

Analysis on the Influence of Family Environment on Symptoms and Functioning of Chinese Children with Attention Deficit/Hyperactivity Disorder: Based on Correlational Analysis and Independent Samples T-Test

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Abstract: This research aimed to test the relationship between family environment and Attention-Deficit/Hyperactivity Disorder (ADHD)-related symptoms and functioning of Chinese children diagnosed with ADHD. Zhou et al. (2005) provided evidence for significant differences in family environment ratings (E.g., cohesion, expressiveness, conflict) between children with and without ADHD (Zhou, 2005). Building on this, the current research investigated the extent to which family environment factors influence ADHD symptoms and children's adaptive behaviors. Data were extracted from the out-patient medical records of 195 children diagnosed with ADHD at Qingdao Women and Children Hospital. The archived outcomes of the Family Environment Scale, Swanson, Nolan, and Pelham-IV rating scale, and Adaptive Behavior Assessment System were adopted as measurements for family environment, ADHD symptoms, and children's adaptive behaviors respectively. The correlation-analysis and independent samples t-test conducted by SPSS version 27. were used to analyze the data. Pearson correlation revealed significant correlation between ADHD symptoms (inattention and oppositional defiant) and family cohesion, organization, and conflict, which supported the hypotheses. This laid a foundation for future investigations regarding whether and how improving the family environment and parenting styles could help children alleviate ADHD symptoms. Nevertheless, no correlations were found between the hyperactivity/impulsivity dimension of ADHD symptoms and any family environment factors. Potential alternative explanations and possible modifications of methodologies in future investigations are discussed.

1 INTRODUCTION

Being characterized by anomalous impulsivity, lack of concentration, and motor hyperactivity, Attention-Deficit/Hyperactivity Disorder (ADHD) is one of the most common neurodevelopmental disorders that onsets in childhood and usually continues into adulthood (Price, 2012). Meta-analysis revealed that 5.29% children worldwide could be classified into one subtype of ADHD (Polanczyk, 2007), either predominantly inattentive (easily distractable and disorganized), predominantly hyperactive-impulsive (excessively fidgety and behave destructively), or combined type (American Psychiatric Association, 2013). Using correlational analysis, this research aimed to investigate the extent to which each family environment subfactor relates to each dimension of ADHD-related symptoms and adaptive behaviours,

based on the sample of Chinese children diagnosed with ADHD.

2 LITERATURE REVIEW

Although the precise cause of ADHD remains undefined, it was strongly approved by family and twin studies that ADHD has a high heritability of 75% (Faraone, 2005), in which genes in the dopaminergic pathway (E.g., DRD4, DRD5, DAT1) are involved (Stergiakouli, 2010). Nurture risk factors mediate with nature factors in contributing to the development of ADHD. This comprises but is not limited to maternal stress (Price, 2012), prenatal toxins exposure (Mill, 2008), and virus infection (Zhou, 2015). These factors might partially explain why ADHD is more prevalent among urban than rural

children (Hinshaw, 1994). Family environment, which refers to how children are raised, also received great attention in how it profoundly affects children's physical, psychological, and social development, and consequently serves as a crucial determinant of individual's vulnerability to ADHD. In specific, it was demonstrated that ADHD children tend to receive more aggressive discipline methods (Woodward, 1998) and authoritarian parenting styles (Lange, 2005), as compared to non-ADHD controls.

According to Pressman et al. (2006) (Pressman, 2006), inadequate parenting practices that exacerbate ADHD symptoms could be triggered by parents coping with multiple inner family stresses, such as high conflict, low cohesion, and low involvement between family members. These dimensions of family traits are measurable through the Family Environment Scale (FES), which examines members interaction and culture within a family (Moos, 1984). By applying the FES, Schroeder and Kelley (2009) (Schroeder, 2009) found that positive parenting (higher family cohesion, expressiveness, organization and lower conflict) was significantly correlated with greater behavioural regulation in children without ADHD. Nevertheless, parenting practices showed no significant influences on behavioural regulation and metacognition of children with ADHD. It should be noted that the vast majority of sample ethnicity was European-American (67.2%), whereas a mere 3% of sample was Asian-American. Therefore, results from Schroeder and Kelley limit in generalizability across cultures, where there are salient differences in child-rearing practices.

It was highlighted that while American parents advocate children's independent styles of thinking and behaviours through active praising and explicit expression of intimacy (Wilcox, 1998; Xu, 2005), parents from non-western societies like China emphasize on obedience to rules and adult authorities, driven by Chinese cultural values of Confucianism and Taoism (Chao, 1994). Zhou et al. (2005) (Zhou, 2005) investigated the influence of family environment on ADHD symptoms on a Chinese sample. As a result, ADHD children scored significantly lower on several positive dimensions of family environment (including *cohesion*, *expressiveness*, *independence*, *achievement orientation*, and *organization*), and scored higher on family *conflict* and *control*, as compared to non-ADHD controls.

However, as the research from Zhou and colleagues was conducted in the period where one-child policy (a family planning strategy to restrict population growth) was still in place in China, all

participants recruited should be the only child in the family. Thus, Zhou's study could limit in the ability of reflecting later social and economic changes (E.g., the multi-child policy being gradually implemented by the Chinese government since 2011). This is due to the significant differences in family environment and parenting style between single-child and multiple-child families. Child-centeredness is a notable phenomenon under one-child policy, which refers to caregivers devoting a large proportion of their money, time, and effort into child development (Chow, 1996). This causes both positive and negative influences on the family environment. For instance, higher expenditure on entertainments could enhance *cohesion*, whereas parents' higher expectations and requirements on child's education could lead to increased familial *conflict*.

The current research aimed at investigating the influence of family environment factors on ADHD symptoms. Previous research compared between the family environments and performances of children with and without ADHD. As a supplementary, the current study investigated the extent to which each family environment factor correlates with each dimension of ADHD symptoms and functioning of children diagnosed with ADHD. Being carried out in 2021, this research targeted at Chinese children born in the period that covered either the one-child policy or the two-child policy (between 2006 and 2016). Containing both single-child and multi-child families in the sample could generate results that differ from if single-child families were recruited solely. This is because for the latter, ratings on certain factors from FES (E.g., *independence*) could be consistently low, resulting from the unique parenting of the only child (E.g. parents devote higher cautiousness). Therefore, for the purpose of maintaining the accuracy of correlational patterns, samples covered both single-child and multi-child families in the current research. Based on what was mentioned above, 2 hypotheses have been proposed:

- Family *cohesion*, *expressiveness*, *independence*, *achievement orientation*, and *organization* would be negatively correlated with *inattention*, *hyperactivity/impulsivity*, and *oppositional defiant*
- Family *conflict* and *control* would be positively correlated with *inattention*, *hyperactivity/impulsivity*, and *oppositional defiant*.

3 METHODS

3.1 Participants

This study obtained data from the out-patient medical record archived between November 2018 and July 2020 at Qingdao Women and Children Hospital. Participants were 195 children diagnosed with ADHD by 8 professional psychiatrists. 16.9% (n=33) were girls and 83.1% (n=162) were boys. Participants had a mean age of 8.17 (SD=1.95), ranging from 5 to 15 years old. At the time of diagnosis, 19.5% (n=38) were in kindergarten, 76.9% (n=150) were in primary school, and 3.6% (n=7) were in middle school. In terms of the specific subtypes of ADHD diagnosis, 26.7% (n=52) were predominantly inattentive, 33.3% (n=65) were predominantly hyperactive-impulsive, and 40% (n=78) were combined type. There were cases with comorbidities, in which 6.7% (n=13) had Tourette Syndrome, 1.1% (n=2) had Autistic Spectrum Disorder. 1.1% were in Obsessive Compulsive state, while 0.5% (n=1) suffered from Emotional Disorder. This study protected patients' privacy by ensuring data confidentiality.

3.2 Primary Measures

The Chinese version of the Family Environment Scale (FES-CV) was employed to quantify family functioning (Fei, 1991). It is 90-item, true or false self-report questionnaire filled out by the caregivers of participants, which normally takes 20-30 minutes to complete. The 10 subscales of family social and environmental characteristics that FES-CV measures are classified into three global dimensions (Moos, 1984). One dimension refers to the Social Relationships domain, which includes the subfactors of family *cohesion* (M=7.7, SD=1.9), *expressiveness* (M=5.8, SD=1.7), and *conflict* (M=2.2, SD=1.9). Another dimension is the Personal Growth domain, including *independence* (M=5.8, SD=1.4), *achievement orientation* (M=6.8, SD=1.7), *intellectual-cultural orientation* (M=5.6, SD=2.1), *active-recreational orientation* (M=4.9, SD=2.0), and *moral-religious emphasis* (M=5.3, SD=1.4). The third dimension is the Family System Maintenance domain, which contains *organization* (M=6.7, SD=1.8) and *control* (M=3.6, SD=1.8). According to Moos and Moos (2013) (Moos, 2013), the internal consistency reliability estimates of FES-CV had a median of .73, which varied between .61 for *independence* and .78 for *cohesion*, *moral-religious emphasis*, and *intellectual-cultural orientation*. For

statistical analysis, the total score of items within each subscale for each patient was applied.

This study collected participants' ADHD-related behaviours from the Chinese version of the Swanson, Nolan, and Pelham-IV rating scale (SNAP-IV), filled out by caregivers of patients for the purpose of diagnosis. This 26-item rating scale measures core ADHD symptoms defined by the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (Swanson, 1999) from three dimensions, including Attention deficit (9 items), Hyperactivity/Impulsivity (9 items), and Oppositional defiant (8 items). Each item was rated on a 4-point Likert scale (0=not at all; 1=just a little; 2=quite a bit; 3=very much). Therefore, scores could range from 0 to 78. The SNAP-IV takes 10 minutes to complete. The statistical analysis was based on the total score of items from each dimension for each patient.

3.3 Secondary Measures

This study collected the level of general adaptive functioning and skills of children with ADHD through the parent form of the Adaptive Behaviour Assessment System-version II (ABAS-II) (Harrison, 2000). It illustrates the General Adaptive Composite (GAC) ability of children and three Domain Composite Scores that encompasses nine adaptive skill-related areas. This includes *conceptual skills* (Communication, Functional academics, Self-direction), *social skills* (Social, Leisure), and *practical skills* (Self-care, Home/school living, Community use, Health and safety, work). The statistical analysis was based on the composite score calculated from the raw score. The GAC score of above/equal to 130 indicates outstanding performance, and the score of below/equal to 70 indicates inferior performance. The ABAS-II was rated by clinicians who are not involved in the diagnosis and treatment of children, through enquiring about children's conditions from their caregivers.

In addition, this study recorded patients' intelligence scores from the Wechsler Intelligence Scale for children (WISC) (Wechsler, 1949). The measurement contains four primary index scores, including verbal comprehension, fluid reasoning, working memory, and processing speed. The total score of above/equal to 130 indicates outstanding IQ, while the score of below 40 indicates retardation of IQ. Patients completed the test individually through face-to-face interaction with a clinician who was blind to the patient's condition.

3.4 Procedure

Data extraction of this research gained permission from the Psychology department of Qingdao Women and Children Hospital. The demographic information of patients was concealed when the researcher went through the archived outpatient medical records (paper version). The researcher collected data from patients who completed the measurements of FES-CV, SNAP-IV, ABAS-II, and WISC, and presented data on the Excel spreadsheet. This research carried out the statistical analysis using the SPSS software version 27. Independent-samples t-test was employed to examine gender differences on *attention deficit*, *hyperactivity/impulsivity*, and *oppositional defiant* measured by SNAP-IV. The Pearson Correlation was used to identify the relationship between FES-CV, SNAP-IV, and ABAS-II factors.

4 RESULTS

Building on existing finding from previous literatures, this research investigated the degree to which family environment factors correlates with ADHD-related behaviors and functioning of children diagnosed with ADHD. Independent samples t-test was applied to examine whether there were gender differences for each of the three dimensions of ADHD symptoms measured by SNAP-IV. As a result, boys scored significantly higher on *hyperactivity/impulsivity* ($t(193)=2.95, p=.004$), *Oppositional defiant* ($t(193)=2.12, p=.035$), and the SNAP-IV total score ($t(193)=2.15, p=.033$), as compared to girls. There were no significant gender differences for the Attention deficit dimension, $t(193)=-.47, p=.64$. Potential confounding effect of IQ was also eliminated, as it was not significantly correlated with *attention deficit* ($r=-.09, p=.23$), *hyperactivity/impulsivity* ($r=.05, p=.5$), or *oppositional defiant* ($r=-.006, p=.94$).

The summary statistics of subfactors under FES-CV and SNAP-IV are illustrated on table 1. Based on the analyses of each FES-CV subfactor, Pearson Correlation revealed that the SNAP-IV total score was significantly negatively correlated with *cohesion* ($r=-.23, p=.001$), *intellectual-cultural orientation* ($r=-.14, p=.04$), and *organization* ($r=-.21, p=.003$); and was significantly positively correlated with *conflict* ($r=.22, p=.002$). Findings were consistent for *attention deficit*, as it also demonstrated significant negative correlation with *cohesion* ($r=-.15, p=.04$), *intellectual cultural orientation* ($r=-.17, p=.02$), and *organization* ($r=-.21, p=.003$); and significant

positive correlation with *conflict* ($r=.22, p=.002$). However, this only partially supported the hypotheses, as *attention deficit* was not correlated with *expressiveness*, *independence*, and *achievement orientation* as hypothesized. In accordance with hypotheses, *oppositional defiant* was significantly negatively correlated with *cohesion* ($r=-.26, p<.001$), *expressiveness* ($r=-.16, p=.03$), and *organization* ($r=-.16, p=.02$); and was significantly positively correlated with *conflict* ($r=.24, p<.001$). However, *oppositional defiant* was not correlated with *independence*, *achievement orientation*, and *control* as hypothesized. Results regarding *hyperactivity/impulsivity* did not support the hypotheses of this research, as no significant correlation was found between *hyperactivity/impulsivity* and any family environment factors.

Table 1: Summary statistics for subfactors of FES-CV and SNAP-IV.

Measures	Subfactors	Mean (SD)
FES-CV	Cohesion	6.30 (2.36)
	Expressiveness	5.03 (1.70)
	Conflict	4.50 (2.28)
	Independence	5.20 (1.43)
	Achievement Orientation	5.79 (1.86)
	Intellectual-cultural orientation	3.90 (1.88)
	Active-Recreational Orientation	4.65 (2.40)
	Moral-Religious Emphasis	5.22 (1.58)
	Organization	5.57 (2.11)
	Control	4.56 (1.97)
	SNAP-IV	Attention Deficit
Hyperactivity/Impulsiveness		13.11(6.44)
Oppositional Defiant		11.09(5.89)

This study also examined the relationship between family environment factors and patients' adaptive behaviour, as measured by ABAS-II. Summary statistics are illustrated on table 2. The General adaptation ability of patients was significantly positively correlated with *cohesion* ($r=.21, p=.003$), *intellectual-cultural orientation* ($r=.39, p<.001$), *active-recreational orientation* ($r=.27, p<.001$), and *organization* ($r=.175, p=.015$). Similar findings were generated for *practical skill*, in which it also demonstrated significant positive correlation with *cohesion* ($r=.21, p=.003$), *intellectual-cultural orientation* ($r=.35, p<.001$), *active-recreational orientation* ($r=.27, p<.001$), *organization* ($r=.17, p=.018$). *Conceptual skill* showed significant positive correlation with *cohesion* ($r=.18, p=.012$), *intellectual-cultural orientation* ($r=.36, p<.001$), and *active-recreational orientation*

($r=.23$, $p=.001$). With respect to *social skill*, it had significant positive correlation with *cohesion* ($r=.20$, $p=.006$), *intellectual-cultural orientation* ($r=.34$, $p<.001$), *active-recreational orientation* ($r=.25$, $p<.001$), *organization* ($r=.17$, $p=.018$), as well as *moral-religious emphasis* ($r=.17$, $p=.018$).

Table 2: Summary statistics for ABAS-II.

Measures	Subfactors	Mean (SD)
<i>ABAS-II</i>	General Adaptation	88.89 (14.31)
	Conceptual Skill	89.70 (14.22)
	Social Skill	87.42 (15.26)
	Practical Skill	90.47 (14.14)

Zhou et al. (2005) (Zhou, 2005) highlighted the role of several subfactors measured by FES-CV in contributing to the differences in behaviours between children with and without ADHD. This includes family *cohesion*, *expressiveness*, *independence*, *achievement orientation*, *organization*, *conflict*, and *control*. Based on the samples of children with ADHD, the current research supported the influences of these factors on patients' behaviours and functioning, except for *independence*. In addition to these factors, the current research also identified the involvement of *intellectual-cultural orientation*, *active-recreational organization*, and *moral-religious emphasis* in affecting ADHD-related performance. Results partially supported the hypotheses, as family environment factors did not exhibit any influences on the *hyperactivity/impulsivity* dimension measured by SNAP-IV. Potential alternative explanations are discussed.

5 DISCUSSION

Although the ways in which family environment contributes to the etiology of neurodevelopmental disorders like ADHD received extensive research, inconsistencies in existing findings highlighted the necessities of further replications. With certain modifications in the methodologies, the current study investigated the extent to which each family environment factor correlates with each dimension of ADHD-related symptoms and functioning, based on the sample of Chinese children diagnosed with ADHD. This study demonstrated the influence of family *cohesion*, *organization*, and *conflict* on both *attention deficit* and *oppositional defiant*. The most influential family environment factor on SNAP-IV total score was *cohesion*, followed by *conflict*, then

by *organization*. *Cohesion*, *intellectual-cultural orientation*, and *active-recreational orientation* also exhibited significant influence on multiple aspects of children's adaptive behaviours. *Intellectual-cultural orientation* was the most strongly correlated factor with children's general adaptation, followed by *active-recreational orientation*, then by *cohesion*.

Nevertheless, while family environment was found to be significantly correlated with SNAP-IV total score, *attention deficit*, and *oppositional defiant*, it did not exhibit any significant correlation with the *hyperactivity/impulsivity* dimension of ADHD symptoms, which was discrepant from the hypotheses and existing findings. In addition, no relationships were generated between *attention deficit* and *expressiveness*, *independence*, and *achievement-orientation* as hypothesized. Meanwhile, *independence*, *achievement-orientation*, and *control* showed no significant correlation with *oppositional defiant*. Potential alternative explanations and limitations in the methodologies are discussed.

5.1 Alternative Explanations

One possible explanation for the lack of correlation between *hyperactivity/impulsivity* and family environment factors refers to the unbalanced gender ratio of the research sample, as there were four times more boys as there were girls. Findings regarding gender differences were congruent with existing literature (Gaub, 1997), in which *hyperactivity/impulsivity* was significantly more prevalent and was rated more frequently in boys than in girls. This suggests that the effect of family environment factors could be confounded by the relatively high *hyperactivity/impulsivity* ratings, which may consequently distort the outcomes of correlational analyses. In addition, as suggested by Rhee et al. (1999) (Rhee, 1999), genetic factors are dominant in influencing boys' vulnerability to experiencing *hyperactivity/impulsivity*, as compared to environmental factors. Similar patterns could not be observed on girls.

Findings did not support significant influences of *expressiveness*, *independence*, *achievement orientation*, and *control* on ADHD symptoms. This could possibly be due to the sole use of FES-CV in assessing family environment, in which subscales for each factor vary in reliability (with *independence* being the lowest). Being relied entirely on self-reports from parents, the FES-CV measurement outcome could involve social desirability bias (Fisher, 1993), as parents may refuse to display

possible inadequacies in their child-rearing practices on the questionnaire. Moreover, although FES-CV reflects the interactions between family members, it does not control family size, socioeconomic status, caregivers' age, and educational background. Thus, the comparability of parents' ratings on family environment factors (E.g., *independence* ratings for family with 3 members vs. family with 6 members) could be affected.

5.2 Limitations

Several inadequacies in the methodologies may restrain the validity and reliability of findings. Although samples recruited from the hospital covered children attending different schools from different regions, findings may not be generalized to children outside the Shandong Province, where diversities of parenting styles could be observed. The size of the sample is limited, in comparison with the 1000 school-age children with balanced gender ratio recruited by Khamis (2006) (Khamis, 2006). Khamis adopted a wide range of measurements to assess the family environment, and collected information from multiple perspectives, including children themselves, caregivers, and teachers. Measures were taken includes parents' socio-demographics (E.g., education, residential patterns, and household income), children's subjective experience of anxiety through family interaction and degrees of satisfaction for parental support, as well as children's behaviour problems rated by teachers. This enabled more holistic and accurate analyses into how family environment could predict ADHD performances. In relation to the current research, measurements of family environment and parenting styles other than FES-CV were not available from out-patient medical records, which implies how future studies could be revised.

5.3 Future Investigations and Implications

Research methodologies could be improved in further investigations regarding the role of family environment underlying ADHD. Larger sample with balanced gender ratio from multiple regions in China should be recruited. Follow-up investigations could be conducted on children diagnosed with ADHD. A variety of rating scales controlling parents' socio-demographics and patients' personalities could be obtained from several caregivers (E.g., grandparents) and children themselves, to gain comprehensive assessment of the family environment. Furthermore,

ADHD-related information could be collected from teachers, who ideally hold better knowledge regarding children's attentiveness in class. Other behavioural measurement (E.g., Child Behaviour Checklist) (Achenbach, 1997) could be adopted in supplement to the SNAP-IV symptom measurement, to examine the consistency of behavioural outcomes and enhance the validity of findings.

Through correlational analyses, the current research provides further evidence for the influences of family *cohesion*, *organization*, and *conflict* on ADHD symptoms, in terms of *attention deficit* and *oppositional defiant*. Findings also reveal the crucial role of *cohesion*, *intellectual-cultural orientation*, and *active-recreational orientation* underlying children's adaptive behaviours. In terms of implications, the most widely adopted ADHD interventions comprise pharmacological intervention, behavioural intervention, and parent-training in home settings (McGoey, 2002). After recognizing the great influence of family environment and child-rearing practices on the severity of ADHD symptoms, future research could focus on whether enhancing family cohesion and organization and reducing conflict could lead to an alleviation of ADHD symptoms. These modifications in the family environment could be aided by family therapy delivered by professionals (Everett, 2001). This would enable caregivers to realize the critical role of themselves in influencing children's ADHD, as well as guide them make improvements in parenting.

6 CONCLUSION

By conducting a correlational analysis based on Chinese children diagnosed with ADHD, this research investigated the extent to which family environment influences on ADHD-related symptoms and functioning. Possible explanations for the partial discrepancies with hypotheses and existing findings were discussed, which highlighted the necessity of further investigations with modifications in methodologies. Nevertheless, this research provided further evidence that family *cohesion* is one most critical factor underlying children's ADHD symptoms and related functioning. Other saliently influential factors include *organization*, *conflict*, *intellectual-cultural orientation*, and *active-recreational orientation*. These findings laid a foundation for future ADHD clinical research, in terms of whether and how improving the environment of families could help Chinese children alleviate ADHD symptoms.

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