Attention deficit hyperactivity disorder and childhood trauma

Emma Andersson and Mirjam Hellgren

Supervisor: PhD Henrik Larsson, Department of medical epidemiology and biostatistics, Karolinska Institute.
Examiner: Professor Petter Gustavsson, Department of clinical neuroscience, Karolinska Institute.
Department of clinical neuroscience
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Sammanfattning

Denna studie använde sig delvis av ett dimensionellt synsätt på ADHD för att undersöka kopplingen mellan barndomstrauma och risken att ha ADHD. I studien togs även hänsyn till hur antalet typer av upplevda trauman är associerat med förekomst och svårighetsgrad av ADHD. I studien deltog 18 316 personer, varav 7 366 män och 10 950 kvinnor. ADHD mättas genom självrapportering av DSM-IV-symptom konverterade till frågor. Fem typer av barndomstrauma mättas; Familjevåld, Emotionell vanvård, Fysisk vanvård, Påtvingad beröring och Påtvingat sex. Alla barndomstrauman var associerade med en ökad risk för att ha ADHD oavsett subtyp. Dessutom, ju fler upplevda typer av trauma, desto högre risk att ha ADHD. Detta gällde både i en mildare och i en svårare form av ADHD. Resultaten stödjer ett dimensionellt synsätt av ADHD och indikerar relevansen i att arbeta förebyggande för att förhindra barndomstrauma.

Nyckelord: ADHD, barndomstrauma, dimensionellt synsätt.

Abstract

This study partly used a dimensional view of ADHD to explore the association between childhood exposure to trauma and the risk of having ADHD. Also, the number of types of trauma experienced was taken into account, and how it is associated with the risk and the severity level of ADHD. There were 18,316 participants in this study, of which 7,366 were men and 10,950 were women. ADHD was measured through self reports using DSM-IV symptoms converted to questions. Five types of childhood trauma were measured; Family violence, Emotional neglect, Physical neglect, Forced touch and Forced sex. All childhood traumas were associated with an increased risk of having ADHD, independent of ADHD subtype. In addition, the more number of types of trauma exposures the higher was the risk of having ADHD. This was true both for a milder and a more severe form of the disorder. The results of this study support a dimensional view of ADHD and indicate the importance of working proactively to prevent childhood trauma.

Key words: ADHD, childhood trauma, dimensional view.
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Introduction

Background

The DSM-IV (American Psychiatric Association, 2002) conceptualizes attention deficit hyperactivity disorder (ADHD), based on two underlying symptom dimensions; a hyperactive-impulsive dimension and an inattentive dimension. The hyperactive-impulsive dimension includes difficulties remaining silent and still, expressing excessive talkativeness and having difficulties in waiting for one's turn. The inattentive dimension includes difficulties in remaining concentrated in tasks that require mental persistence, difficulties in following instructions and in organizing tasks and activities. Using these two dimensions, DSM-IV specifies three ADHD subtypes; a primarily hyperactivity/impulsivity type, a primarily inattentive type and a combined type consisting of both of them (Wasserstein, 2005). The disorder affects children all over the world, and the prevalence is about 3 – 12 % (Biederman & Faraone, 2005; Briscoe-Smith & Hinshaw, 2006; Rucklidge, Brown, Crawford, & Kaplan, 2006).

ADHD was for long considered a childhood disorder, but recent research has also recognized the disorder in adulthood with studies showing that 30 – 80 % of the children diagnosed with ADHD still experience impairments associated with the disorder in adult life (Lara, et al., 2009; Rucklidge, et al. 2006). The prevalence varies from 1 - 6 % in adults (Kooij, et al., 2010; Lara, et al., 2009; Rösler, Casas, Konofal, & Buitelaar, 2010; Rucklidge, et al. 2006; Wasserstein, 2005).

Despite the observed stability of ADHD across time, there are symptom changes during development from childhood to adulthood. For example, while children with ADHD may exhibit inability to sit still, and difficulty in engaging in quiet leisure activities, adults may have difficulties keeping a job, maintaining relationships and difficulties making decisions and organizing daily life (Kooij, et al., 2010; Wasserstein, 2005).

Risk factors of ADHD

Family, twin and adoption studies have demonstrated a strong genetic component, explaining approximately 76 % of the variance of ADHD (Biederman & Faraone, 2005). Besides this, a broad range of environmental factors have been identified as robust predictors of ADHD including prenatal factors, such as maternal health and exposure to alcohol and nicotine (Biederman & Faraone, 2005). Also, postnatal factors such as low socioeconomic status, single parenthood, paternal and maternal mental disorder and other psychosocial risk factors have been associated with an increased risk of ADHD (Biederman & Faraone, 2005; Lara, et al., 2009). However, to the best of our knowledge, only three studies have focused specifically on the association between childhood trauma and ADHD.

First, Rucklidge et al. (2006) used self- and observer-rated ADHD symptoms and retrospective assessments of childhood trauma, in a study of 114 participants. The results revealed that emotional abuse and neglect were more common among those with ADHD compared to controls. The same study also showed that females with ADHD reported more sexual abuse and physical neglect than men with ADHD.

Second, Ouyang, Fang, Mercy, Perou and Grosse (2008), used retrospectively reported DSM-IV ADHD symptoms and retrospectively reported childhood maltreatment in a sample of 14,322 participants, to study the relationship between the three ADHD subtypes and
childhood maltreatment. This study found the inattentive subtype to be associated with supervision neglect, physical neglect, physical abuse and contact sexual abuse, whereas the hyperactivity/impulsivity subtype was associated with supervision neglect and physical abuse to a lesser extent, and was not associated with physical neglect and contact sexual abuse.

Finally, Lara, et al., (2009) reported a dose-response effect of the aggregate of retrospectively reported psychosocial risk factors on self-reported ADHD in adults. This study also found a strong dose-response relationship between the number of trauma types in childhood and the risk of having childhood ADHD.

Taken together, earlier studies have revealed that there is a link between childhood trauma and ADHD, but these few studied needs to be replicated.

**A dimensional view of ADHD**

The validity and clinical utility of categorically defined DSM-IV ADHD is well established, but there are also strong arguments for considering the full range of the ADHD symptom distribution. For example, it has been shown, using statistical models, that ADHD exists on a severity continuum (Lubke, Hudziak, Derks, van Bijsterveldt, & Boomsma, 2009). This indicates the need for studies that evaluate how potential risk factors affect the severity level of ADHD symptoms. For example, using a dimensional view of ADHD would make it possible to examine how each additional exposure to a potential risk factor affect the severity of ADHD. Since DSM-V is in process and that many of the propositions are introducing a dimensional view of disorders, now taking the severity of symptoms into account, supporting research is of great importance (American Psychiatric Association, 2010).

**The aim of the study**

The aim was to replicate the association between childhood exposure to trauma and an increased risk of ADHD. Further, the study explored if the association between trauma and ADHD is explained by any of the subtypes of ADHD. This study also explored if the association between trauma and ADHD is moderated by sex, which is important as prior studies have reported sex differences in the association between ADHD and childhood trauma, and also in the prevalence of ADHD (Mersch, 2010).

To ensure the validity of the effect of each trauma on the risk of having ADHD, the unique contribution of each trauma was measured. Further analyses examined how the number of different types of trauma exposures was associated with the risk of having ADHD, with the aim to explore if each additional exposure increases the risk. The aim was also to explore if increasing numbers of trauma type exposures was associated with higher levels of ADHD severity, using the dimensional view of ADHD.

The causality of trauma as a predictor of the occurrence of ADHD is debated (Rucklidge, et al. 2006). In this study the causality was not taken into account, but in analysis traumas are seen as the independent variable and ADHD as the dependent variable.

**Method**

**Participants**

There were 18,316 participants in this study, of which 7,366 (40.2 %) were men and 10,950 (59.8 %) were women. The age range of the participants was 20 – 47 years, with the average age of men at 33.7 years ($SD = 7.7$) and of women at 33.5 years ($SD = 7.6$).
**Procedure**

The participants were recruited through the population-representative *Swedish twin registry* and the inclusion criterion was being born in Sweden between 1959–1985. A total of 42,582 were included. Of those, 25,321 (59.5%) participated in *The Study of Twin Adults: Gene and Environment*, and they received a letter that invited them to the present study. They also received personal logins to the website of the study. They got a maximum of three reminders. The present study is based on the 18,316 participants who responded to questions regarding ADHD symptoms and childhood trauma. The participants could answer the questions either on the web or through a telephone interview.

The persons included were not significantly different regarding age and birth weight compared with the ones that did not participate. However, the ones that did not participate had significantly higher rates of conviction of any type of crime, higher rates of some sort of psychiatric disorders and/or higher rates of having at least one parent born outside Sweden.

This project was reviewed and approved by the local regional ethic committee of Karolinska Institute, and the participants had confirmed consent either on the web or orally during the telephone interviews.

**Measures**

The material was collected through self reports. The participants received questions that were based on the 18 diagnostic criteria of ADHD in the *Diagnostic and Statistical Manual of Mental Disorders IV* (American Psychiatric Association, 2002), and were asked to rate each symptom question as “no”, “yes, to some extent” and “yes”. No information about childhood onset before the age of seven was collected.

In line with DSM-IV, nine of the questions reflected inattentive symptoms and nine reflected hyperactivity/impulsivity symptoms. Three scales were created; (1) a combined ADHD symptom scale was created from the sum of the 18 DSM-IV symptoms (2) a hyperactivity-impulsivity scale was created from the sum of the nine symptoms of hyperactivity-impulsivity listed in DSM-IV and (3) an inattention scale was created from the sum of the nine DSM-IV items related to inattention. The three ADHD subtypes were classified by applying a norm based approach to these three scales. Specifically, individuals having a score of 2 $SD$ above average on the inattentive scale were classified as having the inattentive subtype, individuals having a score of 2 $SD$ above average on the hyperactivity-impulsivity scale were classified as having the hyperactive/impulsive subtype. To have the combined type the participants had to have a score of 2 $SD$ above the average on the combined ADHD symptom scale. The categorization in the three subtypes was therefore not mutually exclusive.

To be able to look at how the number of different types of trauma exposures affect the severity level of ADHD, three new ADHD variables were created corresponding to three levels of ADHD symptoms, all are $SD$ above the mean; $< 1 \, SD$ (controls), $1 \, SD < \text{variable} < 2 \, SD$ (medium) and $> 2 \, SD$ (high). To obtain information about childhood trauma before the age of 18, five questions were used:

1. The variable *Family violence* was obtained through the question; “Did you ever see physical violence between family members before age 18?” (Yes = 1, No = 0).
2. The variable *Emotional neglect* was obtained through the question; “Have you ever been emotionally abused or neglected? For example, being frequently shamed, embarrassed, ignored, or repeatedly told that you were ‘no good’, before age 18?” (Yes = 1, No = 0).
3. The variable *Physical neglect* was obtained through the question; “Have you ever been physically neglected before age 18?” (If asked, the interviewer said: “For example, not fed, not properly clothed, or left to take care of yourself when you felt you were too young or ill.”) (Yes = 1, No = 0).

4. The variable *Forced touch* was obtained through the question; “Have you ever been 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, before age 18?” (Yes = 1, No = 0).

5. The variable *Forced sex* was obtained through the question; “Have you ever had sex because you felt forced in some way or threatened by harm to yourself or someone else before age 18? By sex, I mean oral, anal, and/or genital.” (Yes = 1, No = 0).

These five questions were also combined to a single scale in which the total number of types of trauma being experienced was counted for each of the participants.

Statistical analyses

All analyses in this study were conducted using the statistical program *Statistical Analysis System 9.2* (SAS Institute Inc., 2002-2008). Logistic regression was used for all analyses, calculating odds ratios using 95% confidence interval, corresponding to an alpha-error of .05. By comparing the odds ratios and confidence intervals between men and women, the gender interaction effects were investigated.

Results

Descriptive statistics

Figure 1 presents rates of the three different ADHD measures and each of the five different trauma exposures, separately for men and women as well as collapsed. Family violence and emotional neglect were the most common types of trauma in the sample. The prevalence of ADHD varied from 4.6 – 5.5 percent dependent on type and gender.

![Figure 1](image-url)  
*Figure 1. Frequencies of the different subtypes of ADHD and of the different types of trauma in the sample.*
Childhood trauma and ADHD in adulthood

Odds ratios, before (crude) and after (adjusted) controlling for the other trauma exposures, for the association between childhood trauma and adult ADHD are presented in Table 1. Each type of childhood exposure to trauma was associated with an increased risk of ADHD, independent of subtype, with crude odds ratios varying between 1.92 – 3.48 (p < .0001). The results of the adjusted analyses revealed that all traumas, except Forced touch, contributed independently to the risk of having ADHD, with adjusted odds ratios varying between 1.51 – 2.20 (p < .05).

The strongest association was found between Physical neglect and the inattentive subtype of ADHD (OR = 3.48, CI95% = 2.78 – 4.37, p < .0001), but the confidence intervals were overlapping when comparing the different subtypes (both crude and adjusted). No significant gender differences were found (data not shown).

Table 1. Odds ratios, before (crude) and after (adjusted) controlling for the other trauma exposures in the total sample.

<table>
<thead>
<tr>
<th>Trauma</th>
<th>ADHD comb. [CI 95%]</th>
<th>ADHD inatt. [CI 95%]</th>
<th>ADHD hyp/imp. [CI 95%]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Crude</td>
<td>Adjusted</td>
<td>Crude</td>
</tr>
<tr>
<td>Family violence</td>
<td>2.45**</td>
<td>1.68**</td>
<td>2.23**</td>
</tr>
<tr>
<td></td>
<td>[2.11; 2.84]</td>
<td>[1.41; 2.01]</td>
<td>[1.94; 2.58]</td>
</tr>
<tr>
<td>Emotional neglect</td>
<td>2.35**</td>
<td>1.76**</td>
<td>2.52**</td>
</tr>
<tr>
<td></td>
<td>[2.04; 2.71]</td>
<td>[1.49; 2.07]</td>
<td>[2.21; 2.86]</td>
</tr>
<tr>
<td>Physical neglect</td>
<td>3.70**</td>
<td>1.84**</td>
<td>3.48**</td>
</tr>
<tr>
<td></td>
<td>[2.90; 4.70]</td>
<td>[1.40; 2.42]</td>
<td>[2.78; 4.37]</td>
</tr>
<tr>
<td>Forced touch</td>
<td>2.39**</td>
<td>1.66</td>
<td>2.35**</td>
</tr>
<tr>
<td></td>
<td>[1.87; 3.06]</td>
<td>[0.86; 1.58]</td>
<td>[1.87; 2.96]</td>
</tr>
<tr>
<td>Forced sex</td>
<td>3.17**</td>
<td>1.83</td>
<td>2.92**</td>
</tr>
<tr>
<td></td>
<td>[2.35; 4.26]</td>
<td>[1.28; 2.62]</td>
<td>[2.19; 3.90]</td>
</tr>
</tbody>
</table>

** Significantly (p < .0001) different from one
* Significantly (p < .05) different from one

Exposure to multiple types of childhood trauma and the risk of having ADHD

The odds ratios of each additional exposure to trauma type on the risk of having ADHD are presented in Figure 2. In general, the more numbers of trauma exposures, the higher risk of having ADHD. Specifically, the odds ratio associated with the combined subtype and exposure to one childhood trauma was estimated at 1.87 (CI95% = 1.57 – 2.23, p < .0001). The corresponding numbers for having two, three and four childhood trauma exposures were 3.09 (CI95% = 2.53 – 3.78, p < .0001), 5.20 (CI95% = 3.89 – 6.94, p < .0001), and 13.50 (CI95% = 7.63 – 23.89, p < .0001). The odds ratio associated with the inattentive subtype and exposure to one childhood trauma was estimated at 2.15 (CI95% = 1.84 – 2.52, p < .0001). The corresponding numbers for having two, three and four childhood trauma exposures were 3.38 (CI95% = 2.80 – 4.07, p < .0001), 4.99 (CI95% = 3.76 – 6.63, p < .0001), and 8.62 (CI95% = 4.63 – 16.06, p < .0001). The odds ratio associated with the hyperactive/impulsive subtype and exposure to one childhood trauma was estimated at 1.53 (CI95% = 1.29 – 1.82, p < .0001). The corresponding numbers for having two, three and four childhood trauma exposures were 2.51
(CI\textsubscript{95\%} = 2.05 – 3.07, p < .0001), 3.92 (CI\textsubscript{95\%} = 2.89 – 5.32, p < .0001), and 7.56 (CI\textsubscript{95\%} = 3.97 – 14.40, p < .0001).

Figure 2. How the number of types of trauma experienced, affect the risk of having ADHD.

Across different levels of ADHD severity

To explore how exposure to multiple types of childhood trauma is associated with the severity of ADHD, odds ratios were calculated, presented in Table 4. The risk of having ADHD increased with increasing number of trauma exposures, both in the milder and the more severe form of ADHD. When comparing the milder and the more severe form of ADHD, confidence intervals were mostly overlapping.

<table>
<thead>
<tr>
<th>Number of trauma</th>
<th>ADHD comb. [CI \textsubscript{95%}]</th>
<th>ADHD inatt. [CI \textsubscript{95%}]</th>
<th>ADHD hyp/imp. [CI \textsubscript{95%}]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Medium</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>1</td>
<td>1.71* [1.51; 1.94]</td>
<td>1.97* [1.66; 2.35]</td>
<td>1.65* [1.48; 1.85]</td>
</tr>
<tr>
<td>2</td>
<td>2.43* [2.07; 2.84]</td>
<td>3.41* [2.79; 4.17]</td>
<td>2.17* [1.86; 2.53]</td>
</tr>
<tr>
<td>3</td>
<td>3.01* [2.30; 3.94]</td>
<td>5.91* [4.41; 7.93]</td>
<td>2.64* [2.04; 3.40]</td>
</tr>
<tr>
<td>4</td>
<td>3.28* [1.53; 7.03]</td>
<td>15.31* [8.51; 27.58]</td>
<td>3.87* [1.99; 7.51]</td>
</tr>
</tbody>
</table>

* Significantly different (p < .0001) from one.
Discussion

All childhood traumas investigated are associated with an increased risk of having ADHD, independent of ADHD subtype. Also, the more number of trauma type exposures the higher is the risk of having ADHD. This is true both for a milder and more severe form of the disorder. No gender differences were found.

The findings of this study replicates the association between childhood trauma and the risk of having ADHD (Lara, et al., 2009; Ouyang, et al., 2008; Rucklidge, et al., 2006), and also the dose-response effect of multiple types of trauma exposures, shown in earlier studies (Lara, et al., 2009).

Support of the dimensional view

When examining how each additional trauma type exposure is associated with the risk of having ADHD, a continuous gradient of increased risk is mostly pronounced in the combined subtype. The inattentive subtype and the hyperactivity/impulsivity subtype follow the same pattern, but more research is needed to support this finding.

This study also supports the dimensional model of ADHD since the risk factors affect not only the severe form of the disorder, but also the milder form. Hence, the present study is of importance in supporting the new propositions of changes in upcoming DSM-V that is moving toward a dimensional view of psychiatric disorders (American Psychiatric Association, 2010). When having a dimensional view on ADHD and recognizing different severity levels of the disorder, interventions directed at not only the most severe form of ADHD but also the milder forms are important. Therefore each contribution, big or small, to prevent and treat ADHD is of great relevance. Since the DSM-system is used worldwide when diagnosing and planning treatment of different disorders this is especially important to emphasize.

Strengths and limitations

This study has a large number of participants (18,316), which gives high power to the study. However, there are too few men participating to be able to compare women and men in advanced analysis. Even though the study aimed to examine gender differences, no analyses regarding differences in effects of each additional exposure to trauma type on the risk of having ADHD were executed due to small sample sizes.

Also, the data being used may be suffering from different kinds of memory/recall biases, because of the retrospective method being used. Studies of the validity of retrospective studies show that people being exposed to different kinds of trauma and maltreatment in childhood tend to forget and underreport later in life. However, there seems to be no risk of false positive reporting (Hardt & Rutter, 2004). Therefore this study may have an unknown number of unreported traumas, and if some specific types of traumas are more easily underreported and are more associated with a certain subtype, this may have affected the results.

Also affecting the results, might be the way of collecting information of ADHD symptoms. The data being used is not based on ADHD diagnosis being present or not, but is instead based on the participants own perception of current ADHD symptoms. In addition, the norm-based approach that was used to classify the participants as cases and controls with regard to ADHD has not been formally validated, but has nevertheless been used previously in epidemiological studies as a proxy for clinical instruments (Friedrichs, Larsson, & Larsson, 2010).
Conclusions

This study supports earlier studies concluding that environmental factors affect the risk of having ADHD (Kooij, et al., 2010; Lara, et al., 2009; Ouyang, et al., 2008; Rucklidge, et al., 2006). Childhood trauma is associated with an increased risk for all subtypes of ADHD. There is also an association of the number of trauma types experienced and the risk of having ADHD. Also, the number of exposures to trauma types is associated with both extreme and lower levels of symptom severity of ADHD.

The results support a dimensional view of ADHD and indicate the importance of working proactively to prevent childhood trauma. More knowledge of the link between the different types of ADHD and the different types of trauma and how it affects men and women separately is needed. Further research is also needed to establish the causality of the association between childhood trauma and ADHD, taking the severity of the disorder into account.

References


