

Role of Denver II and Development Quotients in the management of several pediatric developmental and behavioral disorders

Titi Sularyo¹, Bernie Endyarni², Tri Lestari H¹, Tirza Z. Tamin³, Gitayanti⁴

Abstract

Background Autism spectrum disorder (ASD) and attention deficit and hyperactivity disorder (ADHD) are nowadays becoming more and more frequently found. Parents are worried of the possibility that their children suffer from them. Growth and development clinics (GDC) should be able to deliver professional services. Thus a practical, applicable, objective, valid, reliable, and able to measure development quotient (DQ) values instrument is needed.

Objective To find out whether the Denver II instrument and DQ values can be used in the management of children with ASD and ADHD.

Methods A study was carried out on cases of children with ASD, multisystem development disorder (MSDD), pervasive development disorder – not otherwise specified (PDD-NOS), and attention deficit and hyperactivity disorder (ADHD), consisting of history taking, physical examination, establishing diagnosis, therapy, evaluation, and follow-up. The Denver II instrument was used and DQ values in all development streams established. The study was done at the GDC of Hermina Depok Hospital in July 2008 – June 2009.

Results It revealed that results of the Denver II as seen on the filled Denver II form showed “typical” features related to kind of disorder as far as category of DQ value, dissociation, global delayed development (GDD) as well as abnormality of the test behavior were concerned. It also revealed that establishing the diagnoses by the use of the Denver II and DQ values gave exactly the same diagnoses as when using the conventional way by the expert.

Conclusion The Denver II instrument with DQ values can be used in the management of ASD and ADHD cases. [Paediatr Indones. 2012;52:51-6].

Keywords: ASD, ADHD, Denver II instrument, DQ, and GDC

Autism spectrum disorder (ASD) is a complex neurodevelopmental disorder appearing at an early age, and is characterized by social interaction impairment and communication skill difficulties with the sign of unusual, stereotyped behavior.¹ Attention deficit hyperactivity disorder is a developmental disorder primarily characterized by “the coexistence of attentional problems and hyperactivity with each behavior occurring frequently alone” and symptoms starting before seven years of age.”² These two entities both belonging to pediatric developmental and behavioral disorders are more and more frequently found in daily life and practice. At the Hermina Depok Hospital, data showed an increase of those cases; in 2008 there were 149 cases found but in 2010 the cases increased to 243. These two entities were also the most frequently encountered at the GDC of Hermina Depok Hospital where this study was conducted. Those two disorders are really chronic

From the Growth and Development Clinic Hermina Depok Hospital¹, Department of Child Health FKUI/RSCM², Department of Medical Rehabilitation FKUI/RSCM³, Department of Psychiatry FK UI/RSCM⁴

Reprint requests to: Titi Sularyo. Growth and Development Clinic, Hermina Depok Hospital. Jl. Siliwangi Raya 50 Depok 16436. Phone (021) 7773220, Fax : (021) 7763309. Email : titisularyodrspak@yahoo.com

and serious conditions and actually demand long term, full participation and dedication of the family's part. Sometimes they could evoke a family misery and could even end into family disintegration.³ Thus it is also very true that parents are the more aware of the existence of these disorders with their magnitude of implication and thus become even more worried of the possibility that their child might suffer from them. Actually, with full participation of the family, well organized growth and development clinics (GDC) are most suitable to manage such cases and thus GDCs are obliged to be able to deliver most professional services. The staff of a GDC should be able to work as an integrated team and able to manage cases thoroughly. Thus an instrument that is practical, applicable, valid, reliable, and objective to assess a child's development, including able to measure developmental quotient (DQ) values, is needed.

The Denver II instrument is considered to fulfil all these criteria. DQ is a psychomotor developmental scale for young children (aged 0 – 6 years) that is able to represent with precision the child's quality of development by its percentage of normal development of a child of the same age. In older children and adults the term of DQ will become intelligence quotient (IQ).

For all these a study was conducted to find out whether the Denver II instrument and DQ values can be used in managing ASD and ADHD cases, i.e., establishing the diagnosis, prognosis, therapy, evaluation, and follow up, also judging the presence of dissociation, GDD, deviancy, etc. The aim was also to compare the diagnosis when established by using the Denver II with when using the conventional way by the real expert in this field, a child psychiatrist.

Methods

In this study, based on the clinical point of view, autism spectrum disorder, included autism disorder, PDD-NOS, and MSDDs, while the ADHD consisted of only one group, without dividing it into the combined, the impulsive, and the inattentive type.

We reviewed children with ASD and ADHD at the GDC of Hermina Depok Hospital from July 2008 till June 2009. History taking was done by the team of observers consisting of a pediatrician and

a medical rehabilitation specialist doctor. Relevant data were collected included age when the problem started, abnormal behavior such as "always on the move", quality of eye contact, tantrums, interest to surroundings, attention span, difficult to concentrate, stereotypic movements. Data on schooling were also collected, including whether the child attended play group, kindergarten, formal schools, and feedback from these institutions. Parents' concern of a certain disorder, and the occurrence of possible prenatal, natal, perinatal, and post-natal risk factors, history of immunization, food intake, parental rearing pattern, were also recorded.

The child's development was then assessed using the Denver II tool and DQ values in every stream determined. The DQ values were then categorized as being normal, sub-normal; mild, moderate, or severe delay. The presence of other development abnormalities, such as dissociation, GDD, deviance, etc. were also noted. The test behavior was also evaluated concerning the presence of 1. Typical of appearance, "always on the move", eye contact, stereotypic movements, dysmorfism, 2. Compliance in doing the test task, 3. The child's interest to surroundings, 4. Fearfulness, 5. Attention span. When necessary other questionnaires were also used such as Pervasive Development Disorder Screening Test (PDDST), Pediatric Symptom Checklist 17 items (PSC-17); *Kuesioner Perilaku Anak Prasekolah* (KPAP), sensory screening, feeding screening, etc.

Then physical examination was done. There after the child and parents were invited to enter the observation room and observed about the child's behavior and the rearing pattern. The working diagnosis was then made based on history and mainly on the DQ values in every stream (normal, sub normal, delays: mild, moderate or severe) and results of the test behavior (all these were already revealed just from the already completely filled Denver II form) and result of the PDDST. The therapy consisted of sensory integration, sensory modulation, behavior therapy, and ABA (Applied Behavior Analysis), occupation therapy, speech therapy, physiotherapy and touch therapy, also diet and pharmacotherapy, when needed. Every child should then also be seen by the child psychiatrist enlisted in the list of experts who would make the diagnosis in the conventional way.

Results

There were a total of forty patients consisting of ten patients with autism disorder, ten with PDD-NOS, ten with MSDD B & C, and ten with ADHD. **Table 1** depicts age and sex distribution in each type of disorder. In all types, most of the patients were males.

Table 1. Age and sex distribution of by type of disorder

Characteristics	ADHD	MSDD	PDD-NOS	Autism Disorder
Sex: Male (n/N)	8/10	7/10	10/10	9/10
Age: (mos)	53,5 ± 8,8	26,6 ± 5,3	44,6 ± 8,3	47,5 ± 17,8

Table 2 shows the mean DQ values according to developmental stream in each category of the disorder, while **Table 3** shows the category of DQ value in every stream of development in every type of disorder. Both tables show that the most severe abnormalities were found in children with autism disorder. This phenomenon is further shown in **Figure 1**.

Table 4 reveals the various kinds of behavior found during testing in each type of studied cases. **Table 5** shows typical features as far as category of DQ value, dissociation, global delayed development and test behavior were concerned.

Table 2. Distribution of mean DQ values by type of disorder and developmental stream

Developmental Stream	Mean DQ (unit)			
	ADHD	MSDD	PDD-NOS	Autism Disorder
Personal social	70,8 ± 20,9	72,9 ± 16,7	50,2 ± 10,9	44,2 ± 11,6
Fine motor adaptive	83,9 ± 15,6	82,1 ± 19,6	56,2 ± 15,6	48,7 ± 14,4
Language	86,7 ± 11,5	48,8 ± 11,9	42,6 ± 15,9	34,0 ± 10,6
Gross motor	92,5 ± 19,2	94,9 ± 13,6	79,6 ± 16,0	64,6 ± 17,9

Table 3. Distribution of category of DQ value by type of disorder and developmental stream⁴

Developmental Stream	Category of DQ value			
	ADHD	MSDD	PDD-NOS	Autism Disorder
Personal Social	Mild delay	Mild delay	Moderate delay	Severe delay
Fine motor Adaptive	Sub normal	Sub normal	Moderate delay	Severe delay
Language	Sub normal	Severe delay	Severe delay	Severe delay
Gross Motor	Normal	Normal	Sub normal	Moderate delay

Sub normal : DQ < 90 – 75 Unit Mild delay : DQ < 75 – > 66,7 Unit
 Moderate : DQ ≤ 66,7 - > 50 Unit Severe delay : DQ ≤ 50 Unit

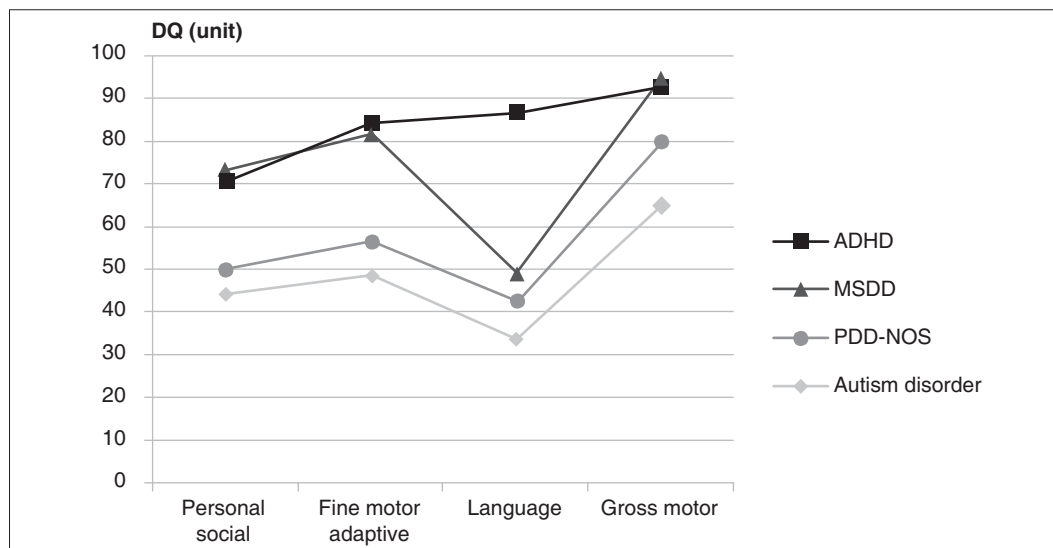


Figure 1. Graphs of developmental stream DQs in studied cases

Table 4. Distribution of test behavior items by type of disorder.

Test Behavior items	Type of Disorder			
	ADHD	MSDD	PDD-NOS	Autism Disorder
Always on move	10/10	10/10	10/10	10/10
No eye contact	0/10	5/10	8/10	10/10
Stereotypic movements	0/10	0/10	2/10	5/10
No compliance	2/10	4/10	6/10	10/10
Disinterest to surroundings	6/10	8/10	10/10	10/10
No fear	10/10	8/10	10/10	10/10
Very distractable	10/10	10/10	10/10	10/10

Table 5. Distribution of typical features by type of disorder

Typical Features	ADHD	MSDD	PDD-NOS	Autism Disorder
1 DQ values :				
Normal	+	+	-	-
Subnormal	+	+	+	-
Delay :				
Mild	+	+	-	-
Moderate	-	-	+	+
Severe	-	+	+	++
2 Dissociation	+	+	+	+
3 GDD	-	+	+	+
4 Test Behavior				
Proper	-	-	-	-
Improper	++	+	++	++

Regarding the comparison of diagnostic study by Denver II and by conventional way done by the expert (a child psychiatrist), we found a complete (100%) agreement between the two approaches. All patients (10 in each category) diagnosed by Denver II were also diagnosed as the same disorder by the expert.

Discussion

This study might be one of the first studies that revealed more advanced use of the Denver II instrument, in a sense to establish and support the diagnosis, therapy, evaluation, follow up of cases of ASD and ADHD, without breaking its original rules as a screening device. The background was the urge of finding a tool that is practical and yet at once also reliable so that cases can be handled more effectively. Further studies are still on the way such as therapy, evaluation, and follow up measures of the above mentioned cases by the use of this same instrument.

The Denver II is one of the many suitable instruments to evaluate the young child's (0 – 6 years) development. It is also already widely used especially by pediatricians. The authors considered Denver II, representing developmental milestones of normal 0 – 6 years children where those milestones are very orderly and sequentially arrayed, also very practical, in a sense, it includes completely all developmental streams; covers any age from 0 – 6 years; can be used by the doctors and therapists as well for guidance and target of operation; and last but not least, covers also very important and typical data about the child's behavior during testing.⁴

Developmental quotient (DQ) is very important as it can measure the child's development precisely, objectively, quantitatively, and qualitatively. DQ is actually a very time honored term, firstly introduced by Arnold Gessel in year 1925. It is defined as a calculation that reflects the rate of development in any given stream, represents the percentage of normal development present at the time of testing. It is used especially for the children aged 0 – 6 years. Similiar to the intelligence quotient (IQ) formula DQ can be calculated as developmental follows:

$$DQ = \frac{\text{developmental age}}{\text{chronological age}} \times 100 ,$$

and can be calculated in any given stream. When development is not progressing normally, pattern of abnormal development is considered and it usually includes: delay, dissociation, global delayed development (GDD), and deviancy.

The term delay is used if the developmental performance is significantly below average ($DQ < 75$) in a given stream. It may occur in one single stream or several. When found only in one stream the term dissociation is used, while when found in more than one stream it is called GDD. The term deviancy refers to only within one single stream and is considered when the development tasks in that stream do not occur according to sequence.⁴

In this study, concerning the ASD cases there was found a preponderance of boys over girls (6:1). The literature also revealed boys to be more affected than girls.^{3,5} Some mentioned a boy : girl ratio of 3 – 4 : 1 (Table 1).³ The mean age of the MSDD was 26,6 months much younger than the PDD-NOS as well as autism disorder, namely 44,6 and 47,5 months, respectively. This fact is in accordance with what was written in the literature as the MSDDs belong to the zero to three diagnostic classification (Table 1).⁶

Table 2 shows that although all DQ streams tended to be low yet in MSDD the DQs in all streams were better followed by PDD-NOS which was worse and in autism disorder to be the worst. In all types of disorder the language stream was all worst affected. In ADHD cases, DQ in all streams were all better compared to the other disorders but results of the test behavior (though they still complied to do the test items, were still alert, had no fear) yet they showed strikingly a very inappropriate attention span, and were very much “on the move” (Table 4).

Table 3 reveals that besides the fact that all disorders had unfavorable performances, in ASD children all had severe delays in the language stream. In the MSDDs the other developmental stream showed still better results compared to the PDD-NOS and autism disorder, having the worst performance. It was also clear that the gross motor stream suffered least, followed by the fine motor adaptive, personal social, and worst affected were that of the language

stream. In ADHD except that the gross motor stream was normal, the language stream was just a bit affected contrary to ASD. In the ASD cases excluding the gross motor stream, in MSDD there were still subnormal and mild delays found which were no more found in PDD-NOS instead they turned to become moderate delays, while in autism disorder all became severe delays. The gross motor stream revealed also MSDD to be still normal but got worse in PDD-NOS becoming subnormal, and in autism disorder it became moderately delayed. In ADHD cases the stream were in overall better than in the ASD. These elaboration are clearly seen in Figure 1, revealing that the DQ graphs formed typical features for each type of disorder. So although as visualized in graphs all development DQ graphs were unfavorable or grave, the ranks were a follows: the mildest was the graph of MSDD, followed by PDD-NOS which was much worse followed by autism disorder being the worst. All graphs showed severely low DQ's in the language stream. This fact might be a hint that in cases of young children with delayed expressive language showing severe delays in that stream, the possibility that they actually may suffer from ASD should be strongly kept in mind. Parents with ASD children usually complain first of all about their children unable to communicate at all and are less aware about their children also being hyperactive. This latter they consider normal as most are boys, so it is only normal to be very active.^{7,8} The second most affected stream was the personal social stream. This stream has all to do with social interaction and activities of daily living (ADL) so it was only reasonable this stream to be secondly most affected as ASD children cannot properly interact socially.^{7,8}

The ADHD graph was a bit different as it had, so to say, a better performance though not typical. More accurate data for ADHD could be found from the result of the test behavior⁹ (Tables 4 & 5). Results from the already filled Denver II form could also reveal other abnormalities, such as dissociation, GDD, deviancy, etc. and as already mentioned before category of DQ values (Table 5).

Just by observing the Denver II results one can distinguish whether the diagnosis is MSDD or PDD-NOS or autism disorder or ADHD, as they all showed their difference of severity of delays in each typical stream and their development graphs.^{4,9} Table 4

reveals that these data were all in accordance as what was written in the literature.^{4,8,9} Of course these data had all a subjective side.

Thus it can be concluded that by analyzing the Denver II test results (**Tables 2-5** and **Figure 1**) namely the DQ values, the severity of delay all in every stream, the presence or absence of dissociation and or GDD, the result of the test behavior, except that it could establish the kind of diagnosis, it also could prove that MSDD was the mildest form of ASD, PDD-NOS much graver, and autism disorder the gravest. ADHD was different though it was also typical in the Denver II test result.

Another important finding was that the type of disorder in studied cases, whichever, whether made by the Denver II or by the conventional approach by a child psychiatrist, all yielded exactly the same diagnosis. This means that the Denver II instrument was indeed reliable in diagnosing ASD and ADHD cases.

After about 3 months therapy the child should be seen again and reassessed by the team of observer for another Denver II test. Many of the MSDD cases revealed satisfactory results after therapy. Some even may cease therapy and attended elementary school. All these will be reported in another paper.

In overall it can be concluded that the number of ASD and ADHD cases is increasing with time, thus GDCs are very needed. By observing the completely filled Denver II form, category of DQ value and test behavior, it was possible to distinguish whether it was MSDD or PDD-NOS or autism disorder or ADHD, as each of them showed typical features. So did the development stream graphs also reveal. The diagnoses (MSDD, PDD-NOS, autism disorder, ADHD), made by using Denver II and DQ gave exactly the same diagnoses as when made by the conventional way by the expert. Thus the Denver II instrument can be used in dealing with ASD and ADHD cases.

Acknowledgments

The authors would like to express their heartfelt gratitude to all staff members of the GDC Hermina Depok Hospital for their sincere cooperation, without which this study could not have been performed.

References

1. Johnson CP, Myers SM. Identification and evaluation of children with autism spectrum disorder. *Pediatrics*. 2007;120:183–215.
2. Biederman J. Attention-deficit/hyperactivity disorder: a life span perspective. *J Clin Psychiatry*. 1998;59:4-16.
3. Pleyte EH. Autisme dan retardasi mental. In: Prasetyo J, Widyawati I, Setiawan GP, Pusponegoro HD, S Samino, editors. *Proceedings of Konferensi Nasional Autisme I "Towards a better life for autistic individuals"*; 2003 July 2-4; Jakarta. Jakarta: Badan Penerbit IDAI; c2003.p. 117-122.
4. Sularyo T, Tamin TZ, Yustiana N. Klinik Tumbuh Kembang dengan minat kusus pada pemanfaatan instrumen Denver II. *Sari Pediatri* (In press).
5. Pusponegoro HD. Pandangan umum mengenai klasifikasi spektrum gangguan autistik dan kelainan susunan saraf pusat. In: Prasetyo J, Widyawati I, Setiawan GP, Pusponegoro HD, S Samino, editors. *Proceedings of Konferensi Nasional Autisme I "Towards a better life for autistic individuals"*; 2003 July 2-4; Jakarta. Jakarta: Badan Penerbit IDAI; c2003.p. 1-7.
6. Widiawati I. Zero to three diagnostic classification. In: Prasetyo J, Widyawati I, Setiawan GP, Pusponegoro HD, S Samino, editors. *Proceedings of Konferensi Nasional Autisme I "Towards a better life for autistic individuals"*; 2003 July 2-4; Jakarta. Jakarta: Badan Penerbit IDAI; c2003.p. 190-8.
7. Mangunatmadja I. Diagnosis banding keterlambatan bicara: pendekatan etiologi pada praktik sehari-hari. In: Pusponegoro HD, Widodo DP, Mangunatmadja I, editors. *Proceedings of the symposium and workshop "A journey to child neurodevelopment: Application in daily practice"*. 2010 July 18-19; Jakarta. Jakarta: Badan Penerbit IDAI; c2010. p. 55-64.
8. Pusponegoro HD. Specific language impairment. In: Pusponegoro HD, Widodo DP, Mangunatmadja I, editors. *Proceedings of the symposium and workshop "A journey to child neurodevelopment: Application in daily practice"*. 2010 July 18-19; Jakarta. Jakarta: Badan Penerbit IDAI; c2010. p. 79-88.
9. Solek P. Diagnosis banding kesulitan belajar: ADHD atau retardasi mental. In: Pusponegoro HD, Widodo DP, Mangunatmadja I, editors. *Proceedings of the symposium and workshop "A journey to child neurodevelopment: Application in daily practice"*. 2010 July 18-19; Jakarta. Jakarta: Badan Penerbit IDAI; c2010. p. 119-26.