

## The association between onset, frequency, duration of seizure and IQ level in epileptic children

Yulia, Sjarif Hidayat Effendi, Budi Setiabudiawan

### Abstract

**Background** Epilepsy is a common neurological disorder found in all races and age groups. Epilepsy becomes a serious problem when occurs during the child's critical development period. It is known that onset, frequency, and duration of seizures are associated with IQ level. Therefore, intelligent assessment is important to determine prognostic and holistic management.

**Objective** To determine the association between onset, frequency, duration of seizure and IQ level in epileptic children.

**Methods** This cross sectional study was carried out at the Department of Child Health, Hasan Sadikin Hospital, Bandung, Indonesia from October to December 2007. The subjects were epileptic children aged 4-16 years old being treated with valproic acid. Statistic analysis was done using logistic regression analysis, OR and RR, with 95% confidence interval.

**Results** There were 90 subjects with epilepsy (46 males). Twenty subjects (22%) showed onset of seizures at <18 months old; these subjects had 3.08 higher risk for having a low IQ level (score <90) compared to those with seizure onset at  $\geq$  18 months old ( $P=0.003$ ). Sixty subjects (67%) had a seizure frequency of >10 times annually; they had 1.68 higher risk of having a low IQ compared to those with seizure frequency <10 times ( $P=0.430$ ). Seven subjects (28.0%) had seizures of >10 minutes; they had 1.17 higher risk of having a low IQ compared to those with seizures of <10 minutes ( $P=0.706$ ).

**Conclusion** Onset of seizures at <18 months old is significantly associated with low IQ level, while frequency and duration of seizure have no significant association with lower IQ level. [Paediatr Indones. 2009;49:177-81].

**Keywords:** epilepsy, onset, frequency, duration of seizure, IQ level, Wechsler intelligence scale

Epilepsy is a common neurological disorder found in males and females in all races and age groups. Epilepsy becomes a serious problem when it occurs during the critical development period of a child.<sup>1-6</sup> Although exact figures are not available, it is predicted that the incidence is between 0.11-1.34 per 1000 population, with a prevalence of 1.5-31 per 1000 population.<sup>7-11</sup> In the Neuropediatric Outpatient Clinic of Hasan Sadikin Hospital, Bandung, the number of epileptic patients increased from 900 visits (91 new cases) in 1998 to 1405 (173 new cases) in 2006.<sup>12</sup> Epilepsy is a chronic neurological disease characterized by recurrent seizures.<sup>7</sup> Nowadays, management of epilepsy is focused on patient quality of life, with cognition being one of the most important parameters.<sup>13</sup> Some studies reported the relationship between epilepsy and cognition dysfunction, especially intellectual function,<sup>1-4,7-10,14-23</sup> while others reported otherwise.<sup>24-28</sup> Prospective studies conducted by Nolan *et al*<sup>4</sup> and Singhi *et al*<sup>20</sup> showed that duration

From the Department of Child Health, Medical School, Padjadjaran University, Hasan Sadikin General Hospital, Bandung, Indonesia.

**Reprint request to:** Yulia, MD, Department of Child Health, Medical School, Padjadjaran University, Hasan Sadikin General Hospital, Jl. Pasteur no.38, Bandung, Indonesia. Tel/Fax. +62 222035957. E-mail: st\_rafael2004@yahoo.com.

and frequency of seizure were significantly correlated with IQ in children with idiopathic generalized epilepsy, while a study conducted by Sturniolo *et al*<sup>26</sup> showed no influence of sex, social background, age of onset, and seizure type on school achievement. In addition, a study by Sillanpaa reported that 31-41% of epileptic children had mental retardation.<sup>29</sup> In epileptic patients, intelligence is influenced by factors such as brain damage, onset, duration and frequency of seizures; therefore early intervention can help optimize the quality of life of the patients.<sup>1-4,15,20,30</sup>

Intelligent assessment of epileptic patients is important to determine prognostic and holistic management. Intelligence of school-age children is assessed using the Wechsler Intelligence Scale for Children (WISC). According to the WISC, IQ levels are classified into very superior (score  $\geq 130$ ), superior (score 120-129), high average (score 110-119), average (score 90-109), low average (score 80-89), borderline (score 70-79), and intellectually deficient/mental retardation (score  $\leq 69$ ). For the purpose of our study, IQ levels were classified into normal/high (score  $\geq 90$ ) and low (score  $< 90$ ).<sup>31</sup> The aim of this study was to determine the association between onset, frequency, and duration of seizure with IQ level in children with epilepsy.

## Methods

Epileptic children at the Neuropediatric Outpatient Clinic of Hasan Sadikin Hospital, Bandung, Indonesia, whose parents had given their consent, were enrolled in this study. Diagnosis of epilepsy was made based on International League against Epilepsy (ILAE) classification.<sup>32</sup> The inclusion criteria were epileptic children aged 4-16 years old being treated with valproic acid. The exclusion criteria were children with congenital anomaly of the central nervous system, children with brain dysfunction (infection, cerebral palsy, malignancy of the central nervous system), and children with visual/hearing impairment. Children who fulfilled the inclusion criteria underwent IQ assessment using WISC. History of onset, frequency, and duration of seizure was recorded. The study was approved by Ethic Committee of Hasan Sadikin Hospital. The estimated sample size was 90.

To determine the association between onset, frequency, and duration of seizure and IQ level, we used multiple logistic regression analysis. Statistical analysis was performed using SPSS 10.0 for Window 1999, SPSS mc, Chicago-Illinois, USA.

## Results

From October to December 2007, 90 subjects were eligible for our study. There were 46 male and 44 female subjects. The mean age of the subjects was 9.24 years old. Characteristics of the subjects are shown in **Table 1**.

IQ levels according to onset of seizure were divided into two groups:  $< 18$  months old, and  $\geq 18$  months old; according to frequency of seizure, IQ levels were divided into two groups:  $< 10$  times annually, and  $\geq 10$  times annually, and according to duration of seizure, IQ levels were classified into two groups:  $< 20$  minutes, and  $\geq 20$  minutes. All the subjects had seizure  $< 20$  minutes, so for this study purpose the subjects were classified into  $< 10$  minutes and  $\geq 10$  minutes.

Next, we looked at the characteristics of the seizures in the Low IQ and Normal/High IQ level groups. We identified subjects in both groups with an onset of  $< 18$  month old, a frequency of  $\geq 10$  times annually and a duration of  $\geq 20$  minutes. Next, we analysed this data using univariate analysis. The data are shown in **Table 2**.

Low IQ level was found in significantly more children with onset of seizure at  $< 18$  months old (40%) than in those with onset of seizure  $\geq 18$  months

**Table 1.** Characteristics of the subjects

Subject characteristics	Number	
	Low IQ Level (Score $< 90$ )	Normal/High IQ Level (Score $\geq 90$ )
Age (years)		
Interval	6-15	4-14
Mean	10.375	8.1
Sex		
Male	9	37
Female	7	37
Total	16	74
Nutritional Status		
Well nourished	16	74
Malnourished	0	0

**Table 2.** Univariate analysis of IQ level according to onset, frequency, and duration of seizure

Seizure characteristics	IQ		P
	Low (score <90) n	Normal/high (score >90) N	
Onset <18 months old	8	12	0.011
Frequency ≥ 10 times annually	8	22	0.296
Duration ≥ 10 minutes	7	18	0.270
Total	16	74	

**Table 3.** Multivariate analysis of IQ level according to onset, frequency, and duration of seizure

Seizure	B	S.E	Wald	df	Sig.	Exp (B)
Onset	-1.860	0.619	9.034	1	0.003	0.156
Frequency	-0.845	1.171	0.521	1	0.470	0.430
Duration	-0.348	1.276	0.881	1	0.644	0.706
Constant	2.973	1.533	3.762	1	0.052	19.544

old (11.43%; P=0.011), in children with frequency of seizure ≥10 times annually (26.67%) than in those with frequency of seizure <10 times annually (13.33%) but statistically not significant (P=0.296), and in children with duration of seizure ≥10 minutes (28.00%) than in those with duration of seizure <10 minutes (13.85%) but statistically not significant (P=0.270).

The results of multivariate analysis to examine the relationship between of IQ level and onset, frequency, and duration of seizure are shown in **Table 3**. This analysis showed that there is a significant association between IQ level and onset of seizure (P=0.003), while frequency and duration of seizure had no significant association with IQ level (P=0.470 and P=0.644 respectively).

## Discussion

In this study, the mean age of the subjects was 9.24 years old (4.42-15.33 years old). Study by Ostrom *et al*<sup>3</sup> found that mean age of the epileptic patients was 10.1+2.4 years old, while study by Sturniolo and Galletti<sup>26</sup> found the most prevalence age of epileptic patient was 6-10.8 years old, and that of the subjects of Henkin Y *et al*<sup>33</sup> was 4-15 years old.

There were more male subjects female (51.1% vs. 49.9% respectively), but the difference was not statistically significant. This was similar to the findings of Mac *et al*<sup>34</sup>, where epidemiology of epilepsy in 23 Asian countries was studied; here the mean age of epileptic patients was 10 years old and there were slightly more males than females but that this was not statistically significant (50.1 males vs. 49.9 females in Singapore and 60.6 males :39.4 females in Laos).

**Table 3** shows a significant difference in IQ level of epileptic children with onset of seizures at <18 months old, compared to that of epileptic children with onset of seizures at ≥18 months old. Children with onset of seizure at <18 months old (40%) had a low IQ level (score <90) compared to those with onset of seizure at ≥18 months old (11.43%; P=0.003). Previous studies also reported the influence of onset on psychosocial function (P<0.005).<sup>1-4,29,35,36</sup> Alvarez<sup>37</sup> found that the mean age of onset of seizure in epileptic patients with mental retardation was 1.3 years old, while Devinsky and Tarulli<sup>2</sup> found this mean age to be one year old. Vasconcellos *et al*<sup>38</sup> reported that patients with onset of seizures during the first 18 months will have a lower IQ (74.0 (SD 21.5)) compared to those with later onset of seizure (87.8 (SD 18.8; P=0.005).

**Table 3** shows that low IQ level was found in more subjects with seizure frequency of ≥10 times annually (26.67%) than in those with seizure frequency of <10 times annually (13.33%), but this was not statistically significant (P=0.430). Hoie<sup>39</sup> reported that seizure frequency of >10 times annually will decrease IQ level.<sup>2,15,40</sup>

In this study we did not find a significant association between frequency of seizures and IQ level, due to variation of epilepsy type. Loiseau and Panayiotopoulos,<sup>41</sup> defined absence seizure as 10-200 seizure daily, for 4-20 seconds each seizure, and still shows good prognosis. There were no subjects with seizures with duration of >20 minutes; this is because epilepsy is very responsive to treatment. Therefore, we classified duration of seizure into <10 minutes and ≥10 minutes. Davis *et al*<sup>42</sup> stated that prolong seizure (more than 20 minutes) can cause neurological impairment, including intelligence impairment. In this study, 28% of subjects with a seizure duration ≥10 minutes had lower IQ compared to 13.85% of subjects with a seizure duration of <10 minutes. However, this

was not statistically significant ( $P=0.706$ ).

In conclusion, there is a significant association between onset of seizure and IQ level of epileptic children. Further study is needed to clarify the association between frequency and duration of seizure and IQ.

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