Paediatrica Indonesiana

VOLUME 49 September • 2009 NUMBER 5

Original Article

Measuring language development in pervasive developmental disorders (PDD) and non-PDD children

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Abstract

Background Impairments in language and related social communication skills can be found in children with pervasive developmental disorders (PDD) and other developmental language disorders (non-PDD). These conditions lead to decision of enrolling children with language disorders to speech therapy despite that it is not the therapy of choice for PDD.

Objectives To explore the differences in receptive language, verbal expressive language, and non-verbal expressive language between PDD and non-PDD children

Methods A cross sectional study was performed in October 2008 to January 2009. Questionnaire using the MacArthur communicative development inventory (CDI) was filled by parents whose children were PDD and non-PDD patients aged 1 to 3 years old. The diagnosis of PDD was based on the diagnostic and statistical manual IV.

Results A total of 42 PDD and 42 non-PDD subjects were evaluated. There was significant difference between PDD and non PDD in receptive language [P= 0.01 (95% CI -170.63 to -24.33) in 12 to 24 month-old subjects and P< 0.01 (95% CI -158.28 to -92.99) in >24 to 36 month-old subjects] and non-verbal expressive language [P= 0.01 (95% CI -20.96 to -1.96) in 12 to 24 month-old subjects and P< 0.01 (95% CI -22.65 to -10.5) in >24 to 36 month-old subjects]. Verbal expressive language was not significantly different between PDD and non-PDD children age 1 to 3 year-old.

Conclusions PDD children are more likely to have a delay in receptive language and non-verbal expressive language compare to non-PDD children. Verbal expressive language can not be used to differentiate PDD and non-PDD children. **[Paediatr Indones. 2009;49:298-292-8]**.

Keywords: *pervasive developmental disorders, developmental language disorders, language*

A developmental language disorder is almost always the presenting complaint of parents and the most common problem in children with pervasive developmental disorders (PDD). These impairments includes receptive and expressive language disorders without non-verbal compensation, repetitive, and stereotypic language.[1-2] Developmental language disorders could also be found in children with hearing impairments, mental retardation, receptive and/or expressive aphasia, selective mutism, maturation delay, and bilingualism. These conditions seems to be overlapping with each other thus distinguishing PDD from other language development disorder (non-PDD). It is difficult to differentiate between the two if we only see it through the language point of view.[1-5] Difficulty to differentiate children with language disorders as PDD or non-PDD children, makes them often to be diagnosed as "delayed speech" and receive the same therapy.[6]

From Allen and Rapin study cited by Tuchman et al[7], it was mentioned that the type of language

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disorders in preschool age with PDD are similar with non-PDD, except that purely expressive disorders do not occur in PDD children. Tuchman et al[7] reported that receptive-expressive disorders were the most common language disorders and similar in both PDD and non-PDD. This study also found that expressive disorders was only found in non-PDD.

Comprehensive measurement of language development such as receptive, verbal expressive, and non-verbal expressive language in the early age must be performed to determine the next therapy. This is valuable in deciding the next management because language ability before five years old in children with language development disorder is an important prognosis factor for the language ability afterwards and social function.[1,3,5]

Until recently there was no data about differences in receptive, verbal expressive, and non-verbal expressive language between PDD and non-PDD toddlers (1 to 3 years old) resulting in frequently mistaken management performed.[8] The aim of this study was to explore the differences in receptive, verbal expressive, and non-verbal expressive language between PDD and non-PDD toddlers using the MacArthur communicative development inventory (CDI).

Methods

This was a cross-sectional descriptive study conducted in 42 PDD and 42 non-PDD subjects in Cipto Mangunkusumo Hospital (CMH) and *Anakku* clinic in Jakarta, from October 2008 to January 2009. Subjects who met inclusion criteria (delayed speech in 1 to 3 years old children and had approval from parents) were drawn by convenient sampling methods. Exclusion criteria included having congenital malformation, blindness, deafness, cerebral palsy, tuberous sclerosis, other neurological disorders, and children who already had speech therapy for more than one month.

Parents whose children met the inclusion criteria will receive MacArthur communicative development inventory (CDI-Infant Form) questionnaires to be filled in whereas several examinations would be performed on children to determine the diagnosis by a senior neuropediatric consultant. Approval from the Ethics Committee, Medical School, University of Indonesia was obtained.

Results

Subjects characteristics

Characteristics of the PDD and non-PDD children in this study, included gestational age, sex, and birth methods, were shown in **Table 1**. Sex ratio of boys and girls in this study was 7.2:1 in PDD children and 3.7:1 in non-PDD children with median age of 25 months old in PDD children. Microcephaly was present in 1 PDD subject and 5 non-PDD subjects. Macrocephaly was not present in this study. Most of the subjects had normal gestational age, birth weight, and perinatal history. History of past illness such as head trauma, febrile seizure, and seizure without fever was present in 1 non-PDD subject (respectively). **Table 1** also summarizes family history data in the first and second degree relatives of PDD and non-PDD subjects. Family history of autism was more common in PDD compared to that of non-PDD while language impairment without PDD was similar between them.

First sign of understanding and starting to talk

Table 2 shows responses to the three questions about early signs of language understanding and whether the child imitated words or parts of a sentences, names and label things. There was significant differences between PDD and non-PDD subjects age 12-24 month in "respond to NAME" and "respond to NO". All first signs of understanding was significantly different in PDD and non-PDD children age >24-36 month.

Phrase comprehension, word comprehension and production

Ability of phrase comprehension, word comprehension and production were measured by totaling the phrases (out of 28) and words (out of 396) from MacArthur CDI qustionnaires. Results are shown in **Table 4** for 12 to 24-month age group and **Table 5** for >24 to 36-month age group.

In 12 to 24-month age group, PDD subjects did

Table 1. Subject characteristics

Characteristics	PDD (n=42)	Non-PDD (n=42)
Sex		
Boys	37	33
Girls	5	9
Age		
12 – 24 month	9	14
>24 – 36 month	33	28
Head circumference		
Microcephaly	1	5
Normocephaly	41	37
Macrocephaly	0	0
Birth weight		
BW < 2500 g	1	2
BW ≥ 2500 g	41	40
Gestational age		
≥38 weeks	41	40
<38 weeks	1	2
Hyperbiliribunemia	3	3
Perinatal hypoxia	0	0
Ventilator support history	0	0
Past illness history		
Head trauma	0	1
Febrile seizure	0	1
Seizure without fever	0	1
Family history		
Epilepsy	0	0
Mental retardation	0	0
Language impairments	4	4
Autistic	3	0
Diagnosis		
Autistic	10	0
PDD-NOS	32	0
Global delayed development	0	7
Expressive language disorder	0	35

not understand more than 17 phrases with mean number of phrase comprehension was 6.22. One subject with autistic and global delayed development did not understand one phrase at all. Mean number of phrase comprehension in non-PDD subjects was 14.93. One subject with expressive language disorder could understand all of the phrases. PDD subjects were more likely to be delayed in phrase comprehension compared to non-PDD subjects at 8.70 point (P= 0.01; 95% CI -15.13 to-2.27).

Mean number of word comprehension in PDD subjects was 39.44 and non-PDD subjects was 136.93. Subjects who did not understand any word at all presented as global developmental delayed. PDD subjects were more likely to be delayed in word comprehension compared to non-PDD subjects at 97.48 point (P= 0.01; 95% CI -170.63 to -24.33). Data distribution of word production in this study was not normal so the mean number of word production could not be calculated.

In >24 to 36-month age group, PDD subjects did not understand more than 24 phrases and mean number of phrase comprehension was 12.5. Non-PDD subjects understood minimal of 17 phrases and mean number of phrase comprehension was 23.14. In this group, PDD subjects were more likely to be delayed in phrase comprehension compared to non-PDD

Table 2. Percentage of children producing first signs of understanding and productive communication

Variable	Age 12-24 month (n=22)			Age >24-36month (n=59)		
	PDD (n=9)	Non-PDD (n=14)	P*	PDD (n=33)	Non-PDD (n=28)	P*
Responds to" NAME"	4	13	0.01	22	28	<0.001
Responds to "NO"	4	11	0.11	23	28	<0.001
Responds to "THERE'S MUMMY/DADDY"	3	11	0.04	24	28	<0.001
Imitating words	1	4	0.33	14	16	0.18
Naming/labelling	0	0		0	5	0.04

* Fischer-exact test

Table 3. Mean number and standard deviation of phrases understood, words comprehended and produced, age 12-24 month

Variable	Age 12 – 24 month (n=23)				
	PDD (n=9) mean (SD)	Non-PDD (n=14) mean (SD)	Mean difference	P	95%CI
Phrases; number understood (out of 28)	6.22 (5.72)	14.93 (8.01)	-8.70	0.01	(-15.13) to (-2.27)
Word comprehension; number of words understood (out of 396)	39.44 (39.20)	136.93 (100.01)	-97.48	0.01	(-170.63) to (-24.33)
Word production; number of words expressed (out of 396)	Median 0 Range (0 - 7)	Median 4 Range (0 – 19)		0.15#	

Mann-Whitney test

Table 4. Mean number and standard deviation of phrases understood and words comprehended and produced, age >24-36 month

Variable	Age >24 – 36month (n=61)				
	PDD (n=33) mean (SD)	Non-PDD (n=28) mean (SD)	Mean difference	P	95%CI
Phrases; number understood (out of 28)	12.5 (7.06)	23.14 (3.18)	-10.68	<0.001	(-13.58) to (-7.79)
Word comprehension; number of words understood (out of 396)	71.39 (50.47)	197.04 (76.09)	-125.64	< 0.001	(-158.28) to (-92.99)
Word production; number of words expressed (out of 396)	Median 1 Range (0 - 46)	Median 5 Range (0 – 76)		0.12#	

Mann-Whitney test

Table 5. Mean number and standard deviation of gestures (SD), age 12 – 24 month

Variable	Age 12 – 24 month (n=23)				
	PDD (n=9) mean (SD)	Non-PDD (n=14) mean (SD)	Mean difference	P	95% CI
Early gestures (A and B) (out of 18)	8.22 (3.63)	10.79 (3.81)	-2.56	0.12	(-5.87) to (0.76)
Late gestures (C,D, and E) (out of 45)	7.22 (4.38)	13.43 (9.39)	-6.20	0.04	(-12.27) to (-0.14)
Total gestures (A to E) (out of 63)	15.78 (6.42)	27.78 (12.78)	-11.36	0.01	(-20.96) to (-1.96)

Table 6. Mean number and standard deviations of gestures, age >24 - 36 month

Variable	Age >24 - 36 month (n=61)				
	PDD (n=33) mean (SD)	Non-PDD (n=28) mean (SD)	Mean difference	P	CI 95%
Early gestures (A and B) (out of 18)	8.42 (4.29)	14.29 (2.19)	-5.62	< 0.001	(-7.40) to (-3.82)
Late gestures (C,D, and E) (out of 45)	16.12 (10.69)	27.93 (6.09)	-11.44	< 0.001	(-16.10) to (-6.78)
Total gestures (A to E) (out of 63)	24.18 (14.17)	41.82 (7.56)	-16.57	< 0.001	(-22.65) to (-10.50)

subjects at about 10.68 point (P< 0.001; 95% CI -13.58 to -7.79).

PDD subjects did not understand more than 166 words and mean number of word comprehension was 71.39 while non-PDD subjects could understand at least 71 words and mean number of word comprehension was 197.04. In this group, PDD subjects were more likely to be delayed in word comprehension compared to non-PDD aubjects at 125.64 point (P< 0.001; 95% CI -158.28 to -92.99).

Gesture

Ability of gesture as nonverbal expressive language was measured by calculating gesture that could be done by the subjects. Early gestures consisted of first communicative gestures (out of 12), games and routines (out of 5), late gesture consists of actions with objects (out of 17), pretending to be a parent (out of 13), and imitating other adult actions (out of 15) from MacArthur CDI questionnaires. These are shown in **Table 6.**

In 12-24-month age group, there was significant difference between PDD and non-PDD subjects in late gestures (P= 0.04; 95% CI -12.17 to -0.14) and total gestures (P= 0.01; 95% CI -20.96 to -1.96). PDD subjects were more likely to be delayed in gesture compared to non-PDD subjects at 11.36 points. In >24-36 month age group, PDD subjects were also more likely to be delayed in gestures compared to non-PDD at about 16.57 points. There was significant difference between PDD and non-PDD in early gestures (P< 0.001; 95% CI -7.40 to -3.82), late gestures (P< 0.001; 95% CI -16.10 to -6.78), and total gestures (P< 0.001; CI 95% -22.65 to -10.5).

Discussion

This study consisted of 84 subjects who were divided into 2 groups by age; 12-24 month and >24-36 month groups. This was done to prevent a wide distribution of data, so the difference in language ability of PDD and non-PDD from 1 year old could be established. In this study, boys/girls sex ratio was higher than any other studies or in Neurology Division of Child Health Department of CMH. This difference was probably due to the limited number of subjects in this study compared to the number of patients in CMH.

Mean of age in PDD subjects was 27.6 (SD 7.4) month and 25.74 (SD 6.3) month in non-PDD. This result was similar to previous studies that reported onset of autistic disorder happens before 30 months old and majority of parents bring their children to the doctor with a complaint of developmental disorder at 24 months old.[9]

Microcephaly was lower in PDD but higher in non-PDD subjects compared to study by Tuchman et al[7], while macrocephaly was not present in this study. This difference was maybe due to difference in the population involved. Tuchman et al[7] performed the study in patients recorded for 10 years, while this study was performed and undergone within for 4 months only. There was no difference in gestational age, birth weight, and perinatal history between PDD and non-PDD, similar to the results reported by Tuchman et al[7]. This study showed that in PDD subjects, it was more likely to have a family history of autism than that of non-PDD whereas family history of delayed or deviant language was not different between the two. Ritvo et al as cited by Tuchman et al[7] concluded that overall chance that each sibling born after an autistic child will develop autism was 8.6% (7% if the first autistic child was male and 14.5% if was a female).

Subjects who respond to words "Name" and "No" in this present sample were fewer than study done by Charman et al[10] in both groups of age. On the other hand, number of subjects who respond to phrase "there's mummy/daddy" was similar to Charman et al[10]. If PDD and non-PDD children were compared, PDD subjects were more delayed than non-PDD subjects in both age group (P< 0.001). This could be one of the sign that in PDD subjects usually will not respond to voices calling their name, and will not search for their parents when informed "There's mummy/daddy".

Number of subjects who had ability of imitating words in this study was different than other studies. Charman et al[10] found that 30% of PDD children that younger than 2 years old were able to imitate word and 34% of PDD children aged 2-3 years old could imitate word. Compared with normal developing children, PDD and non-PDD children were likely to be more delayed in imitating words, approximately 50% of normal population start to imitate speech by the age of 10 months and 90% of those by the age of 16 months.[8]

In this study there was no PDD or non-PDD subjects aged 12-24 months that could labeled or named certain objects, while in the non-PDD subjects aged >24-36 months there was 17.8%. PDD and non-PDD subjects were delayed compared to normal children that could label or name objects by the age of 14 months (50%) and 75% by the age of 16 months.[8]

This study was also similar to the study performed by Charman et al[10] who reported mean number of phrase that could be understood by PDD children aged <2 years were 7.1 (SB 7.6) and 13.8 (SB 9.7) in children aged 2-3 years. This study showed significant difference in mean number of phrase comprehension between PDD and non-PDD subjects in both age groups (P= 0.01 and P< 0.001).

This study also showed significant difference in mean number of word comprehension between PDD and non-PDD subjects (each showed P< 0.001). Charman et al[10] found higher mean number of word comprehension in PDD in <2 year old children at

about 56.9 (SD 76.2) and also in PDD >2 year old children at 118.9 (SD 111.4). In addition, this study was also similar with Luyster et al[11] who found mean number of word comprehension in 2 year old PDD children as 85.18 (SB 75.15). The difference between the studies might be due to the difference of total sample, this study was 42, and Luyster was 49 and both were fewer than Charman (134). Impairment of word comprehension in PDD children is accordance with the literature that stated word comprehensions in PDD were almost always impaired so if the child could speak, language interpretation disorders were often found. [12-13]

Mean number of word comprehension in >2 year old non-PDD children in this study was higher than previous study by Luyster, at about 150.15 (SD 81.89). This difference is maybe due to the majority non-PDD subjects in this study were children with expressive disorder, while majority subjects in Luyster et al[11] study were children with global developmental delayed.

Mean of word production in this study could not be obtained because the data distribution was not normal so median was used instead. Word production was not found in 6 of 9 PDD subjects with autistic disorder and 5 of 14 non-PDD subjects with global developmental delayed. Some literatures mentioned that many PDD children are mute or could not speak.[12-13] This was a hint for parents that if a child could not speak one word by the age of 16 months, evaluation on the possibility of autistic disorder or other disorders should be performed. Difference in expressive language ability between PDD and non-PDD in the two age groups was done using the Mann-Whitney test because of the abnormality of the data distribution and showed insignificant result. This implies that verbal expressive language ability should not be used to differentiate communication ability between PDD and non-PDD children.

Mean gesture in this study was smaller than the result found by Charman et al[10] who found the mean value of 20.7 (SB 11.4) in PDD subjects aged <2 years and 29.9 (SB 14.7) in subjects aged 2-3 years. Compared to normal population, PDD children were delayed in gesture, while in non-PDD the delayed was not too obvious. Significant difference between PDD and non-PDD subjects were accordance with the literatures that stated in autistic disorder; gesture or symbolic language could not be shown to express emotion or behavioral in communication. Non-PDD subjects used gesture to replace verbal expressive language to express their feelings or needs. This study showed that nonverbal expressive language ability may be used to differentiate communication ability between PDD and non-PDD children.

Difficulty in filling the questionaire was the major limitation of this study. Patients attending the clinic were not always in their first visit for their delayed speech problem. This coud be a confounding factor for the parents in filling The MacArthur CDI-Infant Form. Parents may have known the possible diagnosis of their children when filling the questionaire of this study.

In conclusions, PDD children are more likely to be delayed in receptive language and nonverbal expressive language compared to non-PDD children. Verbal expressive language can not be used to differentiate PDD and non-PDD children.

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