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Family Functioning Style as a Predictor of the Quality of Cognitive Functioning of Primary School Students With ADHD

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Abstract

Objective: This study aimed to specify whether family communication and satisfaction are predictors of a child's executive functions and whether attention deficit hyperactivity disorder (ADHD) severity lies in the pathway between these variables.
Method: Two hundred Polish children with ADHD, aged 10 to 13, were tested using Conners 3, the PU1 Battery of Cognitive Tests and Stanford-Binet Intelligence Scale, Fifth Edition (SB5). Parents filled out the FACES IV-SOR questionnaire. Structural equation modeling (SEM) was used to test the hypotheses.
Results: The quality of family communication and satisfaction did not predict executive functioning in children with ADHD, and ADHD severity did not play a mediating role neither in boys or in girls. Intelligent quotient was the only predictor of executive functioning in the group of boys.
Conclusion: These results contrast with those of previous studies that have shown the existence of similar associations in other cultural contexts. *(J. of Att. Dis. XXXX; XX(X) XX-XX)*

Keywords

ADHD, communication, family satisfaction, executive functions, and family functioning style

Attention-deficit hyperactivity disorder (ADHD) is one of the most common neurodevelopmental disorders in school-aged children. According to the latest reports, ADHD affects 2%–7% of the population, with an average of approximately 5% (Sayal et al., 2018). In Poland, the prevalence of ADHD is estimated to be 3%–12% of the population, or 6.6% on average (Kiejna et al., 2020). ADHD is characterized by a deficit of attention, hyperactivity, and impulsiveness, which hinder the child's daily functioning or are disproportionate to his level of development (APA, 2013). The three axial symptoms of ADHD significantly affect the quality of children's social relationships, as they can cause difficulties in inhibiting reactions to new stimuli, coping with unpleasant emotions, and controlling attention processes (V. Harpin et al., 2016; Lipowska & Dykalska-Bieck, 2010).

Family Disturbances in ADHD

The social sphere is one of the areas of functioning that is affected in children with ADHD, where difficulties are visible in interactions with peers, siblings, and parents (Cappe et al., 2017; Kaźmierczak-Mytkowska et al., 2022; Lipowska & Rasmus, 2013). The style of interaction in the family largely determines how social bonds are created in the later stages of a child's development. Moreover, the degree of family adaptation to a child's disorder may affect the course and quality of the child's functioning at many levels (Barkley, 2015).

Undoubtedly, the presence of ADHD in a child hinders the provision of optimal emotional and social conditions necessary for raising children in a family (V. A. Harpin, 2005; Montes & Montes, 2021; Wymbs et al., 2017). Many studies have confirmed that families in which children with ADHD are raised are characterized by a higher level of conflict in the parent-child relationship and between siblings (Anastopoulos et al., 2009; Deault, 2010), parental stress (Ben-Naim et al., 2019; Theule et al., 2013), less effective parenting strategies

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(Gau, 2007; McLaughlin & Harrison, 2006; Montes & Montes, 2021; Wymbs et al., 2017), higher risk of mental disorders in the side of parents (Deault, 2010; Wolafnczyk et al., 2014), and lower marital satisfaction (Ben-Naim et al., 2019). Longitudinal studies conducted with children in early and middle childhood showed that a lower level of parental sensitivity, a positive attitude toward the child on the part of the mother, and a higher level of intrusive behavior on the part of parents resulted in a greater manifestation of ADHD symptoms later in the child's development (Keown, 2012). Disorganized attachment style was another factor that maintained ADHD symptoms in late adolescence, regardless of the baseline symptom level and changes in cognitive functioning in late childhood (Salari et al., 2017). Parents' negative cognitions can also be a factor in sustaining children's difficulties (Barkley, 2015). So far, researchers have dealt with the perspective of communication and family satisfaction in families raising children with ADHD to a limited extent (Barkley, 2015; Theule et al., 2013).

Sex Differences and Family Functioning

Clinical observations and literature also indicate sex differences in the manifested symptoms. To date, reports in the literature have shown a large disproportion in the prevalence of ADHD (3:1 of the clinical population) and greater demonstration of symptoms in boys (Arnett et al., 2015). It is assumed that boys are more likely to be hyperactive and impulsive, and girls are more likely to suffer from attention deficits (Rucklidge, 2010). Moreover, during childhood and adolescence, the environment begins to promote stereotypical behaviors consistent with the child's sex, which significantly influences the parenting strategies. With regard to the relationship between the sex of a child with ADHD and the parenting style, the literature so far has been quite consistent: compared to families raising girls, those raising boys are characterized by a more authoritative style of upbringing (Muñoz-Suazo et al., 2020). However, there have also been reports of the opposite direction of dependence, in which parents of girls used authoritative strategies more often (Muñoz-Suazo et al., 2020). To date, the topic of parenting styles in families raising children with ADHD has not been studied in detail in the Polish population.

Coping With ADHD Within a Family

An interesting approach to parent-child interaction was presented by Barkley (Barkley, 2015; Robin, 2014). His developmental-transactional model of ADHD within the family context assumes the influence of biological, relational, and environmental factors on the course of ADHD. It consists of adolescent characteristics, parental characteristics, marital/coparenting relationships, siblings' relationships (bi-directional influence), school/community, and cultural/social factors (unidirectional influence). In light of this model, parents can be treated as facilitators and inhibitors of children's coping with ADHD. Parenting practices toward a child with ADHD include a spectrum of behaviors: warmth/hostility, structure/chaos, level of monitoring of adolescent behaviors, consistency in administering rules, problem-solving, communication, behavior management skills, and belief systems. When parenting practices reach the negative side of the spectrum, one or more factors can promote conflict in adolescent-parent relationships. While it is difficult to change the personality or genetic characteristics of adolescents and parents, or the family environment/stresses, as they are often beyond the influence of therapeutic interventions, parents can change their parenting practices and, in return, obtain a positive change in adolescent symptoms of ADHD.

Cognitive Functioning of Children With ADHD

Disturbed cognitive functioning at many levels is an axial symptom of ADHD. Children with ADHD often cannot cope with problems that require complex mental operations. For this reason, the greatest severity of difficulties in children occurs at school age, and in addition to increasing scientific challenges, there are also expectations from parents regarding the increasing number of responsibilities related to family life and respecting social orders and bans. In this period, developing executive functions starts to play a significant role, which is associated not only with academic performance but also with emotional, behavioral, and social functioning (Anderson & Reidy, 2012). Executive functions are a group of top-down mental processes that primarily involve cognitive control (inhibitory and interference control), working memory, and cognitive flexibility. Executive functions are needed when an action cannot be performed automatically and to maintain a high level of focus and concentration. They are responsible for complex mental operations (Diamond, 2013). Based on these three main and basic executive function processes, higher-order executive functions such as planning, problem solving, and reasoning are developed. In the latest literature, there is evidence of relationships between cognitive variables in the social context of children with ADHD. Kofler et al. (2017) proved that deficits in family functioning in children aged 8 to 13 with ADHD are correlated with impairments in working memory, where control of reaction inhibition is a predictor of family functioning described by the parent. In another study on a similar sample of participants (Kofler et al., 2018), predictors of social difficulties noticed by parents and teachers were deficits in working memory and attention, as well as hyperactivity and impulsivity. Furthermore, there is evidence that therapeutic interventions aimed at improving the cognitive functioning of parents of children with ADHD improve the cognitive functioning of the children through better self-regulation of the parent (Fosco et al., 2018). In a Spanish population of

children with ADHD in middle childhood (Barreto-Zarza et al., 2022), ADHD symptoms were predictors of better family functioning in terms of social support network, family stress, parental self-efficacy, and attention control. In addition, male sex was also a significant predictor of the intensity of ADHD symptoms, which confirms, in line with the older literature, that male sex is a risk factor for greater severity of ADHD symptoms. Furthermore, studies on Norwegian and Swedish populations (Forssman et al., 2009, 2012) indicate that family risk factors (e.g., family disorganization, low level of parental education, or stressful family events) are related to the quality of cognitive function in children with ADHD, including executive functions. However, to our knowledge, no studies have considered executive functions as a result of the child's attention and memory abilities and the family functioning style, which consists of a positive family climate, high-quality family communication, and satisfaction level.

Family Functioning Style as a Protective Factor for Cognitive Functioning in ADHD

When considering a holistic understanding of neurodevelopmental disorders, it is important to remember that the diagnosis and treatments directed at both the child and the entire family system play an important role, especially since research suggests that the relationship between parenting style and ADHD symptoms may be bidirectional (Tarver et al., 2014). Therefore, we asked whether a balanced family functioning style consisting of good quality communication and satisfaction may be a factor influencing the course of ADHD in children, and whether it may make cognitive deficits less severe in children. The Circumplex Model created by Olson and colleagues since the 1970s shows that balancing the dimensions of cohesion and flexibility as well as good-quality communication and satisfaction with family life are indispensable elements of a healthy family system (Margasiński, 2015). In the case of a family system struggling with child-raising difficulties related to ADHD, these features seem to be important and needed to develop the best coping strategies for both children with ADHD and the whole family (Wolraich et al., 2005). Executive functions are the most important cognitive processes in the context of family functioning, where parents expect their child to have planning, initiating activities, inhibiting reactions, and problem-solving skills in late childhood. However, executive functions are the last to develop in terms of development. Therefore, children with neurodevelopmental deficits will potentially have greater difficulties in self-regulation and, at the same time, in family functioning than children without ADHD. This study aimed to determine whether the style of family functioning is a predictor of the quality of executive functions in children with ADHD aged 10 to 13 years, a problem for which researchers have yet to find a complete solution.

Current Study

In this study, we put forward a hypothesis regarding the influence of family functioning style, and more specifically, the level of communication and family satisfaction from the parent's perspective, on the quality of the child's cognitive functioning in terms of executive functions. We assumed that higher levels of communication and satisfaction would create the conditions for better executive functioning. Furthermore, whether the child's sex and the severity of ADHD symptoms influence executive function quality was investigated. Since boys are more often diagnosed with hyperactive-impulsive ADHD than girls, we assume that the quality of executive function in the family context will be reduced more in boys than in girls. In addition, this study assessed whether the intensity of ADHD symptoms also has a negative impact on the quality of executive functions in children due to increased cognitive difficulties.

Aims and Hypotheses

The current study specifically used a mediation model to define the relationship between family functioning style and executive functioning in ADHD (Figure 1). According to the proposed model, the following hypotheses were tested for the two sexes:

Hypothesis 1: Family functioning style is a predictor of executive functioning in boys and girls with ADHD.
Hypothesis 2: The severity of ADHD mediates the relationship between family functioning style and quality of executive functioning in boys and girls.

Theoretical Framework

Study Variables

Independent Variables. Family communication and satisfaction are components of the overall family functioning style, which is a way of creating bonds between its members (Margasiński, 2015). Communication is the ability of family members to communicate positively. With the ability to communicate effectively, families can change their levels of cohesion and flexibility. Family satisfaction is defined as the level of mutual happiness and fulfillment within the family. The indicators of the level of communication and satisfaction with family life were the results obtained by the respondents on the "communication" and "satisfaction" scales in the FACES IV-SOR parent-filled questionnaire.

Dependent Variable. Executive functions are higher-order cognitive processes that are the link between stimulus perception and behavioral response. They include the ability to formulate goals, plan, maintain the purposefulness of actions, and develop effective strategies for achieving goals

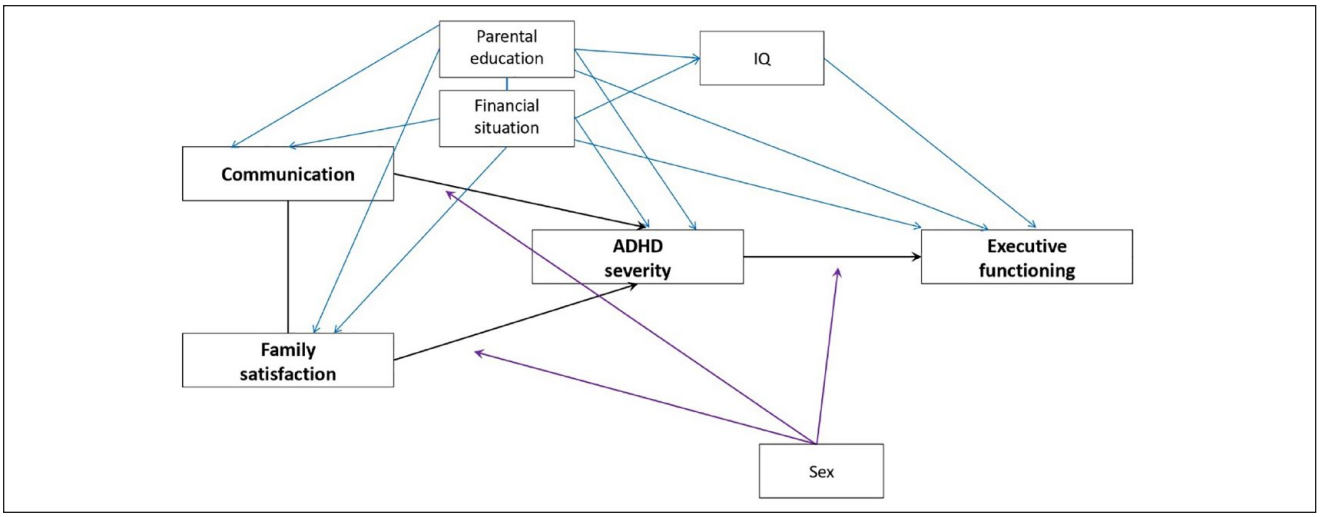

Figure 1. Research model.

(Borkowska et al., 2015). In this study, the indicators of the quality of executive functions were the results obtained by the respondents in the Battery of Cognitive Tests PU1, where statistical analyses used the overall results obtained by the child in tasks requiring the ability to monitor activity, phonological and categorical fluency, and planning.

Mediator Variable. ADHD severity is the child's level of ADHD symptoms as defined by the DSM-5 (Wrocławska-Warchała & Wujcik, 2018). This variable was operationalized using the ADHD index obtained from the Conners 3 questionnaire in the parent version, in which data on the child's symptoms of hyperactivity and attention deficits were obtained.

Covariates. Moderator Variable. Child's biological sex was defined as male, female or other and was indicated by a parent during filling General Questionnaire prepared as a part of NeuroSmog study protocol (Markevych et al., 2021).

Confounders. A full-scale intelligence quotient (IQ) score was obtained using the Stanford-Binet Fifth Edition Intelligence Scale (Roid et al., 2017). Parental education and financial situation in 2019 declared by a parent were also confounders in the study.

Method

Participants

The participants were children who participated in the case-control NeuroSmog project. Two hundred children aged 10 to 13, diagnosed with ADHD and attending primary schools in 18 cities in southern Poland, constituted the analytic sample of this study (Figure 2). Participants were initially selected by cooperating with school psychologists and medical doctors. We also recruited children with suspected ADHD via advertisements in the local media. Initial inclusion factors were the child's age (over 10 years old and up to 13 years old), the absence of diagnosed and/or treated mental disorders and diseases, no diagnosis of mental disorders, no pharmacotherapy (affects on cognitive function), no history of neurological diseases, with normal or corrected to normal visual and auditory acuity, and normal or above intelligence level. The exclusion criteria were autism spectrum disorders, fetal alcohol syndrome/fetal alcohol effects, intellectual disability, metabolic diseases, genetic defects, epilepsy, cerebral palsy, mood disorders, Tourette syndrome, other serious diseases involving pharmacological treatment, affecting the cognitive functioning, an Apgar index <8, low birth weight (less than 2,500 g), and prematurity (gestational age <35 weeks). In the second stage, the independent council excluded children with comorbid disorders such as oppositional defiant disorder (ODD), conduct disorder, mood disorders, anxiety disorders, obsessive-compulsive disorder, post-traumatic stress disorder, ticks, autodestructive disorders, eating disorders, psychosomatic disorders, sensory integration disorders, specific language impairment, developmental co-ordination disorder. In addition to the diagnosis of cognitive function in children, the study involved parents who completed the FACES IV-SOR scale. Figure 2 shows the schemes for selecting participants.

Questionnaires

FACES IV-SOR. This questionnaire, originally written by Olson, was adapted into Polish by Margasiński (2015). It examines the four dimensions of family functioning: cohesion, flexibility, communication, and family satisfaction.

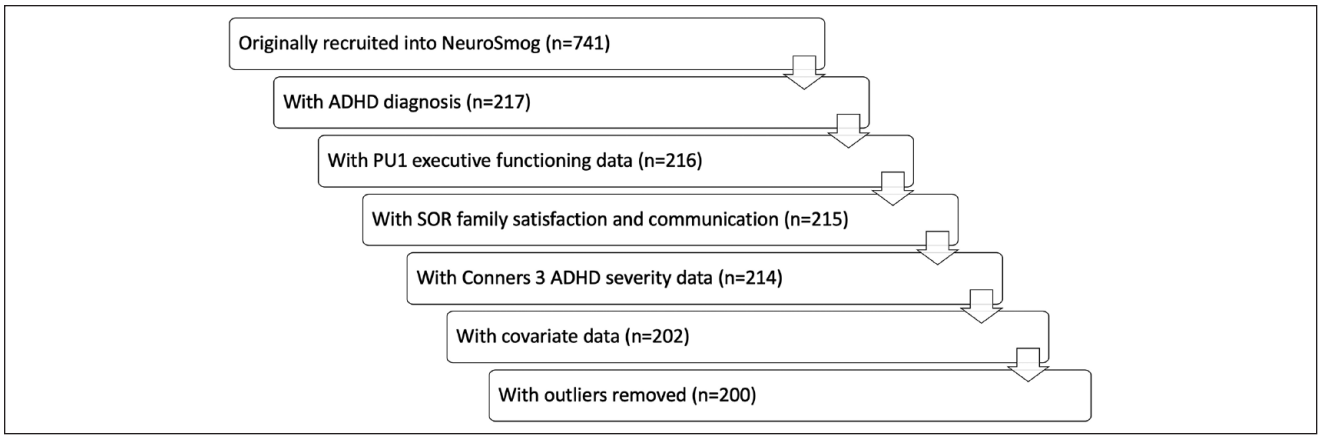

Figure 2. Flow chart of the analytic sample.

Cronbach's alpha reliability indices in this study group for communication and family satisfaction ranged $\alpha = .88$ to .90.

Diagnostic Battery for Cognitive Functions PU1. This tests battery was originally developed by Borkowska et al. (2015). It is a Polish-specific battery consisting of 15 tests examining the structure of cognitive skills in children aged 10 to 13 years. The test examines working memory (the level of visual-spatial and visual-motor working memory functioning, short-term auditory memory on verbal material), attention (the ability to orientate on a stimulus, divisibility of attention, inhibition of external distractors, maintaining alertness, and shifting attention), and executive functions (monitoring, phonological and categorical fluency, planning). This tool enables the diagnosis of various cognitive deficits. In this study, we used a general index of executive functioning, which consists of cognitive and motor inhibition, intentionality, planning, and cognitive flexibility tasks. Cognitive skills were measured using the following four tasks:

Spatial Working Memory. A "square test" was performed in which a participant was shown a 4×4 square matrix and asked to remember the sequences of appearing squares and recall them after the presentation. The child must click the correct sequence backward using a computer mouse. The number of correctly clicked backward sequences and correctly recalled squares in the wrong order were the results of the square test task.

Phonological and Categorical Fluency. This includes the verbal fluency I and II tests. In the first task, the child is asked to recall words starting with K letters within 60 s. In the second task, the child was asked to recall as many names of the animals as possible. The number of names recalled in both categories was the result of verbal fluency tasks.

Planning. This included a "park map test," in which a psychologist presented a drawing diagram of the park with specific requirements to follow. The participant's task was to draw a path from the start to the finish point, following detailed instructions. The time of completion and the number of instructions followed are the results of the park-map test.

The internal consistency, measured by Cronbach's alpha coefficient for the sample of Polish children was $\alpha = .74$.

Conners 3 Questionnaire. This questionnaire, originally developed by C. K. Conners, was adapted into Polish by Wrocławska-Warchała and Wujcik (2018). It includes a set of questionnaires for the diagnosis of ADHD that can also be used for the differential diagnosis of oppositional defiant disorder (ODD) and conduct disorder (CD). This version is suitable for children, parents, and teachers. The Cronbach's alpha reliability indices for Polish population ranged $\alpha = .70$ to .93.

Stanford-Binet Intelligence Scale Fifth Edition-Fifth Edition. The Polish adaptation of the Stanford-Binet Intelligence Scale Fifth Edition was published by Roid et al. (2017). This scale is based on the CHC theory of intelligence and examines five cognitive factors (fluid reasoning, quantitative reasoning, crystallized knowledge, short-term memory, and visual processing). The scale assesses the intelligence and cognitive abilities of people aged 2 to 85 years. The Cronbach's alpha coefficient for the Polish population ranged $\alpha = .92$ to .98.

Procedure

The NeuroSmog study was carried out in 18 cities in southern Poland and had two stages. A psychological evaluation was performed during three comprehensive meetings with assessing psychologists at the child's place of residence. An independent council of three clinical psychologists verified the child's results and diagnosis according to ICD-11

diagnostic criteria. Children who did not meet the criteria were excluded from the study.

Data analyzed in this article were collected during the first and second out of three diagnostic meetings where children and parents were asked to complete the Conners 3 Scale (parents), the PU1 test (children), and the FACES IV-SOR (parents). This study was approved by the Ethics Committee of the Institute of Psychology, Jagiellonian University, Kraków, Poland (# KE_24042019A). The clinical trial identifier was NCT04574414. Written informed consent was obtained from all the children involved in the study and their legal guardians. All methods were performed in accordance with relevant guidelines and regulations. The detailed procedure for the overall study has been described in a previous paper (Markevych et al., 2021).

Data Analysis

Data preprocessing and statistical analysis were performed using the statistical software R, version 2022.07.2 (R Core Team, 2018). Descriptive characteristics of the analytic samples of boys and girls are presented as frequencies and percentages for nominal and ordinal data and as means, standard deviations, minimums, and maximums for numerical data. The distribution of the dependent variable (executive functioning) was tested using a histogram, and no deviation from normality was detected. Two outliers (executive functioning >200) were identified by visual inspection of the scatter plots and were excluded from the analysis. Pearson correlations were performed separately for girls and boys to explore bivariate associations in the data.

To investigate whether ADHD severity was related to the association between family functioning and executive functioning while simultaneously adjusting for confounders, we employed structural equation modeling (SEM) as a powerful and flexible modern mediation approach. SEMs were run separately for boys and girls. Since all numerical variables were on very different scales, we transformed them into z-scores prior to running the SEM; thus, their beta coefficients are standardized. We used a robust diagonally weighted least squares (DWLS) estimator (Bollen & Long, 1993) with bootstrapping (1,000 draws) to estimate standard errors. In line with the recommendations of Hu and Bentler (Rosseel, 2012) we assessed goodness of fit using a set of comprehensive indices: a non-significant $\chi 2$ ($p > .05$), a root mean square error of approximation (RMSEA) ≤ 0.06, with a 90% CI ≤ 0.06, a standardized root mean square residual (SRMSR) ≤ 0.08, and a comparative fit index (CFI) ≥ 0.95. SEM modeling was performed with R's lavaan v. 0.6-12 package (Rosseel, 2012), and a p-value of <0.05 was selected as a threshold for statistical significance.

Results

Descriptive Characteristics of Study Variables

Statistical analysis of the mean values obtained for socioeconomic variables in the group of girls and boys with ADHD showed that the mean age of the was 11.14 ($SD = 0.8$) and 11.20 years ($SD = 0.9$), respectively. The perceived financial situation in the year before this study (2019) was mostly good (67.3% vs. 62.2%). The parents' minimum education level was predominantly high school and additional trainings or Bachelor or Master degree in the group of girls (both 38.5%) or secondary (41.2%).

The mean results of family satisfaction obtained by parents of girls and boys in the FACES IV-SOR were 37.21 ($SD = 7.8$) and 39.16 ($SD = 6.64$), respectively. These results correspond to the sixth to seventh sten for Polish population norms, indicating that the participants presented the average scores of family satisfaction. In the case of communication variable, the mean results for parents of girls and boys in the FACES IV-SOR were 36.88 ($SD = 8.91$) and 38.72 ($SD = 7.02$), respectively. As the family satisfaction, the communication results correspond to the fifth sten for Polish population norms, indicating that the participants presented the average scores of communication within a family. The mean results of ADHD severity obtained in the Conners 3 Questionnaire were 13.1 ($SD = 3.33$) for girls and 14.3 ($SD = 4.14$) for boys. This score is higher than the cutoff point for the diagnosis of a high probability of ADHD (ADHD index ≥ 9). The general IQ score (verbal and nonverbal scales combined) in the group of girls was 99.65 ($SD = 11.04$). In the group of boys, the IQ was 100.42 ($SD = 11.98$). These results mean that the children who participated in the study had an average IQ. The executive functioning index of spatial working memory, phonological and categorical fluency, and planning results obtained in the Diagnostic Battery for Cognitive Functions PU1 was 0.74 ($SD = 10.84$) for girls and 2.74 ($SD = 10.49$) for boys. These results correspond to the fifth sten for Polish population norms, indicating that the participants presented an average level of executive functioning. Table 1 shows the detailed results.

The Correlation Analysis

We found several statistically significant relationships between the study variables. The only correlation with a high level of strength was between family satisfaction and communication. However, both variables were measured with the same FACES IV-SOR test and are not the main relationships examined in this study. Figures 3 and 4 show the detailed results.

Structural Equation Modeling

In boys, the SEM results showed only one statistically significant relationship, important for a research model,

Table 1. Descriptive Characteristics of Qualitative and Quantitative Variables in the Group of Children with ADHD.

Variable	Descriptive statistics	Value
GIRLS		
Perceived financial situation in the year 2019	*n* (%)	1 (1.9)
Bad		
Managed	*n* (%)	6 (11.5)
Good	*n* (%)	35 (67.3)
Very good	*n* (%)	10 (19.2)
Minimum parental education	*n* (%)	12 (23.1)
Primary school or vocational education		
High school and additional trainings after high school	*n* (%)	20 (38.5)
Bachelor or Master degree	*n* (%)	20 (38.5)
Age	Mean ± *SD* (min-max)	11.14 ± 0.8 (9.97–12.85)
Family satisfaction	Mean ± *SD* (min-max)	37.21 ± 7.8 (16.0–49.0)
Communication	Mean ± *SD* (min-max)	36.88 ± 8.91 (11.0–50.0)
ADHD severity	Mean ± *SD* (min-max)	13.1 ± 3.33 (5.0–18.0)
IQ	Mean ± *SD* (min-max)	99.65 ± 11.04 (71.0–123.0)
Executive functioning	Mean ± *SD* (min-max)	0.74 ± 10.84 (−24.0–23.41)
BOYS		
Perceived financial situation in the year 2019	*n* (%)	6 (4.1)
Bad		
Managed	*n* (%)	14 (9.5)
Good	*n* (%)	92 (62.2)
Very good	*n* (%)	36 (24.3)
Minimum parental education	*n* (%)	36 (24.3)
Primary school or vocational education		
High school and additional trainings after high school	*n* (%)	61 (41.2)
Bachelor or Master degree	*n* (%)	51 (34.5)
Age	Mean ± *SD* (min-max)	11.20 ± 0.9 (9.92–13.98)
Family satisfaction	Mean ± *SD* (min-max)	39.16 ± 6.64 (19.0–50.0)
Communication	Mean ± *SD* (min-max)	38.72 ± 7.02 (19.0–50.0)
ADHD severity	Mean ± *SD* (min-max)	14.3 ± 4.14 (0.0–20.0)
IQ	Mean ± *SD* (min-max)	100.42 ± 11.98 (69.0–132.0)
Executive functioning	Mean ± *SD* (min-max)	2.74 ± 10.49 (−23.53–31.89)

Note. ADHD = attention deficit hyperactivity disorder; IQ = intelligent quotient; n = number of observations; SD = standard deviation; min = minimum; max = maximum.

between IQ and executive functioning (β=−.22). This means that the higher the IQ score of the male participants, the better their level of executive functioning. No other significant effects were observed. Furthermore, no significant effects were observed in girls. Figures 5 and 6 show the detailed results.

Discussion

At the time of writing this article, this study had gathered one of the largest samples of children with ADHD in Poland who had a reliable and multistage differential diagnosis of this disorder. The sample also reflects the prevalence of ADHD in terms of sex (N=200, 74% of boys) and the intensity of symptoms (Conners ADHD index < 13 in both groups). The study group only included children aged 10 to 13, making it a narrow sample of one of the age groups most sensitive to cognitive deficits in the course of ADHD. The period of pre-adolescence is a time when school education is more focused on achieving school success than before. Furthermore, at this age, the first signs of puberty are already visible, and the normative crisis is connected to it. Contrary to many studies of such clinical trials (Ben-Naim et al., 2019; Fosco et al., 2018; Kofler et al., 2017; Muñoz-Suazo et al., 2020; Wymbs et al., 2017), we took care of the high degree of group homogeneity, particularly in terms of the participants' age and multilevel diagnosis reliability, so that adequate comparisons and conclusions can be made for a specific developmental period, which in this study is preadolescence.

Family Functioning Style Within Families Raising Children With ADHD

The research model presented in this article assumes that communication and family satisfaction directly explain the

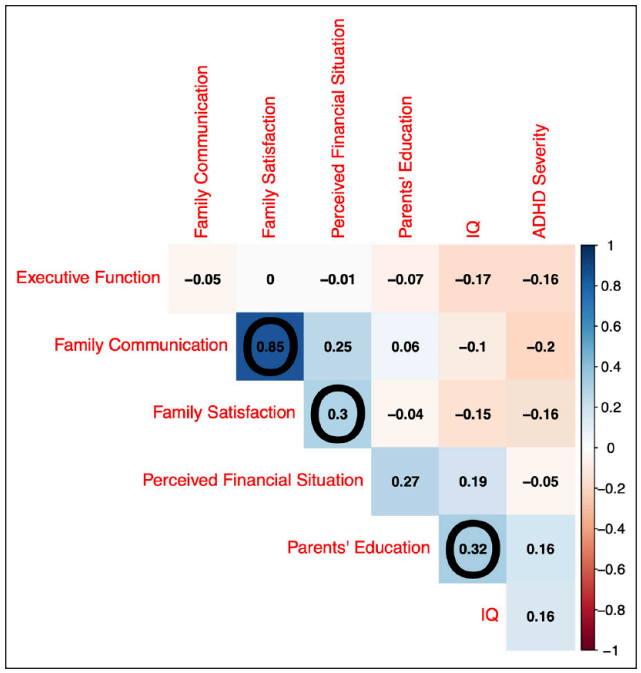

Figure 3. Correlations between all covariates used in the study in the group of girls are reported as Pearson (or phi/point-biserial) correlation coefficients.
Note. Significant correlations ($p < .05$) are encircled.

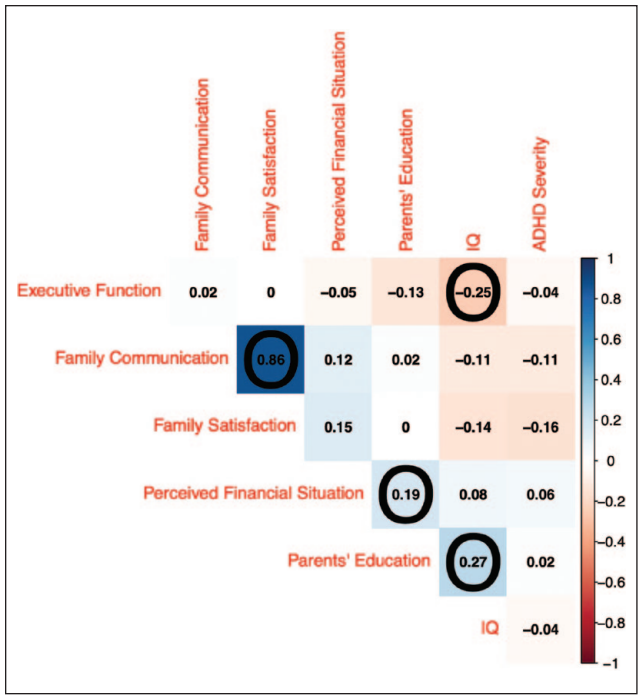

Figure 4. Correlations between all covariates used in the study in the group of boys are reported as Pearson (or phi/point-biserial) correlation coefficients.
Note. Significant correlations ($p < .05$) are encircled.

level of executive functioning in children with ADHD aged 10 to 13 years. Such a model of the relationship between the abovementioned variables has not been widely explored in the literature. However, the analysis of the results did not confirm this hypothesis, indicating that family functioning style is not a predictor of executive functioning. Considering previous reports suggesting that the family climate in which children with ADHD are raised has a significant impact on the demonstration of clinical symptoms (Barkley, 2015; Keown, 2012; Muñoz-Suazo et al., 2020; Salari et al., 2017), the results of this study seem surprising. It might seem that if there is a significant relationship between parental behavior (i.e., parental insensitivity to the needs of a child with ADHD and a positive attitude toward them), intrusive behavior, or an insecure attachment style, the opposite behavior, which is high-quality communication and satisfaction with family life, will constitute a protective factor for the cognitive functioning quality of a child with ADHD, which is one of the pivotal symptoms of this disorder. However, such a relationship could not be visualized, suggesting that the depth of cognitive deficits in a child with ADHD extends beyond the direct and indirect influences of family factors and those that are under the parent's control. The results also do not confirm the validity of the developmental-transactional model of ADHD (Barkley, 2015; Robin, 2014), which indicates that parenting practices can facilitate or inhibit the development of adaptive coping strategies in the context of ADHD. In the context of the present results, such a relationship has not been confirmed, which may indicate that there is no such relationship or that family therapy in the case of families raising children with ADHD may not necessarily have a visible effect on children, including their cognitive functioning, but more on the parents' side and promote more adaptive ways of coping with the difficulties of the child in family life. Furthermore, family systems with children with ADHD obtained average results in terms of communication and family satisfaction, which was also a surprising result. These results differ from those obtained by researchers in other cultural contexts (Muñoz-Suazo et al., 2020), which may mean that parents raising children with ADHD in Poland do not differentiate their communication and parenting strategies by gender as much as in other countries. Perhaps the differences in parenting styles in families raising children with ADHD are not generally visible in the larger sample or in the pre-adolescent period.

Executive Functioning in Family Context

The examined children obtained average results for executive function. This raises questions about the reasons for this result, as we expected that the executive functioning of children with ADHD would be lower than normal for their

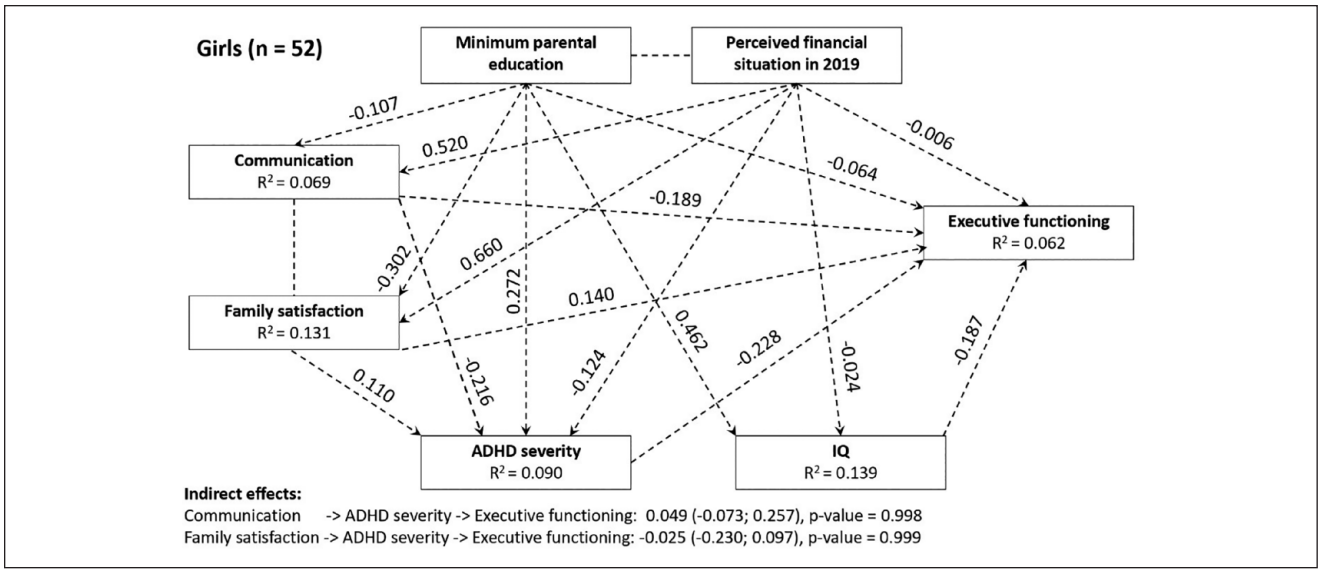

Figure 5. Structural equation model showing the estimated path of family satisfaction and communication to executive functioning through ADHD severity and IQ in the group of girls.
Note. Statistically significant ($p < .05$) standardized beta coefficients are marked with asterisks. R2 shows the proportion of the variance explained for each endogenous variable. Control variables (perceived financial situation and minimum parental education), covariances, and error terms were not displayed for better readability.

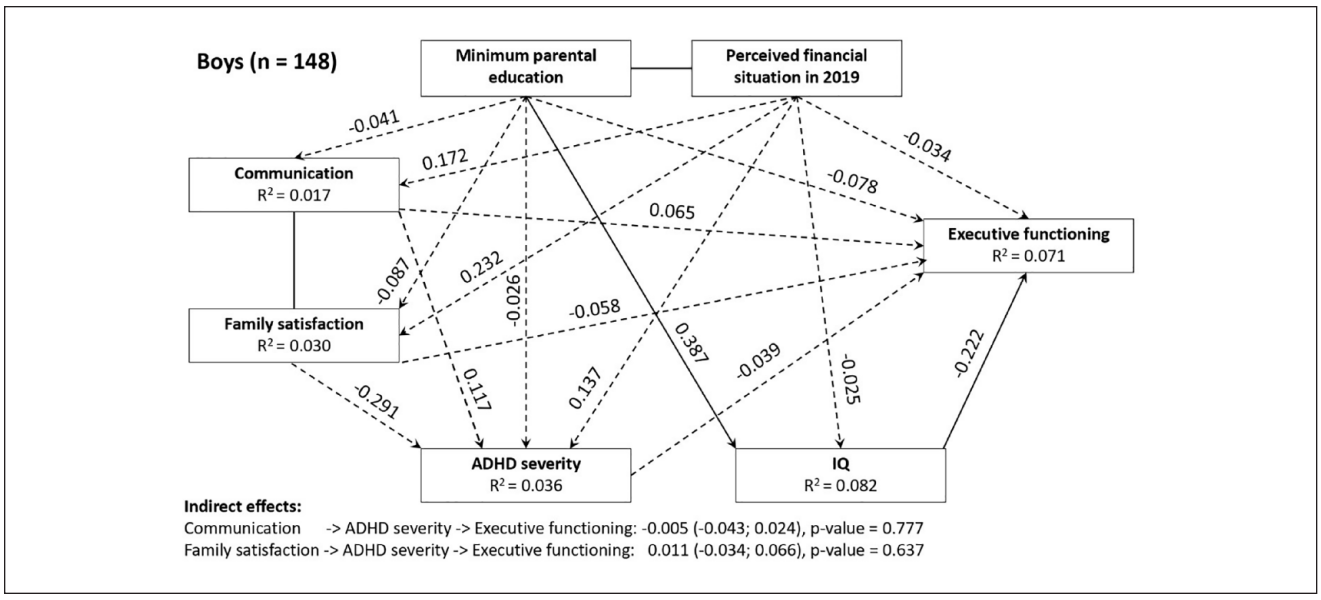

Figure 6. Structural equation model showing the estimated path of family satisfaction and communication to executive functioning through ADHD severity and IQ in the group of boys.
Note. Statistically significant ($p < .05$) standardized beta coefficients are marked with asterisks. R2 shows the proportion of the variance explained for each endogenous variable. Control variables (perceived financial situation and minimum parental education), covariances, and error terms were not displayed for better readability.

age, which is consistent with the clinical picture of ADHD. However, there are no reports in the literature that would allow a detailed comparison of the results obtained in this study with others on the executive functions of children with ADHD. The current literature on the matter describes attention and memory factors on the side of the child that condition family functioning (Kofler et al., 2017, 2018). However, there is very little evidence in the authors' knowledge describing the outcome of these abilities, which are executive functions, in the selected research context.

Furthermore, considering previous reports on the cognitive functioning of parents and children with ADHD and therapeutic interventions in this area (Fosco et al., 2018), these results do not support the validity of research models in which relationships are sought based on parental attitudes and strategies toward the impact on the cognitive functioning of children with ADHD. Fosco et al. (2018) showed that better parental self-regulation improves cognitive functioning in children with ADHD. Therefore, perhaps the key to indirectly improving the cognitive functioning of children with ADHD is not to focus on the family system and its broad functioning but rather to improve the parent's individual self-regulation techniques, which may also be affected to some extent by the ADHD spectrum.

We found a statistically significant relationship between IQ and executive functioning exclusively in boys. No such connection was found among the girls. The boys who had a higher overall IQ also presented better executive functioning. Given the size effect ($\beta = -.22$, $R^2 = .08$), this score is probably of little practical importance and should be considered with caution. This result implies that the family functioning of boys with ADHD may be facilitated by a higher IQ.

Furthermore, this study did not consider the results of other cognitive components, such as attention and memory, as was the case in other studies cited above. There may be significant relationships between family and cognitive factors that are not visible in complex cognitive skills such as executive functions.

This study aimed to find relationship between family protective factors of communication and family life satisfaction, executive functioning quality, and ADHD symptom intensity. Earlier literature (Forssman et al., 2009, 2012) suggests that family risk factors are related to cognitive functioning in children with ADHD, which, compared to the results we have obtained, shows that perhaps only the risk factors in this case should be considered when diagnosing and treating children with ADHD. The impact of a more adaptive family climate is likely to be a negligible factor. However, there is insufficient evidence to consider this a stable effect.

Limitations

The lack of relationships between family functioning style and executive functions may also be the result of differences in the nature of the cognitive variables studied. Memory and attention are considered the basic cognitive functions. Perhaps we have not been able to capture the relationship between executive functions and family functioning style in the group of children with ADHD because, in the case of higher-order cognitive functions, there are other, more important factors modeling this influence that have not been investigated in this study. Contrary to the approach of other researchers who focused on selected cognitive skills (Barreto-Zarza et al., 2022; Forssman et al., 2012; Kofler et al., 2017), a general index of the quality of executive functioning was used for statistical analysis, consisting of several tests that examined lower-and higher-order executive functions. This may have caused the relationship between the variables in this study to not be shown and may have somewhat blurred the validity of the study. A better research approach would probably be to either a) include a specific study model or single scores of cognitive skills composing executive functions or b) focus more on other cognitive skills (i.e., attention or working memory) than executive functions themselves in future studies. Executive functions are fragile constructs that are defined differently by researchers (Anderson & Reidy, 2012; Barkley, 2015; Diamond, 2013), which could be another factor influencing the results of this study.

Conclusions

The study described in this article did not confirm statistically significant relationships between family functioning style and the quality of executive functions in the group of Polish children with ADHD aged 10 to 13 years. Despite previous evidence in the literature and described in smaller clinical groups, where the study group was composed of a multidimensional clinical group of children with ADHD, no substantive relationships were found.

On the one hand, these results may open a discussion about the methodology of selecting participants for the study group, where many researchers examine children underdiagnosed with ADHD too liberally or conduct research and draw conclusions from a sample that is too small. These are important issues, primarily because of the characteristics of ADHD. First, in the course of ADHD, there is a large spectrum of symptoms, along with many comorbid disorders, which can cause diagnostic difficulties and contaminate the reliability of the results. Second, for methodological reasons, studies on smaller groups of participants are less reliable than those carried out on larger groups, despite the difficulties that researchers may encounter in gathering such clinical groups.

However, the findings of this study may indicate that the upbringing climate in families raising children with ADHD may be of secondary importance in the treatment of this disorder. Perhaps a more accurate research direction, as indicated in the reports mentioned above, is to focus on looking for relationships between the level of self-regulation of parents and that of children with cognitive difficulties. This research may also dispel some doubts that practitioners who aim to holistically approach the therapy of the entire family system raising children with ADHD may place greater emphasis on working with a parent-child dyad than on other, wider relationships in the family.

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Supplemental Material

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