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The Dysregulation Profile Mediates Functional Impairments in School-Aged Children with ADHD: A Large Cross-Sectional Study

Xuanzi Zhou
Capital Medical University, National Center for Children's Health
Yihan Ma
Chengdu University of Traditional Chinese Medicine
Ying Li
liying@bch.com.cn

Capital Medical University, National Center for Children's Health

Article

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Abstract

This large cross-sectional study investigated the prevalence of the dysregulation profile (DP) in school-aged children with attention-deficit/hyperactivity disorder (ADHD) and its mediating role in functional impairment. A total of 13,240 children with clinician-diagnosed ADHD were enrolled, and behavioral problems, emotional dysregulation, and functional impairment were assessed using parent-report scales including the Conners Parent Rating Scale, Strengths and Difficulties Questionnaire-Dysregulation Profile (SDQ-DP), Swanson Nolan and Pelham Rating Scale (Version IV), and Weiss Functional Impairment Rating Scale. Participants were categorized into DP (SDQ-DP ≥ 5, n = 1,243) and non-DP (n = 11,005) groups. The overall DP prevalence was 9.57%, with no significant differences across age or sex strata. Children with DP exhibited significantly more severe functional impairment across all domains (family, social, life skills, self-concept, school, risk-taking behaviors), with the largest effect size in the self-concept domain (Cohen's d = 0.85). Mediation analyses showed DP accounted for 29.6% of the total effect between ADHD symptom severity and overall functional impairment, and 17.9%–22.8% of the effects linking specific behavioral problems to functional impairment. These findings indicate DP is not merely a marker of clinical severity but a key mechanistic pathway exacerbating real-world dysfunction in children with ADHD. Routine DP screening and targeted emotion-regulation interventions are warranted to improve adaptive outcomes.

1. Introduction

Attention-deficit/hyperactivity disorder (ADHD) is a prevalent neurodevelopmental condition affecting approximately 5% of children globally, characterized by symptoms of persistent inattention, hyperactivity, and impulsivity [1–3]. Accumulating clinical and epidemiological evidence, however, underscores that a substantial subset of these children concurrently exhibit severe emotional and behavioral difficulties, including anxiety, depressive symptoms, and oppositionality [4]. This complex clinical constellation, characterized by severe affective lability, irritability, and defiant behavior, is frequently conceptualized as the Dysregulation Profile (DP). Initially operationalized using subscales of the Child Behavior Checklist and now efficiently captured by tools such as the Strengths and Difficulties Questionnaire (SDQ-DP), this phenotype identifies a highly vulnerable subpopulation [5]. These children are burdened not merely by core neurodevelopmental deficits but by a pervasive inability to modulate emotional responses, representing a severe trajectory associated with heightened risk for mood disorders and poorer long-term outcomes [6].

The clinical imperative to identify DP lies in its devastating impact on real-world adaptive functioning. While core ADHD symptoms independently compromise academic performance and behavioral conduct, the emergence of emotional dysregulation is associated with a significantly accelerated developmental deterioration across family, social, and academic contexts [7]. Children exhibiting DP struggle profoundly with peer relationships, endure higher rates of familial conflict, and manifest critical deficits in essential life skills and self-concept [8]. Consequently, capturing these cross-domain deficits using ecologically

valid multidimensional scales—such as the Weiss Functional Impairment Rating Scale (WFIRS)—is critical for understanding the true burden of DP, which extends far beyond the mere summation of core ADHD symptoms [1,9].

Few contemporary studies have integrated robust structural mediational analyses with comprehensive measures of functional impairment (e.g., WFIRS) to quantify the incremental contribution of DP across the ADHD symptom continuum. Despite growing recognition of DP's severity, the mechanistic pathways linking core behavioral symptoms, emotion dysregulation, and ultimate functional impairment remain a subject of active scientific debate. Emotion dysregulation is increasingly regarded not merely as a comorbid feature but as an intrinsic aspect of ADHD psychopathology. Faraone et al. [2] proposed that deficient emotional self-regulation (DESR) arises from the same executive function deficits underlying poor inhibitory control. Clarifying whether DP functions as a robust mediator is paramount; if confirmed, it necessitates that clinical interventions explicitly target emotion regulation to effectively rescue a child's overall adaptive functioning.

Unfortunately, the existing literature addressing this triadic relationship is constrained by several methodological limitations. On the one hand, most investigations of DP rely heavily on clinic-referred samples, which may overestimate symptom severity and limit generalizability of findings to community-based populations [10,11]. On the other hand, it remains unclear whether age and sex modulate the expression or clinical impact of DP in school-aged children, particularly given inconsistent findings regarding gender differences in emotion regulation and internalizing comorbidities [12].

To address these gaps, the present study utilized a large-scale clinical sample to comprehensively investigate the clinical impact and structural role of DP. Specifically, our objectives were to: (1) estimate the prevalence of DP using the established SDQ-DP cut-off and examine its demographic correlates; (2) map the interrelationships among ADHD symptoms, behavioral difficulties, and multi-domain functional impairment; (3) compare the severity of functional deficits between children meeting the clinical threshold for DP and those below it; and (4) empirically test a mediation model to quantify the extent to which DP mediates the association between ADHD symptom severity and functional impairment across family, social, learning, and self-concept domains. Based on current psychopathology frameworks, we hypothesized that children with DP would exhibit pervasively worse functional impairment, and that DP would serve as a significant mediator translating core symptomatology into profound real-world functional decline.

2. Methods

2.1 Study Design

This cross-sectional, observational cohort study enrolled children and adolescents (aged 1–18 years) undergoing initial diagnostic assessment at the psychosomatic department of Beijing Children’s Hospital, Capital Medical University, between July 2024 and December 2025. All participants received a

primary diagnosis of ADHD, rendered by certified child psychiatrists in strict accordance with *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (DSM-5) criteria.

Inclusion criteria were: (1) a clinician-confirmed primary diagnosis of DSM-5 ADHD; (2) age between 6 and 18 years; and (3) complete, valid parent-reported datasets for the SDQ-DP, SNAP-IV, CPRS, and WFIRS-P. Exclusion criteria were: (1) a formal comorbid diagnosis of autism spectrum disorder, moderate-to-severe intellectual disability, bipolar spectrum disorder, or acquired organic brain pathology; (2) > 10% missing item-level data on any core assessment inventory; or (3) parental inability to complete the standardized assessments due to language or cognitive barriers.

Initial screening identified 13,308 eligible participants. After excluding 68 participants with substantial incomplete data, the final sample comprised 13,240 children (71.7% male; mean age = 8.77 ± 2.51 years). Consistent with established international thresholds [13], participants with an SDQ-DP total score ≥ 5 were categorized into the DP group (n = 1,274, 9.6%), while the remaining children constituted the non-DP group (n = 11,966, 90.4%). To address missing data, available-case analysis (pairwise deletion) was employed for all statistical procedures. This approach maximizes statistical power, resulting in minor, methodologically acceptable variations in specific analyses (see **Fig. 1**).

Figure 1 Flowchart of participant recruitment and grouping by dysregulation profile (DP)

status

Participants were consecutively enrolled from the outpatient clinic, assessed with the Conners Parent Rating Scale, Strengths and Difficulties Questionnaire (SDQ, including the SDQ-Dysregulation Profile, SDQ-DP), Swanson Nolan and Pelham Rating Scale (SNAP-IV) and Weiss Functional Impairment Rating Scale-Parent Report (WFIRS-P). Based on the SDQ-DP cut-off (SDQ-DP ≥ 5), the final analytic sample (N = 13,240) was classified into a DP group and a non-DP group for subsequent analyses.

All procedures involving human participants were performed in accordance with the ethical standards of the 1964 Helsinki Declaration and its later amendments. The study protocol was approved by Beijing children's hospital of the Ethics Committee Review Board of Beijing Children's Hospital (Approval No. [2024]-Y-253-D), and was funded by the Institutional Review Board of Beijing Children's Hospital (Approval No. IEC-C-008-A09-V.05.2). Written informed consent was obtained from all legal guardians prior to clinical assessment and retrospective data extraction. All personal information was anonymized.

2.2 Assessment Instruments

All four scales utilized validated Chinese versions, which possess established normative reliability and validity for pediatric ADHD populations in China.

2.2.1 Strengths and Difficulties Questionnaire-Dysregulation Profile (SDQ-DP)

The 5-item parent-rated DP subscale, extracted from the full Strengths and Difficulties Questionnaire (SDQ) [14], quantifies cross-cutting affective and behavioral dysregulation. Each item is scored on a 3-point Likert scale (0 = not true, 1 = somewhat true, 2 = certainly true), yielding a total possible score range of 0–10. Consistent with international literature, a cutoff score of 5 was utilized to define clinically significant dysregulation [15]. In this study, the SDQ-DP total score demonstrated excellent internal consistency (Cronbach's α = 0.80).

2.2.2 Swanson, Nolan and Pelham Rating Scale (Version IV) (SNAP-IV) Rating Scale

The 26-item parent-administered SNAP-IV comprises three independent subscales: Inattention (9 items), Hyperactivity-Impulsivity (9 items), and Oppositional Defiant Disorder symptoms (8 items). Items are rated on a 4-point Likert scale (0 = Not at all to 3 = Very much). Subscale average scores were calculated, with higher scores reflecting greater symptom severity. The combined total score of the Inattention and Hyperactivity-Impulsivity subscales served as the independent predictor variable for structural mediation analyses [16]. Internal consistency was excellent across subscales (Inattention: α = 0.93; Oppositional Defiant Disorder: α = 0.90; Hyperactivity-Impulsivity: α = 0.85).

2.2.3 Conners' Parent Rating Scale (CPRS)

The CPRS [17] is a standardized parent-report instrument for assessing behavioral, emotional, and attentional difficulties in children aged 3–17 years. The 48-item version employed in the present study evaluates a spectrum of externalizing and internalizing disturbances across six domains: conduct problems, learning problems, psychosomatic problems, impulsivity-hyperactivity, anxiety and psychotic symptoms. Items are rated on a 4-point Likert scale based on behavioral frequency over the preceding month (0 = Not at all to 3 = Very much). Raw subscale scores are derived by summing responses within each domain, with higher scores indicating greater clinical impairment [18]. The CPRS total score demonstrated excellent reliability in this sample (α = 0.94).

2.2.4 Weiss Functional Impairment Rating Scale-Parent Report (WFIRS-P)

The WFIRS-P [19] is a 50-item parent-completed instrument designed to quantify real-world, cross-domain functional limitations in children and adolescents with neurodevelopmental disorders. It assesses everyday functioning across six domains: family functioning (10 items), learning/school (10 items), life skills (10 items), self-concept (5 items), social activities (8 items), and risk-taking behaviors (7 items). Domain scores are calculated as the mean of items within each domain, and the total score is the mean of all 50 items. This mean-score scaling ensures comparability across domains with unequal item counts [20]. In this study, Cronbach's α coefficients were 0.91 for family, 0.93 for learning/school, 0.83 for life skills, 0.92 for self-concept, 0.80 for social activities, and 0.99 for risk-taking behaviors. The total scale demonstrated exceptional internal consistency (α = 0.97).

2.3 Statistical Analysis

All quantitative analyses were conducted using IBM SPSS Statistics 27.0, supplemented by the SPSS-PROCESS Macro (Version 4.0) developed by Hayes (2017). A two-tailed significance level of $\alpha = 0.05$ was adopted for all inferential tests. Demographic and clinical variables were summarized using means and standard deviations for continuous data, while frequencies and percentages for categorical data. Pearson bivariate correlation coefficients were calculated to quantified linear associations among age, SDQ-DP severity, and core ADHD symptom dimensions. Independent-samples t-tests compared CPRS, SNAP-IV, and WFIRS-P scores between DP and non-DP subgroups; Welch's correction was applied when Levene's test indicated heterogeneity of variance. Cohen's d was calculated to determine standardized effect sizes.

Six separate mediation models were constructed using Hayes' PROCESS Model 4 (single-mediator framework). In each model, the SNAP-IV total core ADHD score served as the predictor variable (X), the SDQ-DP total score as the hypothesized mediator (M), and one of the six WFIRS-P domain scores as the endogenous outcome variable (Y). Bias-corrected percentile bootstrapping with 5,000 random resamples was employed to generate 95% confidence intervals (CIs) for indirect effects. Mediation was considered statistically significant if the 95% CI excluded zero; effect sizes were reported as the proportion of the total effect accounted for by the indirect effect.

3. Results

3.1 Descriptive Statistics

The final sample comprised 13,240 children (10,375 boys, 78.4%; 2,933 girls, 21.6%). Means, standard deviations, skewness, and kurtosis for all scales are presented in Table 1.

Table 1
Demographic characteristics and descriptive statistics of scale scores (N = 13,240)

Variable	Mean ± SD	Skewness	Kurtosis
Age (years)	8.76 ± 2.51	-	-
Gender (Male/Female)	78.0% / 22.0%	-	-
Conners' Parent Rating Scale (CPRS)			
Conduct Problems*	1.04 ± 0.55	0.52	-0.06
Learning Problems*	0.89 ± 0.54	0.66	0.16
Psychosomatic Problems*	0.93 ± 0.51	0.61	0.21
Impulsivity-Hyperactivity*	0.86 ± 0.44	0.53	0.18
Anxiety*	0.55 ± 0.40	1.06	1.31
Psychiatric*	3.00 ± 0.29	1.54	3.50
Conners Total Score*	1.21 ± 0.38	0.68	0.45
SDQ-Dysregulation Profile (SDQ)			
Emotional Symptoms†	0.54 ± 0.43	0.76	0.11
Conduct Problems†	0.77 ± 0.26	0.10	0.31
Hyperactivity/Inattention†	0.96 ± 0.27	0.20	0.14
Peer Relationship Problems†	0.99 ± 0.33	0.10	-0.11
Prosocial Behavior†	0.95 ± 0.36	-0.23	-0.34
Total Difficulties†	3.23 ± 0.91	0.18	0.66
SDQ Total Score†	4.17 ± 1.06	-0.04	1.12
SNAP-IV Rating Scale			
Inattention‡	1.60 ± 0.76	0.04	-0.88
Hyperactivity-Impulsivity‡	0.89 ± 0.68	0.87	0.20
Oppositional Defiance‡	0.93 ± 0.65	0.72	0.04
SNAP-IV Total Score‡	1.14 ± 0.58	0.47	-0.18

*Notes: * CPRS factors and total score; † SDQ factors and total score; ‡ SNAP-IV factors and total score; § WFIRS-P factors and total score. All scale items were rated on a 0–3 point scale. Skewness > 0 indicates positive skew, < 0 indicates negative skew. Kurtosis > 0 indicates a more peaked distribution than normal, < 0 indicates a flatter distribution.*

Variable	Mean ± SD	Skewness	Kurtosis
Weiss Functional Impairment Rating Scale-Parent Report (WFIRS-P)			
Family Function§	0.64 ± 0.55	1.01	0.91
Social Activities§	0.82 ± 0.70	0.85	0.18
Life Skills§	0.37 ± 0.52	1.92	4.44
Self-Concept§	1.09 ± 0.54	0.77	1.13
School/Learning§	0.73 ± 0.51	0.87	0.76
Risky Activities§	0.55 ± 0.48	1.80	4.29
Weiss Total Score§	0.72 ± 0.43	0.91	0.70

*Notes: * CPRS factors and total score; † SDQ factors and total score; ‡ SNAP-IV factors and total score; § WFIRS-P factors and total score. All scale items were rated on a 0–3 point scale. Skewness > 0 indicates positive skew, < 0 indicates negative skew. Kurtosis > 0 indicates a more peaked distribution than normal, < 0 indicates a flatter distribution.*

On the CPRS, mean scores were 1.04 (SD = 0.55) for conduct problems, 0.89 (SD = 0.54) for learning problems, 0.97 (SD = 0.51) for psychosomatic problems, 0.87 (SD = 0.44) for impulsivity-hyperactivity, 0.62 (SD = 0.41) for anxiety, and 3.02 (SD = 0.29) for psychotic symptoms, with a total score mean of 1.21 (SD = 0.38). Distributions were predominantly right-skewed (skewness: 0.52–1.72; kurtosis: -0.61 to 3.73), with the psychotic symptoms factor exhibiting marked kurtosis (3.73), suggesting a high proportion of extreme values.

On the SDQ-DP, mean scores were 0.54 (SD = 0.43) for emotional symptoms, 0.91 (SD = 0.27) for conduct problems, 0.96 (SD = 0.27) for hyperactivity/inattention, 1.01 (SD = 0.33) for peer relationship problems, and 0.69 (SD = 0.36) for prosocial behavior. The difficulties total score and overall total score were 3.23 (SD = 0.91) and 4.17 (SD = 1.06), respectively. Distributions approximated normality across all dimensions (skewness: -0.22 to 0.98; kurtosis: -0.34 to 1.12).

On the SNAP-IV, mean scores were 1.60 (SD = 0.76) for inattention, 0.89 (SD = 0.68) for hyperactivity-impulsivity, and 0.93 (SD = 0.65) for oppositional defiant behavior, with a total score mean of 1.14 (SD = 0.58). Distributions were largely symmetric (skewness: 0.04–0.87; kurtosis: -0.88 to 0.20), although the inattention factor showed mild negative skew.

On the WFIRS, mean scores were 0.64 (SD = 0.55) for family functioning, 0.82 (SD = 0.70) for social activities, 0.37 (SD = 0.52) for life skills, 1.09 (SD = 0.54) for self-concept, 0.73 (SD = 0.51) for learning/school, and 0.55 (SD = 0.48) for risk-taking behaviors, with a total score mean of 0.72 (SD = 0.43). Distributions were right-skewed (skewness: 0.77–1.92; kurtosis: 0.18–4.44). Life skills and risk-taking behaviors exhibited pronounced kurtosis (> 4), indicative of considerable extreme values.

3.2 Correlations Between Scales

Pearson correlation analyses revealed significant positive associations among all scale total scores (all $p < 0.001$), with coefficients ranging from 0.25 to 0.72 (see Table 2). The CPRS total score demonstrated a strong positive correlation with the SNAP-IV total score (r = 0.68), a moderate correlation with the WFIRS total score (r = 0.51), and a moderate correlation with the SDQ difficulties total score (r = 0.47). Similarly, the SNAP-IV total score correlated moderately with both the WFIRS total score (r = 0.55) and the SDQ difficulties total score (r = 0.52). The SDQ-DP total score showed significant positive correlations with the CPRS (r = 0.39), SNAP-IV (r = 0.44), and WFIRS (r = 0.38) totals, but a weak negative correlation with the SDQ prosocial behavior factor (r = -0.12). At the factor level, the strongest association was observed between CPRS anxiety and WFIRS self-concept (r = 0.48), followed by SNAP-IV inattention and CPRS learning problems (r = 0.52). These findings indicate extensive positive interrelationships among ADHD symptoms, behavioral problems, emotional dysregulation, and functional impairment (see **Fig. 2**).

Table 2
Pearson correlation coefficients between DP severity and ADHD core symptoms (N = 13,240)

Variables	Age	SDQ-DP	SNAP-AD	SNAP-HI	SNAP-OD
Age	1				
SDQ-DP	-0.026**	1			
SNAP-AD	0.039**	0.405**	1		
SNAP-HI	-0.279**	0.484**	0.572**	1	
SNAP-OD	-0.015	0.585**	0.484**	0.586**	1

*Note: SDQ-DP = Strengths and Difficulties Questionnaire-Dysregulation Profile. **p < 0.01 for all correlations.*

Figure 2 Correlation heatmap among Conners factors, SDQ-DP score and SNAP-IV factor scores

Pearson correlation coefficients are displayed as a symmetric heatmap. The Conners Parent Rating Scale factors (Conduct, Learning, Psychosomatic, Impulsivity-Hyperactivity, Anxiety, Psychiatric problems and Total score), the SDQ-DP score and SNAP-IV factors (Inattention, Hyperactivity-Impulsivity, Oppositional Defiance and Total score) are arranged along both axes; colour intensity represents the magnitude and direction of each correlation.

3.3 Age and Gender Effects on DP

Applying the SDQ-DP cutoff (≥ 5), the overall prevalence of DP was 9.57% (1,274/13,308; 95% CI [9.08%, 10.08%]). Prevalence was 9.80% (1,017/10,375) in boys and 8.76% (257/2,933) in girls. A chi-square test indicated no significant gender difference ($\chi^2 = 2.95$, $p = 0.086$). DP prevalence exhibited a modest

upward trajectory with age, increasing from approximately 8.2% at age 6 to 10.5% at age 12, followed by a slight decline. Stratified analyses revealed marginally higher prevalence in boys across all age groups (by ~ 1–2 percentage points). However, logistic regression indicated no significant main effect of age (OR = 1.02, p = 0.154), suggesting relative stability throughout the school-age period (**see Fig. 3**).

Figure 3 Trend of DP positive rates across age strata

Children were grouped by age stratum and the proportion meeting the SDQ-DP-based DP criterion (SDQ-DP ≥ 5) was calculated within each stratum. The figure displays the DP positive rate (%) by age group, illustrating the age-related trend in DP prevalence among school-aged children with ADHD.

3.4 Group Comparisons Between DP and Non-DP Children

The DP (n = 1,243) and non-DP (n = 11,005) groups did not differ significantly in age (9.2 ± 2.3 vs. 9.1 ± 2.4 years; t = 1.19, p = 0.234) or sex distribution (81.8% vs. 78.1% male; χ^2 = 2.95, p = 0.086). Independent-samples t-tests revealed that the DP group scored significantly higher on all scales (all p < 0.001), with effect sizes ranging from 0.35 to 1.12 **(see** Table 3). On the CPRS, significant differences were observed across all factors and the total score (d = 0.62–0.98), with the largest effect for anxiety (d = 0.98). On the SDQ, the DP group showed significantly higher scores on emotional symptoms, conduct problems, hyperactivity/inattention, peer relationship problems, and total difficulties (d = 0.55–1.12), but significantly lower prosocial behavior scores (d = -0.38). On the SNAP-IV, all factors and the total score were elevated in the DP group (d = 0.72–0.89), with oppositional defiant behavior demonstrating the largest effect (d = 0.89). On the WFIRS, the DP group exhibited significantly higher impairment across all domains and the total score (d = 0.48–0.85), with the largest effect observed for self-concept (d = 0.85). These results indicate that children meeting the clinical threshold for DP present with substantially more severe ADHD symptoms, behavioral difficulties, and functional impairment.

Table 3
Comparison of clinical symptoms and functional impairment between children with and without dysregulation profile (DP + vs DP-)

Variable	DP+ (n = 1,243) Mean ± SD	DP- (n = 11,997) Mean ± SD	Statistic	p-value	Cohen's d
Age (years)	8.90 ± 2.40	8.82 ± 2.51	t = 1.192	0.234	0.03
Gender (Male/Female, %)	80.4%/19.6%	78.2%/21.8%	χ^2=2.954	0.086	0.05
Conners Parent Rating Scale					
Conduct Problems	1.721 ± 0.505	1.027 ± 0.520	t = 45.843	< 0.001	1.338
Learning Problems	1.424 ± 0.536	0.795 ± 0.473	t = 39.643	< 0.001	1.31
Psychosomatic Problems	1.432 ± 0.472	0.778 ± 0.412	t = 46.854	< 0.001	1.561
Impulsivity-Hyperactivity	1.423 ± 0.448	0.836 ± 0.411	t = 44.146	< 0.001	1.415
Anxiety	0.990 ± 0.460	0.490 ± 0.347	t = 37.129	< 0.001	1.388
Psychiatric	3.757 ± 0.414	3.441 ± 0.272	t = 26.275	< 0.001	1.091
Total Score	1.706 ± 0.370	1.130 ± 0.338	t = 52.461	< 0.001	1.688
SDQ-Dysregulation Profile					
Emotional Symptoms	1.112 ± 0.420	0.483 ± 0.377	t = 50.544	< 0.001	1.647
Conduct Problems	1.015 ± 0.266	0.741 ± 0.241	t = 34.808	< 0.001	1.127
Hyperactivity/Inattention	1.102 ± 0.277	0.945 ± 0.268	t = 19.068	< 0.001	0.585
Peer Relationship Problems	1.245 ± 0.316	0.959 ± 0.324	t = 30.191	< 0.001	0.886
Prosocial Behavior	0.969 ± 0.380	0.942 ± 0.351	t = 2.455	0.014	0.078

Notes: DP + = SDQ-DP score ≥ 5; DP- = SDQ-DP score < 5. Cohen's d values of 0.2, 0.5, and 0.8 represent small, medium, and large effect sizes, respectively. Family Function subscale is rated on a 0–10 scale, all other scales on a 0–3 scale.

Variable	DP+ (n = 1,243)	DP- (n = 11,997)	Statistic	p-value	Cohen's d
	Mean ± SD	Mean ± SD			
Total Difficulties	4.474 ± 0.769	3.127 ± 0.790	t = 58.350	< 0.001	1.709
Total Score	1.098 ± 0.183	0.827 ± 0.181	t = 49.618	< 0.001	1.496
SNAP-IV Rating Scale					
Inattention	2.140 ± 0.637	1.577 ± 0.746	t = 28.998	< 0.001	0.765
Hyperactivity-Impulsivity	1.487 ± 0.725	0.847 ± 0.645	t = 29.814	< 0.001	0.979
Oppositional Defiance	1.702 ± 0.637	0.870 ± 0.601	t = 43.890	< 0.001	1.376
Total Score	1.779 ± 0.540	1.107 ± 0.548	t = 41.565	< 0.001	1.229
Weiss Functional Impairment Scale					
Family Function	7.235 ± 3.668	7.271 ± 5.075	t=-0.316	0.752	-0.007
Social Activities	1.301 ± 0.650	0.771 ± 0.611	t = 27.400	< 0.001	0.861
Life Skills	0.886 ± 0.725	0.523 ± 0.575	t = 17.048	< 0.001	0.613
Self-Concept	0.886 ± 0.582	0.561 ± 0.512	t = 18.865	< 0.001	0.626
School/Learning	1.174 ± 0.472	0.841 ± 0.446	t = 23.701	< 0.001	0.741
Risky Activities	0.846 ± 0.455	0.498 ± 0.405	t = 25.839	< 0.001	0.848
Total Score	1.839 ± 0.524	1.490 ± 0.639	t = 21.764	< 0.001	0.556

Notes: DP + = SDQ-DP score ≥ 5; DP- = SDQ-DP score < 5. Cohen's d values of 0.2, 0.5, and 0.8 represent small, medium, and large effect sizes, respectively. Family Function subscale is rated on a 0–10 scale, all other scales on a 0–3 scale.

3.5 Mediation Analyses

To quantify the mediating role of DP in the relationship between ADHD core symptoms and functional impairments, we conducted two sets of mediation analyses using the full sample (N = 13,240).

Model 1 examined the dimensional DP score as the mediator (M), ADHD total symptom score as the independent variable (X), and WFIRS total impairment score as the dependent variable (Y). Model 2 utilized DP group (non-DP vs. DP) as a binary mediator. Separate models were further run for each WFIRS domain (family, learning, peer, school, risky, and community) to explore domain-specific mediation effects.

All mediation models were performed using the SPSS PROCESS macro (Model 4) with 5,000 bootstrap samples. The indirect effect was considered significant if the 95% confidence interval (CI) did not include zero. We reported the unstandardized indirect effect, direct effect, and total effect, along with their 95% CIs. Age and gender were included as covariates in all models. (see **Fig. 4**).

Model 1: The SNAP-IV total score served as the predictor (X), SDQ-DP as the mediator (M), and WFIRS total score as the outcome (Y). The total effect of SNAP-IV on WFIRS was significant (c = 0.428, $p < 0.001$). The X→M path (SNAP-IV → DP) was strong and significant (a = 1.565, $p < 0.001$), indicating that greater ADHD severity was strongly associated with higher emotional dysregulation. The M→Y path (DP → WFIRS), controlling for SNAP-IV, was also significant (b = 0.081, $p < 0.001$). The indirect effect (a × b = 0.127, $p < 0.001$) accounted for 29.6% of the total effect, while the direct effect remained substantial (c' = 0.299, $p < 0.001$), explaining 70.4% of the total variance (see **supplement material**).

Model 2: Five separate mediation models tested each Conners factor (conduct problems, learning problems, psychosomatic problems, anxiety, and psychotic symptoms) as the predictor, DP as the mediator, and WFIRS total score as the outcome. All X→M paths were significant (a range: 1.33–1.52, all $p < 0.001$). The M→Y paths (DP → WFIRS) were uniformly significant (b range: 0.070–0.082, all $p < 0.001$). Indirect effects were statistically significant (all $p < 0.001$), ranging from 0.090 (learning problems) to 0.109 (psychotic symptoms). The proportion of the total effect mediated by DP ranged from 17.9% (anxiety) to 22.8% (psychotic symptoms). Direct effects remained dominant across all models (c' range: 0.359–0.404, all $p < 0.001$), accounting for 77%–82% of the total effects (see **Fig. 4**).

Figure 4 Multiple mediation analysis results for the effect of ADHD-related symptoms on Weiss functional impairment via DP

Six separate mediation models are shown. Panel a: SNAP-IV total score → DP → Weiss functional impairment. Panels b-f: Conners factors Conduct Problems (b), Learning Problems (c), Psychosomatic Problems (d), Anxiety (e) and Psychiatry (f), each → DP → Weiss functional impairment. In each panel, path coefficients (standardised), statistical significance and the proportion of the total effect mediated by DP are presented, indicating that DP partially mediates the association between core behavioural/emotional problems and overall functional impairment.

4. Discussion

This large-scale, cross-sectional cohort study elucidates the clinical prevalence of the Dysregulation Profile (DP) and its profound impact on functional impairment in children with ADHD. The salient finding

is unequivocal evidence that children meeting the clinical threshold for DP suffer from substantially more severe and pervasive functional deficits than their non-DP counterparts. Furthermore, robust mediation models establish DP not merely as a peripheral behavioral manifestation but as a critical pathogenic mediator bridging core neurodevelopmental symptoms and real-world adaptive failure [21],[22].

Our overall DP prevalence was 9.57%, which differs substantially from prior published data. Clinical ADHD cohorts reported DP positive rates of 18.4%–50% 5,23, while community child samples yielded lower prevalence around 5%–18% 7. These gaps arise from inherent sampling differences: clinic samples concentrate severe multi-comorbid patients, while community screening includes mild subclinical participants. Our 13,240-case large-scale ADHD cohort produces a moderate 9.57% rate, better reflecting real-world outpatient clinical characteristics. In line with Deutz et al. (2018) 13, age and gender exerted no significant predictive effects on DP risk, confirming that emotional dysregulation captured by SDQ-DP is a stable trait instead of temporary developmental mood fluctuation. Previous narrative reviews only theoretically described the correlation between emotion dysregulation and ADHD, yet lacked large-sample quantified epidemiological data, which the present study complements with native Chinese pediatric ADHD population evidence.

The absence of a main effect for age suggests that severe emotional and behavioral dysregulation captured by the SDQ-DP is a deeply ingrained, trait-like characteristic rather than a transient developmental phase. This structural stability aligns with recent epidemiological findings indicating that once emotional dysregulation crystallizes in childhood, it maintains homotypic continuity into adolescence, underscoring the need for early and sustained screening [5,24].

Beyond broad functional deficits, data elucidated that the DP group exhibited severely elevated symptomatology across all CPRS and SNAP-IV dimensions. Robust effect sizes—particularly in CPRS anxiety (d = 0.98) and SNAP-IV oppositional defiant behavior (d = 0.89)—demonstrate that DP is inextricably linked to both profound internalizing distress and externalizing hostility. This phenotypic severity supports the contemporary hypothesis that DP identifies a complex, "hybrid" clinical presentation. These children are not merely experiencing exacerbated inattention or hyperactivity; they are burdened by a multidimensional collapse in self-regulation permeating mood, conduct, and cognitive focus [5,25].

The functional sequelae of this dysregulation are profound. Across all six WFIRS-P domains, children in the DP group exhibited significantly greater impairment. This pervasive pattern—spanning family dynamics, academic performance, peer relations, and activities of daily living—positions DP as a systemic disruptor of adaptive development [26].

Notably, the most striking deficit occurred in the self-concept domain (d = 0.85). This marked degradation of self-worth underscores the severe psychological toll of chronic emotional dysregulation [27]. Children with DP experience intense emotional volatility, leading to recurrent social rejection and disciplinary actions. Over time, these negative interactions are internalized, severely distorting self-

perception [28]. This critical finding emphasizes that DP enacts a hidden yet profound destruction of the child's psychological core, often preceding later depressive disorders [29].

To elucidate the architectural relationship between symptoms and impairment, mediation analyses evaluated the pathway from core ADHD symptoms (SNAP-IV) to functional impairment (WFIRS-P) through DP. The analysis revealed a highly significant indirect effect, with DP accounting for 29.6% of the total variance. This finding provides robust quantitative support for Barkley's (2016) model of DESR [30], confirming that nearly one-third of the functional failure historically attributed directly to hyperactivity or inattention is actually mediated by affective dysregulation [31].

Model 2 expanded this framework by testing five CPRS behavioral factors. In every model, DP emerged as a significant mediator, explaining 17.9% to 22.8% of functional impairment. This consistency illustrates the transdiagnostic utility of DP, echoing the original conceptualization of the SDQ-DP [8]. Whether the primary clinical issue is somatic complaints, anxiety, or conduct problems, emotional dysregulation acts as a common mechanistic funnel through which diverse psychiatric vulnerabilities are amplified into concrete functional failures [32–34].

While emphasizing DP's mediational power, it is equally important to acknowledge that direct effects of behavioral symptoms on impairment remained substantial (accounting for ~ 70%–80% of variance). This dual-pathway architecture implies that functional impairment is driven by two parallel mechanisms: one driven by direct neurocognitive and behavioral deficits, and an additive, highly destructive pathway mediated by emotional dysregulation. Recognizing this duality avoids oversimplification and underscores the multifaceted nature of clinical impairment [35].

These findings necessitate a paradigm shift in pediatric psychiatric care. Because DP significantly mediates functional decline and uniquely erodes self-concept, treatment protocols focusing solely on core symptoms (e.g., stimulant monotherapy) are insufficient. Our data strongly suggest that meaningful functional recovery requires dual-target interventions: routine screening utilizing the SDQ-DP and prompt enrollment in emotion-focused therapies (e.g., cognitive-behavioral emotional regulation training) for children exceeding the clinical threshold [36,37].

This study benefits from immense statistical power afforded by its large sample size (N = 13,240), enabling precise structural modeling. However, limitations must be acknowledged. The cross-sectional design precludes establishing strict temporal causality; future longitudinal studies are required to map how DP cascades into functional impairment over time. Furthermore, reliance on parent-reported instruments introduces potential shared-method variance. Future research should employ multi-informant assessments and replicate these models in diverse, cross-cultural, community-based cohorts to elucidate the long-term impacts of DP [38].

In conclusion, this large-scale study demonstrates that children with DP endure exceptionally severe and pervasive functional impairments across all life domains, particularly regarding self-concept. Crucially,

DP functions not merely as a marker of heightened clinical severity but as a pivotal pathogenic mediator, translating core neurodevelopmental and behavioral symptoms into real-world adaptive failure. These results underscore the need for a paradigm shift in clinical practice: therapeutic strategies must extend beyond core symptom management to include routine DP screening and targeted emotion-regulation interventions. Such integrated approaches are vital to safeguarding the daily functioning and long-term developmental trajectories of these highly vulnerable children.

Declarations

Competing interests

The authors declare no competing interests.

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Declaration

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Author Contribution

X.Z. and Y.M. contributed to data curation, formal analysis, and writing—original draft. Y.L. contributed to conceptualization, methodology, supervision, funding acquisition, and writing—review and editing. All authors read and approved the final manuscript.

Data Availability

The de-identified participant data supporting the findings of this study are available from the corresponding author upon reasonable request, subject to approval by the Institutional Review Board of Beijing Children's Hospital to protect patient privacy. The raw scales used in this study are publicly available via their respective official websites: the Conners Parent Rating Scale (https://www.mhs.com/MHS-Assessment-Catalog/Conners-CPRS), the Strengths and Difficulties Questionnaire (https://www.sdqinfo.org/), the SNAP-IV Rating Scale (https://www.adhd.net/snap-iv/), and the Weiss Functional Impairment Rating Scale (https://www.weissfunctionalscale.com/).

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Figures

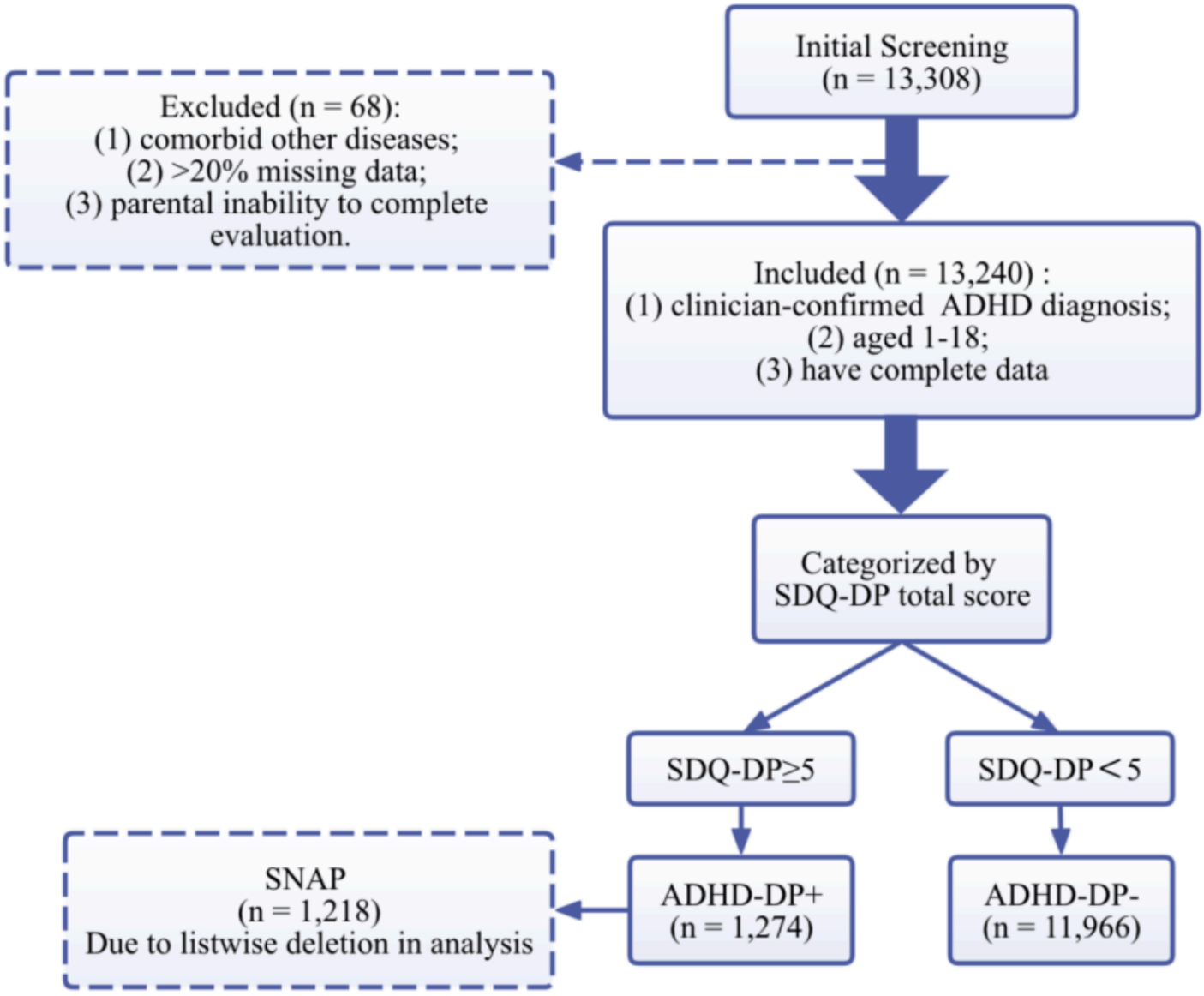


Figure 1

Flowchart of participant recruitment and grouping by dysregulation profile (DP) status

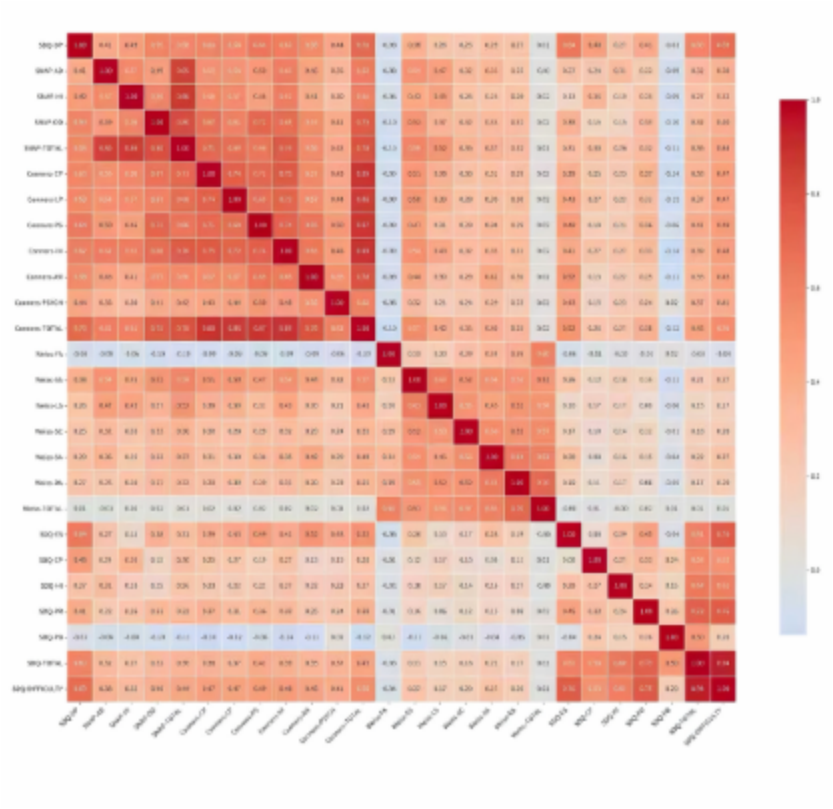


Figure 2

Correlation heatmap among Conners factors, SDQ-DP score and SNAP-IV factor scores

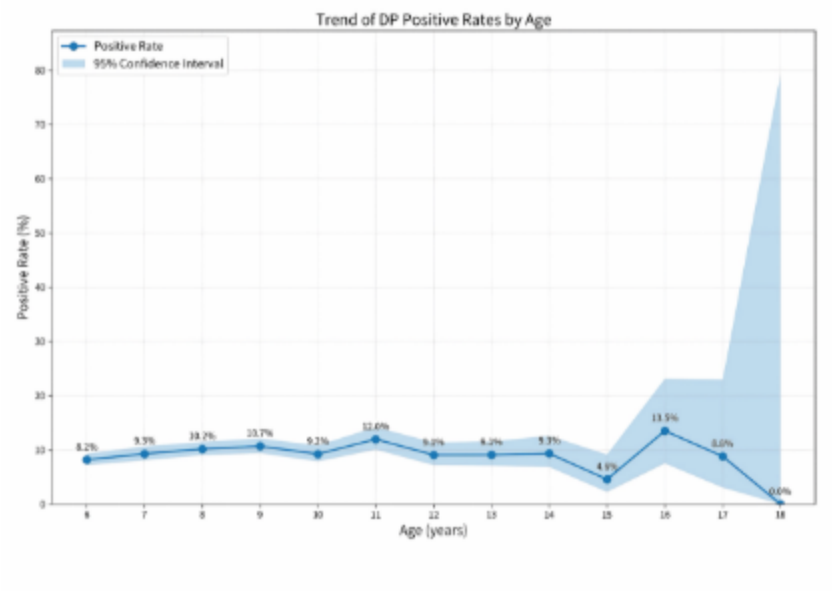


Figure 3

Trend of DP positive rates across age strata

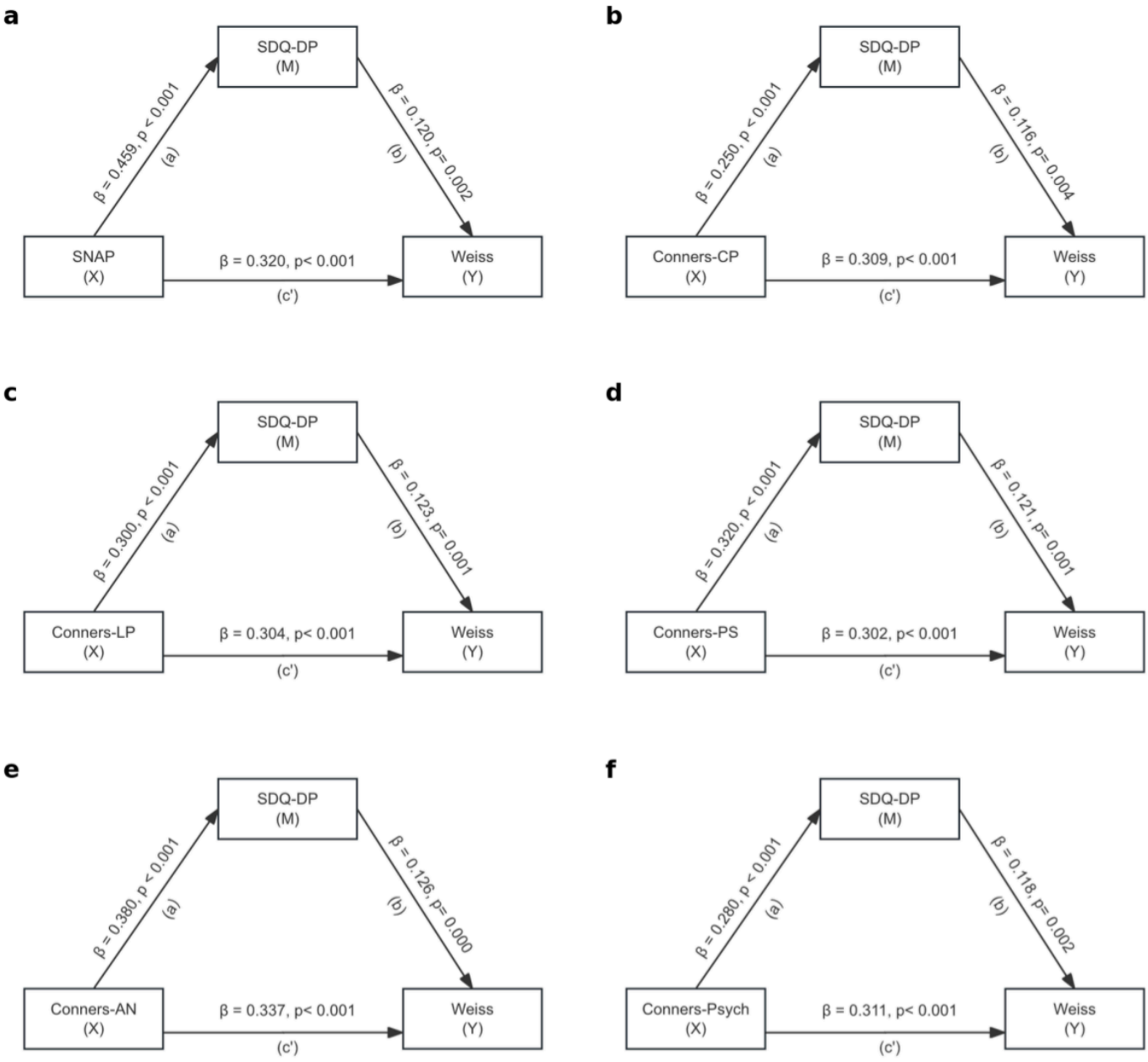


Figure 4

Multiple mediation analysis results for the effect of ADHD-related symptoms on Weiss functional impairment via DP

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