

Attention Deficit and Hyperactivity Symptoms in Children with Convergence Insufficiency: Based on of Teacher and Parent Reports

Masoom Rezaee^a, Parvin Dibajnia^{b*}

^a Master of Optometry, Shahid Beheshti University of Medical Sciences, Tehran, Iran; ^b Department of Psychiatry, School of Rehabilitation, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

* **Corresponding author:** Parvin Dibajnia Associate Professor, Department of Psychiatry, School of Rehabilitation, Shahid Beheshti University of Medical Sciences, Tehran, Iran **E-mail:** pdibaj@gmail.com

Submitted: 2022-08-21; **Accepted:** 2022-12-18; **Doi:** <https://doi.org/10.22037/jcpr.v8i1.45170>

Abstract

Introduction: This research intends to determine the occurrence of ADHD-related symptoms in children with Convergence Insufficiency (CI), a treatable visual issue that may be misconstrued as ADHD. It focuses on understanding how often these behaviors are noticed by parents and educators in various environments, such as home and school. **Methods:** This was a case-control study and 108 children attended. Eye examinations were performed and the children were divided into the with CI and control groups. The Children Symptoms Inventory-4 (CSI-4) questionnaire was completed by teachers and parents. CSI-4 is a rating scale that screens for emotional and behavioral symptoms of childhood disorders. These questionnaires ask the parent and teachers to rate the frequency of behaviors observed: never, sometimes, fairly often, or most of the time. **Results:** A total of 108 school-aged children were evaluated by parents and 100 of them by the teachers. There were 51% girls in the CI group and 49% in the control group. Comparison of the mean scores of the parent questionnaire in CI group and control group in ADHD symptoms showed that these two groups did not have significant difference ($P < 0.05$) in ADHD symptoms. The results of the teacher questionnaire indicated that these two groups had a significant difference ($P < 0.05$) for inattention symptom. **Conclusion:** The results from this study suggested that based on teacher information, CI children have a higher frequency of inattentive behaviors, compared to normal binocular children. ADHD may make diagnosis of CI difficult, exacerbate the symptoms of CI and vice versa. For children who have ADHD symptoms or other learning difficulties, a comprehensive visual examination can be useful for diagnosis of CI and other vision problems.

Keywords: Attention Deficit Hyperactivity Disorder; Symptoms; Convergence Insufficiency

Please cite this paper as: Rezaee M, Dibajnia P. Attention Deficit and Hyperactivity Symptoms in Children with Convergence Insufficiency: Based on of Teacher and Parent Reports. J Clin Physio Res. 2023; 8(1): e81. Doi: <https://doi.org/10.22037/jcpr.v8i1.45171>

Introduction

One of the most commonly diagnosed pediatric neurobehavioral disorders, attention deficit hyperactivity disorder (ADHD) is characterized by three primary symptoms, these being poor sustained attention, impulsiveness, and hyperactivity. As a result, There are three types of ADHD: predominantly inattentive, predominantly hyperactive-impulsive, and combined types (1).

ADHD occurs in approximately 3-7% of the childhood population. Overdevelopment, ADHD is associated with lack of success in school, low academic achievement, poor school performance, slow progression in school, poor peer and family relations (2). In a study comparing ADHD subjects and no

ADHD, Farrar (3) found that 14 of the 33 symptoms were more severe in the ADHD group than in the control group. Consequently, ADHD children have more visual and quality of life symptoms than do a similar group of non ADHD children. Damari *et al.* (4) noted some cases misdiagnosed as ADHD, when in fact they were easily treatable visual dysfunctions and as a result, complete visual evaluation is an important step toward avoiding misdiagnosis. Therefore, it is essential that a precise and complete clinical and psychological evaluation of the child be performed before the definitive diagnosis of ADHD. For the diagnosis, a complete medical evaluation should be performed and vision or hearing deficits should be ruled out. These problems can affect the academic performance and concentration (5).

Attention plays an equally important role in lower order visual abilities. Examination and treatment for visual efficiency dysfunction is essential when a child's history includes ADHD. This is particularly relevant in evaluating children whose ADHD is accompanied by delay in reading or writing skills, or marked avoidance of such tasks (6). One of the ways to judge the visual attention is to keep a sustained attention at near work. One of the features of convergence insufficiency (CI) is lack of keeping attention when reading. CI is a prevalent binocular disorder and it is associated with symptoms during near viewing, include; difficulty concentrating, slow reading, trouble remembering what have read, need to re-read the same line, inattentiveness during reading (7, 8).

Recent studies have suggested a possible relationship between CI and ADHD based on parental report (5, 8-10). David Granet *et al.* (5) through a retrospective review of clinical records reported a much higher incidence of convergence insufficiency in children with ADHD. Borsting *et al.* (9) suggested that school-aged children with symptomatic accommodative dysfunction or convergence insufficiency often present with poor school performance and poor reading skills and inattention, in a comparison of visual symptoms between ADHD and normal children. While the authors are cautious about the conclusion, they emphasized that patients with ADHD diagnosis should be examined to determine if they have convergence insufficiency.

The most common criteria for diagnosis of ADHD are the Diagnostic and Statistical Manual of Mental Disorders Fourth Edition (DSM-IV). These criteria depend on the observation of the individuals who have the most interaction with the child. In the past, the diagnosis had been made mostly from the history provided by parents. Recently there has been a greater emphasis on the requirement that the symptoms must be present in more than one setting (11). Some studies examined concordance between parent and teacher reports of ADHD. They pointed to the importance of using multiple informants when diagnosing this disorder (12, 13). Although each informant may be reasonably reliable and observes the child in quite different situations and communicates only occasionally, so it is not surprising that agreement is low. The lower rate of reporting inattention by parents may indicate that parents under-report the inattentive symptoms (14), perhaps because they seldom observe the child in class situations that elicit the inattentive symptoms, and do not have a reference group to compare their children to. Performance in the school setting can be an important indicator of overall adjustment (11). Teachers see the child in task-oriented and social situations and because teachers can

compare a child's behavior with that of other children in the same situation (13).

Because of this incoordination, some studies have tried to find out the best single informant for certain types of problems. In the Loeber *et al.* study (15) mental health professionals thought that the teacher was the most useful informant, more useful than the mother. Also in the Phares study (16), mothers considered teachers as the most accurate informants for hyperactivity/inattentiveness. Teacher observations have been reported to be reliable and agree with direct observations (11) and a better at predicting ADHD subtypes than parent ratings (17).

Because of the importance of collecting parent with teacher reports, as well as importance of teacher reports in examining symptoms, this study evaluates ADHD symptoms in school-aged children, using both the parent reports and the teacher reports and then comparing these reports. And so far, this is the only study that has applied both the parent reports and the teacher reports in evaluating ADHD symptoms in children with CI.

Materials and Methods

This study was a case-control investigation involving children between the ages of 8 and 15 years who attended the study. To participate, a parent provided written consent, and each child gave their assent before any testing took place. Exclusion criteria included individuals with a history of ocular surgery, mental diseases, significant ocular pathology, ADHD diagnosis, or reading difficulties. To be included in the study, participants had to meet specific criteria, such as having a corrected visual acuity of 20/25 or better in each eye, no constant strabismus, no significant ocular pathology, and no history of vision therapy programs. Additionally, participants with refractive errors beyond certain limits wore corrective lenses for at least a month before participating in the experiment. These inclusion and exclusion criteria helped ensure a focused and appropriate study population for the investigation.

In this study, both groups of participants underwent a series of eye examinations conducted by an optometrist. The comprehensive tests included visual acuity measurements with and without correction, non-cycloplegic refraction using an auto-refract meter and manual refraction, heterophobia evaluation through cover tests, near point of convergence (NPC), fusion reserves for distance and near, ocular motility examination, and assessment of the posterior segment using indirect ophthalmoscopy. Additionally, considering the strong association between convergence and accommodation, the

Table 1. T-test results (mean comparison) ADHD symptoms in children with CI and normal group, based on parent questionnaire

Variables	Mean (SD)		Standard error		F	Sig	T-score	Significance level
	CI	Normal	CI	Normal				
Attention deficit	1.30 (1.88)	0.97 (1.55)	0.27	0.20	3.25	0.08	-1.003	0.32
Hyperactivity	1.49 (1.76)	1.67 (2.09)	0.26	0.27	2.76	0.10	0.54	0.59

Table 2. Test results for comparing the symptoms of ADHD in children with CI and normal, based on teacher questionnaire

Variables	Mean rank		Sum of ranks		U statistics	Z results	Significance level
	CI	Normal	CI	Normal			
Inattention	57.16	45.05	2572	2478	938	2.08	0.03
Hyperactivity	49.49	51.33	2227	2823	1192	-0.33	0.74

study incorporated extra tests like Donder's push-up, monocular accommodative facility, and accommodative response by MEM retinoscopy to measure these functions accurately 18-20. The diagnostic criteria for CI were based on specific parameters, including an exo deviation at near that was at least 6 prism diopters greater than at far, failure to meet Sheard's criteria or a minimum normative positive fusion vergence at near (≤ 15 prism diopters for break), and a significant NPC break (6 cm or greater). These criteria help in identifying and diagnosing CI in the study participants 21, 22.

One parent of each child was asked to complete the questionnaire in a separate room while the child was examined. In addition, the questionnaires were completed by teachers. Current research tool was Children Symptoms Inventory-4 (CSI-4). CSI-4 is a DSM-IV- referenced rating scale that screens for emotional and behavioral symptoms of childhood disorders (18, 19). The study utilized both parent and teacher forms in the form of questionnaires. These questionnaires required parents and teachers to rate the frequency of observed behaviors on a scale ranging from "never" to "most of the time." To ensure the reliability of the responses, the internal consistency of the questionnaires was assessed using Cronbach's Alpha. This analysis demonstrated excellent consistency, with a Cronbach's Alpha value of 0.91 for the teacher form and 0.85 for the parent form, indicating that the questionnaires were effective in capturing consistent responses from both parents and teachers.

The study employed SPSS-19 software for all calculations and statistical analysis. A p-value less than 0.05 was considered statistically significant. To analyze the data from parent reports, the researchers used Chi-square and independent t-tests. For the teacher reports, the Mann-Whitney U test was applied. Additionally, the Wilcoxon test was utilized to compare and contrast the reports obtained from both parents and teachers. These statistical methods helped the researchers draw meaningful conclusions from the collected data.

Results

A total of 108 children (47 in the CI group and 61 in the control group) were evaluated by parents and 100 of them (45 in the CI group and 55 in the control group) by the teachers. The mean age of children assessed by parents was 10.7 ± 1.6 in the CI group and 10.7 ± 1.10 in the control group. There were 51% girls in the CI group and 49% in the control group. The mean (SD) age of children assessed by teachers was 10.82 ± 1.64 in the CI group and 10.63 ± 1.85 in the control group. 53% of the subjects in CI group were girls and 47% boys in the control group ($P < 0.01$).

Evaluation of the parent questionnaire results

Comparison of the mean scores of the parent questionnaire in CI group and control group in ADHD symptoms showed that these two groups did not have significant difference ($P < 0.05$) in ADHD symptoms (Table 1)

Also, the results of the comparison of the frequency of children with ADHD symptoms showed only 4% of CI children and 3% of normal children had inattention symptom, which this difference is not statistically significant (significant level 0.49). Also, 4% of CI children and 6% of normal children had impulsive-hyperactivity, this difference was not statistically significant (significant level 0.61).

Evaluation of the results of the teacher questionnaire

To ensure the data adhered to normal distribution, the Kolmogorov-Smirnov (K-S) test was conducted for both the comparison and control groups. The results indicated that the distribution of inattention and hyperactivity factors in the comparison group (CI) and scores in all three factors for the normal group were not normally distributed ($P > 0.05$). Since the normality assumption was not met, the researchers proceeded with a non-parametric test, the Mann-Whitney U test, to analyze the data. The results of the Levene test for equal variances showed that all variances were homogeneous ($P > 0.05$). Table 2 presents the findings from the Mann-Whitney U test, which was employed due to the non-normal distribution of the data.

Table 3. Test results (Wilcoxon) to compare the symptom of inattention for parents and teachers

Inattention/ Parent-teacher factor	Number	Mean rank	Sum of ranks	Z results	Significant level
Negative ranks	9	21.56	194	-7.16	0.0001
Positive ranks	76	45.54	3461		
Tie	15				
Total	100				

Table 4. Test results (Wilcoxon) for comparison of hyperactivity symptoms for parents and teachers

Hyperactivity/ Parent-teacher factor	Number	Mean rank	Sum of ranks	Z results	Significant level
Negative ranks	33	31.48	1039	-2.05	0.041
Positive ranks	42	43.12	1811		
Tie	25				
Total	100				

These results indicated that these two groups had a significant difference ($P < 0.05$) for inattention symptom. However, there was no significant difference in hyperactivity symptom ($P > 0.05$).

Comparing teachers and parent views of inattention

The results of Wilcoxon test showed that there was a significant difference ($P < 0.05$) between the rank score of teacher and parent reports for inattention in CI and control group (Table 3).

According to Wilcoxon test, there was a significant difference ($P < 0.05$) among teacher and parent reports in hyperactivity symptom in CI and normal group (Table 4).

Discussion

The results of this study indicated that there was a significant difference between the report of parent and teacher for the ADHD symptoms. Some studies (11-13) suggested that agreement between parents and teachers for diagnosis of ADHD and its subtypes is relatively poor. Because of the low number of samples in this study, we cannot get a result in terms of agreement between teacher and parent reports.

Based on our results, parent and teacher reports of hyperactivity are similar but teacher reports are significantly higher for inattentive symptoms. The findings are similar to previous studies (using different diagnostic criteria) comparing parent and teacher observations (11, 17). This study did not show any difference in the inattentive symptoms of the two groups, according to the parent reports. The lower rate of reporting inattention by parents may indicate that parent's under-report the inattentive symptoms,

perhaps because they seldom observe the child in task-oriented and social situations like class situations that elicit the inattentive symptoms. Performance in the school setting can be an important indicator of total modification.

Because of this inconsistency, some studies have tried to find out the best single informant for certain types of problems and considered the teacher as a better informant at predicting ADHD subtypes than parent ratings (11, 15-17). Teachers see the child in task-oriented and social situations and because teachers can compare a child's behavior with that of other children in the same situation (13).

So, according to teacher reports, CI children have higher frequency of inattention behaviors, compare to children with binocular vision. Regardless of the different method of this study with previous studies, which the teacher report is used, the results are consistent with previous studies.

Damari *et al.* (4) noted that visual problems can be diagnosed as attention disorders. Many children have ADHD behaviors that are exacerbated by visual problems. In these cases, when a vision problem is treated effectively, the ADHD behaviors are reduced, but they are not completely eliminated. Granet (5) found the prevalence of ADHD behaviors in children with CI three times more than the normal population and concluded that ADHD children should be considered for CI. Rouse *et al.* (8) Examined the presence of ADHD symptoms based on parent report in CI children and concluded that in CI children with ADHD symptoms, compare to CI children without ADHD symptoms, complaints of poorer academic performance, like inattention, avoidance of close work and difficulty in doing near work were more. Borsting (9) said that children with CI, compared with other children, behaviors like low concentration, attention problems and lack of completion of work.

Conclusion

For children experiencing ADHD disorders or learning challenges, a thorough vision evaluation can be beneficial in determining the presence of CI. This is particularly significant for children with ADHD, as they may have unresolved vision issues. Studies focusing on the relationship between ADHD and CI can contribute to a better understanding of these conditions and enhance the treatment process. Optometrists play a vital role in addressing common visual problems like CI, which can exacerbate ADHD symptoms or complicate the diagnosis.

Acknowledgments

We would like to express our gratitude to all individuals and institutions that supported and contributed to the completion of this research article.

Ethical considerations

This study was conducted following all relevant ethical guidelines and regulations to ensure the protection of participants' rights and confidentiality.

Funding support

None.

Conflict of interest

None.

Authors' contributions

Masooome Rezaee: formal analysis, investigation, and Parvin Dibajnia: methodology, writing, original draft.

References

1. Diagnostic A. statistical manual of mental disorders. American Psychiatric Association. Washington, DC. 1994:886.
2. Barkley RA. Attention-deficit hyperactivity disorder: A handbook for diagnosis and treatment: Guilford Publications; 1990.
3. Farrar R, Call M, Maples W. A comparison of the visual symptoms between ADD/ADHD and normal children. *Optometry* (St Louis, Mo). 2001;72(7):441-51.
4. Damari D, Liu J, Smith K. Visual disorders misdiagnosed as ADHD: case studies and literature review. *J Behav Optom*. 2000;11:87-91.
5. Granet DB, Gomi CF, Ventura R, Miller-Scholte A. The relationship between convergence insufficiency and ADHD. *Strabismus*. 2005;13(4):163-8.
6. Hong CL, Press LJ. Visual factors in childhood behavioral disorders. *California Optometry*. 2009;36(4):46-54.
7. Borsting E, Rouse MW, Deland PN, Hovett S, Kimura D, Park M, et al. Association of symptoms and convergence and accommodative insufficiency in school-age children. *Optometry* (St Louis, Mo). 2003;74(1):25-34.
8. Rouse M, Borsting E, Mitchell GL, Kulp MT, Scheiman M, Amster D, et al. Academic behaviors in children with convergence insufficiency with and without parent-reported ADHD. *Optometry and vision science: official publication of the American Academy of Optometry*. 2009;86(10):1169.
9. Borsting E, Rouse M, Chu R. Measuring ADHD behaviors in children with symptomatic accommodative dysfunction or convergence insufficiency: a preliminary study. *Optometry-Journal of the American Optometric Association*. 2005;76(10):588-92.
10. Grönlund M, Aring E, Landgren M, Hellström A. Visual function and ocular features in children and adolescents with attention deficit hyperactivity disorder, with and without treatment with stimulants. *Eye*. 2007;21(4):494.
11. Wolraich ML, Lambert EW, Bickman L, Simmons T, Doffing MA, Worley KA. Assessing the impact of parent and teacher agreement on diagnosing attention-deficit hyperactivity disorder. *Journal of Developmental & Behavioral Pediatrics*. 2004;25(1):41-7.
12. Mitsis EM, McKay KE, Schulz KP, Newcorn JH, Halperin JM. Parent-teacher concordance for DSM-IV attention-deficit/hyperactivity disorder in a clinic-referred sample. *Journal of the American Academy of Child & Adolescent Psychiatry*. 2000;39(3):308-13.
13. de Nijs PF, Ferdinand RF, de Bruin EI, Dekker MC, van Duijn CM, Verhulst DC. Attention-deficit/hyperactivity disorder (ADHD): parents' judgment about school, teachers' judgment about home. *European child & adolescent psychiatry*. 2004;13(5):315-20.
14. Sherman DK, McGue MK, Iacono WG. Twin concordance for attention deficit hyperactivity disorder: a comparison of teachers' and mothers' reports. *The American journal of psychiatry*. 1997;154(4):532.
15. Loeber R, Green SM, Lahey BB. Mental health professionals' perception of the utility of children, mothers, and teachers as informants on childhood psychopathology. *Journal of Clinical Child Psychology*. 1990;19(2):136-43.
16. Phares V. Accuracy of informants: Do parents think that mother knows best? *Journal of Abnormal Child Psychology*. 1997;25(2):165-71.
17. Fergusson DM, Horwood LJ. The structure, stability and correlations of the trait components of conduct disorder, attention deficit and anxiety/withdrawal reports. *Journal of Child Psychology and Psychiatry*. 1993;34(5):749-66.
18. Gadow K, Sprafkin J, Pierr C. Test-retest reliability study of the child symptom-inventory-4 parent checklist. Unpublished Data Reported in Gadow and Sprafkin. 1997.
19. Gadow KD, Sprafkin J, Salisbury H, Schneider J, Loney J. Further Validity Evidence for the Teacher Version of the Child Symptom Inventory-4. *School Psychology Quarterly*. 2004;19(1):50.