

# Migraine and cognition in children

## A controlled study

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### ABSTRACT

**Objective:** Evaluate the cognitive functions of children with migraine and compare them to A control group. **Method:** 30 migraineur children and 30 control group children without migraine, age ranging from 8 to 12 years old, were subjected to a cognitive functions assessment with Wechsler Intelligence Scale for Children (WISCIII). **Results:** Although both groups had a normal cognitive performance, children with migraine had significantly worse scores compared to the control group in the subtests of Information, Arithmetic, Vocabulary, Object Assembly and in the Indexes of Perceptual Organization, Resistance to Distraction and Processing Speed. **Conclusion:** Children with migraine had impairment in some cognitive functions such as attention, memory, information speed, and perceptual organization compared to the control group.

**Key words:** migraine, children, Wechsler Scale, WISC-III.

### Migrânea e cognição em crianças: um estudo controlado

### RESUMO

**Objetivo:** Avaliar as funções cognitivas de crianças com e sem migrânea, utilizando a Escala de Inteligência Wechsler para Crianças (WISC-III). **Método:** A amostra foi composta por 30 crianças com diagnóstico de migrânea na idade entre 8 a 12 anos e grupo controle de 30 crianças sem migrânea na mesma faixa etária. Todas foram avaliadas pela Escala de WISC-III. **Resultados:** Embora ambos os grupos tenham demonstrado um quociente de inteligência dentro da média, as crianças com migrânea, quando comparados aos controles, tiveram desempenho inferior nos subtestes de Informação, Aritmética, Vocabulário, Armar Objetos e nos Índices de Compreensão verbal, Organização Perceptual, Resistência à Distração e Velocidade de Processamento. **Conclusão:** Quando comparadas aos controles, crianças com migrânea apresentaram desempenhos inferiores em vários domínios cognitivos como atenção, velocidade de processamento, memória e organização perceptual.

**Palavra-chave:** migrânea, criança, Wechsler Scale, WISC III.

Migraine in childhood has prevalence rates that range from 7.5 to 9.7%<sup>1,2</sup>, and despite being so common and causing impact in migraineur children lives, it still remains underdiagnosed and not properly treated<sup>3,4</sup>.

Studies about cognitive dysfunction in pediatric migraine are scarce and showed variable results<sup>5-8</sup>.

D'Andrea et al.<sup>5</sup> reported impairment both in short-term and in long-term memory in the migraine group of a comparative study involving 20 migraineur children and 20 control group children. Riva et al.<sup>6</sup>, reported worse visuomotor processing speed in both migraineur children with (n=17) and without (n=31) aura. Villa et al.<sup>7</sup>, in a comparative and

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controlled study, found selective and alternate attention deficits in a migraine group. However, Haverkamp et al.<sup>8</sup> did not find any cognitive disturbances in migraineurs when compared to their siblings without headache.

In the adult population studies, Calandre et al.<sup>9</sup> reported deficits of attention, memory, and information speed in migraineurs when compared to a control group. Le Pira et al.<sup>10</sup> compared 30 individuals with migraine to a control group and showed that immediate and delayed memory were impaired in the migraine group. Mulder et al.<sup>11</sup> found that migraineurs with aura performed worse on a measure of sustained attention than migraineurs without aura and a control group. However, Leijdekkers<sup>12</sup> and Pearson et al.<sup>13</sup> did not find significant differences between a migraineur group and a control group.

In a recent study, Parisi et al.<sup>14</sup>, using the Wechsler Intelligence Scale for Children - 3 Edition (WISC III), found that migraineur children without aura and children with tension-type headache had significantly minor total and verbal intelligence quotient (VIQ), when compared to a control group. WISC III is a worldwide recognized tool which has been validated for the Brazilian population. It measures specific cognitive functions and intelligence quotient (IQ) of 6-to-16 year-old children<sup>15,16</sup>.

In this present study, our purpose was to evaluate the cognitive functions in migraineur children comparing them to control group children without migraine.

## METHOD

### Sixty children participated in the study

**Migraine group:** Thirty patients, newly-admitted to the outpatient childhood headache service at the Division of Investigation and Treatment of Headaches (DITH) of Federal University of São Paulo; all diagnosed as episodic migraineurs with (n=8) and without aura (n=22), according to the International Headache Society criteria (ICDH-II, 2004)<sup>17</sup>, being 15 boys, aged between 8 and 12 (age average of 10.8±1.6 years), with crisis average of 6.1±3.5 per month, lasting up to 24 hours and confirmed by a 30-day filled headache diary. All children were students from the public school system of São Paulo city.

**Control group:** Thirty children, 18 boys, similar age range (age average 10.0±1.3 years), also from public schools of São Paulo city, where 280 parents responded a questionnaire on headache. Children were included if they had never reported a headache before. This was the only determined inclusion criteria.

Both groups were matched based on school attendance, family education background and socioeconomic status. All children did not have records of learning disabilities, school failure or repeated absences at school and were submitted to medical and psychological evaluations. Exclusion criteria for both groups considered

abnormalities in the neurologic examination, systemic diseases, psychiatric disturbances, sleep disorders, records of epilepsy or severe head trauma, or using medications with action in the central nervous system, including drugs for migraine prophylaxis.

Wechsler intelligence scale for children (WISC III) was administered in only one center, having session lasting about 90 minutes each, in a quiet and non-distracting environment, between May 2008 and December 2009. Children with migraine had not manifested headaches for at least the two days prior to the evaluation.

Informed consent was obtained from parents or tutors and the study was approved by our Local Research Ethics Committee (CEP 0149/08).

The results of neuropsychological test were compared through analysis of the Student t test, followed by the Mann-Whitney correlation the gender and number of migraine attacks. The significance level was at least p=0.05.

## RESULTS

All children had a normal cognitive performance, but children with migraine had a significant lower score on information (p=0.034), arithmetic (p=0.002), vocabulary (p=0.021), and object assembly (p=0.026) subtests, compared to the control group children (Table 1).

Table 2 displays the composite scores (indexes) for both groups. Significant differences were observed for perceptual organization (p=0.047), resistance to distraction (p=0.008), and processing speed (p=0.043).

Because of these results, we found significant differences in intelligence quotient (IQ) scores between the groups. Intelligence quotient (IQ) values are displayed in Table 3.

## DISCUSSION

Although average intelligence quotient (IQ) was within normal limits for both groups, significant differences in cognitive functions were observed between the groups. Children with migraine had worse performance in attention, memory, and speed of processing information. These differences reflected on the intelligence quotient (IQ) scores.

Our findings are supported by other pediatric and adult studies that showed cognitive deficits such as decreased processing speed, memory deficits, and attention problems<sup>5-11</sup>, as well as intelligence quotient (IQ) differences<sup>14</sup>. In an important, longitudinal study, Waldie et al.<sup>18</sup> found impaired verbal skills in a migraine group when compared to a control group, more evident between 3-to-13-year-old migrainer children.

The relatively impaired performance in tests, involving retention and manipulation of verbal and vi-

**Table 1.** WISC-III subtests: migraine group and control group's scores.

Subtests	Migraine group		Control group		P-value
	Average	SD	Average	SD	
Picture completion	11.0	±2.9	12.0	±3.1	0.186
<b>Information</b>	<b>9.4</b>	<b>±3.3</b>	<b>11.3</b>	<b>±3.5</b>	<b>0.034*</b>
Coding	10.6	±2.6	11.9	±2.8	0.069
Similarities	11.0	±3.1	11.9	±4.1	0.361
Picture arrangement	10.0	±3.3	11.0	±3.1	0.270
<b>Arithmetic</b>	<b>9.5</b>	<b>±3.4</b>	<b>12.2</b>	<b>±3.1</b>	<b>0.002**</b>
Block design	10.8	±3.0	12.4	±3.2	0.054
<b>Vocabulary</b>	<b>11.0</b>	<b>±2.7</b>	<b>12.8</b>	<b>±3.3</b>	<b>0.021*</b>
<b>Object assembly</b>	<b>9.6</b>	<b>±3.4</b>	<b>11.4</b>	<b>±2.8</b>	<b>0.026*</b>
Comprehension	11.1	±2.6	12.3	±3.1	0.102
Symbol search	11.5	±2.4	12.7	±2.8	0.088
Digit span	10.5	±3.3	11.7	±2.9	0.140

\*Significant at the 5% level; \*\*Significant at the 1% level; \*\*\*Significant at the 0.1% level.

**Table 2.** Factorial indexes: migraine group and control groups scores.

Index	Migraine group		Control group		P-value
	Mean	SD	Mean	SD	
Verbal comprehension	103.3	±15.1	112.0	±19.1	0.054
Perceptual organization	101.7	±16.7	110.4	±16.8	0.047*
Resistance to distraction	98.5	±18.2	110.1	±14.7	0.008**
Processing speed	104.2	±12.4	111.6	±14.9	0.043*

\*Significant at the 5% level; \*\*Significant at the 1% level; \*\*\*Significant at the 0.1% level.

**Table 3.** Total IQ, verbal IQ and executive IQ: migraine group and control group's scores.

I.Q	Migraine group		Control group		P-value
	Mean	SD	Mean	SD	
Verbal IQ	102.4	±15.3	113.1	±18.7	0.019*
Performance IQ	102.8	±16.2	112.2	±15.7	0.026*
Total IQ	102.8	±15.3	113.7	±17.5	0.013*

\*Significant at the 5% level; \*\*Significant at the 1% level; \*\*\*Significant at the 0.1% level; IQ: intelligence quotient.

sual-spatial information, suggests an overall operational memory deficit associated to attention. Indeed, in clinical practice, individuals with migraine often complain of problems on their memory, attention, and organization. We observed that children with migraine had difficulties in information and vocabulary subtests despite of clearly having the background knowledge. Similar problems were found in arithmetic subtest.

A neurobiological subtract to explain our findings are still poorly known. Magnetic resonance imaging studies found a correlation between white matter lesions and frequency of headache attacks in adults<sup>19-21</sup>. Migraineurs with white matter abnormalities seem to have more cognitive deficits (mainly affecting verbal and visual mem-

ories), decreased verbal fluency, and reduced ability for abstract thoughts<sup>9,19</sup>. Neuroimaging studies also demonstrated that adults with migraine often have multiple areas of brain hypoperfusion, likely to be related with visual and verbal memory deficits<sup>9,19</sup>.

Cognitive functions involve both brain regions (cortical and subcortical areas)<sup>14</sup> and several neurotransmitters such as dopamine and noradrenaline, important in verbal fluency, attention, working memory, learning, motivation and adaptive behavior, and glutamate, which also seems to play an important role in learning and memory<sup>22-26</sup>. It is believed that these neurotransmitters play an important role in the pathophysiology of migraine<sup>27-30</sup>.

Accordingly, maybe neurochemical aspects involved in the physiopathology of migraine and cognition mechanisms may explain our findings.

Our study had limitations. Sample size was small. We did not find differences between migraineurs with and without aura. However this was likely to be due to the sample sizes and resulting low statistical powers. Additionally, we could not observe a relationship between the length of migraine, attacks frequency and cognitive functions impairment in the migraine group.

Studies correlating migraine and cognitive functions are important, and the matter should still be investigated. Migraine may be associated with cognitive dysfunction in children. Careful clinical evaluation should be done in children with migraine, in order to diagnose early cognitive dysfunction, and if available, have them treated properly.

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