

Validity of parents' evaluation of developmental status (PEDS) in detecting developmental disorders in 3-12 month old infants

I Wayan Gustawan¹, Soetjiningsih¹, Soeroyo Machfudz²

Abstract

Background Early detection of development disorder is an effort to recognize disorders in every developmental stage. Parents' concern can be helpful in identifying children in need of assessment and can be used as a prescreening test to reduce the number of children who require formal screening.

Objective To examine diagnostic value of parents' evaluation of developmental status (PEDS) instrument in order to determine developmental disorders in infant.

Methods One hundred and seventy infants, 3-12 months old who visited Pediatric Outpatient Clinic were recruited. The parents filled in the PEDS questionnaire and the results were compared with those of Bayley Scales of Infant Development Second Edition (BSID-II) as a gold standard. The diagnostic properties of PEDS were then calculated.

Results PEDS showed a sensitivity of 83.9% (95% CI 67.8 to 93.8), a specificity of 81.3% (95% CI 74.2 to 87.1), a positive predictive value of 50.0% (95% CI 40.6 to 59.4), a negative predictive value of 95.8% (95% CI 91.2 to 98.0), a likelihood ratio positive of 4.5 (95% CI 3.1 to 6.6), a likelihood ratio negative of 0.2 (95% CI 0.1 to 0.4), a pre-test probability of 18.2% and a post-test probability of 49.9% (95% CI 40.6 to 59.3).

Conclusion PEDS can be used as an initial screening test to detect developmental disorders in 3-12 month infants. [Paediatr Indones. 2010;50:6-10].

Keywords: parents' concern, developmental screening, PEDS

The development of a child occurs in a relatively regular and consecutive pattern and the previous step will influence the next one. Every disorder in any developmental stage will result in alteration of the quality of human resources in the future.¹ In the United States, 15 to 18% of children have developmental or behavioral disabilities.² Study in Bandung on under five children found 20 to 30% of children have developmental disorders.³ All infants and children should be screened for developmental delays, because developmental screening is a process that selects children who will receive more intensive evaluation or treatment. Pediatricians should consider using standardized developmental screening tools that are practical and easy to use in the office setting.⁴

Studies show that parents' concern are extremely helpful in identifying children in need of assessment. Parents' concern can be used as a prescreening

From the Department of Child Health, Medical School, Udayana University, Sanglah Hospital, Denpasar, Bali, Indonesia (IWG, S).¹

From the Department of Child Health, Medical School, Gadjah Mada University, Dr. Sardjito Hospital, Yogyakarta, Indonesia (SM).²

Reprint request to: I Wayan Gustawan, MD, Department of Child Health, Medical School, Udayana University, Sanglah Hospital, Jalan Nias, Denpasar, Bali, Indonesia. Tel/Fax: 0361-244038 or 0361-257387. E-mail: yanawantara@yahoo.com

test to reduce the number of children who require formal screening.⁵⁻⁷ Systematically eliciting parental concern about development is an important new method of identifying infants and young children with developmental problems. Parents' Evaluation of Developmental Status (PEDS) is one of screening tools that pediatrician can use in their office for early detection of developmental disabilities. The PEDS is useful in primary care because it is brief and makes use parents' concern or judgment about their child's development and behavioral status. PEDS has high sensitivity of 74 to 79% and specificity of 70 to 80%, that can be used in 0-8 years old.^{2,7,8} In the United States, PEDS has high sensitivity and specificity but it is not available in Indonesia. The aim of this study was to determine the validity of PEDS in detecting developmental disorders in 3 - 12 month old infants at Pediatrics Outpatient Clinic Sanglah Hospital, Denpasar.

Methods

We performed a diagnostic test to determine diagnostic value of PEDS instrument in evaluation

of developmental deviation, with Bayley Scales of Infant Development Second Edition (BSID-II) as a gold standard. PEDS and BSID-II were performed by independent examiners. This study was carried out at Pediatrics Outpatient Clinic in Sanglah Hospital, Denpasar from December 1st 2007 until November 30th 2008.

We included infants 3-12 months old of age born at term, attended Pediatrics Outpatient Clinic with her/his parents, first time visit, and the parents agreed to join this study. We excluded infants with severe infectious diseases, severe malnutrition, and those who had severe handicap. Subjects were recruited consecutively.

The sample size was estimated by formula for single proportion;⁹ the minimal sample size to estimate the sensitivity was 74. By considering the proportion of developmental disorders in Growth and Developmental Clinic of Sanglah Hospital (45%), the minimum were 170.

The PEDS instrument had been translated into Indonesian and tried out in some population, under Professor Glascoe permission. The reliability of the test was determined by accounting the test-retest

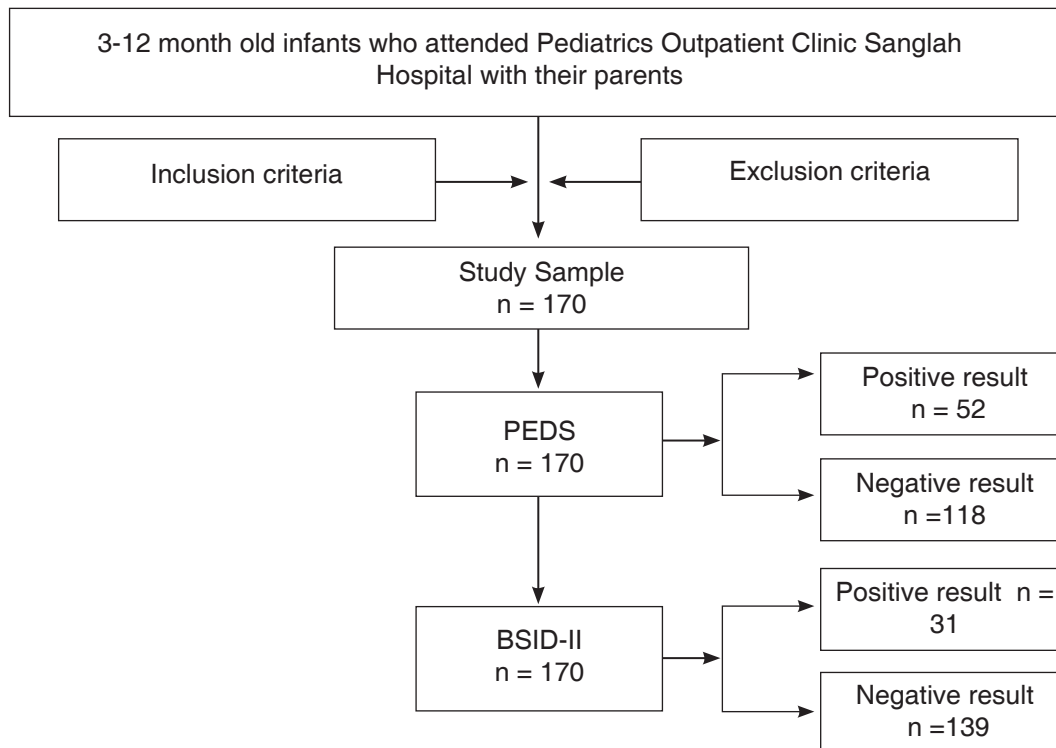


Figure1. Flowchart of study enrollment

reliability coefficient. By this method, the variables were evaluated two times. A PEDS instrument was filled in by 30 parents who were included in the study. The PEDS questionnaires were given to the

parents to be filled in independently; if necessary the parents could ask to one of the investigators. Having completed the questionnaires, the parents were asked to comeback 2 weeks later to fill in another questionnaires.

Infants of the corresponding parents were then brought to a special room to get BSID-II examination by one of the investigators who was not aware of the result of PEDS test. All data were collected and analyzed in several steps. Test-retest reliability coefficient was done to determine instrument reliability, then the diagnostic accuracy was calculated.

The study was approved by the Ethics Committee of the Research Center of Medical School Udayana University/Sanglah Hospital and informed consent was obtained from the parents.

Table 1. Characteristics of subjects

Characteristics	n (%)
Age of infant (month)	
3	8 (4.7)
4-5	30 (17.6)
6-11	112 (65.9)
12	20 (11.8)
Gender	
Male	107 (62.9)
Female	63 (37.1)
Number of children	
1	41 (24.1)
2	70 (41.2)
3	43 (25.3)
≥4	16 (9.4)
Nutritional status	
Moderate malnutrition	8 (4.7)
Mild Malnutrition	28 (16.5)
Normal	107 (62.9)
Overweight	27 (15.9)
Mother educational status	
No education	0 (0)
Elementary School	15 (8.8)
Junior High School	25 (14.7)
Senior High School	99 (58.2)
College	31 (18.2)
Mother occupation	
Civil officer	12 (7.1)
Private	49 (28.8)
Other	18 (10.6)
No occupation	91 (53.5)
Mother race	
Balinese	138 (81.2)
Non Balinese	32 (18.8)
Father educational status	
No education	1 (0.6)
Elementary School	7 (4.1)
Junior High School	26 (15.3)
Senior High School	95 (55.9)
College	41 (24.1)
Father occupation	
Civil officer	18 (10.6)
Private	120 (70.6)
Other	32 (18.8)
No occupation	0 (0)
Father race	
Balinese	135 (79.4)
Non Balinese	35 (20.6)
PEDS	
Abnormal	52 (30.6)
Normal	118 (69.4)
BSID II	
Abnormal	31 (18.2)
Normal	139 (81.8)

Results

Most subjects were in 6-11 month old of age group (65.9%), with male predominance. The results of the study were shown in **Figure 1**.

The reliability of PEDS instrument was achieved by accounting the test-retest reliability coefficient. The PEDS instrument was filled by 30 parents who met the inclusion and exclusion criteria, and agreed to come to the clinic twice within 2 weeks until 1 month interval. Since outcome variable was dichotomy variable, hence we used kappa value as the reliability coefficient. The kappa value of this study was 0.67.

The characteristics of subject are shown in **Table 1**. This study found developmental disorder in 18.2% of the infants. The results of PEDS instrument examination compared to BSID II examination were are in **Table 3**.

Table 3 shows that 31 of 170 subjects showed different result with BSID-II (26 false positive and 5

Table 3. The validity of PEDS instrument in evaluating infant developmental disorders

	Developmental Disorders		Total
	Positive	Negative	
PEDS	Positive	26	52
	Negative	5	118
	Total	31	170

false negative). PEDS instrument revealed sensitivity 83.9% (95% CI 67.8 to 93.8), specificity 81.3% (95% CI 74.2 to 87.1), positive predictive value 50.0% (95% CI 40.6 to 59.4), negative predictive value 95.8% (95% CI 91.2 to 98.0), positive likelihood ratio 4.5 (95% CI 3.1 to 6.6), negative likelihood ratio 0.2 (95% CI 0.1 to 0.4), pre-test probability or prevalence 18.2% with post-test probability 49.9% (95% CI 40.6 to 59.3).

Discussion

Several studies had previously been done to evaluate PEDS validity. Glascoe¹⁰ studied 157 of 6-77 months old children and found sensitivity 83% and specificity 72% of PEDS in detecting speech and language disorder. This study result was not different with that of our study. The only differences found were subject characteristics, the gold standard, and the developmental aspect to be tested. Glascoe studied PEDS for speech and language disorder. They used The Arizona Articulation Proficiency Test, the Test of Language Development, and the Sequenced Inventory of Communication Development as a gold standard.

Glascoe¹¹ also studied 408 of 21-48 month old children and found PEDS sensitivity was 79% and specificity 72%. This result was different with that of our study. The difference was in sample characteristics and gold standard. The gold standard that they used was Woodcock-Johnson Psychoeducational Battery, Slosson Intelligence Test, and Child Development Inventory (CDI).

Pritchard et al¹² studied 362 children born with birth weight \leq 1250 g, who survived at 2 and 4 years of age corrected for prematurity, revealed PEDS sensitivity was 69% (95% CI 62 to 81), specificity 72% (95% CI 62 to 81), positive predictive value 31% (95% CI 14 to 48) and negative predictive value 31% (95% CI 11 to 59). They used PEDS as the criteria of developmental abnormality. But the result of this study was different, that might be due to differences in subject's characteristics and the gold standard. Their study samples were children born with birth weight \leq 1250 g who survived at 2 and 4 years of age corrected for prematurity, and the gold standard was Griffith Mental Development Scales, BSID-II and

McCarthy Scales.

Good developmental screening tests were considered acceptable for developmental screening performed in children if they had sensitivity of more than 70% and specificity between 70% and 80%.^{2,4,13} Committee on Children With Disabilities, 2001 recommended that the best instruments have good psychometric properties, including adequate sensitivity, specificity, validity, and reliability, and have been standardized on diverse populations.⁴ This study revealed the sensitivity of PEDS instrument was 83.9% (95% CI 67.8 to 93.8), specificity 81.3% (95% CI 74.2 to 87.1). This was not different with that of other studies. This screening test can be accepted as first line screening test to detect developmental disorder in child.

Clinical applicability of a diagnostic test is determined by its accuracy in identifying the target. Good sensitivity and specificity do not always reflect the accuracy of diagnostic test. Likelihood ratio (LR) has higher correlation to express the result of the test. Likelihood ratio = 1 means the diagnostic test is not informative; hence it can not be used. Likelihood ratio > 10 or < 0.1 shows conclusive changes of pre-test probability to post-test probability. Likelihood ratio 5-10 shows moderate changes, while LR 2-5 shows mild changes.¹⁴ This study revealed LR was 4.5 (95% CI 3.1 to 6.6) which means it is only mild changes from pre-test probability to post-test probability. This fact might be because of the sample size we used too small, in which we determined it based on the prevalence of developmental disorder from clinical based not population based. But, although the LR was too small, we still can use this diagnostic test as prescreening test.

Several studies revealed the sensitivity was approximately 69-83%.¹⁰⁻¹² It means that 17-31% of developmental disorder was not detected. In our study, we revealed the sensitivity of PEDS was 83.9%, means that 16.1% of developmental disorder cases were not detected due to false negative result. The specificity was 81.3% indicating 18.7% of developmental disorder cases were misdiagnosed due to false positive result. Factors that were considered to influence this results are the limitations of parents' concern due to over-worries result in over-diagnosis, the parents likely detect severe disorder more accurately, the educational state and knowledge of the parents varied

result in failure in detecting developmental disorders. Sometimes the parents denied and refused to inform the physician to hide their anxiety. The information can be inaccurate if the child was supervised by their grandparents or their nannies, while their parents did not know precisely their child development. Further examination is needed for definitive diagnosis.

The main limitation of this study was that we used only 3-12 months old infants so that the developmental milestones observed by the parents were limited.

Acknowledgments

We thank Professor Frances Page Glascoe for her permission to translate and use the PEDS instrument in this study.

References

1. Soetjningsih. Tumbuh kembang anak. Jakarta: EGC; 1995.
2. Glascoe FP. Early detection of developmental and behavioral problems. *Pediatr Rev.* 2000;21:272-80.
3. Alisjahbana EM. Asuhan dini tumbuh kembang anak. In: Siswanto MT, editor. Simposium penatalaksanaan mutakhir bidang ilmu kesehatan anak untuk mencapai tumbuh kembang optimal; 2000 Jul 21-22; Bandung: Indonesian Pediatric Society, West Java branch; 2000.
4. Committee on Children with Disabilities. Developmental surveillance and screening of infant and young children. *Pediatrics.* 2001;108:192-5.
5. Glascoe FP. Developmental screening. In: Parker S, Zuckerman B, editors. Behavioral and developmental pediatrics a handbook for primary care. 2nd ed. Boston: Little, Brown and Company, 1995; p. 25-9.
6. Glascoe FP. The value of parents' concerns to detect and address developmental and behavioral problems. *J Paediatr Child Health.* 1999;35:1-8.
7. Glascoe FP. Evidence-based approach to developmental and behavioral surveillance using parents' concerns. *Child Care Health Dev.* 2000;26:137-49.
8. Glascoe FP. Using parents' concerns to detect and address developmental and behavioral problems. *J Soc Pediatr Nurs.* 1999; 4:24-35.
9. Lemeshow S, Hosmer Jr DW, Klar J, Lwanga SK. Adequacy of sample size in health studies. Massachusetts: John Wiley & Sons; 1990.
10. Glascoe FP. Can clinical judgment detect children with speech language problems? *Pediatrics.* 1991;87:317-22.
11. Glascoe FP. Parents' concerns about children's development: prescreening or screening test? *Pediatrics.* 1997;99:522-8.
12. Pritchard MA, Colditz PB, Beller EM. Parents' evaluation of developmental status in children born with a birth weight of 1250 g or less. *J Paediatr Child Health.* 2005;41:191-6.
13. Sonnander K. Early identification of children with developmental disabilities. *Acta Paediatr Suppl.* 2000;434:17-23.
14. Sackett DL, Straus SE, Richardson WS, Rosenberg W, Haynes RB. Evidence-based medicine how to practice and teach EBM. 2nd ed. Edinburgh: Churchill Livingstone, 2000; p. 67-93.