

# Family and Developmental History of Female Versus Male Adolescents With ADHD: Disorder-specific Overlap but Few Gender Differences

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## Research article

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# Abstract

**Background:** Gender differences in the development of children and adolescents are well known in the psychiatric examination including the clinical diagnostic interview technique. Some gender-specific differences in behaviors of patients as assessed in the clinical examination are related to typical development and some are related to disorders. Family and developmental history is an important part of the clinical diagnostic interview. Attention-deficit/hyperactivity disorder (ADHD) is associated with disorder-specific markers in family and development history. However, it is unclear to what extent ADHD-specific signs and narratives differ between female and male adolescents. The aim of this study was to assess and to compare the family and developmental history profiles of female versus male adolescents with ADHD.

**Methods:** Data were collected using the clinical diagnostic interview technique from parents of female and male patients diagnosed with ADHD (ICD-10 F90.0, F90.1 and F98.8) between the ages of 12 and 17 years (n = 92). The two groups were matched in pairs for gender, IQ and ICD-10 diagnosis (F90.0, F90.1 and F98.8). The majority of interview data were non-metric and operationalized in three categories: 0 - normal behavior, 1 - minor pathological behavior, 2 - major pathological behavior. The two groups were compared with two-way ANOVA.

**Results:** Female in comparison to male adolescents were reported by the parents with very few differences in items that are typical for ADHD. However, there were a few differences in items in which gender-specific differences are known regardless of ADHD.

**Conclusions:** Our study suggests that ADHD-related items in family and developmental history, as obtained with the clinical diagnostic interview technique, appear in female compared to male adolescents more similar than different.

## Background

### Gender differences in diagnosing ADHD

Gender refers to the socially constructed norms that impose and influence social roles and relationships. The development as a girl or a boy in a family influences the children's way they are parented and people's reactions to certain behaviors, play styles or interests. Besides underlying genetic and endocrine processes, these social expectations lead to differing behaviors in female adolescents and male adolescents (Endendijk et al., 2018). Gender-related behaviors in adolescents do not influence only parents' view on children, but also mental health professionals' (MHP) view on patients with ADHD in daily clinical routine. There is an increasing awareness among experts that females with ADHD show a somewhat different set of behaviors in school, in family life and in clinical settings in comparison to male adolescents with ADHD. These common and typical perceptions in daily clinical routine lead to social expectations on gender-specific behaviors by MHPs. The use of these stereotypes like "the disruptive boy" or "the dreamy girl" among parents and among experts in working with children and adolescents with

ADHD takes part in our daily social life (Blakemore et al., 2009). Gender expectations could therefore be related to the diagnostic process and outcome during the first consultation of an MHP service. Working with females with ADHD highlights special challenges in recognition of this group, possibly caused by female compensatory strategies or developmental differences on the one hand and stereotypical expectations of MHPs, parents or teachers on the other hand (Young et al., 2020). A better understanding of the diagnostic view of MHPs in daily clinical routine regarding female in comparison to male patients with ADHD appears important to improve the clinical understanding of early diagnostic recognition and identification of females with ADHD.

## **Diagnostic routines leading to ADHD**

Following clinical guidelines, the diagnostic process of potentially psychopathological behavior is typically tripartite including a clinical diagnostic interview, the use of rating scales and the assessment of setting-specific information like school reports (AWMF, 2018; National Institute for Health and Care Excellence, 2018; Young et al., 2020). The clinical diagnostic interview, performed by an MHP with parents (or other persons related to the patient), takes an important part at this early stage in the diagnostic process. This technique based on a recall of memories of certain events, stored in the brains of patients and parents. They are the subjective views of patients and parents and can differ from an objective assessment of described events. During this face-to-face-interview, patients and parents are asked questions on several domains, such as current symptoms, history of present illness, developmental history, personal history, family history, assessed by the professional interviewer (Laux & Waltereit, 2017; Martin & Volkmar, 2007; Sadock et al., 2009; Thapar et al., 2015).

In contrast to the clinical diagnostic interview technique, rating scales are a useful and time-saving tool in the process of forming diagnostic hypotheses and treatment monitoring. In everyday clinical practice, however, rating scales should be carefully included in first diagnostic decisions, because rigid adherence to cut-offs can lead to a high number of false-positive and false-negative results. In particular, norms for female patients are often not available or females are in some cases underrepresented (Taylor, Shoumitro, & Unwin, 2011). School reports are a very helpful source of information in order to better assess the potentially psychopathological behavior of the patient in a setting-specific manner. Unfortunately, there is still little evidence for evaluating school certificates. In diagnosing ADHD in female adolescents, the clinician's experience of disorder-specific symptoms as opposed to gender-specific symptoms plays a key role (Young, Adamo, Ásgeirsdóttir, Branney, Beckett, Colley, Cubbin, Deeley, Farrag, Gudjonsson, Hill, et al., 2020).

## **Gender differences in prevalence and clinical presentation of ADHD**

In non-referred population samples of children and adolescents, ADHD is more common in males than in females with a sex ratio of around 3:1 (Willcutt, 2012). By contrast, in clinical samples there was found an up to nine times higher prevalence in males (Gershon & Gershon, 2013). These findings suggest that in clinical diagnostic settings male adolescents receive the diagnosis of ADHD even more often than

predicted by the higher prevalence in population samples. An explanation for this phenomenon may be attributed to the diagnostic criteria of DSM-V or ICD-10, which may be predominantly suitable for male children and adolescents, but only partially for female children and adolescents or even for adults of both sexes. Are these differences substantial in disorder-specific behaviors and do they influence the clinicians view? This discrepancy highlight on the other hand a potentially large number of unidentified and untreated female adolescents with negative consequences for well-being and psychosocial, educational and clinical outcome (Gershon & Gershon, 2013). These differences may lead to the perception of less symptomatic impairment in female adolescents or a misinterpretation of internalizing behaviors in female adolescents with ADHD (Quinn & Wigal, 2004). On the other hand, stereotypes of the “disruptive boy” and the “dreamy girl” trigger access to treatment in the context of ADHD (Mowlem et al., 2019). In addition, MHPs, parents and teachers may experience and respond to the same behavior of female and male children and adolescents in different ways due to gender-related behavioral expectations (Millenet et al., 2018).

## **Role of family and developmental history in diagnosing ADHD**

ADHD is associated with a specific profile in family and developmental history, but the empirical literature is still scarce in this domain. In a previous work by our group (Waltereit et al., 2019), a profile of markers in family and developmental history of male adolescents with ADHD compared to healthy controls was found, using the clinical diagnostic interview technique. In family history, the parents reported cumulative transgenerational effects of more mental disorders, more psychosocial burden like less years in school and lower school-leaving qualifications and impaired relationships between parents and grandparents in the families with children with ADHD. In developmental history, the parents of children with ADHD reported more conflicts and persistent problems, in particular verbal aggressions toward the child. For pregnancy and the first year of life of their child with ADHD, mothers reported increased stress and more crying behavior of the child. Male children with ADHD were more likely to struggle with speech and language problems. In primary and secondary school age, parents of male children diagnosed with ADHD reported extensive impairments in social and cognitive functioning, not only in concentration (Waltereit et al., 2019).

### **Aims of the study**

In our previous study, we have investigated family and developmental history of male adolescents with ADHD compared to typically developing male adolescents (Waltereit et al., 2019). As we have outlined above, there is a knowledge gap about the picture of ADHD in female adolescents. It is for example unclear to what extent ADHD-specific signs and narratives in family and developmental history differ between female and male adolescents. Do females with ADHD show a different profile in family and developmental history in comparison to male adolescents? If so, how can the peculiarities of females with ADHD in family and developmental history be characterized? The aim of this study was to assess and compare family and developmental history profiles of female and male adolescents with ADHD. Here, we investigated 46 pairs of female and male adolescents with ADHD matched for IQ, ICD-10-

diagnosis and gender, using a typical set of questions regarding family and developmental history assessing with a clinical diagnostic interview technique.

## Methods

# Parental participants, female and male adolescents with ADHD

In this study, we investigated family and developmental history of female adolescents and male adolescents with ADHD, by interviewing the parents. In the following, the participants are the parents.

This sample is consisting of two groups of participants ( $n = 92$ ). The first one are parents of a female adolescent diagnosed with ADHD ( $n = 46$ ) and the second one are parents of a male adolescent with ADHD ( $n = 46$ ), matched in pairs for IQ, diagnosis and gender of their children. Twenty-four data sets out of these 46 sets of parents of male adolescents with ADHD used for this study were identical with 24 out of 56 data sets from our previous study comparing male adolescents with ADHD versus healthy controls (Waltereit et al., 2019). Thus, male adolescents with ADHD were considered as the control group in the current study.

Patients included in the study had at any time between the ages of 12 and 17 the WHO ICD-10 diagnoses F90.0, F90.1 or F98.8, the latter one representing attention deficit without hyperactivity. All diagnoses were made during regular treatment by board-certified specialists at Child and Adolescent Psychiatry, University Hospital Carl Gustav Carus. Twenty-six pairs had the ICD-10 diagnosis F90.0, 14 pairs the diagnosis F98.8 and 6 pairs F90.1. Exclusion criteria in both groups were the presence of comorbid psychiatric or neurological disorders according to ICD-10 chapters F and G or an intelligence quotient (IQ) below 70. Additional sample characteristics can be found in Table 1.

The study has been approved by the Ethics Committee of the University Hospital Carl Gustav Carus (reference number EK 295072016) and was performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments. Participants and also their children gave written informed consent to participate.

## Recruitment

### Recruitment of participants

Parents of adolescents with an ADHD diagnosis were recruited as participants. Adolescents with ADHD were current or former patients at the University Hospital Carl Gustav Carus, Dresden. All participants were contacted by telephone and invited for an interview. All participants were contacted by telephone and invited for an interview. Both parents and children provided written informed consent before being included in the study.

## Interviewers

Medical students from the Medical Faculty Carl Gustav Carus, Technical University Dresden, in their final year of Medical Studies, participated in the project as part of a voluntarily scientific program and without financial benefit. They were thoroughly trained in the “family and developmental history questionnaire” and were always supervised by a board-certified specialist in child and adolescent psychiatry.

Interviewers were not blinded for the diagnosis of the patients and were equally distributed among both groups.

## **Interview**

Parents and interviewer met for an agreed appointment. Family and developmental history data were collected from at least one parent. Modeling a clinical setting, participant and interviewer were seated face-to-face in an examination room of the hospital. The interviewer asked the questions in the same order as they can be found in Supplementary Table S1 and documented answers of parents word-by-word.

## **Measures**

### **“Family and developmental history questionnaire”**

The “family and developmental history questionnaire” to study family and developmental history in the clinical examination scenario by the MHP has been described (Waltereit et al., 2019) and consists of a selection of relevant questions that could still be answered in a 45 min interview. These questions are commonly used for diagnostics at several German academic child and adolescent psychiatry departments and were aligned with leading textbooks (Martin & Volkmar, 2007; Sadock et al., 2009; Thapar et al., 2015). Questionnaires and instructions for the clinical diagnostic interview were obtained from the child and adolescent psychiatry departments at the university hospitals Göttingen, Hamm, Leipzig, Mannheim, Tübingen, Würzburg and Dresden. Those items concerning family and developmental history were considered. The questions and possible operationalizations are presented in Supplementary Table S1.

## **Operationalization**

Operationalization was oriented on the CASCAP-D system, which in turn was developed for children and adolescents on basis of the AMDP System for adult patients in psychiatry and the WHO ICD-10 diagnostic inventory (Döpfner et al., 1999). The CASCAP-D system is used to operationalize psychopathological items. These items can be categorized into not present/regular (0), lightly (1), moderately (2) or severely present (3). For the operationalization of patient history data, most items in the “family and developmental history questionnaire” were oriented on the description of deficient or pathological behavior. In this sense, these history items were categorized into regular behavior (0), minor pathological (1) and major pathological behavior (2). We decided for this more simple decision tree to ensure a straightforward categorization into three options: (rated as 0) obviously neurotypical behavior, (rated as 2) pathological behavior as described in WHO ICD-10/DSM-V or obviously (from the viewpoint

of a board-certified specialist in child and adolescent psychiatry) associated with psychiatric disorder, and (rated as 1) behavior at risk for psychiatric disorder. This more simple categorization is similar to the K-SADS structured interview (Kaufman et al., 1997). Some items represented different levels of social function or burden of disease rather than psychopathology. In those cases, representing markers of social or educational functioning or degree of disease burden, history items were—in analogy—categorized into high psychosocial functioning (0), regular psychosocial functioning (1) and low psychosocial functioning (2) or no disease burden (0), low disease burden (1) and high disease burden (2), respectively.

Interviewers wrote down the answers to a specific question provided by the parents. In case of non-metric answers, interviewers made a preliminary operationalization according to the rules described above. Primary data sheets with all given answers were regularly reviewed together with the interviewers during study team meetings led by a specialist in child and adolescent psychiatry (R.W.) and operationalization was finalized. Modeling the scenario of the clinical diagnostic interview, a regular clinical technique performed by MHPs, the study team interpreted during the process of operationalization the answer of the parents in terms of neurotypical versus psychopathological behavior or constellation, as described above.

## Collection of IQ data

The HAWIK (Hamburg-Wechsler-Intelligenztest für Kinder) is the German version of the Wechsler Intelligence Scale for Children (e.g., WISC-IV) (Petermann & Petermann, 2010). In the ADHD group, IQ scores had been regularly measured using HAWIK-IV and in some cases using the previous version HAWIK-III. The IQ's of the control group had been measured with HAWIK-IV.

## Statistical analysis

As there were few differences between the two groups, we did not correct for multiple comparisons, in order to prevent the false-negative interpretation of absent gender differences. The statistical method to analyze variances, two-way ANOVA, was performed with Prism software (GraphPad, San Diego, CA; USA). Differences were considered statistically significant if  $p < 0.05$ . Graphical artwork was created with Prism software. Graphs show mean, standard error of the mean (SEM) and significant results from two-way ANOVA. Tables show mean and significant results from two-way ANOVA. One asterisk in a graph represents  $p < 0.05$ , two asterisks  $p < 0.01$ , three asterisks  $p < 0.001$ . “ns” indicates a non-significant result ( $p > 0.05$ ). Detailed statistical results are deposited in the Supplementary Table 2.

## Results

### Socioeconomic, psychosocial, psychiatric and medical history of parents and grandparents

In the first part of the interview, regarding family history, we collected information using parental memories about themselves and about the grandparents of the child. We assessed socioeconomic,

psychosocial, psychiatric and medical history of parents and grandparents. For almost all items, parents of female adolescents and male adolescents remembered similar information about themselves and grandparents, irrespective of the gender of their child (Fig. 1). As the only exception, mothers of female adolescents with ADHD were more often described as having a dysfunctional family compared to mothers of male adolescents with ADHD (Fig. 1B). The obstetrical history of mothers with female adolescents and male adolescents with ADHD showed no differences (Table 2A). Detailed information about statistical analyses can be found in Supplementary Table 2.

## **Family relationships, conflicts in the family, maternal stress and medical history of the child**

We then assessed family relationships, conflicts in the family, maternal stress and medical history of the child. Parents of female adolescents and male adolescents with ADHD had for most items similar memories, irrespective of the gender of their child (Fig. 2). For female adolescents with ADHD in contrast to male adolescents with ADHD, there was more support reported by caregivers who does not live in the household of the family (Fig. 2B). Female adolescents with ADHD were reported to receive less often medication for ADHD than male adolescents (Fig. 2D). The composition of persons living in the family household during late childhood was equal for female adolescents and male adolescents with ADHD (Table 2B).

## **Prenatal and perinatal history, birth parameters and early childhood**

For prenatal and perinatal history, birth parameters and early childhood we observed again strong similarities in the memory of parents of both female adolescents and male adolescents (Fig. 3). There were two effects of gender. For mothers of female adolescents with ADHD, less social support was reported during pregnancy (Fig. 3A). For male adolescents with ADHD, more crying behavior was remembered during the first year of life (Fig. 3D). The APGAR score was decreased for male adolescents with ADHD in comparison to female adolescents with ADHD (Table 2C). Otherwise, birth parameters and markers of development were not reported differently between female adolescents and male adolescents (Table 2C,D).

## **Middle childhood history and late childhood history**

Finally, we assessed the socio-emotional and cognitive behaviors of female and male patients with ADHD during preschool and primary school. Again, most items were not remembered with a gender difference (Fig. 4, Table 2E,F). Mothers of male adolescents with ADHD reported lower fine motor skills than mothers of female adolescents with ADHD and were more likely referred to occupational therapists during preschool age and primary school age (Fig. 4A, Fig. 4C). The parents reported male adolescents with ADHD to show more difficulties with teachers after a school change in primary school (Fig. 4B). The concentration in primary school was, however, in female adolescents with ADHD more impaired than in

male adolescents with ADHD after a school change (Fig. 4C). Parents of female adolescents with ADHD reported poorer calculation skills in secondary school (Fig. 4E).

## Discussion

We investigated here family and developmental history in matched pairs of female adolescents with ADHD compared to male adolescents with ADHD. Remarkably, there is a large overlap in family and developmental history among female and male adolescents with ADHD. There were only few gender differences between both groups with ADHD, most of them appearing not to be related to the disorder, but to neurotypical development.

## Overlap between genders in family and developmental history

Family history is important for the diagnostic process of ADHD as it reveals information about the burden of mental disorders and other diseases in the family, conflicts and relationships in the family and socioeconomic background. Developmental history reveals information about the development of psychopathological markers and finally symptoms of ADHD. In our previous study of family and developmental history, female adolescents with ADHD were compared to male adolescents without psychiatric diagnosis (Waltereit et al., 2019). In our previous study we found for female adolescents with ADHD a profile of family and developmental history significantly differing from male adolescents without psychiatric diagnosis. As we found here only few differences between female and male adolescents, the first main conclusion of this study is that family and developmental history in adolescents with ADHD, as remembered by their parents, is only little influenced by gender. In turn, the picture of female adolescents with ADHD is very typical for the disorder.

The disorder-specific overlap between genders is on first glance surprising, because the current scientific view emphasizes the importance to study and to take gender issues into account, in particular here in mental healthcare of children and adolescents (Blakemore et al., 2009; Endendijk et al., 2018; Young, Adamo, Ásgeirsdóttir, Branney, Beckett, Colley, Cubbin, Deeley, Farrag, Gudjonsson, & Hill, 2020). However, it is also an important finding if gender does not cause relevant differences, here in family and developmental history of adolescents with ADHD.

## Gender differences in our sample

There were, however, a couple of gender differences in our findings. For mothers of females with ADHD, more dysfunctional interaction in the mother's family was reported (Fig. 1B). This has not been described in the literature so far. It may be speculated that dysfunctional family relationships could be better remembered or recognized in the context of females. Gender effects could be recognized in our sample for females as having less adult caregivers than males (Fig. 2B). For female adolescents with ADHD it is described to form damaging peer relationships, for example joining an antisocial peer group or engaging in risky sexual practices and partners instead of forming potentially protective relationships to caregivers

like teachers (Young et al., 2020). In medical history, we found females receiving specific medication for ADHD less often than males (Fig. 2C), in line with the literature (Dalsgaard et al., 2014). Pharmacological treatment is associated with improved psychosocial long-term outcomes (Biederman et al., 2009; Halmøy et al., 2009; Kim et al., 2011). Less stimulant treatment in females could be the result of better masking behavior and better social compliance in females (Young et al., 2020) as well as a different symptom perception in parents and teachers when viewing females with ADHD in comparison to males with ADHD (Du Rietz et al., 2016; Quinn & Madhoo, 2014). Better social compliance may result in an underdiagnosis in females with ADHD. In addition, in clinical settings medication was less often considered as a treatment strategy for females even with a diagnosis of ADHD (Quinn & Madhoo, 2014; van Lieshout et al., 2016).

Lower Apgar scores were reported in our sample for males with ADHD (Table 2C). Between Apgar scores and the diagnosis of ADHD no correlation was described in the literature (Silva et al., 2014). By contrast, lower Apgar scores were described for male full-term neonates (Nagy et al., 2009). For mothers of females with ADHD, less social support during pregnancy was remembered compared to mothers of males with ADHD (Fig. 3A). Less social support is part of long-term stressful life events during pregnancy. The literature on this specific issue is scarce. Prenatal stress of the mother seems however to be more harmful for males than for females (Thibaut, 2016). Mothers of females with ADHD in our sample reported less frequent and less prolonged crying behavior during the first year of their child's life than mothers of males with ADHD (Fig. 3D). ADHD symptoms in children younger than three years have only been sparsely investigated. Increased irritability and increased crying behavior in males or mixed samples with ADHD were reported by mothers in the first year of life of their babies (Bilgin et al., 2020; Hemmi et al., 2011). Gender differences are, to our knowledge, not investigated.

For middle childhood, parents reported more impaired fine motor skills for males with ADHD during preschool and primary school ages (Fig. 4A, Fig. 4C). Female gender is in typically developing children associated with earlier accomplishment of fine motor items (Comuk-Balci et al., 2016). Thus, the finding appears more likely associated with gender and not with ADHD. In comparison to males with ADHD, females with ADHD were reported to have substantially less difficulties with teachers after a school change (Fig. 4B). In contrast, difficulties with concentration of females with ADHD stayed at a consistently high level after changing school (Fig. 4C). However, these data must be interpreted with caution because the number of patients changing school was low (for both females and males 28,3%, see Table 2E). Nevertheless, interesting tendencies can be seen: while these findings may fit into the social stereotypes of the "externalizing and disruptive boy" and "the dreamy girl who doesn't take medications for ADHD" (Young et al., 2020). Parents reported poorer calculation skills for females with ADHD (Fig. 4E). Males usually are outperforming females in most mathematic competencies. (Winkelmann et al., 2008). Thus, this finding appears related to gender and not to ADHD.

As we have discussed above, we found in our sample a great overlap between females and males with ADHD and only a couple of differences. As we did not correct here for multiple comparisons – in order not to mask remaining differences, besides the main finding of great overlap in the data set – most of

these few differences could disappear when applying alpha correction. Irrespective of these considerations, the differences appear more likely to be related to gender and not to reflect a mechanism of ADHD itself.

## **Gender-sensitive implications for clinical practice**

For family and developmental history, we found in our sample an overlap between females and males in the disorder-specific clinical presentation of parentally reported concerns, observations and experiences with their children with ADHD. Our findings support the recommendation that the disorder-specific therapeutical approach should be for females with ADHD similar to males with ADHD (Rucklidge, 2008, 2010), notably therapeutic decisions related to medication in females.

Despite the overall impression of great overlap, we still found a couple of gender differences in our sample, especially gender differences in mathematical competencies and fine motor skills are well-known (Comuk-Balci et al., 2016; Dalsgaard et al., 2014; Winkelmann et al., 2008) and should be considered by the clinician. Therapeutic strategies to improve the individual achievement profile of children and adolescents with ADHD should be developed in a gender-sensitive manner. Other gender differences like less support of female adolescents by adult caregivers, possible transgenerational female stereotypes and gender differences after school changes may be considered by the clinician as well and could be novel questions to be addressed by future research. Taken together, a gender-sensitive view in clinical practice is needed to improve the long-term outcome and the psychosocial wellbeing of both females and males with ADHD.

## **Limitations**

Limitations of our study are non-blinded student interviewers, localized samples and a limited number of participants. Our study was an exploratory study and equipped with limited resources. However, our study is to our knowledge the first one to investigate gender differences in family and developmental history in ADHD. In addition, the differences found in our exploratory study could establish novel questions for future research.

## **Conclusions**

Our study suggests that ADHD symptoms in family and developmental history, as obtained with the clinical diagnostic interview, appear in female adolescents versus male adolescents more similar than different. The few differences especially in poorer mathematical skills in girls and poorer fine motor skills in boys and less medication treatment strategies for girls require a gender-sensitive perspective of the clinician for an improved long-term-outcome in girls and boys with ADHD.

## **Declarations**

### **Ethics approval and consent to participate**

The study has been approved by the Ethics Committee of the University Hospital Carl Gustav Carus (reference number EK 295072016) and was performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments. Participants and also their children gave written informed consent to participate.

### **Consent for publication**

Not applicable.

### **Availability of data and materials**

The datasets used and/or analyzed during the current study are available from the corresponding authors on reasonable request.

### **Competing interests**

The authors declare that they have no competing interests.

### **Funding**

The study was performed without external financial funding.

### **Authors' contributions**

JW collected data, interpreted results and wrote the paper. JZ collected data and wrote the paper. VR wrote the paper. RW designed the study, supervised collection of data, interpreted results and wrote the paper.

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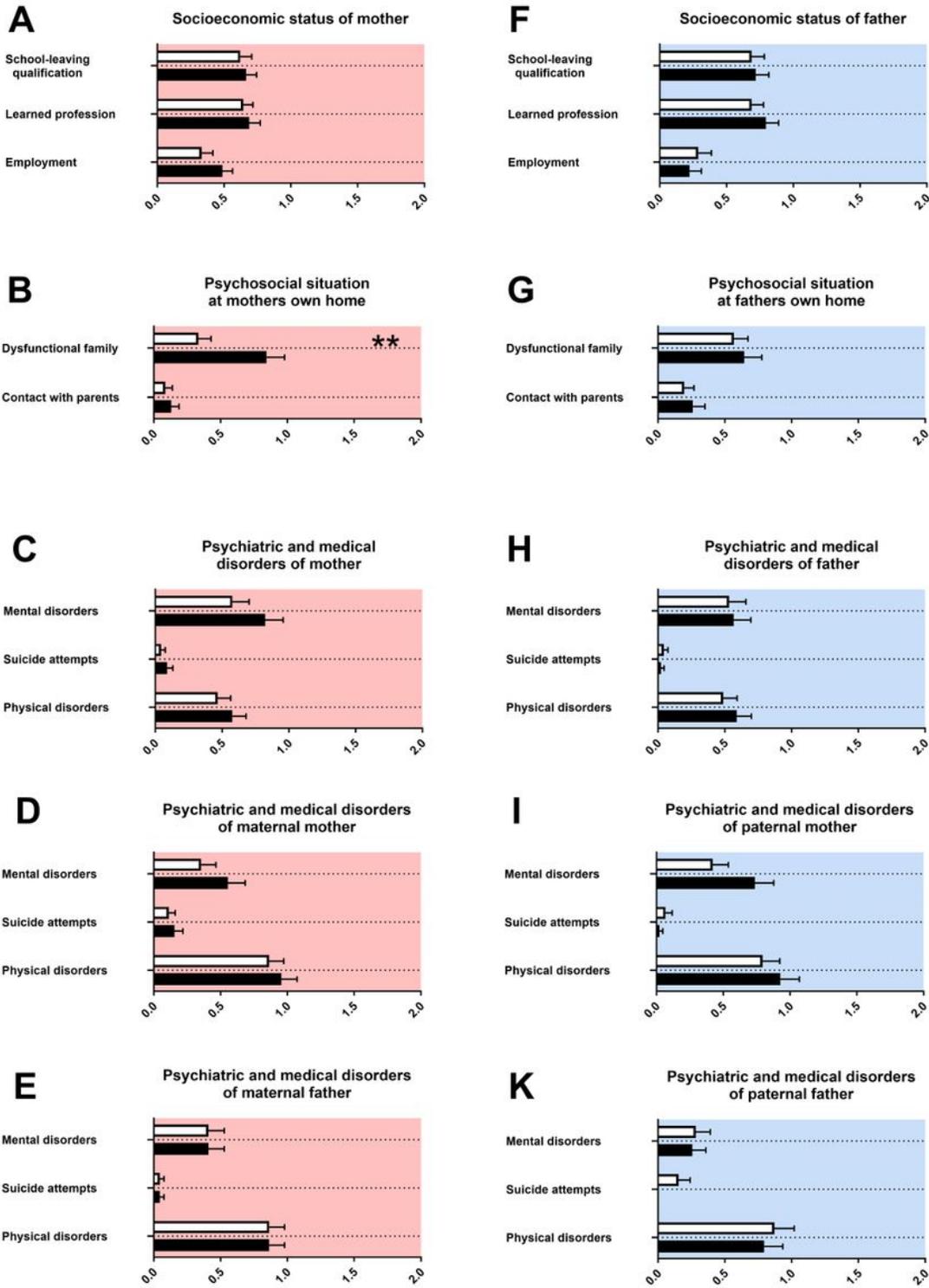
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## Tables

Due to technical limitations, table 1 and 2 xlsx are only available as a download in the Supplemental Files section.

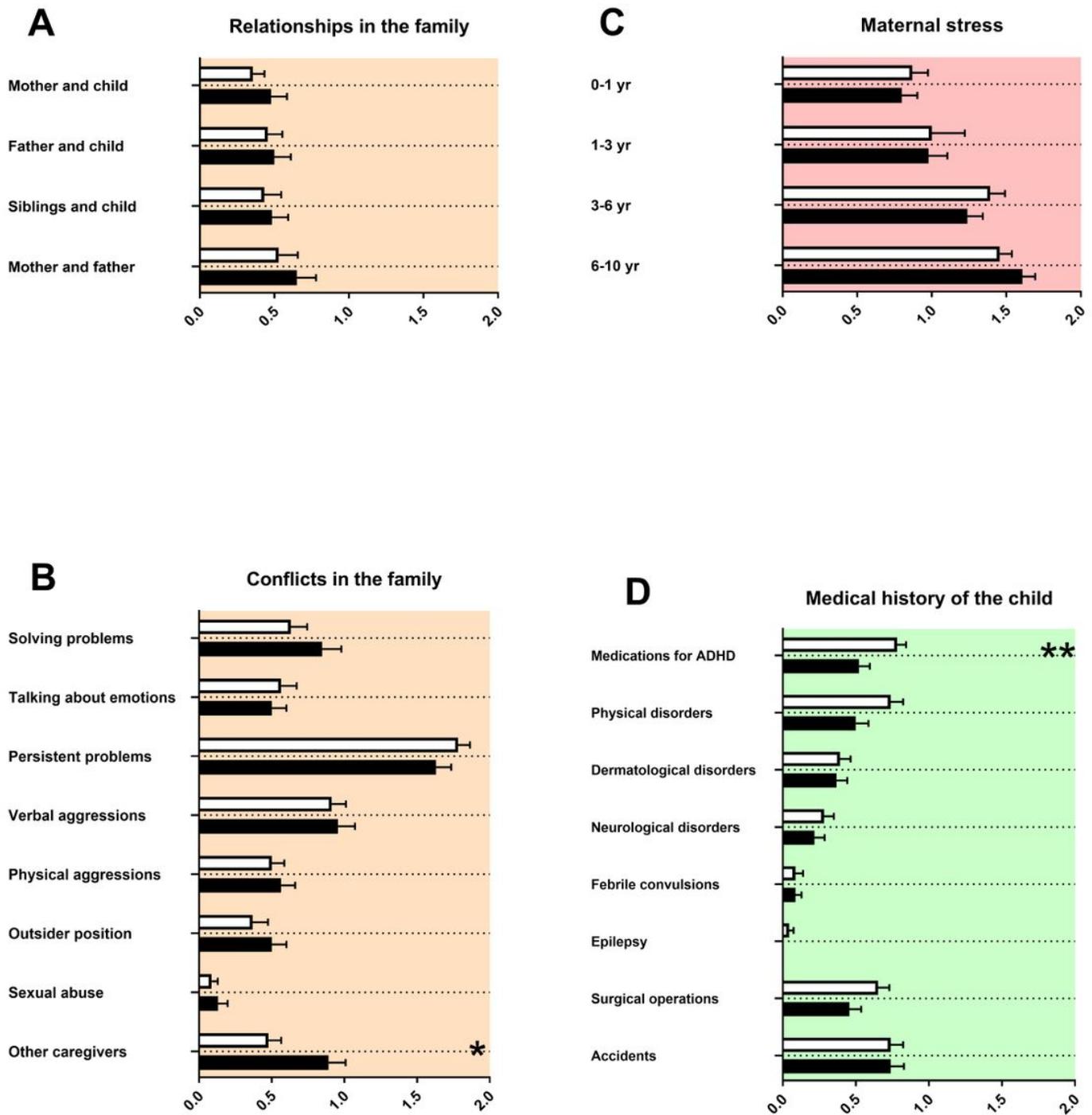
## Figures



**Figure 1**

Family history. The x-axes in Fig. 1A and 1F represent the level of academic dysfunction (academic, non-academic, no certification) or employment status, respectively (full-time, part-time, no employment). The x-axes in Fig. 1B-E and Fig. 1G-K represent the level of psychiatric, psychosocial or medical burden. Graphs show mean, SEM and results from two-way ANOVA. Black symbols represent female adolescents with ADHD and white symbols male adolescents with ADHD. Red color in the plotting area represents

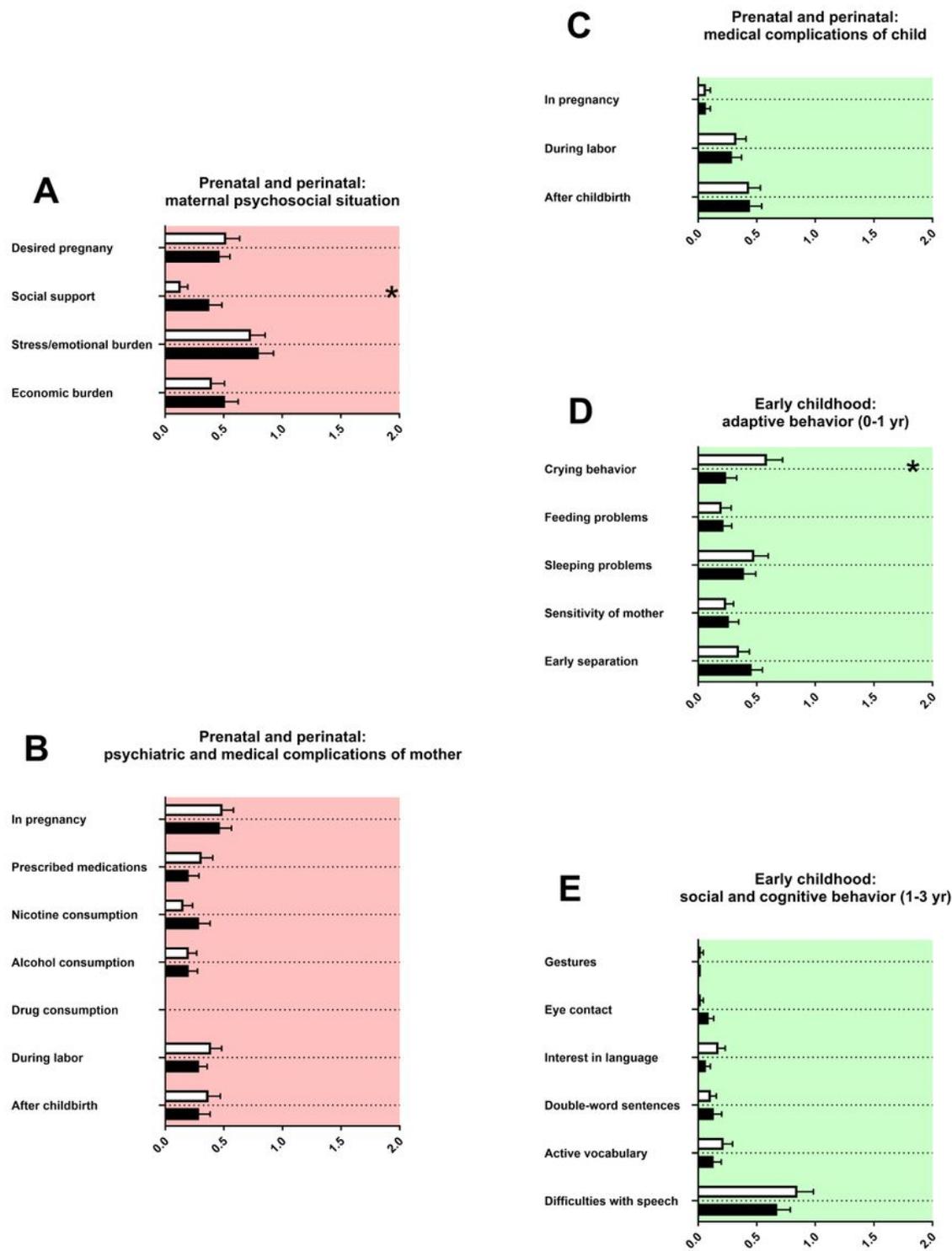
data about mothers of patients and blue color data about fathers of patients. Two asterisks represents  $p < 0.01$ .



**Figure 2**

Family relationships and conflicts and medical history of the child. The x-axes in Fig. 2A-C represent the level of psychosocial burden. The x-axis in Fig. 2D represents the level of medical burden. Graphs show mean, SEM and results from two-way ANOVA. Black symbols represent female adolescents with ADHD and white symbols male adolescents with ADHD. Red color in the plotting area represents data about

mothers of patients, orange color data about the whole family of patients and green color data about the patients themselves. One asterisk represents  $p < 0.05$  and two asterisks  $p < 0.01$ .

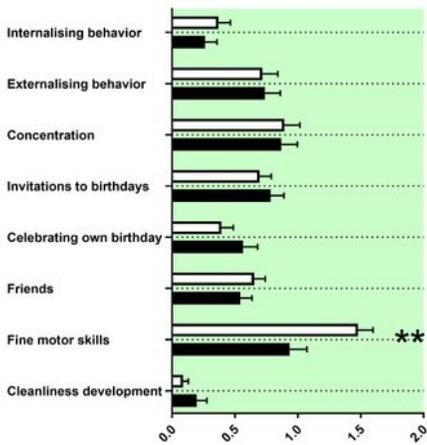


**Figure 3**

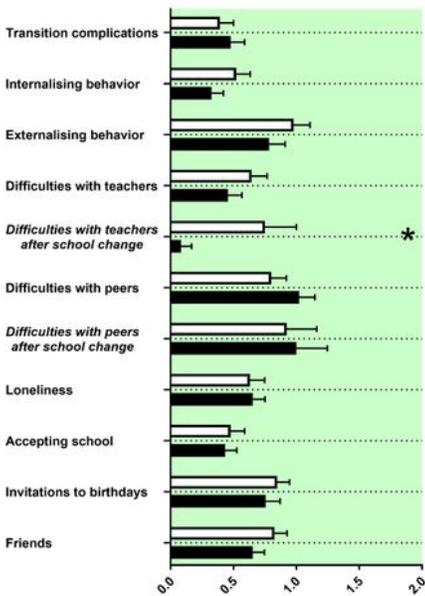
Prenatal and perinatal history and early childhood. The x-axis in Fig. 3A represents the level of psychosocial burden. The x-axis in Fig. 3B represents the level of psychiatric and medical burden. The x-axis in Fig. 3C represents the level of medical burden. The x-axis in Fig. 3D represents the level of

maladaptation between mother and child. The x-axis in Fig. 3E represents the level of social and cognitive dysfunction. Using gestures and interest in language (songs, rhymes or books) were remembered for the first birthday of the child, eye contact for the first year of life. Double-word-sentences and active vocabulary were remembered for the second birthday. Difficulties with speech represent the use of speech therapy. Graphs show mean, SEM and results from two-way ANOVA. Black symbols represent female adolescents with ADHD and white symbols male adolescents with ADHD. Red color in the plotting area represents data about mothers of patients and green color data about the patients themselves. One asterisk represents  $p < 0.05$ .

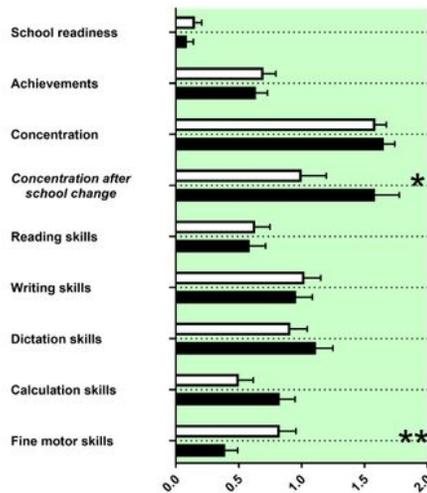
**A** Middle childhood - preschool: social and cognitive behavior (3-6 yr)



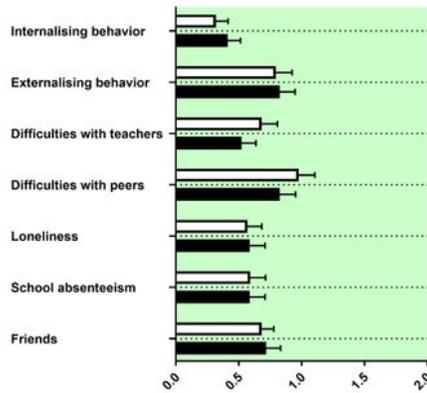
**B** Middle childhood - primary school: socio-emotional behavior (6-10 yr)



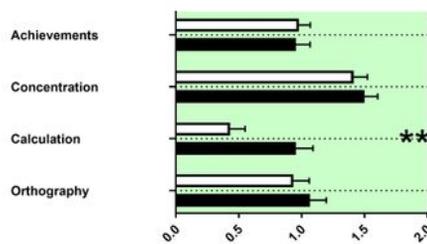
**C** Middle childhood - primary school: cognitive behavior (6-10 yr)



**D** Late childhood: socio-emotional behavior (10-17 yr)



**E** Late childhood: cognitive behavior (10-17 yr)



**Figure 4**

Middle and late childhood history. The x-axes represent the level of socio-emotional or cognitive burden. Graphs show mean, SEM and results from two-way ANOVA. Black symbols represent female adolescents with ADHD and white symbols male adolescents with ADHD. Green color in the plotting area represents data about the patients themselves. One asterisk represents  $p < 0.05$  and two asterisks  $p < 0.01$ .

## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

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