Buehler, 2012). Ebejer et al. (2012) found that in a sample of 3,795 twins and their nontwin siblings, individuals with interview-assessed ADHD were almost three times more likely to report having experienced childhood sexual assault (Ebejer et al., 2012). Moreover, in a cross-sectional, population-based study including 10,496 men and 12,877 women, reporting sexual abuse prior to age 16 was associated with self-reporting a clinical diagnosis of ADHD (Fuller-Thomson & Lewis, 2015). This association might arise because impulsive individuals are more prone to risk-taking sexual behavior (White & Buehler, 2012) and substance use

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(Groenman et al., 2013), both of which have been associated with an increased risk of sexual victimization (Adams-Curtis & Forbes, 2004). In addition, many individuals with ADHD tend to struggle with pragmatic language skills and with attending to social cues (Marotta et al., 2014; Staikova, Gomes, Tartter, Mccabe, & Halperin, 2013), which is why the same mechanism described above in relation to ASD may apply also to children with ADHD. Moreover, ASD and ADHD are often comorbid with language disorder, which has been associated with an increased risk of childhood sexual abuse (Brownlie, Graham, Bao, Koyama, & Beitchman, 2017).

However, at least one study found no association between ADHD and sexual abuse. This study tried to control for temporal order and therefore only included events that had occurred during the last year, which may have limited power to detect differences (Turner, Vanderminden, Finkelhor, Hamby, & Shattuck, 2011).

Although past studies indicate that children with NDDs may be at increased risk of sexual victimization, they were hampered by methodological limitations. First, past research is based almost exclusively on cross-sectional data. As NDD symptoms might constitute both a risk factor for and a consequence of sexual abuse, it is important to establish temporal order by assessing neurodevelopmental problems prior to the abuse.

Second, although NDDs are often conceptualized as separate conditions, comorbidity is a rule rather than an exception (Pettersson, Anckarsäter, Gillberg, & Lichtenstein, 2013). Recent research has indicated that a general genetic factor accounts for much of the covariance among NDDs symptoms. It may be that this general NDD factor is driving the association with sexual victimization rather than specific NDDs. To our knowledge, no prior study on NDDs and sexual abuse controlled for comorbidity, and it remains unclear if particular diagnoses uniquely predict sexual victimization or whether NDDs in general account for the association.

Third, an observed association between NDD and sexual abuse may not necessarily be causal; instead, it might arise from confounding variables, such as dysfunctional parenting (Govindshenoy & Spencer, 2007). The association could also be attributable to common genetic factors, as both the susceptibility to traumatizing life events (Kendler & Baker, 2007) and neurodevelopmental problems (Pettersson et al., 2013) are influenced by genetic sources. It may be that the same genes that influence NDDs also impact the risk of being sexually abused, perhaps through an evocative gene–environment correlation (Plomin, Defries, & Loehlin, 1977). For example, social skills deficits might lead potential sexual abusers to perceive such individuals as easier to manipulate and therefore target them for victimization (Sevlever et al., 2013).

We had three aims with the current study. First, we examined if parent-reported ASD and ADHD symptoms in childhood predicted coercive sexual abuse self-reported at age 18 in a population-based sample of Swedish twins. Second, we examined if potential associations could be attributed to general problems, versus that which was unique to a given condition (Holzinger & Swineford, 1937). Third, we employed a twin design to investigate to what extent the associations were influenced by genetic and environmental factors, respectively. This also allowed us to rule out potential unmeasured genetic and shared environmental confounding (Turkheimer & Harden, 2014).

Method

Participants

The participants were part of an on-going, prospective longitudinal population-based study of all twins in Sweden (*The Child and Adolescents Twin Study in Sweden*; CATSS), initiated in 2004. In connection with the twins' 12th (cohort born July 1992 to June 1995) or 9th birthday (cohort born from July, 1995), their parents completed a telephone interview about the twins' somatic problems, mental health, and social environment (the response rate was approximately 80%). When twins turned 18 years old (between July 2010 and 2015), they were asked to participate in a web-based follow-up study. This follow-up contained questions about traumatic and maltreatment experiences, including coercive sexual abuse (for detailed information about included questionnaires, see Anckarsäter et al., 2011). Of the twins included at baseline, 48.5% did not participate in the follow-up study or had missing values on the questions about sexual victimization in the follow-up, rendering 4,500 individuals with data on both measures.

Measures

Neurodevelopmental problems. At age 9/12, parents rated their twins mental health with the Autism –Tics, AD/HD and other Comorbidities inventory (A-TAC). The A-TAC is a comprehensive screening interview for NDDs and consists of 96 items arranged in 19 modules (Larson et al., 2010). The response options are 'no' (scored 0), 'yes, to some extent' (scored 0.5), and 'yes' (scored 1). The questionnaire has good specificity and sensitivity (Larson et al., 2010), and accurately distinguishes individuals with NDDs from individuals without NDDs (Larson et al., 2013).

Coercive sexual victimization. At age 18, coercive sexual victimization was measured by two questions: 'Were you ever touched or made to touch someone else in a sexual way, because you felt forced in some way or threatened by harm to yourself or someone else?' and 'Did you ever have sex because you felt forced in some way or threatened by harm to yourself or someone else?'. These items were adapted from the Life Stressor Checklist - Revised (LSC-R; Wolfe, Kimerling, Brown, Chrestman, & Levin, 1996). Twins who endorsed either of these items were also asked to indicate at which age the abuse had first occurred.

Zygosity. In 86% of all same-sex twins, zygosity was assigned based on DNA analysis. For the remaining 14%, zygosity was determined according to an algorithm based on five questions about twin similarity. Only twin pairs with more

than 95% probability of being correctly classified were assigned a zygosity by this method (Anckarsäter et al., 2011).

Statistical analyses

Predictors. We used childhood NDDs as both binary variables (ASD vs. not ASD and ADHD vs. not ADHD) and as continuous, latent variables. To investigate the risk of coercive sexual victimization associated with having a childhood NDD, ASD cases were identified as having an A-TAC ASD score ≥4.5, and ADHD cases were identified as having an A-TAC ADHD score ≥6.0. These cut-offs have previously been validated against clinical assessments (Larson et al., 2010). We then used latent modeling to explore if such associations could be attributed to the specific disorders versus general problems. First, we used confirmatory factor analyses (CFA) to identify one ASD-, one inattention-, and one hyperactivity/impulsivity factor based on 17, nine, and ten items, respectively (see Appendices S1–S3). Second, to separate general from specific variance, we fit a bifactor model to 50 items selected a priori, which were designed to measure typical NDD symptoms (Appendix S4; Holzinger & Swineford, 1937). In a bifactor model (Figure 1), one assumes that the covariation among all symptoms can be accounted for by a single, general factor. Remaining variance related to a particular disorder or symptom is captured by the same three factors as denoted above (i.e. ASD, inattention, and hyperactivity/impulsivity). The general and the specific factors are constrained to be unrelated, such that the latter measure the unique part of each disorder.

Outcome. In the first analysis, the two sexual victimization items were combined into one binary variable. In the latent variable modeling, we combined these two items into a single, latent variable (we constrained the loadings to be equal to facilitate factor identification).

Regressions. First, we regressed a binary sexual victimization outcome on the binary predictors. Second, we separately regressed the latent sexual victimization factor on the latent ASD, inattention, and hyperactivity/impulsivity factors. Third, we regressed the latent sexual victimization factor on the bifactor model. This allowed us to examine to what extent the associations between ASD, inattention, and hyperactivity/impulsivity, and the latent sexual victimization factor could be attributed to general variance shared across all 50 symptoms, versus variance that was unique to each syndrome or symptom after controlling for the general factor. All analyses were stratified on sex because there are sex differences both in the prevalence of NDDs (Elsabbagh et al., 2012; Polanczyk, De Lima, Horta, Biederman, & Rohde, 2007) and sexual victimization (Breiding et al., 2014). All symptoms and outcomes were treated as categorical, and we used the mean- and variance-adjusted unweighted least square (ULSMV) estimator. Because observations were nested within twin pairs, we used the sandwich estimator to estimate unbiased standard errors. The multivariate analyses were performed in Mplus (Muthén & Muthén, 2012).

Sensitivity analysis. In a sensitivity analysis to control for reversed causality, we excluded individuals who self-reported that the sexual abuse had occurred before the A-TAC interview (20 individuals for forced sexual touch and five for forced sex). We also conducted a sensitivity analysis where we explored the specific effect of each symptom-cluster (language problems, social problems, inflexibility, inattention, and hyperactivity/impulsivity) controlling for the general NDD factor.

Twin analyses. We Cholesky-decomposed the statistically significant phenotypic associations into that which could be attributed to shared genes (A), the shared environment (C), and the nonshared environment (E), respectively. This analysis rests on different genetic relationships between twins; monozygotic twins share all their genes, whereas dizygotic twins share, on the average, half their segregating genes. Further, all pairs are expected to experience a shared environment (e.g. intrauterine milieu and childhood socioeconomic status), and, by definition, a nonshared environment (e.g. different friends or teachers, and measurement error). A stronger association within MZ compared to DZ twin pairs suggests an influence of genetic effects, whereas a similarly strong association between MZ and DZ pairs implies an effect of the shared environment. The influence of the nonshared environment is inferred when MZ pairs are not perfectly correlated. The E-parameter is interesting from an intervention perspective because if it is positive and significant, it indicates that within an identical twin pair, the twin with more NDDs is also more likely to self-report coercive sexual victimization, compared to his or her cotwin. In other words, this would indicate that the predictor influences the risk for coercive sexual victimization independently of potential confounds shared between identical twin pairs (Turkheimer & Harden, 2014).

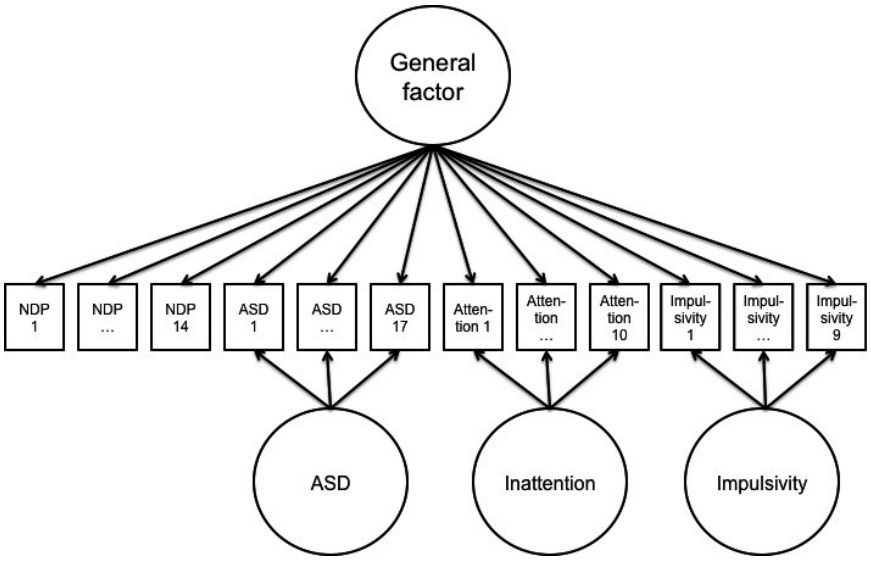

Figure 1 Bifactor model

Ethical considerations

Informed consent was collected from all participants and the study was approved by the Karolinska Institute ethics review board (CATSS-9/12 Dnr 03-672 and 2010/507-31/1, and CATSS-18 Dnr: 2010/1410/31/1).

Results

Observed associations between parent-reported childhood ASD, ADHD, and later self-reported coercive sexual victimization

Descriptive statistics are provided in Table 1. Eighteen males (1%) and 256 females (9%) reported that they had been sexually victimized.

First, we explored the association between parent-reported ASD and ADHD in childhood and having been sexually victimized up to age 18 years. In the logistic regression analysis, scoring over the cut-off for ASD at age 9/12 was associated with an almost three times increased risk of self-reported coercive sexual victimization in females (OR = 2.97, 95% CI = 1.32–6.71, Table 2). Likewise, females scoring above the cut-off for ADHD displayed a doubled risk. In males, the associations were of the same magnitude but did not reach conventional levels of statistical significance (Table 2).

Table 1 Descriptive statistics of twin characteristics and sexual victimization

	All	Males	Females
N (%)	4,500	1,902 (42)	2,598 (58)
Zygosity (%)			
Monozygotic	1,536 (34)		
Dizygotic same sex	1,494 (33)		
Dizygotic opposite sex	1,421 (32)		
Unknown	49 (1)		
Sexual victimization (%)	274 (5)	18 (1)	256 (9)
Forced sexual touch (%)	242 (5)	15 (1)	227 (9)
Mean age at first forced sexual touch (SD)[a]	13.4	11.0 (5.3)	13.6 (3.4)
Childhood sexual abuse (≤12 years) (%)[a, b]	27 (26)	4 (57)	23 (24)
Perpetrator was a relative (%)[c, b]	18 (8)	3 (19)	15 (7)
Forced sex (%)	133 (3)	6 (0.3)	127 (5)
Mean age at first forced sex (SD)[d]	14.5 (2.6)	15.0 (–)	14.5 (2.7)
Childhood sexual abuse (≤12 years) (%)[d, b]	7 (14)	0	7 (14)
Perpetrator was a relative (%)[e, b]	6 (4)	1 (17)	5 (4)

[a]Data on age at first forced sexual touch were available from 102 twins.
[b]The percentage figure refers to the proportion of the responders.
[c]Data on perpetrator for forced sexual touch were available from 239 twins.
[d]Data on age at first forced sex were available from 50 twins.
[e]Data on perpetrator for forced sex were available from 133 twins.

Table 2 Logistic regression of sexual victimization reported at age 18 on attention-deficit/Hyperactivity disorder (ADHD) and autism spectrum disorder (ASD) at age 9/12

Predictor: NDD at age 9/12		Outcome: Childhood and adolescent sexual victimization reported at age 18	
		Males	Females
1	Binary ASD	4.06 (.93, 17.73)	**2.97 (1.32, 6.71)**
2	Binary ADHD	2.81 (.92, 8.60)	**2.02 (1.16, 3.51)**

95% confidence intervals in parentheses. Bolded figures are significant at $p < .05$.

Second, we repeated the analyses with latent variables. The unifactor models of ASD (Root Mean Square Error of Approximation, RMSEA, = 0.02, 90% Confidence Interval, CI, = 0.02, 0.03; Confirmatory Fit Index, CFI = 0.97; χ^2 = 723.20 *degrees of freedom, df,* = 119, $p < .001$; mean loading = 0.72; range = 0.51, 0.87), inattention (RMSEA = 0.07, 90% CI = 0.07, 0.07; CFI = 0.97; χ^2 = 1,314.27, *df* = 27, $p < .001$; mean loading = 0.83; range = 0.71, 0.92), and hyperactivity/impulsivity (RMSEA = 0.05, 90% CI = 0.05, 0.06; CFI = 0.97; χ^2 = 914.01, *df* = 35, $p < .001$; mean loading = 0.80; range = 0.70, 0.89) fit the data adequately. The respective loading patterns are displayed in Appendices S1–S3. The outcome factor fit the data perfectly because it is a saturated model (modeling one parameter based on one observed correlation), with the two sexual victimization items loading at 0.94 (standard error, *SE* = 0.01). Parent-reported ASD symptoms in childhood (9/12 years) significantly predicted self-reported later coercive sexual victimization (up to age 18 years) in both boys and girls (males β = .340, *SE* = 0.144; females β = .216, *SE* = 0.072; Table 3). This implies that for one standard deviation increase in ASD score, the probability of endorsing either of the two sexual abuse items increased by 74% for boys and 42% for girls. Inattention- and hyperactivity/impulsivity symptoms were also associated with a significantly increased risk among boys and girls (Table 3).

Next, we examined the association between the bifactor model and coercive sexual victimization. The bifactor model fit the data relatively well (RMSEA = 0.03, 90% CI = 0.03, 0.03; CFI = 0.90; χ^2 = 9,771.75, *df* = 1,139, $p < .001$). The factor loadings are displayed Appendix S4. All items had positive loadings on the general factor (mean loading = 0.65; range = 0.44, 0.84). There was a significant effect of the general factor in both sexes (male β = .250, *SE* = .089; female β = .228, *SE* = 0.051; Table 3, bifactor model). However, after controlling for the effect of the general factor on neurodevelopmental problems, the unique part of ASD-, inattention-, and hyperactivity/impulsivity symptoms did no longer

Table 3 Any sexual victimization reported at age 18 years regressed on neurodevelopmental disorders (NDDs) at age 9/12 years

	Outcome: Childhood sexual victimization reported at age 18	
	Males	Females
Predictor: NDD at age 9/12		
Latent, continuous autism spectrum disorder (ASD)	**.340 (.144)**	**.216 (.072)**
Latent, continuous inattention	**.245 (.116)**	**.210 (.049)**
Latent, continuous hyperactivity/impulsivity	**.226 (.109)**	**.155 (.059)**
Bifactor model		
Latent, continuous general factor	**.250 (.089)**	**.228 (.051)**
Latent, continuous ASD	.254 (.995)	.039 (.107)
Latent, continuous inattention	.097 (.142)	.025 (.068)
Latent, continuous hyperactivity/impulsivity	.058 (.181)	−.010 (.071)

Standardized betas with standard errors in parentheses. Bolded figures are significant at $p < .05$.

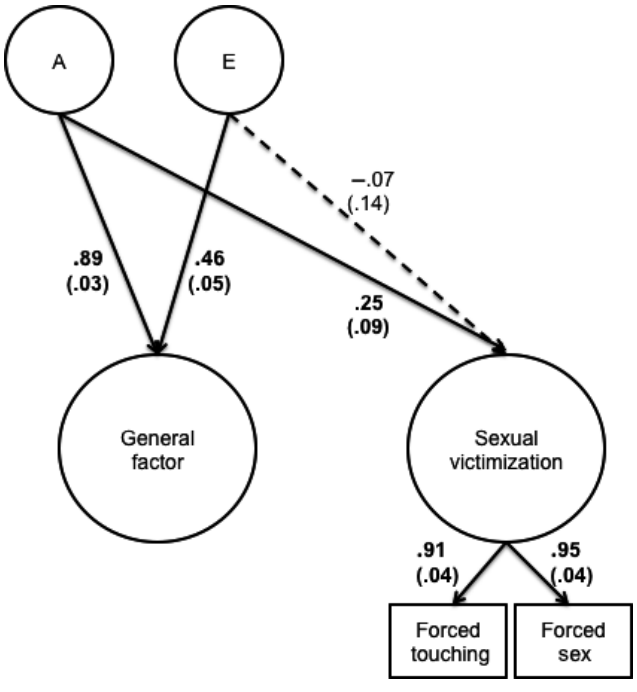

Figure 2 Cholesky decomposition. Loadings for the general factor are available in Table 1. Standard errors are presented in parentheses

significantly predict coercive sexual victimization (Table 3, bifactor model).

In the sensitivity analyses where we excluded individuals who had experienced abusive events before the NDD assessment, the results remained approximately the same for both the analyses with the binary and the latent variables (Appendices S5 and S6). In the analysis where we examined the effects of specific symptom-clusters, we did not find a significant effect of language problems, social problems, inflexibility, inattention nor hyperactivity/impulsivity on coercive sexual victimization. Instead, we only found a significant positive effect of the general factor on risk of coercive sexual victimization (Appendix S7).

Twin analysis

Next, we explored to what extent observed associations could be explained by genetic and environmental factors. We only Cholesky-decomposed the significant associations, namely between the general factor and coercive sexual victimization. This was only possible to do with the female subsample because too few males indicated that they had been sexually victimized after the sample had been divided into MZ and DZ twins. Because the general factor correlation was about twice as large among the MZ compared to the DZ twins (*rMZ* = 0.79, *SE* = 0.06; *rDZ* = 0.38, *SE* = 0.06), we omitted modeling the C-parameter (indeed, when included in the model, the C-estimate approximated zero).

The Cholesky decomposition of the female subsample indicated that the observed association between general NDDs and coercive sexual victimization was primarily explained by shared genetics. The A path between the general NDD factor and the sexual victimization latent factor was significant (Figure 2: $\beta_a = .25$, *SE* = 0.09), whereas the E path was non-significant ($\beta_e = -.07$, *SE* = 0.14). This means that within an identical female twin pair, the twin with more general NDDs did not report more coercive sexual victimization compared to her cotwin (Figure 2).

Discussion

In this population-based, prospective twin study, adolescent girls with parent-reported ASD and ADHD at age 9/12 years self-reported more coercive sexual victimization up to age 18 years than those without ASD and ADHD. However, when controlling for overall NDD symptom load, there was no unique additional effect of ASD-, hyperactivity/impulsivity-, or inattention symptoms, indicating that the associations were not specific to these symptoms. In females, a Cholesky decomposition suggested that the increased risk of sexual victimization associated with general neurodevelopmental problems was explained by additive genetics.

Phenotypic association between NDD and coercive sexual victimization

This result converges with previous findings, which have found an increased risk of sexual victimization in children and adults with NDDs (e.g. Brown-Lavoie et al., 2014; Roberts et al., 2015; White & Buehler, 2012). However, our findings that there were no

specific effect of ASD- or ADHD symptoms when controlling for general symptom load, fail to lend support to the hypotheses that social deficits, communication difficulties or impulsivity (Sevlever et al., 2013; White & Buehler, 2012) mediates the association between ASD/ADHD and coercive sexual victimization. This suggests that rather than focusing on a specific symptom-cluster or diagnosis, it is the general NDD phenotype that predicts increased risk of victimization.

Genetic link between NDD and coercive sexual victimization

The result from the Cholesky decomposition analysis can be interpreted to suggest that the twin with more NDD symptoms did not have an increased risk of sexual victimization compared to their cotwin with whom they share the same genetics. In other words, there was no evidence for a direct causal effect of NDD symptoms on the risk of sexual victimization. This genetic association between the general NDD factor and sexual victimization might occur because the genes associated with general NDDs may evoke a certain response from the environment, that is, an evocative gene–environment correlation (Plomin et al., 1977). One speculation is that children with a high genetic load on the general NDD factor may be perceived as different, making them easier to dehumanize and thereby increase the likelihood of boundary transgression and abusive behaviors from a motivated, potential offender (Bandura, Barbaranelli, & Caprara, 1996). Dehumanizing the victim functions as a justification of the offender's immoral behavior and has been suggested to be a precursor both to physical (Haslam, 2006) and sexual aggression (Rudman & Mescher, 2012).

A complementary speculation is that sexual victimization exists within a network of negative outcomes associated with the NDD phenotype. In fact, the genetically influenced NDD factor has been associated with other negative outcomes, including bullying victimization (Törn et al., 2015), psychotic symptoms (Cederlöf et al., 2016), and alcohol problems (Quinn et al., 2016). Genetically influenced traits or behaviors may increase the risk for several adverse consequences that are related through a chain of events. For example, genetically influenced poor school achievement may conduce to substance use, which in turn may result in a higher risk of subsequent sexual victimization (Borsboom & Cramer, 2013).

Implications

Importantly, although we identified characteristics that put individuals at risk for coercive sexual victimization up to age 18, we do not suggest that individuals with such traits are to blame for the abuse. Sexual victimization cannot occur without perpetrators, and only those who abuse are accountable. To guide risk assessment and selective prevention strategies against sexual victimization, we however argue that it may be important to identify characteristics that put individuals at increased risk of abuse, regardless of whether they are internal (e.g. NDDs) or external (e.g. risky environments). Thus, it may be important for health professionals to screen for sexual victimization among patients with NDDs (Spencer et al., 2016). Moreover, instead of focusing on specific diagnoses or symptoms, clinicians should consider general NDD symptom load as an indicator of increased risk of victimization.

Strengths and limitations

This study overcomes several limitations of previous studies. First, it was based on a representative sample of all Swedish twins (Anckarsäter et al., 2011) and the exposure variables were measured by a validated instrument based on DSM-IV-TR criteria (Larson et al., 2010, 2013). Second, the exposures and the outcome were measured at separate occasions: neurodevelopmental disabilities at age 9/12 and sexually abusive events at age 18. Third, the raters differed, minimizing potential rating bias. We also accounted for the direction of the association between disability and abuse by excluding events that had occurred before the assessment of neurodevelopmental disabilities in a sensitivity analysis, thereby making reversed causation unlikely (Sensitivity analysis reported in Appendices S5 and S6). Fourth, we accounted for unmeasured confounding related to genes and shared environment.

However, the present results should be interpreted in the light of certain limitations; first, approximately 80% of the twin parents first contacted in CATSS-9/12 study participated (Anckarsäter et al., 2011), and only 51,5% of the twins answered the questions about sexual victimization in the 18-year follow-up web survey (CATSS-18). Nonresponders in the CATSS-9/12 study had substantially more neurodevelopmental disabilities compared to the responders. Furthermore, nonresponders more frequently belong to lower socioeconomic strata, and had parents who had been convicted of crimes (Anckarsäter et al., 2011). This may implicate that they have an increased risk to become victims of crimes (Nilsson & Estrada, 2003), possibly including crimes related to sexual victimization. Thus, the present study may underestimate the prevalence of sexual victimization, and the risk of coercive sexual victimization in relation to NDD.

Second, the study only includes twins, which may limit the generalizability of the results. It is possible that twins are differently exposed to sexual victimization than the nontwin population. For example, one study found an increased prevalence of different types of life events (not including sexual abuse) in twins compared to nontwin siblings, which was

partly but not fully explained by that the twins had a higher mean age (Bemmels, Burt, Legrand, Iacono, & Mcgue, 2008). Moreover, the risk of sexual victimization may not be independent within twin pairs, if, for example, the perpetrator was a relative. However, other studies have found no differences between twins and singletons in respect to academic performance (Christensen et al., 2006), brain morphology (Ordaz et al., 2010), or morbidity and mortality (Öberg et al., 2012), which indicates that results from twins may generalize to singletons. It was also only a small percentage of perpetrators that were specified to be someone within the family (Table 1).

Regarding the sexual victimization measure, wording of the questions may introduce variability in understanding and response patterns, since the words 'sex' and 'forced' may implicate events of varying severity to different responders (Adams-Curtis & Forbes, 2004). Individuals who suffered sexual abuse via manipulation or bribery rather than physical force might not have endorsed the items. As a consequence, our study might have underestimated the prevalence of early childhood sexual victimization where perpetrators could be less likely to use direct force. Moreover, although the sexual victimization measure was based on a validated measure of trauma (LSC-R; Wolfe et al., 1996), and uses field-specific mainstream wording, the Swedish translation has not been formally validated.

The participants reported that the perpetrator of the abuse was a relative in 8% of the instances of coercive touching and in 4% of instances of coercive sex (Table 1). Although our estimates are in line with past studies (Finkelhor, Shattuck, Turner, & Hamby, 2014; Kloppen, Haugland, Svedin, Maehle, & Breivik, 2016), we might underestimate the prevalence of intrafamilial sexual abuse. As the participants were asked about sexual victimization when they are 18 years old, it is probable that most of them still live with their parents, which might have decreased their willingness to disclose such information.

Another limitation was the lack of statistical power to perform the Cholesky decomposition within the male sample. This limits the generalizability of the results to both sexes. However, in all other analysis, results were similar for both sexes.

Conclusions

In this population-based, prospective twin study, parent-reported childhood ASD and ADHD symptoms increased the risk of self-reporting having been sexually abused with coercion at age 18. However, this increased risk was primarily attributable to a general NDD factor. Furthermore, twin analyses implied that the association could be attributed to genetic factors. Thus, genetic risk for general NDD may be an important risk factor for coercive sexual victimization in childhood and adolescence.

Supporting information

Additional Supporting Information may be found in the online version of this article:

Appendix S1. ASD factor loadings.
Appendix S2. Inattention factor loadings.
Appendix S3. Impulsivity/hyperactivity factor loadings.
Appendix S4. Bifactor loadings for A-TAC items.
Appendix S5. Logistic regression of sexual victimization reported at age 18 on ADHD and ASD at age 9/12, after removing subjects that reported victimization prior to NDD assessment.
Appendix S6. Any sexual victimization reported at age 18 years regressed on neurodevelopmental disorders at age 9/12, after removing subjects that reported victimization prior to NDD assessment.
Appendix S7. Any sexual victimization reported at age 18 regressed on specific neurodevelopmental disorder symptoms at age 9/12.

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Key points

- Psychiatric disorders increase the risk for sexual victimization, but the specific influence of neurodevelopmental disorders on this risk is less known. It is also unclear if specific symptoms are related to heightened risk, or if that risk is related to a general neurodevelopmental phenotype.
- ASD and ADHD symptoms were associated with coercive sexual victimization, but the effect was not specific to these disorders.
- The association between NDDs and coercive sexual victimization was mediated through shared genetics.

- Rather than focusing on specific diagnoses or symptoms, clinicians should consider the general NDD symptom load as an indicator of increased risk of childhood sexual victimization.

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