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ORIGINAL ARTICLE

Cognitive and academic outcomes in children with myelin oligodendrocyte glycoprotein antibody-associated disease

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Abstract

Aim: To describe the impact of paediatric myelin oligodendrocyte glycoprotein antibody-associated disease (MOGAD) on academic and cognitive outcomes.

Method: This was an observational, retrospective, and descriptive single-centre study, carried out on a paediatric case series of children with MOGAD.

Results: A total of 51 patients were included (22 females); their median age was 8 years and the median follow-up duration was 31.1 months (interquartile range 23.5). The most frequent clinical presentation was acute disseminated encephalomyelitis (54.9%), followed by optic neuritis (35.5%). At the last follow-up, regardless of the clinical phenotype at disease onset, 39.5% of patients with MOGAD received academic and educational interventions ($p < 0.05$ compared to before disease onset), including academic accommodations ($p < 0.05$) or the need for a learning support assistant ($p < 0.05$). Ten patients were evaluated with the Wechsler Intelligence Scale for Children, Fifth Edition (WISC-V). The overall IQ was calculated for six patients (mean = 92); two of these patients had an IQ lower than 85. No difference was found regarding prenatal and neonatal neurodevelopmental characteristics between this cohort and the general population.

Interpretation: MOGAD was associated with a need for academic support; lower scores were found on the WISC-V. Patients with MOGAD should receive cognitive and academic assessments to inform educational planning and support academic success.

Antibodies against myelin oligodendrocyte glycoprotein (MOG) have been observed in the paediatric population, with an estimated incidence of 0.31 per 100 000 children per year (0.13 per 100 000 adults per year).[1] Several studies suggested that these antibodies are found in approximately 40% of all acute demyelinating syndrome presentations in children.[2–4] Initially, MOG antibodies were considered as potential biomarkers for multiple sclerosis; however, it has now been established that they indicate a different condition, namely MOG antibody-associated disease (MOGAD).[2,3]

Multiple clinical phenotypes have been described for MOGAD. The most frequent presentation in children, especially in younger children, is acute disseminated encephalomyelitis (ADEM) (46%);[5–7] MOG antibodies have been identified in 64% of patients.[6,8] Optic neuritis is the second most frequent presentation in children (30%)[5] and occurs more often in older children;[6,7] in addition, MOG antibodies have been identified in 43% of patients with optic neuritis.[6] Transverse myelitis (11%),[5] neuromyelitis optica spectrum disorder-like phenotype (4%),[5] and cortical encephalopathy are less frequent.[5] MOGAD encompasses monophasic and

Abbreviations: ADEM, acute disseminated encephalomyelitis; MOG, myelin oligodendrocyte glycoprotein; MOGAD, myelin oligodendrocyte glycoprotein antibody-associated disease; WISC-V, Wechsler Intelligence Scale for Children, Fifth Edition.

relapsing courses. In children with MOGAD, the relapsing course can occur in 34% to 38% of patients;[4,9] the overall course is usually rather good as 75% to 96% of patients experience complete recovery.[10,11] However, sequelae are possible, depending on the initial phenotype and on the affected area of the central nervous system; sequelae include visual, sensory, or motor deficits, as well as epilepsy and bladder dysfunction.[12]

Only a few studies have evaluated the cognitive impact of MOGAD in paediatric populations. Several cognitive sequelae have been reported, such as memory impairment, attentional problems, and academic difficulties.[13] Among these studies, the frequency of this cognitive impact is highly heterogeneous, affecting from 10% to 50% of patients.[10,14–18] Cognitive difficulties have been associated with young age, ADEM phenotype at disease onset, and abnormal brain magnetic resonance imaging (MRI).[16–18] The aim of the present study was to describe, in a case series of paediatric patients with MOGAD, the impact of the disease on academic outcomes, and the impact on cognition in a subgroup of patients.

What this paper adds

- The neonatal characteristics of patients with myelin oligodendrocyte glycoprotein antibody-associated disease (MOGAD) are comparable to those of the general population.
- Evaluation with the Wechsler Intelligence Scale for Children, Fifth Edition showed overall results below the mean of the general population at the last follow-up.
- Academic performance is altered after paediatric-onset MOGAD, regardless of the clinical phenotype.

METHOD

Study design, participants, and data collection

This study was an observational, retrospective, and descriptive case series of patients diagnosed with MOGAD between 2008 and 2020. The inclusion criteria were: (1) presenting at least one clinical episode of acute demyelinating syndrome in the central nervous system lasting 24 or more hours, as defined by the International Pediatric Multiple Sclerosis Study Group;[19] (2) being younger than 18 years at disease onset; (3) MOG antibodies present in the serum when using a live cell-based assay (at disease onset or during follow-up); and (4) a minimum follow-up of 1 year. All patients included in the study fulfilled recently acknowledged criteria.[2] All patients tested negative for aquaporin-4 antibodies. There were no exclusion criteria. This single-centre study was conducted at the Hospices Civils de Lyon, a tertiary referral centre. Patient follow-up was performed between disease onset and 2021.

Data were collected retrospectively using a standardized evaluation form and registered in the French nationwide database for neuromyelitis optica spectrum disorder (NOMADMUS, a nested cohort of the French multiple sclerosis registry, the Observatoire Français de la Sclérose en Plaques). Data collected included demographic characteristics (sex, age at disease onset), medical history (tumour, autoimmune disease, epilepsy or febrile seizures, family history of autoimmune disease), clinical data (preclinical symptoms, phenotype at disease onset, during relapses, and during the follow-up), imaging data, laboratory data (cell count in cerebrospinal fluid, protein levels, oligoclonal bands, presence of viruses), and treatment (type, duration, dose).

A relapsing course was defined as at least two episodes of acute demyelinating syndrome, delayed by at least 3 months for ADEM and 1 month for other clinical presentations. Relapses were diagnosed based on the clinical presentation. Imaging and laboratory assessments were performed when necessary to exclude any differential diagnosis.

Additional data, including prenatal and neonatal features (pregnancy, birth, inbreeding), psychomotor development (language, walking), autism spectrum disorder, and education (type of institution, whether repeating the school year or requiring a learning support assistant, academic accommodation, part-time schooling) were collected, when available, from the patient medical records. Data on ethnicity were not available.

MOG antibody detection assay

MOG antibody detection was performed as described previously.[20] Briefly, an in-house live cell-based assay was performed using HEK 293 cells transfected with the pEGFP-N1-hMOG plasmid. An allophycocyanin goat IgG-Fc-γ receptor fragment was used as a secondary antibody; evaluation of signal intensity was performed using fluorescence-activated cell sorting.

French educational system

In France, special education is provided through two pathways: special classes and schools in the public educational system (Unites Localisées pour l'Inclusion Scolaire à l'École) and medicosocial institutions (Institut Medico-Éducatif). In addition, at the end of the school year, when the school level is considered insufficient, repeating the year is an option.

As stated earlier, educational information was collected from the medical records. Academic accommodations are defined as the requirement for particular equipment (e.g. computer), additional time, or any personalized assistance. Any difference with normal educational attainment can

be described as an academic or educational intervention: special education; repeating the school year; academic accommodation; a learning support assistant; and part-time schooling.

Cognitive outcome

Cognitive outcome was assessed by neuropsychologists specialized in paediatrics, using the Wechsler Intelligence Scale for Children, Fifth Edition (WISC-V). This measure is considered by experts and practitioners as the criterion standard among psychological and intellectual measures, providing a reliable and valid measure of the intellectual capacity of a child. The WISC-V includes five primary index scores: the Fluid Reasoning Index, the Processing Speed Index, the Verbal Comprehension Index, the Visual–Spatial Index, and the Working Memory Index, representing the abilities of a child in different cognitive domains. The mean (SD) score in the normative population is 100 (15), with low average scores ranging from 89 to 80, and borderline scores ranging from 79 to 70.[21] The WISC-V was performed in patients when deemed necessary by the clinician.

Ethical approval

The patients enrolled in the NOMADMUS (Observatoire Français de la Sclérose en Plaques) registry provided written informed consent to participate in this study. In accordance with French law, the Observatoire Français de la Sclérose en Plaques was approved by both the French data protection agency (Commission Nationale de l'Informatique et des Liberté, approval request no. 914066v3) and an institutional review board (Comité de Protection des Personnes, reference no. 2019-A03066-51). Computer processing of the data in this study is registered with the Commission Nationale de l'Informatique et des Libertés register of the Hospices Civils de Lyon (reference methodology MR004, no. 21_5840).

Statistical analysis

All statistical analyses were performed using R v4.0.5 (R Foundation for Statistical Computing, Vienna, Austria); $p < 0.05$ was considered statistically significant. Comparison of educational modalities over time was performed using a mixed effects logistic regression model, with patient number as the random effect. Comparisons between the groups 'academic or educational intervention' and 'without academic or educational intervention' were performed using a Fisher's exact test for categorical variables and a Mann–Whitney *U* test for continuous variables without a normal distribution. When descriptive analysis was performed, percentages were used for qualitative values, and medians or means for quantitative values.

RESULTS

General characteristics of the population

A flow chart summarizing the main results is shown in Figure S1. A total of 51 patients were included in the present study, 22 of 51 (43.1%) were females and the median (minimum–maximum) age at onset was 8 years (5 months–17 years 1 month) (Table 1). Four out of 48 patients (8.3%) had a history of tumour: ovarian cyst; ovarian teratoma; acute lymphoid leukaemia; and Ewing sarcoma. Regarding the prenatal and neonatal characteristics, 5 out of 46 (10.8%) patients had a low birthweight. Data were available for 42 to 47 of 51 patients and are described in Table S1.

An infection was found in 20 of 51 patients (39.2%) in the month before disease onset. For eight patients (15.7%), the infection was identified using polymerase chain reaction or blood serology (IgM-positive). Different viruses and bacteria were found: one instance of *Chlamydia pneumoniae*, one instance of picornavirus, one instance of enterovirus, one instance of influenza A virus, one instance of herpes simplex virus, one instance of human herpesvirus 6, and two instances of Epstein–Barr virus. Preclinical headaches were frequently reported ($n = 19$, 37.2%) and were associated with both ADEM and optic neuritis. ADEM was the most frequent clinical presentation ($n = 28$, 54.9%), followed by optic neuritis ($n = 18$, 35.2%), and myelitis ($n = 3$, 5.8%). Two patients had other clinical presentations, that is, mild encephalopathy with reversible splenial lesion and cortical encephalitis. Details about the acute and maintenance treatments used are shown in Table 1.

Neuroimaging

At disease onset, at least one MRI was performed in 49 patients (Table 2): a brain MRI in 49 patients, a spinal cord MRI in 38 patients, and an optic nerve MRI in 10 patients. Brain imaging was normal for eight patients (16.3%), all had an optic neuritis phenotype. There was an involvement of the deep grey matter in 23 of 49 patients (46.9%); among patients with ADEM, it accounted for 82%. Two patients only had a computed tomography scan at disease onset (MRI was performed 6 months and 12 months from disease onset respectively). Both presented with typical optic neuritis, with MOG antibodies in the serum.

Among the 40 patients for whom an early follow-up MRI (less than 8 months) was performed, the MRI was normalized in 23 patients (57.5%), improved in 15 patients (37.5%), while two patients (5%) had new lesions.

Impact of MOGAD on academic and cognitive outcomes

Educational characteristics before disease onset ($n = 46$), during follow-up (between 6 months and 1 year, $n = 49$), and

TABLE 1 General characteristics of the study population.

Characteristic	Population
Sex	
Female	22/51 (43.1)
Male	29/51 (56.9)
Median age at onset (years:months), (minimum–maximum)	8:1 (0:5–17:1)
Medical history	
Tumour	4/48 (8.3)
Autoimmune disease	0/48 (0)
Epilepsy or febrile seizure	2/48 (4.2)
Family history of autoimmune disease	8/42 (19.0)
Psychomotor development (before ADS)	
Delayed walking age (after 18 months)	3/42 (7.1)
Language delay	4/44 (9.0)
Autism spectrum disorder	2/48 (4.2)
Follow-up duration (months), median (IQR)	31.1 (23.5)
Clinical presentation at disease onset	
ADEM	28/51 (54.9)
Optic neuritis	18/51 (35.3)
Myelitis	3/51 (5.8)
Other	2/51 (3.9)
Prodromes	
Infection	20/51 (39.2)
Vaccination	1/51 (1.9)
Headaches	19/51 (37.2)
Treatment received at disease onset	
High-dose methylprednisolone	48/51 (94.1)
First-line treatment	44/51 (86.2)
Median number of doses (minimum–maximum)	3.5 (2–10)
Oral corticosteroid only	1/51 (1.9)
Intravenous immunoglobulin	6/51 (11.7)
First-line treatment	4/51 (7.8)
Plasma exchange	3/51 (5.8)
Oral corticosteroids after First-line treatment	23/51 (45.1)
Median duration (months), (minimum–maximum)	1 (0.5–6)
Maintenance therapy	
No maintenance therapy	44/51 (86.2)
Oral corticosteroid	2/51 (3.9)
Azathioprine	5/51 (9.8)
Rituximab	2/51 (3.9)
Mycophenolate mofetil	4/51 (7.8)
Glatiramer acetate	1/51 (1.9)
Natalizumab	1/51 (1.9)
Cyclophosphamide	1/51 (1.9)
Relapsing disease	
Relapse	14/51 (27.4)

All data are presented as *n* (%) unless otherwise indicated. Abbreviations: ADEM, acute disseminated encephalomyelitis; ADS, acute demyelinating syndrome; IQR, interquartile range.

TABLE 2 Characteristics of magnetic resonance imaging at disease onset.

Characteristic	*n* (%)
Cortical	10/49 (20.4)
White matter	28/49 (57.1)
Asymmetrical	27/28 (96.4)
Bilateral	25/28 (89.2)
Deep grey matter	23/49 (46.9)
Infratentorial	19/49 (38.8)
Spinal (≥3 segments)	15/38 (39.4)
Cervical	11/38 (28.9)
Thoracic	11/38 (28.9)
Lumbar	4/38 (10.5)
Optic nerve	10/43 (23.2)
Unilateral	9/10 (90.0)
Bilateral	1/10 (10.0)
Gadolinium enhancement	7/44 (15.9)

at the last follow-up ($n = 48$) are described in Table 3 and Figure S1. A total of 9 out of 48 (18.7%) patients had academic accommodations at the last follow-up, which was significantly different when compared to before disease onset ($n = 2$ of 46, 4.3%, $p < 0.05$). There was a significant difference ($p < 0.05$) regarding the proportion of patients who needed a learning support assistant before disease onset ($n = 1$ of 46, 2.1%), during follow-up ($n = 8$ of 49, 16.3%), and at the last follow-up ($n = 11$ of 48, 22.9%). Before disease onset, 4 out of 46 (8.6%) patients needed educational support; among them, three needed more help at the last follow-up. Overall, 19 out of 48 (39.5%) patients received an academic and educational intervention at the last follow-up, compared to four out of 46 (8.6%) patients before disease onset ($p < 0.05$).

The comparison between the groups 'academic and educational intervention' and 'without academic or educational intervention' at the last follow-up is shown in Table 4. There was no significant difference regarding age at disease onset between the two groups. In the academic and educational intervention group, the follow-up duration and an ADEM presentation at disease onset were significantly greater (15 of 19, 78.9%) compared to the patients in the group without academic or educational interventions (12 of 29, 41.3%) ($p = 0.02$). Among patients with ADEM in the academic and educational intervention group, 13 of 15 (86.6%) had deep grey matter involvement on MRI. Overall, in the academic and educational intervention group, two children had a low birthweight and one was born preterm; however, all had a normal educational level before disease onset. Except for two children, all had typical psychomotor development; one was already in a special class in the public educational system before disease onset; the other had a simple language delay, with a normal educational level before disease onset. At the last follow-up, the four patients with optic neuritis at disease onset in the academic and

TABLE 3 Characteristics of the population with regard to education.

Characteristic	Before disease onset ($n=46$)	Between 6 months and 1 year from disease onset ($n=49$)	Last follow-up ($n=48$)
Part-time school	0/46 (0)	3/49 (6.1)	0/48 (0)
Academic accommodations	2/46 (4.3)	5/49 (10.2)	9/48 (18.7)[a,b]
Learning support assistant (effective or asked for)	1/46 (2.1)	8/49 (16.3)	11/48 (22.9)[a,b]
Repeating the school year	0/46 (0)	2/49 (4.0)	4/48 (8.3)[b]
Special classes in the public education system (ULIS)	2/46 (4.3)	2/49 (4.0)	2/48 (4.1)
Medicosocial institutions (IME)	0/46 (0)	0/49 (0)	2/48 (4.1)
Academic or educational intervention	4/46 (8.6)	–	19/48 (39.5)[a]

All data are presented as *n* (%) unless otherwise indicated. A mixed effects logistic regression model was used.

[a]$p<0.05$ before disease onset vs 'between 6 months and 1 year' or last follow-up.

[b]$p<0.05$ 'between 6 months and 1 year' and last follow-up. Missing data before disease onset: 0/51 (0%), five children were younger than 3 years; loss to follow-up at 6 months to 1 year: 1/51 (1.9%), one child was younger than 3 years; loss to follow-up at the last follow-up: 2/51 (3.9%), one child was younger than 3 years. Abbreviations: IME, Institut Medico-Éducatif; ULIS, Unites Localisées pour l'Inclusion Scolaire à l'École.

TABLE 4 Comparison between children with and without academic accommodations at the last follow-up.

Characteristic	Academic or educational intervention ($n=19$)	Without academic or educational intervention ($n=29$)	*p*
ADEM	15/19 (78.9)	12/29 (41.3)	0.02
With involvement of deep grey matter	13/15 (86.6)	9/12 (75)	0.63
Optic neuritis	4/19 (21.1)	13/29 (44.8)	0.13
Low birthweight	2/19 (10.5)	3/29 (10.3)	1
Preterm birth	1/19 (5.2)	1/29 (3.4)	1
Atypical psychomotor development	2/19 (10.5)	4/29 (13.8)	1
Age at disease onset (years:months), mean (SD)	5:7 (4:11)	8:11 (5:1)	0.45
Time between disease onset and the last follow-up (months), mean (minimum–maximum)	52.4 (12–120)	33.8 (12–68)	0.03
Normalized early MRI	6/14 (42.8)	17/26 (65.4)	
Improved early MRI	7/14 (50)	8/26 (30.8)	0.32
New lesions on early MRI	1/14 (7.2)	1/26 (3.8)	

All data are presented as *n* (%) unless otherwise indicated. A Fisher's exact test was performed for categorical variables; a non-parametric Mann–Whitney *U* test was performed for continuous variables. Abbreviations: ADEM, acute disseminated encephalomyelitis; MRI, magnetic resonance imaging.

educational intervention group had normal visual acuity (ranging from 9/10 to 10/10 in both eyes). Data for one patient with ADEM, one patient with optic neuritis, and one patient with other clinical presentation at disease onset were missing.

Description of cognitive outcome

The WISC-V was performed in 10 patients (Figure 1). All had an ADEM phenotype at disease onset. A brief description of the demographic characteristic of these patients is shown in Table 5. Except for patient 1, all had learning difficulties or cognitive impairment, justifying the need for the WISC-V. More details of the clinical and demographic characteristics, and details of the evaluation are described in Table S2.

Patient 1 had no impairment and was tested on a systematic basis. Their results were normal, heterogeneous, and above the mean of the normative population. All other patients had learning difficulties or cognitive impairment. As the results were very heterogeneous, calculating the global IQ was not relevant. However, when all the subtest results were available, the global IQ was calculated (it ranged from 79–105) and the results are reported in Table S2: none of these patients had an intellectual disability. Most primary index scores for 6 of these 10 patients (patients 1, 3, 5–7, and 9) were between the mean of the normative population and −2SD; for most of them, they had at least one low average or borderline score. Patients 6 and 8 did not undergo complete evaluation because of attention-deficit/hyperactivity disorder. Throughout these evaluations, multiple disorders were diagnosed: attention disorder, dyspraxia, executive

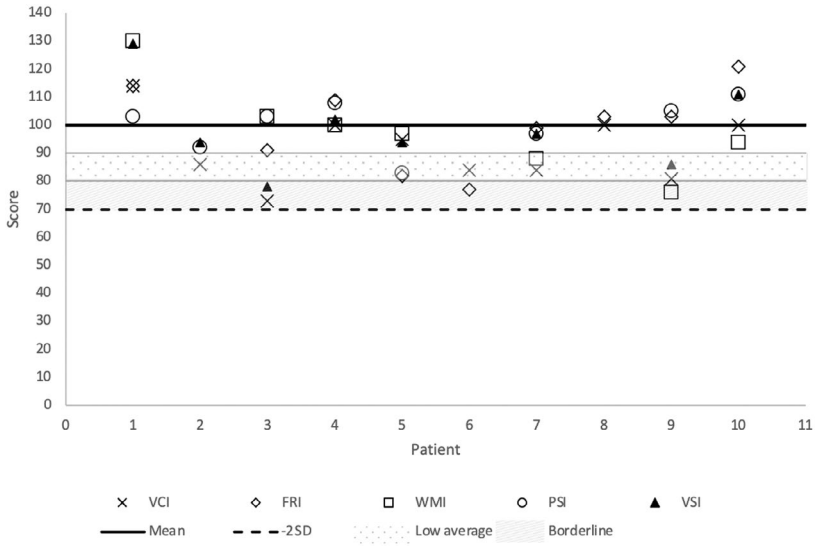

FIGURE 1 Wechsler Intelligence Scale for Children, Fifth Edition primary index score results for 10 patients. A pathological grade was defined by a result lower than 70 (–2SD). The mean score in the general population is 100. The hatched areas correspond to low results, that is, low average and borderline. Abbreviations: FRI, Fluid Reasoning Index; PSI, Processing Speed Index; VCI, Verbal Comprehension Index; VSI, Visual–Spatial Index; WMI, Working Memory Index.

TABLE 5 Main demographic characteristics of the children evaluated with the WISC-V.

Patient number	Age at disease onset (years:months)	Age at evaluation (years:months)	Relapsing disease	Time since disease onset (months)	Time from last relapse (months)
1	5:7	6:4	Yes	9	5
2	4:7	6:2	No	19	–
3	5:7	8:0	Yes	29	22
4	7:10	12:10	Yes	60	55
5	12:11	21:6	Yes	104	16
6	4:6	5:10	Yes	14	11
7	5:5	6:0	No	6	–
8	3:5	6:2	No	34	–
9	1:10	7:4	No	66	–
10	3:5	6:8	No	40	–

Abbreviation: WISC-V, Wechsler Intelligence Scale for Children, Fifth Edition.

function disorder, and specific learning disorders (language, mathematics).

Attention-deficit disorder interferes with results from the WISC-V. Among these 10 patients, six also underwent attention testing (Test of Attentional Performance for Children), which showed attention-deficit disorder in all six. The results of the subtests are shown in Figure S2.

DISCUSSION

The present study suggests that a large proportion of patients with paediatric-onset MOGAD experience academic difficulties. These difficulties can occur independently of the clinical phenotype at disease onset. The main demographic characteristic of our study population (sex ratio, age at disease onset, and phenotype at disease onset) are comparable with those of paediatric cohorts with MOGAD described in previous studies.[5] Conversely, the present results reported a slightly lower relapse rate compared to other studies.[9,22]

To our knowledge, this is the first study evaluating prenatal and neonatal characteristics in paediatric MOGAD. Our findings are in accordance with the general population for all the studied criteria,[23] apart from low birthweight (11% in this study compared to 4.85% in the general population),[20] which is not a risk factor for neuroinflammatory diseases in children. Therefore, this difference is probably due to sample size. Although low birthweight is a moderate risk factor of neurodevelopmental disorders, it was equally distributed in our case series between patients with and without academic difficulties.

Interestingly, despite the lack of prenatal and neonatal risk factors for cognitive impairment, paediatric-onset MOGAD was associated with a higher risk of academic and educational interventions, secondary to academic difficulties. A previous study[17] showed that patients with MOGAD had academic difficulties after disease onset at a lower frequency (26% at the last follow-up), but with a higher likelihood of repeating the year (11.8%). These differences may be explained by the duration of different follow-ups and by different definitions of academic accommodation.

Most of the patients with educational issues at the last follow-up had an ADEM phenotype at disease onset. A strong association between clinical presentation and cognitive impairments has been described.[16] However, in the present study, 21.1% of patients with academic and educational implications at the last follow-up had optic neuritis. All these patients had normal visual acuity at the last follow-up, suggesting that academic difficulties are not related to visual impairments but to the underlying disease. Therefore, our findings suggest that even when there is an association between clinical presentation and cognitive outcome, all children can be affected by cognitive difficulties and should be screened after a first episode of MOGAD.

Cognitive outcome is not well described and has never been tested in a standardized way in paediatric patients with MOGAD. The present study described the cognitive evaluation of 10 patients. The results were very heterogeneous and mostly under the mean scores of the normative population. The only patient without impairment had good results, greater than the mean scores of the normative population, which suggests that impairment is related to lower results. We could not identify one specific cognitive pattern after MOGAD in these children.

Although a few studies included patients with relapsing MOGAD, high percentages of cognitive impairment in multiphasic disseminated encephalomyelitis have already been reported (50%–67%).[10,16] A recent Canadian study suggested that patients with relapsing MOGAD had a slower response time and reduced reasoning skills.[13] In the present study, half of the tested patients had a relapsing course, also suggesting that relapsing disease is probably involved in cognitive impairment.

Of note, these observations were made using a small sample that is not representative of the whole population with MOGAD. Further studies are necessary to confirm these findings. Moreover, attention disorder, which is known to interfere with the results of the cognitive evaluation, was a frequent complaint. In addition, we could not estimate the prevalence of attention disorder in the present case series; as attention deficit prevalence is not well known in patients with MOGAD, it would be interesting to investigate this further.

The 10 WISC-V evaluations performed in the present study were conducted at very variable time frames from disease onset; however, patients who were tested a long time after disease onset did not present with better results than other participants. Change in cognitive difficulties is not known; it would be useful to repeat the evaluations during the follow-up to better evaluate the final cognitive outcome in accordance with a recent European Consortium, which recommended that all paediatric patients with MOGAD should undergo cognitive evaluation.[12] A brief screening instrument to assess cognitive dysfunction in paediatric-onset multiple sclerosis has been described (Multiple Sclerosis Inventory of Cognition for Adolescents); this may also be useful in MOGAD.[24]

The present study has some limitations, mostly because of its retrospective design. It was conducted on a relatively small sample, with a limited and heterogeneous follow-up. There were a few missing data, especially concerning prenatal and neonatal characteristics; the differences observed between the present case series and the general population were probably due to the sample size. In addition, there was no information regarding socioeconomic status, which could interfere with the cognitive outcome. The population with ADEM described in the present study was younger and with a limited follow-up; academic difficulties may appear over time as they are more likely to appear as learning progresses. Moreover, interpretation must be cautious as the follow-up may be stopped before the emergence of difficulties.

In conclusion, the present findings suggest that the prenatal and neonatal characteristics of patients with MOGAD were similar to those of the general population; no risk factor for a delay in psychomotor development was reported. However, after disease onset, a large proportion of patients experienced academic difficulties, resulting in academic and educational implications: some of our patients underwent a WISC-V evaluation, justified by cognitive impairment. Even though none of them had an intellectual disability, their results were below the mean of the normative population, suggesting that impairment is linked to low scores in the WISC-V. We suggest that screening for academic difficulties should be systematic for every patient after MOGAD, regardless of the clinical presentation. Moreover, this screening should be repeated during the follow-up. Cognitive evaluation should be performed to determine any difficulties more precisely, inform educational planning, and provide adapted support.

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DATA AVAILABILITY STATEMENT

No data available.

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SUPPORTING INFORMATION

The following additional material may be found online:
Table S1: Prenatal and neonatal features of the study cohort.
Table S2: Demographic, clinical, and cognitive evaluation characteristics of the 10 patients who underwent cognitive evaluation.
Figure S1: Flow chart of the studied population.
Figure S2: Subtest results.

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