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Relationship between quality of life and cognitive function in school aged children with attention deficit and hyperactivity disorder

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Abstract

Children with attention deficit hyperactivity disorder have deficiency in many aspects of cognitive functions and quality of life (QOL). The study aimed to examine the relationship between cognitive functions and quality of life in children with Attention Deficit and Hyperactivity Disorder (ADHD). This analytical study is a correlation one. 60 participants were chosen according to statistical formula. Participants were evaluated using the Wechsler Intelligence Scale for Children Revised edition (WISC-R). Their cognitive functions and quality of life (QOL) were assessed by Cognitive Assessment System (CAS), Continuous Performance Test plus Integrated Visual/Auditory (CPT+IVA) and Pediatric Quality of Life inventory (Pads 4.0) Generic Core Scale. After analyzing data a significant correlation was found between attention and school functioning of QOL in all grades, separately. Furthermore, significant correlations were found among full scale attentions of CPT+tIVA test with psychosocial functioning and also total score of QOL, in grade 2 and in grade 5, as well Social Functioning in two grades children. Also significant correlations were found among simultaneous subscale of CAS and emotional, social and psychosocial functioning of QOL, in grade 4. Cognitive functions of children with ADHD have effects on some domains of QOL.

Keywords: Attention Deficit Disorder, Child quality of life

Introduction

Attention deficit hyperactivity disorder (ADHD) is described as the recurring pattern of hyperactivity, impulsivity and attention deficit which often begins before the age of seven and is attributed to natural growth. This problem has affected on 3.0-%5 of children in US [1]. This disorder causes impairment of normal functions such as academic success, behavior at school, interaction with family and peer relationships. In addition these children face serious problems in basic functions. As this research suggests, defects in cognitive functions in these children are very common [2].

Cognitive theory of planning, Simultaneous, Successive, Processing (PASS) has been introduced first by Das in 1972 and then by Naglieri and Kirby in 1994 [3]. The theory has considered four cognitive processes such

as planning, attention, sequential processing and simultaneous processing. Planning is an intellectual activity which facilitates cognitive control, organization, self-regulation and the application of knowledge, skills, and other cognitive processes. This process involves self-monitoring, impulse control, production and evaluation of programs for solving the problem. Attention is a mental process providing the possibility of concentration, selective cognitive activity over a time. Through this process individual voluntary pay attention to stimulant and does not respond to other stimuli [4].

The sequential process is the one through which stimuli are proceeded by a special order to reach a chain sequence. For achieving this sequence, data should not be neither integrated nor considered as a significant whole in this process, the individual has processed the stimuli by special order. The simultaneous process is the one in which individual must integrate a set of stimuli in the form of a total one. In other words, the person should establish a relation between the various components of a stimulant, and recognize it as a perceptual or conceptual unite [5].

Studies have shown that children suffering from attention deficit and hyperactivity disorder often have lower efficacy than healthy children of the same age in cognitive functions based on the theory of PASS, especially in the planning process [6-8]. Some of the studies indicate that they have weaker performance in comparison to normal group in two scales of sequential processes and simultaneous procedures [4,7-9].

On the other hand, based on several researches conducted on life quality of children with attention deficit and hyperactivity disorder, it has been shown that these children have lower quality of life in comparison to their peers. The more attention, hyperactivity, impulsivity problems are in these children, the lower life quality will be [10,11].

World health organization defines the quality of life as the individual's perception of his/her status and position in the life regarding the culture, and system value in which the live as well as the relation with goals, expectations, standards and preferences having in individual's life. Studies show that parents' of children suffering from attention deficit and hyperactivity disorder compared with parents of control group have reported more difficulties in emotional and behavioral functioning, mental health, self-esteem as a subcategory of children's life quality [12].

In addition, if children suffering from attention deficit and hyperactivity disorder show more and more symptoms of having lower quality of life in aspect of psychosocial functioning [13]. Children with attention deficit and hyperactivity disorder got lower scores less than normal peers in school performance and social functioning. And some problems related to their academic performance and quality, have also been reported [14]. For instance, in a study conducted by Kandemir and colleagues it has been observed that children have lower educational attainment than normal children and this suffering group has more absences at school, lower Problem-solving skills, communication, playing major roles within the life and emotional response in children with attention deficit and hyperactivity disorder show more problems compared with normal children and overall quality of life for these children is lower than normal children [15]. Many parents also have reported a negative impact of this impairment on a wide range of areas of psychosocial; achievement and self-evaluation in children with attention deficit and hyperactivity disorder [16].

With attention to the review of previous studies, it seems problems related to children's quality of life and cognitive function deficits have been considered separately by many researchers. And so far, an independent study to examine the relationship between these two categories of children with attention deficit and hyperactivity disorder has not been done. This study aimed to evaluate the correlation between quality of life and cognitive functions in children with attention deficit and hyperactivity disorder.

Method

This analytical study is the correlative type that has been done on 60 elementary students suffering from ADHD referred to "Atiye performance promotion center". The sample size was calculated according to related formula. 65 samples were obtained, and the sampling has been done based on available method. After informing the families about research purpose, free participants in this study and lack of any interference on therapy process, we succeed to get permission and written consent from parents.

After reviewing the patients' medical records and considering admitted the inclusion and exclusion criteria for the study, 15 children in each grade (among 60 patients) were eligible to enter the study. For gathering data, a questionnaire containing demographic information, Wechsler Intelligence Test, General form of the PedSQL children fourth edition and a cognitive function test of CAS and Continuous Performance Test (CPT+IVA) was used .

Inclusion criteria of this research included suffering from attention deficit, hyperactivity disorder based on DSM-IV and diagnoses of child psychiatrist, being a student in one of the elementary grades from 2nd to 5th, not taking methylphenidate (Ritalin) by the specialist 24-48 hours before cognitive testing and exclusion criteria as well as having an IQ less than 90, according to the Wechsler Intelligence Test for Children (WISC-R). All psychometric tests were conducted by a psychologist.

The instrument of gathering data included children's quality of life questionnaire (PedSQL 4), CPT+IVA test and Cognitive Assessment System (CAS). Questionnaire of children's quality of life (PedSQL 4) has been designed in both child and parent version as a general tool to assess health related quality of life in children (HRQOL; Health Related Quality of Life)

Parent report form was used in this study. This questionnaire consists of assessing the physical, emotional, social and school performance in children 8-12 years. Also, the total scores of the domains of functioning, emotional, social and school functioning, psychosocial functioning domains are reported. The tool has good construct validity. Pearson's correlation coefficient (-0.15 to -0.50) and Cronbach's alpha is (0.86-0.90) [17], content validity and reliability of this questionnaire has been approved [18].

Cognitive Assessment System (CAS) has been designed to evaluate the four cognitive processes in 5 to 18 years and has been organized in three levels of general scale (Full scale), the FPS four scales of cognitive process, FPS, and subtests. General Scale: This scale provides the general measures of cognitive processes. The overall scale score is the score obtained from sum of the scores of the subtests of each of the four cognitive measures of scale. General scale has a normalized mean of 100 and standard deviation of 15.

Score of general scale provides an indicator of general level of individual's cognitive functions. Four scale of cognitive process: CAS includes four scales of planning, attention, simultaneous processing, and sequential processing. Each of these scales consists of three subtests; these four scales indicate individuals' cognitive functions and are used for recognizing weakness and strength points of cognitive processes.

Subtests of planning include matching numbers, planned codes, and planned connections. Subtests of attention cover visual attention, number detection, and receptive attention. Subtests of simultaneous process include nonverbal matrices and subtests of sequential process include word series, sentence repetition, and speech rates. Each of subtests has meant of 10 and standard deviation of 3.

The time running this test is approximately 60 minutes. The validity and reliability of cognitive assessment system in Iran being the Pearson correlation coefficient is from 0.71 to 0.77 for examining the relationship between test-retest subtests scales of planning and attention process, Richardson coefficient is

from 0.78 to 0.81 for assessing the reliability of subtests scale of sequential and simultaneous process [19].

Continuous performance test version numbers integrated visual and auditory continuous performance test CPT+IVA is one of the Continuous Performance Testes, continuous performance test was prepared in 1956 by Rasvold [20]. About children with ADHD, the purpose of this test is to measure sustained attention . The numbers of omission errors, and commission errors and latency (response) are variables of continuous performance test. Persian version of this test has the validity coefficient of 0.53-0.93 [21,22]. Wechsler Intelligence Scale for Children (WISC-R) was developed in 1937 by David Wechsler in New York.

There are three scales for this test, that in present study the scale related with children 5 to 15 years old has been used. Reliability and validity of the test was determined by Shahim in Iran. Subtests validity coefficient has been in range of 0.24 to 0.69 and their reliability coefficient varies from 0.44 to 0.94 [23].

For analyzing the research data, techniques of both descriptive statistics (mean, standard deviation, frequency, frequency percentages) and inferential statistics such as Pearson correlation coefficient and two-variable regression have been used. These data have been analyzed by SPSS-19.

Results

60 children suffering from attention deficit and hyperactivity disorder participated in this study that their demographic information has been presented in Table 1.

Table 1 *Demographic information of participants suffering from attention deficit and hyperactivity disorder*

	5th grade	4th grade	3rd grade	2nd grade	Total numbers
Gender boy (girl)	(2)13	9(6)	8(7)	10(5)	60
Drug consumption yes (no)	2(13)	2(13)	1(14)	2(13)	60
Mothers' jobs (housewife) employed	6(9)	4(11)	8(7)	7(8)	60
Number of children (2 children or more), one child	5(10)	5(10)	7(8)	9(6)	60

* ADHD children in any grades have been matched from perspective of IQ, economic status of families and education level of parents.

* Number of the sample in each grade is 15 and in whole is 60.

In accordance with Table 1, in each grade 15 students have been examined, that according to gender in the 2nd grade 10 boys and 5 girls, in the 3rd grade 8 boys and 7 girls, in the 4th grade 9 boys and 6 girls and in the 5th grade 13 boys and 2 girls. In all 4 grades the numbers of boys were more than the girls.

Drug use has the same interpretation with gender. Based on the above table, in the 2nd grade two students taking medication and 13 students without drug use have been studies, likewise other grades. In the 2nd grade, 7 students' mothers were employed and 8 mothers were housewives, similar way to other grades.

In the 2nd educational grade, 9 students were born in one-child families and 6 students in a family of two or more children.

The mean and standard deviation scores of students with attention deficit and hyperactivity disorder in the areas of questionnaires of children's life quality have been indicated in Table 2. The mean and standard deviation of the test scores of students in the subtest of CAS and the continuous performance test CPT+IVA have been given in Table 3, Correlation coefficients between the scores of students with attention deficit and hyperactivity disorder in the areas of quality of life questionnaire PedsQL and subtest of the CAS and attention CPT+IVA from the second to fifth grades have been shown in Table 4 with details.

According to Table 2, the average physical performance of students in the 5th grade, emotional performance of students in the 4th grade, social performance of students in the 4th grade, students' performance in school in 5th grade, psychosocial performance of students in the 4th grade, and ultimately the life quality of students in the 4th grade in comparison to other grades was greater.

Regarding Table 3, the average subtest in the 3rd and 4th, subtest planning in 3rd grade, subtests in simultaneous process in the 5th grade, subtest of sequential process in the 5th grade, total score of cognitive function in the 3rd grade, subtest of attention test CPT+IVA in the 5th grade have been higher than other grades.

According to the results of Table 4, the calculated correlation coefficient in the 2nd grade, between attention test CPT+IVA test and the domains of social functioning is (0.565), school (0/.572), psychosocial (0.593) and quality of life (0.548) which is significant at 0.05. In the 3rd grade, the correlation coefficient between attention test CPT+IVA and school performance is calculated (0.591) which is significant at 0.05. In the 4th grade, the correlation coefficient between attention tests CPT+IVA and area of school performance was calculated (0.522).

Moreover, there is a significant relationship among simultaneous processing with domains of emotional performance (0.637) and psychosocial (-0.533) at level 0/5 and simultaneous processes with domains of social performance (-0.666) that at level 0.01. In the 5th grade, correlation coefficient between CAS test and regarding school performance (0.539) at 0.05 and CPT+IVA test and scope of school performance (0.827) and social functioning (0.715) and quality of life (0.648) at 0.01

Table 2 *Mean and standard deviation of students' scores suffering from attention deficit and hyperactivity disorder in the 2nd to the 5th grades regarding the life quality questionnaires for children.*

Domains	5th grade	4th grade	3rd grade	2nd grade
Physical performance	610±122.9	561.7±154.1	540±132.2	600±135.3
Emotional performance	310±73.7	365±80.6	336.7±66.1	351.7±50.4
Social performance	348.3±83.7	376.7±93.8	310±108.1	331.7±85.8
School performance	303.3±69.4	288.3±91.1	268.3±75.9	291.7±84.9
Psychosocial performance	965±178.7	1030±190.9	915±178.2	975±183.7
Total score of life quality	1571±272.9	1591.7±292.7	1455±263.6	1575±280.3

Table 3 *The mean and standard deviation scores of students with attention deficit and hyperactivity disorder in the grades from 2nd grade to the 5th in subtest of cognitive assessment system and continuous performance test according CPT+IVA.*

	5th grade	4th grade	3rd grade	2nd grade
Attention	87.5±7.5	90±9.9	90±9.8	83.2±15.3
Planning	82.7±10	83.7±11.8	86.7±13.2	81.5±13.6
Simultaneous process	103.7±12.6	99.1±11.2	101.7±14.9	98.2±17.9
Sequential process	94.1±11.9	91±9.9	93.7±12.8	89.7±15.9
Total score of cognitive performance	91.1±10.9	89.3±8.1	92.9±12	84.4±17.3
Attention test CPT+ IVA	76.9±19.2	70.7±13.4	71.9±16.9	71.7±20.6

Table 4 *The correlation coefficient between the scores of students with attention deficit and hyperactivity disorder on the 2nd grade to the 5th grade in quality of life questionnaire PedsQL and subtests of cognitive assessment system (CAS) and continuous performance test of attention.*

	PedsQL CAS& CPT+IV	Quality of life	Psychosocial performance	School performance	Social performance	Emotional performance	Physical performance
2nd grade	Attention CAS	-0.006	0.011	0.043	0.097	-0.195	-0.029
3rd grade		0.033	0.13	-0.187	0.289	0.093	-0.11
4th grade		0.18	-0.026	0.004	-0.017	-0.047	0.374
5th grade		0.262	0.411	0.539*	0.205	0.222	0.005
2nd grade	Planning CAS	-0.146	-0.147	-0.147	-0.043	-0.215	-0.104
3rd grade		-0.005	0.026	-0.13	0.247	-0.185	-0.046
4th grade		0.169	0.006	0.08	-0.079	0.016	0.314
5th grade		-0.28	-0.185	0.074	-0.386	-0.073	-0.356
2nd grade	Simultaneous process	-0.037	0.04	0.079	0.073	-0.113	-0.131
3rd grade		-0.052	0.128	-0.354	0.032	0.008	0.069
4th grade		-0.476	-0.533*	0.132	-0.666**	-0.637*	-0.244
5th grade		0.198	0.207	0.25	0.057	0.217	0.13
2nd grade	Sequential process CAS	-0.024	0.15	0.183	0.111	0.049	-0.252
3rd grade		-0.163	-0.114	-0.092	-0.137	0.023	-0.17
4th grade		0.181	0.162	0.168	0.161	0.007	0.144
5th grade		-0.096	-0.229	-0.067	-0.34	-0.052	0.087
2nd grade	Cognitive performance CAS	-0.065	0.027	0.072	0.075	-0.148	-0.172
3rd grade		-0.21	-0.015	-0.128	0.002	0.102	-0.399
4th grade		0.056	-0.163	0.054	-0.185	-0.233	0.309
5th grade		0.043	0.144	0.316	-0.121	0.177	-0.101
2nd grade	Attention CPT+IV	0.548*	0.593*	0.572*	0.565*	0.237	0.331
3rd grade		0.09	0.068	0.591*	-0.186	-0.192	0.088
4th grade		0.000	0.069	0.522*	-0.193	-0.201	-0.086
5th grade		0.648**	0.715**	0.827**	0.44	0.383	0.443

*p<0.05

**p<0.01

Discussion

The aim of this study was to investigate the relationship between cognitive functions and quality of life in children with attention deficit hyperactivity disorder at school age. These variables have been assessed by means of CAS, auditory and visual attention test CPT+IVA, quality of life questionnaire PedsQL 4 and demographic questionnaire were measured. And their relation with each other was evaluated.

Studies show that emotional control problems associated directly with symptoms of hyperactivity and impulsivity are due to the liability of people in inhibiting response. [20,21]. Since the planning is involved in assessment (Self-monitoring and controlling impulses and devise), and consequently it involves response inhibition.

Pennington said the deficit in executive functions in children with attention deficit and hyperactivity disorder may be caused by the reduction of frontal lobe performance which in sequence it may be due to structural or biochemical changes in the prefrontal areas [22,23].Because response inhibition and planning according to Luria's theory are concerned with the areas of the brain [8]. It can be concluded that Planning and socio-emotional functions are related to each other.

In addition, these children in cognitive performances based on PASS theory especially in planning process and attention perform significantly are weaker than healthy peers [4,7,8,24]. On the other hand, the influence of the executive functions of the brain deficits on daily activities has been approved by the researchers. Defects of attention make difficult performance of daily activities.

Therefore it can be concluded that the cognitive performance influence the quality of life having a direct connection with daily activities. Children suffering from attention deficit and hyperactivity disorder the more symptoms related with this disorder, they experience lower life quality in the field of psychosocial functioning [13]. In this study there was not any relationship between planning and domain of emotional and social performance.

In addition, people with attention deficit and hyperactivity disorder have poorer ability to regulate or manipulate and suppress their emotional responses. As a result, emotional responses and more impulsive will be shown by them than their peers. Emotional deregulation has an important role in understanding this disorder [25]. Difficulty in regulating emotions associated directly with symptoms of hyperactivity and impulsivity, and is due to lack of response inhibition [20,21].

Regarding the fact that planning includes self-monitoring, and impulse control and created plan [26], it can be concluded that the planning is associated with emotional and social performance. In this study, no significant relationship between planning and life quality has been found. This lack of correlation may be because of the quality of life questionnaire PedsQL 4 did not examine emotional and social performance extensively. Therefore, it seems that in the future studies a more precise tool for assessing emotional and social functions of these people will be used.

Children with attention deficit and hyperactivity disorder in several aspects of cognitive functions (especially planning and attention) are deficient, [3,27-30]. Between international attention CPT+IVA test and quality of life questionnaire in all grades of school performance, any significant relationship was observed. There can be found a significant relationship between CPT+IVA test in the 2nd and 5th grades and total grade of life quality as well as psychosocial performance. And in the 2nd grade between CPT+IVA and social performance, a significant correlation can be found.

It seems that there should be a significant relationship between CAS test and domain of school performance quality of life questionnaire but that relationship was significant just in the 5th grade. This issue can

be interpreted through the differences of two tests and gradual growth of cognitive talents with aging in children. CPT+IVA test examines the audio-visual attention from sustained attention [31].

In this case, complex cognitive tasks requiring the significant knowledge has not been evaluated and is associated greatly with abilities of response inhibition dealing with symptoms of hyperactivity disorder and impulsivity in attention deficit and hyperactivity. And it will be run with a simple click of the mouse. Significant work which is measured by the CAS test requires higher-level of cognitive skills (reading and writing) and is in the written form. Therefore, the CPT+IVA test than CAS test, is related more with skills in areas of school performance measured in quality of life questionnaire PedsQL.

"Sequential" and "simultaneous" processes have been considered an important role in educational performance [32,33]. However, any significant relationship between sequential process and domains of life quality cannot be observed in none of 2nd to 5th grades. In the 4th grade there was a significant relation between simultaneous processes and areas of emotional, social, and psychosocial performances. It can be said that perhaps items measured by Quality of Life Questionnaire PedsQL4 were little to do the simultaneous and sequential processes. Especially lack of significant relationship between cognitive functions and other areas of quality of life could be due to having higher IQ than its normal level among all participants. And high IQ can partly cover the decline in cognitive function [34]. Thus, the impact of impaired cognitive functions on quality of life of these children is not clearly specified.

It is recommended for a more accurate evaluation of the relevance and impact of cognitive functions in all domains of quality of life, extensive studies with a larger sample size and with more precise tests in the field of children's life quality will be performed.

Conclusion

Findings showed that cognitive function was effective in school performance, psychosocial performance and emotional performance of children with attention deficit and hyperactivity disorder. Lack of a significant relationship between cognitive functions and quality of life domains could be because, firstly, the natures of the cognitive tests used in this study are different.

CPT-IVA test is based on the use of computers and has implementation of short duration (average duration of 15 minutes) and is dependent on the level of education as well as the speed of response and response inhibition. CAS test is the kind of pen and paper form (written), and takes long (average 60 minutes) and include a review of multiple cognitive functions.

Therefore, regarding the different nature of the tests, the different performances of the children in these two tests are expected. Secondly, all the subjects in this study were higher than normal IQ and high IQ can somehow compensate and affect greatly deficient basic cognitive functions. Thirdly, since children were selected from different ages among the 2nd to 5th grades and naturally there was a significant difference in their cognitive development, based on the relationship between cognitive functions and quality of life, it can be concluded that the differences in their cognitive development is efficient.

So according to these three questions in this study, it appears that some cognitive functions are associated with certain domains of quality of life.

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Study design: HH, SB
Data collection and analysis: SB, RR, SN
Manuscript preparation: GHH, SB

Conflict of Interest

"The authors declare that they have no competing interests."

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