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Original Article

Ouvrier's Modified Mini Mental State Examination as a screening test for cognitive impairment in pediatric epilepsy

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Abstract

Background Epilepsy may affect children's development, including their cognitive function. The prevalence of cognitive impairment in epilepsy patients is quite high. *Weschler Intelligence Scale for Children* (WISC) takes a long time to administer and is expensive, so a simpler screening tool for cognitive evaluation is needed in pediatric epilepsy patients.

Objective To assess the diagnostic value of *Ouvrier's Modified Mini Mental State Examination* (MMSE) for detecting cognitive impairment in children aged 8-11 years with epilepsy.

Methods This diagnostic study was conducted in December 2018 to February 2019 at Cipto Mangunkusumo and Fatmawati Hospitals in Jakarta. Data were collected with purposive sampling of children with epilepsy aged 8 to 11 years. Cognitive function was assessed by *Ouvrier's Modified* MMSE and WISC. *Ouvrier's Modified* MMSE was compared to WISC as the gold standard. Results were analyzed using a 2x2 table.

Results The prevalence of cognitive impairment in 8 to 11-year-old epilepsy patients was 72.9%. *Ouvrier's Modified* MMSE had 83% sensitivity, 85% specificity, 94% positive predictive value, 65% negative predictive value, and 83% accuracy.

Conclusions *Ouvrier's Modified* MMSE has good diagnostic value, thus it may be useful for early detection of cognitive impairment in pediatric epilepsy. **[Paediatr Indones. 2020;60:136-40 doi: http://dx.doi.org/10.14238/pi60.3.2020.130-5**].

Keywords: *pediatric epilepsy; MMSE modified Ouvrier; cognitive function*

Childhood epilepsy is known to impact cognitive development.[1,2] There is a high prevalence of cognitive impairment in children with epilepsy, even in patients without brain lesions.[3] The presence of cognitive impairment has a significant effect on the quality of life for children with epilepsy through its impact on learning and social skills.[4]

Cognitive function is assessed by measuring thinking ability, according to age and stage of development. The most widely accepted gold standard measure of cognitive function is the *Wechsler Intelligence Scale for Children* (WISC), from which the intelligence quotient (IQ) can be computed. However, the WISC requires administration by a trained professional, most often a psychologist, is time-consuming and costly.

Ouvrier's Modified Mini Mental State Examination (MMSE) is a reliable alternative to screen for cognitive impairment in children.[5-7] In Indonesia, it

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has been validated in children aged 8 to 11 years in three elementary schools in Bandung, West Java.[8] At Cipto Mangunkusumo Hospital in Jakarta, *Ouvrier's Modified* MMSE revealed a 74.2% prevalence of cognitive impairment in epilepsy patients aged 8 to 11 years.[9] However, the sensitivity and specificity of the Indonesian version have not been validated against a gold standard test in children with epilepsy. This study was conducted to determine the diagnostic value of *Ouvrier's Modified* MMSE in children aged 8 to 11 years with epilepsy.

Methods

We conducted a cross-sectional study from December 2018 to February 2019 in the Pediatric Neurology Outpatient Clinic of Cipto Mangunkusumo Hospital and Fatmawati Hospital, Jakarta. We included children aged 8 to 11 years with epilepsy identified from medical records. Children with visual impairment and/or severe hearing loss, new patients who had seizures within one day of the examination, those who did not complete the MMSE questionnaire, and patients with comorbidities affecting cognitive function, such as cerebral palsy and Lennox Gastaut syndrome, were excluded.

All subjects were tested using the *Ouvrier's Modified* MMSE. The MMSE consists of seven cognitive domains: orientation, registration, attention and calculation, recall, language, and visuospatial function. In children aged 8-11 years, *Ouvrier's Modified* MMSE had a total score of 35 and it had been translated to bahasa. Children with scores below the cut-off value of 26 were considered to have cognitive impairment. All subjects who had been tested using *Ouvrier's Modified* MMSE were then subjected to a gold-standard cognitive examination using the *Wechsler Intelligence Scale for Children* (WISC) administered by a psychologist. The study protocol was approved by the Medical Research Ethics Committee, Universitas Indonesia Medical School.

Data analysis was done using *SPSS version 20.0*. We constructed a 2x2 table of the results of both tests and calculated the sensitivity, specificity, and predictive values of *Ouvrier's Modified* MMSE.

Results

From the medical record search, we identified 155 epilepsy patients aged 8 to 11 years in Cipto Mangunkusumo Hospital (130 patients) and Fatmawati Hospital (25 patients). Of these, 42 subjects in Cipto Mangunkusumo Hospital and 6 subjects in Fatmawati Hospital completed the study (**Figure 1**). Subjects' characteristics are shown in **Table 1**.

Mean MMSE sub-test scores are presented in **Table 2**. Mean scores were highest in the language and orientation sub-tests and lowest in the attention and calculation sub-test. On WISC testing, mean full IQ was 76.08 (SD 19.99), mean verbal IQ was 79.19 (19.48), and mean processing IQ was 75.85 (SD 20.10). According to the gold standard WISC test, 35 subjects had cognitive impairment. Of these, 29 had MMSE scores below the cut-off of 26. Out

Table 1. Subjects' characteristics

Characteristics	(N=48)
Gender, n (%)	
Male	27 (56.2)
Female	21 (43.8)
Age, n (%)	
8-9 years	14 (29.2)
9-10 years	7 (14.6)
10-11 years	27 (56.2)
Age at onset of epilepsy, n (%)	
≤ 5 years	24 (50)
> 5 years	24 (50)
Types of onset, n (%)	
Focal onset	19 (39.5)
General onset	29 (60.5)
Types of epilepsy, n (%)	
Intractable	18 (37.5)
Not intractable	30 (62.5)
Type of therapy, n (%)	
Monotherapy	28 (58.4)
Polytherapy	20 (41.6)

Table 2. Mean and median MMSE sub-test results

MMSE	Mean (SD)	Median (range)
Orientation	6.23 (2.95)	7 (1-10)
Registration	2.88 (0.49)	3 (0-3)
Attention & calculation	3.44 (3.13)	3 (0-10)
Recall	2.73 (0.74)	3 (0-3)
Language	8.02 (1.66)	9 (3-9)

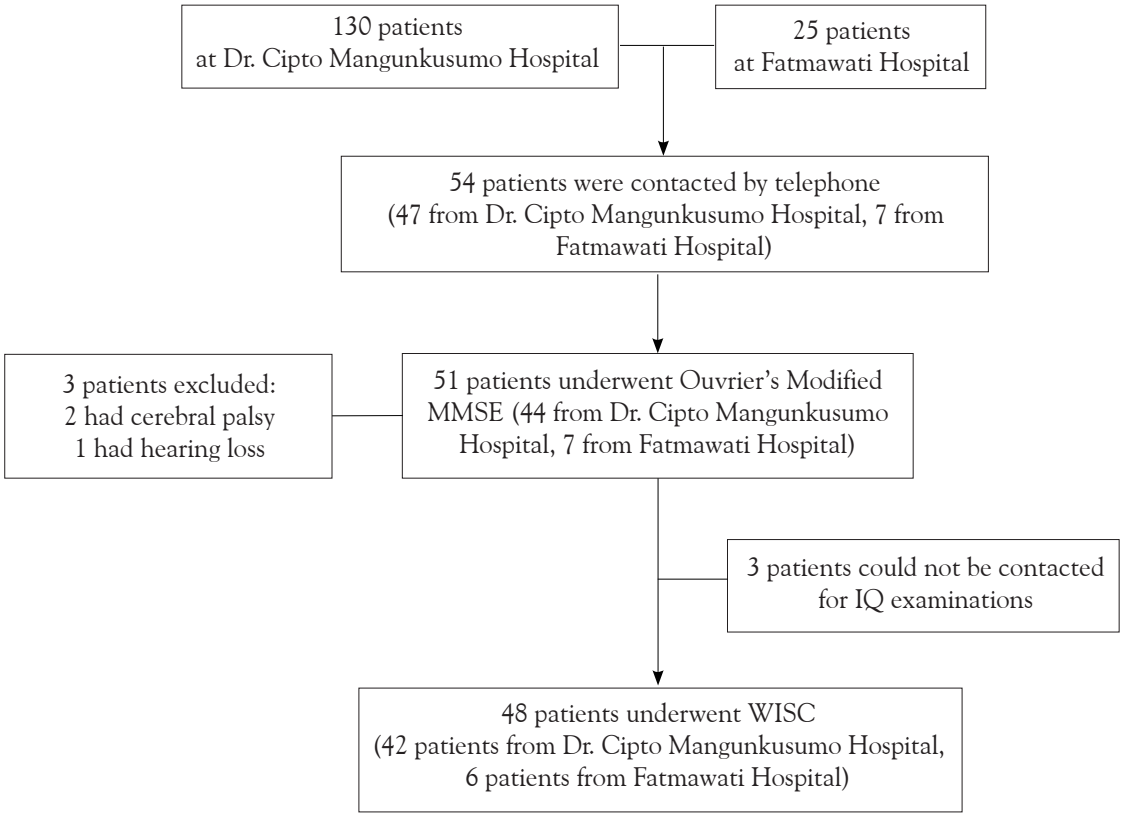

Figure 1. Subject recruitment flow chart

Table 3. Determination of cognitive impairment using *Ouvrier's Modified* MMSE *vs.* WISC

		Gold standard (WISC)		
	Cognitive impairment	Yes	No	Total
Ouvrier's Modified MMSE	Yes	29	2	31
	No	6	11	17

of 13 subjects without cognitive impairment, 11 had normal MMSE scores (**Table 3**). Ouvrier's Modified MMSE had a sensitivity of 83%, specificity of 85%, positive predictive value of 94%, negative predictive value of 65%, and an accuracy of 83%.

Discussion

Ouvrier's original study was conducted in 117 children aged 4-15 years, 71% of whom were male.[5] In a Bandung, West Java, Indonesia study involving 100 students aged 8-11 years, males comprised 55%.[8] Another study in Jakarta using *Ouvrier's Modified MMSE* found cognitive impairment in 74.29% of children with epilepsy aged 8-11 years. The study also found a frequency of seizures > 10 times, the statistical risk of 59.5 times greater for increasing cognitive numbers. In addition, patients receiving antiepileptic drug polytherapy had a greater increase in improved cognition than patients receiving monotherapy.[9]

In our study, the proportion of children with cognitive impairment was quite high, 35 subjects (72.9%). Mean WISC Full IQ test score for all subjects was 76.08 (SD 19.99). Treatment plans for cognitively impaired patients include specialized therapy to help children adapt and develop with their conditions. The subjects were advised to attend specialized schools. Cognitively impaired children also need counseling, as well as evaluations of the family system and the

influence of this cognitive disorder on the family.

The MMSE sub-tests with the highest mean scores were language [mean 8.02 (SD 1.66)] and orientation [mean 6.23 (SD 2.95)]. This result is consistent with the existing view that brain development during middle childhood is characterized by growth of the frontal lobe and maturation of the temporal lobe, two structures that play an important role in the orientation and language processes.

The dose and timing of stimulation given to a child determine whether the stimulus will be maintained as an experience. Such experiences play an important role in synaptogenesis. Adequate, repetitive, and consistent stimulation increases the branching of dendrites and proliferation and stabilization of synapses.[10-13]

In our study, the attention and calculation sub-test had the lowest mean MMSE score [mean 3.44 (SD 3.13)]. Calculation and backward spelling require more complex work and involve both cerebral hemispheres, especially in the counting process. Counting skills require a more complicated interaction between the language, visuospatial, and executive centers to maintain attention and working memory. These functions require communication between several brain areas, such as the dorsolateral prefrontal portion, the frontal lobe, the inferior parietal lobe, and the angular gyrus of the corpus callosum. Logical reasoning ability begins to develop at the age of 8-12 years. The development of working memory in the frontoinsular-temporal networks continues into adolescence, and the capacity of this system is associated with prefrontal-parietal connectivity. The dorsolateral prefrontal area of the frontal lobe is closely associated with the ability to analyze and solve problems. Immature development of these areas is also affected by a lack of experience and improper learning processes, which will manifest as difficulties in counting and backward spelling.[10-14] Since children who have these difficulties tend to avoid mathematical learning, they tend to be understimulated in this area.[15-17] These reasons may explain the low sub-test score in counting and backward spelling in our subjects.

The sensitivity (83%) and specificity (85%) of *Ouvrier's Modified MMS*E in our study suggests that this tool is potentially useful as a screening test for cognitive function abnormalities in children of this age group. A meta-analysis of the diagnostic performance of MMSE in detecting dementia and mild cognitive impairment in primary care reported a sensitivity of 78.4% and specificity of 87.8%.[18] Another study which used MMSE to assess cognitive function in children aged 3-14 years with encephalopathy reported a sensitivity of 35% and specificity of 100%. Re-testing four days after the first administration showed a sensitivity of 68% and specificity of 100%.[6] Despite slight differences between studies, all studies to evaluate the performance of MMSE have reported that this test can be used as a screening tool to assess cognitive function in normal children, as well as in children with epilepsy. The Indonesian version of *Ouvrier's Modified MMSE* requires only 5-10 minutes to administer and can be done on a regular outpatient follow-up visit at no additional cost, while the WISC may take up to 60 minutes and incurs a significant cost.

In conclusion, the Indonesian version of *Ouvrier's Modified MMSE* has a reasonably high sensitivity and specificity to predict cognitive impairment in 8 to 11-year-old children with epilepsy, therefore, it may serve as a useful screening tool.

Conflict of Interest

None declared.

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