

Cognitive characteristics and quality of life in attention deficit hyperactivity disorder

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Abstract

Background: Attention deficit hyperactivity disorder (ADHD) is the most frequent pediatric neurodevelopmental disorder. Studies in Mexico about health-related quality of life (QOL) and cognitive characteristics in these patients are scarce. **Objectives:** The objective of this study is to describe the relationship between cognitive characteristics and health-related QOL in children with ADHD in Puebla, Mexico. **Method:** A cross-sectional, analytical study was carried out in a second-level care hospital in Puebla, Mexico. Both genders, from 6 to 12 years old patients with ADHD were included. Those with visual/hearing disabilities and/or severe language delays were excluded. Patients who did not complete the information were eliminated. The Wechsler Intelligence Scale for Children IV (WISC-IV), The Neuropsi and Brief Multidimensional Life Satisfaction Scale for Students (as health-related QOL indicator) scales were applied. Spearman test was used; $p \leq 0.05$ was considered significant. **Results:** 104 children were recruited, 71 male (68.26%), medium age was 8.94 years old ($SD = 1.83$, $min = 6$, $max = 12$). Work memory and processing speed (WISC-IV), and memory and attention (Neuropsi) were the most affected domains. Health-related QOL was low at 60%. WISC-IVs intellectual quotient ($r = 0.3962$, $p = 0.000$), and Neuropsi's memory and attention ($r = 0.451$, $p = 0.018$) reported a significant moderated correlation with health-related QOL. **Conclusion:** Attention, memory, and processing speed were the most affected cognitive characteristics in children with attention deficit/hyperactivity disorder. Health-related QOL resulted low. Intellectual coefficient, as well as memory and attention, reported a significant moderated correlation with health-related QOL.

Keywords: Neurodevelopmental disorders. Neuropsychology. Cognition. Intelligence.

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Características cognitivas y calidad de vida en el Trastorno por Déficit de Atención con Hiperactividad

Resumen

Introducción: El Trastorno por Déficit de Atención e Hiperactividad es el desorden pediátrico del neurodesarrollo más frecuente. Los estudios en México que evalúan Calidad de vida y características cognitivas son escasos. **Objetivo:** Describir la relación entre las características cognitivas y la calidad de vida en niños con trastorno por déficit de atención e hiperactividad en Puebla, México. **Método:** Se realizó un estudio transversal, analítico en un Hospital de 2º nivel de atención en Puebla, México. Se incluyeron pacientes con Trastorno por Déficit de Atención e Hiperactividad de 6 a 12 años. Se excluyeron aquellos con discapacidad visual/auditiva y retraso severo del lenguaje. Se eliminaron quienes no completaron la información. Se les aplicó WISC-IV, Neuropsi y BMSLSS (como indicador de Calidad de Vida). Se utilizó Coeficiente de Spearman; $p \leq 0.05$ se consideró significativa. **Resultados:** 104 niños reclutados, 71 hombres (68.26%), edad media 8.94 años (DE 1.83, mín. 6, máx. 12). Los dominios más afectados fueron Memoria de trabajo, Velocidad de procesamiento (WISC-IV), y Atención y memoria (Neuropsi). La Calidad de Vida fue mayoritariamente baja (60%). Coeficiente intelectual (WISC-IV) ($r = 0.3962$, $p = 0.000$) y Atención y memoria (Neuropsi) ($r = 0.451$, $p = 0.018$) reportaron correlación moderada significativa con Calidad de vida. **Conclusión:** Atención, Memoria y Velocidad de procesamiento son las características cognitivas más afectadas en niños con Trastorno por Déficit de Atención e Hiperactividad. La Calidad de vida es baja. Coeficiente intelectual y Atención y memoria reportaron correlación moderada significativa con Calidad de Vida.

Palabras clave: Trastornos del Neurodesarrollo. Neuropsicología. Cognición. Inteligencia.

Introduction

Attention deficit hyperactivity disorder (ADHD) is the most common neurodevelopmental disorder in the pediatric age group. This is a heterogeneous syndrome of multifactorial origin, characterized by moderate-to-severe distractibility, brief periods of attention, motor restlessness, emotional instability, and impulsivity¹⁻⁴. It begins in childhood and up to 40-60% persists into adulthood, which affects psychosocial, school, and family functioning². This has the prevalence in children of up to 41.1%, in adolescents and adults in 26.2%⁵. In Mexico, the prevalence is 14.6%^{3,6}.

Executive functions are individual cognitive abilities that transform thoughts into decisions, plans, and actions. At least 4 functions are distinguished: Setting of objectives and planning, working memory, cognitive flexibility (task-switching ability), and inhibitory control. These altered functions characterize the patient with ADHD, and hinder family, school/work, and friendships social performance. It is frequently detected in the school because social interaction is evident in the group⁷⁻¹⁰.

The evaluation of executive functions is indispensable in the patient with suspicion or diagnosis of ADHD. It identifies strengths and opportunities to improve and allows to plan a psychobehavioral treatment with frequent evaluations of evolution¹⁰⁻¹³. The determining impact of ADHD on the quality of life (QOL) of children and adolescents is reflected in all areas of life and neurodevelopment^{13,14}. This article evaluates the hypothesis

about the correlation between cognition and QOL in children with ADHD.

The aim of this study was to describe the relationship between neuropsychological characteristics and QOL in children with ADHD in a second-level health care of the Mexican Social Security Institute in Puebla, Mexico.

Method

A prospective, analytical, and cross-sectional study was carried out. This work was approved by the Research Ethics Committee No. 21028 and the Local Health Research Committee No. 2102 of the Mexican Social Security Institute. All patients agreed to participate and their parents signed informed consent. They were given the possibility of not participating or leaving the study when they decided to do so. The individual results were given to the guardians and to the treating physicians. Personal data were handled with strict confidentiality.

Outpatients treated in a General Hospital of the Mexican Social Security Institute in Puebla, Mexico, were included. Patients were recruited with a diagnosis of ADHD established by neuropsychiatrist, (based on the criteria of the Diagnostic and Statistical Manual of Mental Disorders, fifth edition of the American Psychiatric Association DSM-5), of any gender, aged 6 to 12 years, who signed a letter of informed consent, and whose parents signed a letter of informed consent. Patients with visual or hearing impairment, severe delay in language development were excluded from this study.

Those who did not complete the information and/or who requested to leave the study were eliminated from this study.

Patients who met the selection criteria received: Parental interview, and the Wechsler Intelligence Scale for Children IV (WISC-IV) and Neuropsi scales, which were applied by physicians trained for this purpose by neuropsychology.

The following instruments were applied:

- Interview with parents recording age, schooling, occupation, and behavioral disorders during childhood; about the patient: Perinatal history, time of diagnosis, sibling with ADHD, and treatment
- WISC-IV it is essential for the diagnosis of intellectual disability, learning disorders, autism spectrum, ADHD, and others, including differential diagnoses. This identifies global intellectual capacity, general abilities, and a specific profile in patients aged 6-16 years, at primary school level to the beginning of high school. It has excellent consistency (α -Cronbach = 0.93) and validity. It consists of 15 tests (10 main and 5 optional) through which a profile of scalar scores, a total intellectual quotient (IQ) and four indices (*verbal comprehension, perceptual reasoning, working memory, and processing speed*) are obtained. Scores in each domain can be: *Very high* (130 and above), *superior* (120-129), *high average* (110-119), *average* (90-109), *low average* (80-89), *borderline* (70-79), and *extremely low* (69 and below)¹⁵
- Neuropsi attention and memory third edition (*Neuropsi*). Evaluates the cognitive subprocesses of: *Attention and executive functions, memory, and global attention and memory*. It has a consistency of 0.89-1, a sensitivity of 93% and a specificity of 98%. It is standardized for the Mexican population. The values can be: *High normal range* (116 points and above), *normal* (85-115 points), *mild-to-moderate disturbances* (70-84 points), or *severe disturbances* (69 points or less)^{16,17}
- Brief multidimensional life satisfaction scale for students (*BMSLSS*). Self-report consists of 6 questions exploring different environments: family, friends, residence, school, personal, and general. It is widely used in Spanish-speaking populations. It reports high consistency (α -Cronbach = 0.85) and high concordance with other life satisfaction measures and related variables. One of 3 life satisfaction scores is obtained: *High, Medium, and Low*. *Life satisfaction* was used as an indicator of QOL^{12,18}.

Table 1. Patient characteristics (n = 104)

| | |
|---|--------|
| Age (years) | |
| 6-7 | 29.80% |
| 8-10 | 50.00% |
| 11-12 | 20.19% |
| Pregnancy number | |
| 1 ^o | 20.19% |
| 2 ^o | 36.54% |
| 3 ^o | 39.42% |
| 4 ^o | 2.08% |
| 5 ^o | 2.08% |
| Academic degree | |
| 1 ^o -2 ^o Elementary | 31.73% |
| 3 ^o -4 ^o Elementary | 34.61% |
| 5 ^o -6 ^o Elementary | 20.19% |
| 1 ^o High school | 13.46% |
| Time to ADHD ^a Diagnosis (years) | |
| < 3 | 57.69% |
| 3-5 | 34.61% |
| > 5 | 7.69% |
| Pharmacological treatment | |
| MPDb | 77.88% |
| MPD+MVC | 14.42% |
| MPD+risperidone | 2.08% |
| MPD+sertraline | 2.08% |
| Oxybutinin | 2.08% |
| MV | 2.08% |

^aADHD: attention deficit and hyperactivity disorder; ^bMPD: methylphenidate;

^cMV: magnesium valproate.

Statistical analysis

Descriptive statistics were used. Spearman's coefficient was used for the correlation between *Neuropsi* and WISC-IV with *BMSLSS*. The $p \leq 0.05$ was considered significant. The statistical package SPSSv17.0 was used.

Results

Of the 148 patients in control with the diagnosis, 104 accomplished inclusion criteria, representing 70%. They were 33 (31.73%) females and 71 (68.27%) males, aged 6-12 years, with a mean of 8.94 (SD = 1.83).

The most frequent values in the patients were (Table 1): Age 8-10 years; 2nd and 3rd gestation; 1st-2nd and 3rd-4th grade schooling; time since diagnosis less than 3 years; no siblings with ADHD; pharmacotherapy with methylphenidate. There were 51 (49%) patients born in the first half of the year, and 53 (51%) were born in the second half. Only 10 (9.61%) patients reported siblings with ADHD, and only 5 (5%) received psychotherapy. The main comorbidities were sleep disorders (69 patients, 66.34%), epilepsy (67, 64.42%), and gastroesophageal reflux disease (61, 58.65%).

Table 2. Characteristics of parents

| | (n = 104) Father or tutor | | (n = 104) Mother or tutor | |
|--------------------------------|--|-----------------|-------------------------------------|-----------------|
| Medium age (years) | 38.56 (\pm^a 7.88 mín ^b 24, máx ^c 62) | | 37.02 (\pm 7.81, mín 24, máx 69) | |
| Academic degree | High school | 53.84% (n = 56) | High school | 44.23% (n = 46) |
| | College | 22.11% (n = 23) | Secondary school | 29.80% (n = 31) |
| | Secondary school | 20.19% (n = 21) | College | 20.19% (n = 21) |
| | Does not live with the family | 3.84% (n = 4) | Elementary school | 5.76% (n = 6) |
| Occupation | Manual worker | 60.57% (n = 63) | Housewife | 55.76% (n = 58) |
| | Professional | 21.15% (n = 22) | Professional | 24.03% (n = 25) |
| | Did not answer | 14.42% (n = 15) | Manual worker | 20.19% (n = 21) |
| | No contribution to the family | 3.84% (n = 4) | | |
| Conduct disorders in childhood | 22.11% (n = 23) | | 16.34% (n = 17) | |
| | Both 11.53% (n = 12) | | | |

^a±: standard deviation; ^bmín: minimum; ^cmax: maximum

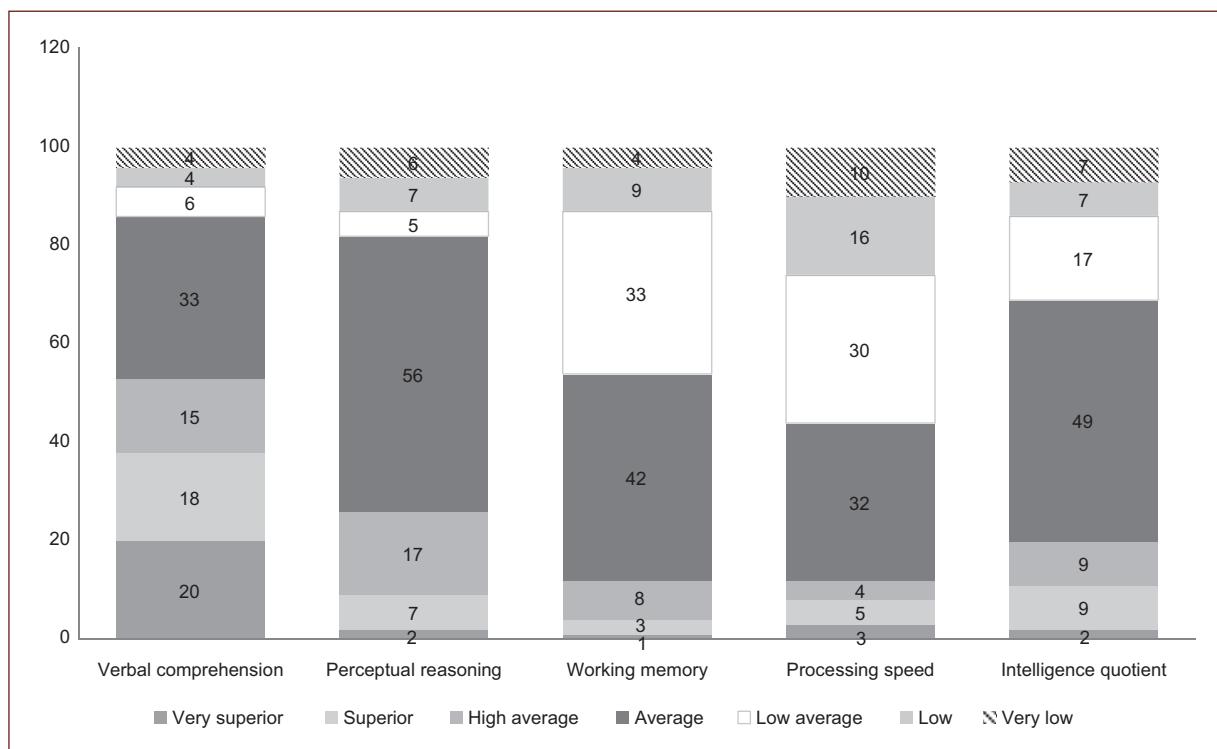


Figure 1. Cognitive characteristics (WISC-IV) in children with attention deficit hyperactivity disorder. Scores in percentages of children on the Wechsler Intelligence Scale for Children IV (WISC-IV). n = 104.

The most frequent values in mothers were (Table 2): during childhood. For fathers: Age 38.56 years, high Mean age 37 years, high school education, school, manual worker, and behavioral disorders in occupation homemakers, and behavioral disorders childhood.

Table 3. Perinatal characteristics of patients (n = 104)

| | |
|------------------------------|--------|
| History of gestational risk | |
| Infections | 54.80% |
| TA/TPTD ^a | 45.19% |
| Alcohol/smoking | 43.26% |
| Falls | 23.07% |
| Accidents | 3.84% |
| Other diseases | 4.80% |
| Birth care | |
| IMSS ^b | 48.07% |
| Particular means | 43.26% |
| Other public services | 8.65% |
| Length of labor | |
| 2-4 h ^c | 19.23% |
| 5-7 h | 10.57% |
| 8-10 h | 29.80% |
| 12-19 h | 27.88% |
| 24-48 h | 3.84% |
| > 48 h | 8.65% |
| Pregnancy outcome | |
| Eutocic birth | 50% |
| Cesarean delivery | 50% |
| Apgar at 5 min | |
| 0-3 Bad | 27.61% |
| 4-6 Regular | 6.73% |
| 7-10 Good | 65.38% |
| In-hospital stay after birth | |
| 0-3 days | 77.88% |
| 4-10 days | 4.80% |
| 15 days or more | 17.30% |

^aTA/TPTD: Threatened abortion/Threatened Preterm Delivery; ^bIMSS: Mexican Social Security Institute; ^ch: hours.

The most frequent findings in perinatal history were (Table 3) gestational risk: infections (frequently urinary), labor duration 8-10 and 12-19 h, apgar at 5 min 7-10, and in-hospital stay 0-3 days.

The WISC-IV categories with the highest percentage were (Fig. 1): in *verbal comprehension*: Average and *very high*; in *perceptual reasoning*: Average and *high average*; and in *working memory, processing speed* and *IQ*: Average and *low average*.

In *Neuropsi*, *moda* in the 3 domains (*attention and executive functions*, *memory*, and *attention and memory*) were the categories *normal* and *mild alterations* (Fig. 2).

The BMSLSS results are detailed in figure 3. The highest frequencies were reported in the *Horrible-Sad* responses. The most frequent *life satisfaction* was *low* (59.61%), followed by *medium* (31.73%), and *high* (8.65%).

The correlation between *IQ* (WISC-IV) and *life satisfaction* (BMSLSS) was $r = 0.3962$ ($p < 0.001$). The correlation between *attention and memory* (*Neuropsi*) and *life satisfaction* (BMSLSS) was $r = 0.451$ ($p = 0.018$).

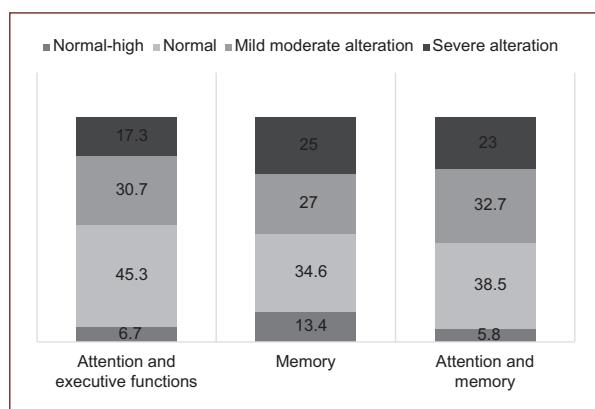


Figure 2. Cognitive characteristics (*Neuropsi*) in children with attention deficit hyperactivity disorder. Results in percentages of patients in the *Neuropsi* Attention and Memory test 3rd ed (*Neuropsi*). n = 104.

Discussion

The prevalence of ADHD is high and progressive, and affects the cognitive performance of the carrier. Reports of cognitive characteristics in Mexico and Latin America with large samples are scarce^{13,18,19}. In this study, the behavioral history of the parents, the most frequent diagnosis in 8-10 years, 3 years of evolution or less, and the management with methylphenidate are in agreement with other reports^{3,5,8-10,13,20,21}. Some particularities differ from other reports: Less than 10% of siblings carriers of ADHD, and no differences in the demand for attention according to the semester of birth. This finding opposes to suggestions about the heritability near 75-80%, and about risks of misdiagnosis depending of the month of birth^{4,22}. This confirms the role of the social-environmental context to develop this disorder.

Methylphenidate is the cornerstone in the treatment of ADHD, and improves QOL. Other pharmacological options are atomoxetine, lisdexamfetamine, and guanfacine. Treatment with oxybutynin, valproate, risperidone, and sertraline in this study indicates the broad spectrum of comorbidities²⁰.

The presence of perinatal factors and childhood behavioral characteristics and disturbances in fathers and mothers in the present work represents the opportunities for prevention. The existence of more than one risk factor in several patients increases the possibility of neurological dysfunction, clinical variability, and vulnerability to ADHD. Youth, schooling, and parental occupation are conditions to be considered for comprehensive management^{1,3,5,12,21}.

The higher prevalence of low mean and borderline scores in *working memory* and *processing speed*

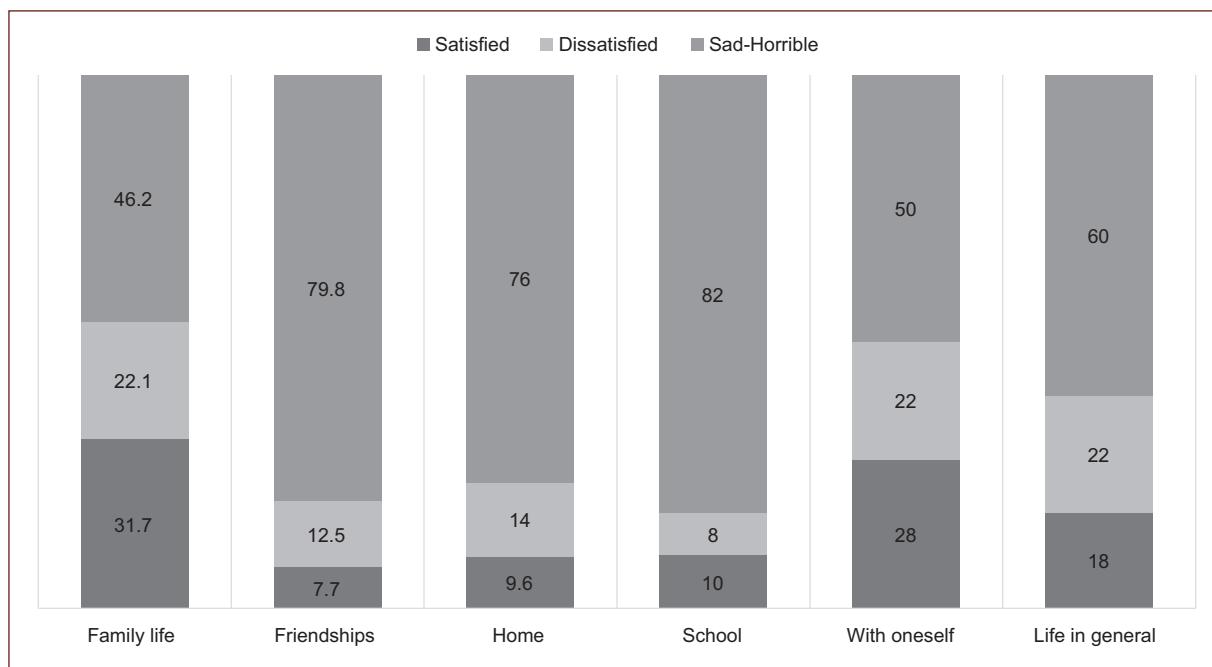


Figure 3. Quality of life in children with attention deficit hyperactivity disorder.
Results in percentages by domain of the brief multidimensional life satisfaction scale for children (n = 104).

(WISC-IV), and *attention and memory* (*Neuropsi*) in this study is noteworthy. The ability to learn and transforming thoughts into actions starts with attention, is fixed with memory, and supports processing, including inhibition of impulsivity. These cognitive deficits are fundamental in ADHD. The importance of verbal comprehension/expression in this disorder is also established by other reports. The specific role of perceptual reasoning and other executive functions and their combinations remains to be investigated^{8,9,13,17,21}.

In these patients, assessing the functional alteration of the individual and the results of the treatment is an essential and not only as symptomatological reduction. QOL is used for this purpose since the results in the physical, emotional, social, and cognitive dimensions are similar regardless of the instruments used to assess it^{23,24}.

There are few studies in Mexico about QOL and cognition in patients with ADHD. In this study, life satisfaction was used as an indicator of QOL, as well as previous reports^{12,17}. Pharmacotherapy generally improves the perception of QOL in these patients^{20,23,24}. Despite all patients in this study receiving pharmacotherapy, 95% were not receiving psychotherapy in this study, and most reported low life satisfaction. This is alarming, and underscores the importance of combined drug and psychological treatment.

The lowest scores occurred in school, followed by friendships and housing, corresponding with reports from Latin America and Spain^{12,17,23-25}. This is related to difficulties in the recognition of facial expressions and own and other people's emotions, which are essential skills for social relationships^{11,13,25,26}. These deficits explain why children with ADHD perceive social rejection and poor acceptance by their peers^{10,27}.

On the other hand, they may rate their cognitive and social competencies more positively than they actually do, which explains why the family environment and self-satisfaction received better evaluation^{12,27}.

The IQ measured with WISC-IV is not an absolute parameter, it serves as a reference and patient labeling should be avoided. Although psychotherapy does not substantially modify it, it can optimize the evaluation score^{10,13}. Like *Neuropsi*, it registered a moderate correlation with *life satisfaction*, both highly significant.

Only 5 patients of the sample (4.8%) received psychotherapy. Neuropsychological evaluation refines the diagnosis of the patient with ADHD, and behavioral follow-up is indispensable in comprehensive management. Psychoeducation and cognitive behavioral therapy optimize the performance of executive functions, self-esteem, and self-satisfaction. They support resilience and social performance, and decrease the probability of dissociative behaviors and future addictions^{10,13,17,19}.

Although the present study is one of the largest samples among similar studies in this region^{3,9,13,17,19}, it is still a limited population. Studies with more patients and multicenter studies are required to strengthen the conclusions. Another limitation is the omission of personal dimensions such as family functionality and/or parental characteristics, schools, and others.

Conclusions

Attention, memory, and processing speed are the cognitive characteristics most affected in children with ADHD. QOL is low, especially in school and friendship contexts. Psychobehavioral care strategies, together with pharmacotherapy, are essential to improve the patient's health status and prognosis.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

Ethical disclosures

Protection of human and animal subjects. The authors declare that the procedures followed were in accordance with the regulations of the relevant Clinical Research Ethics Committee and with those of the Code of Ethics of the World Medical Association (Declaration of Helsinki).

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors have obtained the written informed consent of the patients or their parents mentioned in the article. The corresponding author is in possession of this document.

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