

# The Feasibility of the Ages & Stages Questionnaires, Third Edition (ASQ-3, Thai Version) for the Assessment of Child Development in Thailand

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**Objective:** To conduct a feasibility and psychometric properties study by assessing the validity, sensitivity, specificity, and length of time answering the Ages & Stages Questionnaire, Third Edition (ASQ-3, Thai version) to pinpoint developmental progress in children aged 12, 30, and 36 months and compare it with the standardized Bayley-III.

**Materials and Methods:** Three hundred participants, who were the parents of children aged 12, 30, and 36 months old, and the children engaged in the present research. They were divided into two groups, 1) participants who received the questionnaires beforehand and completed them at the Queen Sirikit National Institute of Child Health (QSNICH), 2) participants who received and completed the questionnaires at the QSNICH on the same day. While the parents were filling out the ASQ-3, Thai version, child development progress was assessed using the Bayley-III. The length of time was recorded and compared between the two groups.

**Results:** The present study showed that the ASQ-3, Thai version had a sensitivity of 78.6%, 96.7%, and 83.3% among children at 12, 30 and 36 months old, respectively. The specificity was at 90.3%, 95.7%, and 98.7% among 12, 30 and 36-month-old children, respectively. The validity for 30-month-old children was very high and had almost perfect kappa agreement of 0.81 to 1, while the validity among children at 12 and 36-month-old was substantial (kappa agreement of 0.67 to 0.86).

**Conclusion:** The feasibility and accuracy of ASQ-3, Thai version is an applicable suitable developmental screening tool for children at 12, 30 and 36 months old in time limited circumstances and with insufficient health personnel. The validity of the ASQ-3, Thai version is acceptable when comparing to the standardized Bayley-III. The questionnaire is faster to complete than the child development progress assessment using the Bayley-III.

**Keywords:** ASQ-3 (Thai version), Psychometric properties, Developmental screening, Feasibility

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Early childhood development is the foundation for respectable adults of the future. Global developmental delay (GDD) and intellectual disability (ID) affect up to three percent of the pediatric population<sup>(1)</sup>. Parents and involved parties need to

understand the child's developmental milestones<sup>(2)</sup> to monitor the child's progression and provide early developmental stimulation. This helps manage the development of appropriate behaviors. To achieve these, developmental screening tools are effective, valid, and standardized procedures that can detect developmental problems in children suspected to have delayed development with parental concern<sup>(2-4)</sup>. Currently, there are no universal developmental screening tools that can be used for all demographic groups. A good developmental screening tool<sup>(2,5-7)</sup> is considered to have high reliability and validity with sensitivity and specificity of 70% to 80%<sup>(2)</sup> and measures across five key developmental areas. In addition, the adopted developmental screening tools should be adjusted and well-validated to the contexts, cultures, and settings in that country, based on the standardized qualifications, which are easy to

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understand, easy to use, cost effective, and accurate. The Bayley-III is a gold standard developmental assessment that is widely used in many countries to identify and diagnose children with delayed development that are aged between 1 and 42 months. However, the limitations of the Bayley-III are the high details and the time-consuming issues. Ages & Stages Questionnaires, Third Edition (ASQ-3) is widely used in the United States and has been translated in more than 16 languages in 23 low- and middle-income countries (LMIC) and adjusted to the context of culture of each region in those countries to make the developmental screening system available nationwide<sup>(6,7)</sup>. In addition, the ASQ-3 is a parent-friendly instrument for screening and monitoring the development and behavior of young children, educate parents about developmental milestones, and engage them more in the screening process. It is also suitable for clinical purposes, especially in the high-volume outpatient department. In 1986, the ASQ-3 (Thai version)<sup>(8)</sup> had been translated by Dr. Prasong Saihong and implemented among children aged 24, 30, and 36 months in the Northeastern region of Thailand. It demonstrated high reliability. The previous clinical studies<sup>(9-12)</sup> showed moderate to substantial agreement between ASQ-3 Thai version and the Denver Developmental Screening Test II (DDST-II). The comparison of the ASQ-3 Thai with the Bayley-III showed good validity, sensitivity, and specificity. However, the study should include more age ranges. The aim of the present study was to conduct a feasibility and psychometric properties study by assessing the validity, sensitivity, specificity of the ASQ-3.

## Materials and Methods

Two types of developmental diagnostic and screening tests were used in the present research, the ASQ-3 Thai version and the Bayley-III. The ASQ-3 Thai is composed of 21 age-specific questionnaires covering five developmental domains, communication, gross motor, fine motor, problem solving, and personal-social skills. There were six questions in each domain. Parents chose the answers among the three choices, “yes”, “sometimes”, or “not yet”, with the total score of 60, using the same intersection point as in the ASQ English version for the age ranges of 12, 30, and 36 months. If the score was lower than the intersection point at 50 percentiles (2 standard deviation or 2SD), the result was considered in acceptable range. If the score was lower than the standard, the researchers discussed

with the parents regarding how to improve the development of their child, identify the causes, and provide appropriate treatment. Bayley-III is the gold standard developmental diagnostic test for children aged 0 to 42 months, measuring five developmental areas, cognitive, language (summative evaluation of receptive and expressive communication subtests), motor (summative evaluation of gross and fine motor subtests), social-emotional, and adaptive behavior. The Bayley-III has more test items, requires more time, and must be administered by a trained examiner.

## Study participants

Three hundred parents and children who visited the Well Child Clinic and Child Development Center at Queen Sirikit National Institute of Child Health (QSNICH) between January 1 and December 31, 2016 were enrolled. All of them were divided into three groups according to age ranges based on ASQ-3 User's Guide, Group 1) 12 months (11 months through 12 months 30 days), Group 2) 30 months (28 months 16 days through 31 months 15 days), and Group 3) 36 months (34 months 16 days through 38 months 30 days). The informed consents were obtained from the parents. The present study was approved by the Office for Ethics in Human Research, QSNICH (EC.226/2557).

## Procedure

1) All 300 parents completed the demographic data such as age, gender, education, occupation, income, and hometown.

2) After the instruction on ASQ-3 Thai were given to parents, they were divided into two groups (150 persons each) and Group 1 received and looked through ASQ-3 Thai before taking the test, while Group 2 completed the questionnaire right after it was distributed. The results were compared to age norms and classified as “yes” (your child does this activity or has done it: 10 marks), “sometimes” (your child begins to do this activity but not regularly: 5 marks) or “no” (your child has not yet started doing this: 0 mark). The results were compared to the standardized cut off score: either “normal”, “borderline” or “delayed”.

3) All children development were assessed using the Bayley-III. The researcher team consisted of a Developmental Behavioral Pediatrician and nurses who have been trained in tool use. The process of developmental assessment strictly adhered to the manual and result interpretation can only be done by researcher.

**Table 1.** Demographic data of study participants

Demographic data	12 months (n=100) n (%)	30 months (n=100) n (%)	36 months (n=100) n (%)
<b>Sex</b>			
Male	53 (53)	49 (49)	37 (37)
Female	47 (47)	51 (51)	63 (63)
<b>Monthly income</b>			
Less than 30,000 baht	23 (23)	30 (30)	32 (32)
Father's age (years); mean±SD	28.02±5.81	26.95±3.75	27.56±4.70
<b>Father's education</b>			
Primary school	3 (3)	9 (9)	4 (4)
Secondary school	11 (11)	15 (15)	18 (18)
Vocational certificate	28 (28)	24 (24)	22 (22)
Bachelor's degree or higher	58 (58)	52 (52)	56 (56)
<b>Father's employment</b>			
Governmental/state enterprise	34 (34)	30 (30)	16 (16)
Non-government officer	25 (25)	27 (27)	28 (28)
Employee	31 (31)	22 (22)	29 (29)
Other	10 (10)	21 (21)	27 (27)
Mother's age (years); mean±SD	25.13±4.62	24.94±3.85	25.27±4.54
<b>Mother's education</b>			
Primary school	12 (12)	10 (10)	3 (3)
Secondary school	15 (15)	32 (32)	20 (20)
Vocational certificate	27 (27)	16 (16)	24 (24)
Bachelor's degree or higher	46 (46)	42 (42)	53 (53)
<b>Mother's employment</b>			
Governmental/state enterprise	22 (22)	22 (22)	10 (10)
Non-government officer	25 (25)	25 (25)	25 (25)
Employee	29 (29)	24 (24)	33 (33)
Other	24 (24)	29 (29)	32 (32)

SD=standard deviation

4) The length of time completing both types of assessments were recorded and compared.

### Statistical analysis

The descriptive statistics including percentage, mean and standard deviation were used for analyzing data. Kappa statistic was used to determine the agreement between the ASQ-3 Thai and the Bayley-III. Crosstabs analysis was used to identify sensitivity, specificity, positive predictive value (PPV) and the negative predictive value (NPV) thus, to determine the concurrent validity of the ASQ-3 (Thai version) with the Bayley-III.

Available sampling was used. Obtained data was analyzed by IBM SPSS Statistics software, version

26.0 (IBM Corp., Armonk, NY, USA).

### Results

The parents of children among the three age ranges were divided into three groups and completed the ASQ-3 Thai developmental screening test, as shown on Table 1. Demographic data showed that among 100 parents of children aged 12 months, 53 parents were male (53%) and 47 parents were female (47%). The average ages of the mother and father were 25.13 years ±4.62 and 28.20 years ±5.81, respectively. The data showed that 46% of mothers and 58% of father completed bachelor's degree. Out of the 100 parents of children aged 30 months, 49 parents were male and 51 parents were female. Average ages of

**Table 2.** Sensitivity, specificity, and agreement of ASQ-3 Thai version comparing with Bayley-III

Validity and agreement	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Kappa
12 months old	78.6	90.3	89	80.8	0.677
30 months old	96.7	95.7	95.7	96.6	0.864
36 months old	83.3	98.7	98.5	85.5	0.785

PPV=positive predictive value; NPV=negative predictive value

the mother and father were 24.94 ±3.85 and 26.95 years ±3.75, respectively. The education background of both mother and father were above undergraduate level at 42% and 52%, respectively. Seventy percent of the parents of children in this group received more than 30,000 baht of monthly income and most live in urban areas. Out of the 100 parents of children aged 36-months, 37 parents were male and 63 parents were female. The average age of the mother and father were 25.27 years ±4.54 and 27.56 years ±4.70, respectively. The education of mothers and fathers in this group were higher than bachelor's degree at 53% and 56% with 68% of the family having monthly income above 30,000 baht and living in urban areas.

The ASQ-3 Thai and the Bayley-III had similar predictive values as shown in Table 2. The sensitivity of the ASQ-3 Thai among children aged 12, 30, and 36 months were 78.6%, 96.7%, and 83.3%, respectively, meaning that developmental delay was suspected, and the Bayley-III confirmed the developmental delay. The ASQ-3 Thai allocated the specificity of 90.3%, 95.7% and 98.7%, respectively, meaning that children among these age groups were not suspected to have developmental delay as the result of the ASQ-3 Thai were normal and the Bayley-III confirmed that they were normal. From these data, it supported that the ASQ-3 Thai had good sensitivity and specificity for developmental screening in Thai children. The PPV from ASQ-3 Thai were at 89%, 95.7%, and 98.5%, respectively, representing children with positive test for developmental delay, and the Bayley-III supported this result. Lastly, the ASQ-3 Thai showed the NPV of 80.8%, 96.6%, and 85.5%, respectively, representing that children with normal result had normal development, which was compatible with the Bayley-III result. An overall agreement, using the kappa agreement of 0.677, 0.864, and 0.785, respectively, was found between the ASQ-3 and the Bayley-III. These results showed high or almost perfect validity of 0.81 to 1 among children at 30 months, and substantial validity of 0.61 to 0.80 among children aged 12 months and 36 months.

The concurrent validity of ASQ-3 Thai and

Bayley-III divided child development aged 12, 30, and 36 months into four domains. The personal social development of children at 30 months had high or almost perfect validity of 0.81 to 1, while other development had substantial validity kappa of 0.61 to 0.80 as shown in Table 3.

From Table 4, the testing time for ASQ-3 Thai were less than the Bayley-III. The differences were statistically significant and especially apparent when assessing children in the 30 and 36-month age groups.

Table 5 showed factors associated with amount of time answering the questionnaire, education, hometown, and a chance to read the ASQ-3 Thai before answering. Parents with higher levels of education, living in urban area, or allowed to review the questionnaire spent less time to finish the questionnaire with statistical significance. Therefore, additional explanation and time were necessary for parents with lower education or living in other provinces to help them understand more about the questions and each domain in child development. The questionnaire could be sent to them in advance, so that they could read and understand it first as shown in Table 5.

## Discussion

The ASQ-3 Thai is a developmental screening test while the Bayley-III is a standardized developmental assessment tool for children between 0 and 42 months old. The present research was conducted to compare the ASQ-3 Thai with the Bayley-III and to determine the feasibility of using the ASQ-3 Thai as a developmental screening tool. The present study indicated that using ASQ-3 Thai as the screening tool for children with suspected developmental delayed at the aged 12, 30, and 36 months had relatively high sensitivity (91.3%, 85.2%, and 90.6%, respectively) and high specificity as well (90.9%, 90.4%, and 93.2%) when comparing to the standardized Bayley-III. An average value for the three age groups were 82% to 95%, which met the standard sensitivity and specificity of 70% to 80%<sup>(6,10)</sup>. The validity among children at 30-month-old is 0.81 to 1 (very high or

**Table 3.** Sensitivity, specificity, and agreement in equivalent domains of ASQ-3 (Thai version) and Bayley-III

Equivalent domains/age groups	Sensitivity (%)	Specificity (%)	Kappa
1. Communication			
12 months old	75	88	0.64
30 months old	80	88	0.70
36 months old	78	87	0.62
2. Gross motor			
12 months old	75	78	0.62
30 months old	82	91	0.69
36 months old	73	86	0.61
3. Fine motor and problem-solving skills			
12 months old	78	81	0.61
30 months old	89	91	0.79
36 months old	82.3	89	0.75
4. Personal-social skills			
12 months old	72	88	0.65
30 months old	74	93	0.82
36 months old	76	90	0.73

**Table 4.** Administration time for developmental screening using ASQ-3: Thai version and the Bayley-III

Administration time	ASQ-3: Thai (minutes) Mean±SD	Bayley-III (minutes) Mean±SD	p-value
12 months old	12.66±5.78	22.95±10.38	0.221
30 months old	13.06±5.38	28.99±9.60	0.038*
36 months old	11.29±3.92	31.61±9.44	0.042*

ASQ-3=Ages & Stages Questionnaire, Third Edition; SD=standard deviation

\* Significant difference (p<0.05)

**Table 5.** Factors affecting administration time to complete the questionnaires

Factors	Less than 10 minutes n (%)	More than 10 minutes n (%)	p-value
Education: Secondary or higher	109 (18)	459 (76)	0.032*
Income: >30,000 baht	138 (23)	462 (77)	0.508
Hometown: Non-urban	122 (20)	498 (80)	0.042*
ASQ-3 (Thai version) provided before answering	105 (17)	495 (83)	0.031*

ASQ-3=Ages & Stages Questionnaire, Third Edition

\* Significant difference (p<0.05)

almost perfect) and validity among children at 12 and 36 months old are 0.61 to 0.80 (substantial). Kappa statistical analysis yields the validity of 0.677, 0.864, and 0.785, respectively. This study confirmed that a developmental screening test is recommended, and a systematic support should be provided to children who lack of age-appropriate development. The present

research also examined the differences between the length of time to complete both screening tools as illustrated in Table 4. The present study showed the average time to complete ASQ-3 Thai for the three target groups were 12.66, 13.06 and 11.29 minutes, respectively. On the other hand, the average testing times of the Bayley-III were 32.95, 28.99, and 31.61

minutes, respectively. The time differences were 20.29, 15.93, and 20.32 minutes, respectively. The administration time for the ASQ-3 Thai is less than the Bayley-III. The ASQ-3 Thai screening test is consisting of 30 questions in each age group. Some questions raise awareness to inform parents on their child development, such as fine motor skills in children at 30 months: Does your child hold a pencil, crayon, or pen between fingers and thumb like adults? If the parents are not sure, they will take more time to observe their children. The amount of time to complete the ASQ-3 Thai increases in older children due to their more complex development. In this study, the first group of parents could look through all the questions in the test, reviewed them and observed their children in advance, thus spending less time than the parents who did not receive the questionnaire beforehand. Factors associated with the length of time are education and hometown. Parents with higher education than high school take shorter time to complete the questionnaire with statistical significance. Parents live in Bangkok metropolitan area take less time than those from other provinces with statistical significance. Therefore, explanation and time should be provided to parents whose education is below high school and live in the provinces to help them understand more about the developmental domains and the questions in the assessment. The present study complies with the previous studies in Thailand<sup>(10,11)</sup>. The study<sup>(6,12-14)</sup> of feasibility of time spent on the questionnaire is approximately 20 to 30 minutes in North India and rural areas in Canada, Africa. ASQ in South Africa was translated into Hindi and 15 parents were asked to complete the questionnaire. Of those, 11 parents finished within 20 to 40 minutes, while other three parents took longer than 40 minutes. The present study shows that the administration time for ASQ-3 Thai is only 10 to 15 minutes because the test has been translated according to translation guideline, 1) forward and backward translation by experts, 2) cultural validation to map the concepts of the Thai culture, 3) expert committee review, and 4) community based preliminary pilot testing. The community found that the accuracy and precision were good and the feedback from respondents said that it is an appropriate developmental screening in the community, and that they gained knowledge from the questionnaire. To make the developmental screening more effective, it should be integrated with the community, education system, and public health<sup>(9,14,15)</sup>. When comparing the PPV and the NPV

of the ASQ-3 Thai with the Bayley-III, the values are at 85% to 98% and 80% to 96%, respectively. The PPV and NPV are relatively high due to the severity of developmental problems of children treated at the Child Development Center, QSNICH. However, 10% to 15% prevalence<sup>(1,9)</sup> of Thai children who are suspected of developmental delay are based on biological reasons, so the values of the population cannot be reflected. The data were collected from children at the Child Development Center and the Well Child Clinic at QSNICH, so the tendency for prevalence was higher. The previous studies in Thailand on the ASQ-3 Thai screening test aimed to identify the agreement with the developmental assessment tools only. The results<sup>(10,11)</sup> from comparing the agreement with the Denver II developmental screening test is acceptable and should be used alongside other developmental screening tools. A study by Srinithiwat and Ularntinon<sup>(10)</sup> was conducted with the same objective, which was to identify the concurrent validity of the ASQ-3 Thai and the Denver II developmental screening test. The agreement between the two screening tools was fair to moderate. Both studies were pilot studies on clinical demographic groups. The validity, the sensitivity, and the specificity in the present study were low because of the smaller population size. A study of the validity of ASQ-3 comparing to the Denver II by Shahshahani et al<sup>(15)</sup> shows that both developmental screening tools have a weak consistent coefficient agreement of 0.21. In addition, a comparative study by Ga et al<sup>(16)</sup> on the ASQ Korean version and the Denver II developmental screening test also aimed to determine the concurrent validity. The study was conducted on 226 children aged 4 to 60 months old. The sensitivity was at 76.3% to 90.2%, the specificity was at 62.5% to 76.5%, and the agreement relationship had fair to good strength ( $k=0.442$ ,  $p<0.05$ ). The sensitivity, specificity, and validity were lower in the present research as well because of the size of target population. The studies<sup>(15,16)</sup> were conducted in a primary care setting and included wider age ranges of 0 to 6 years old. In contrast, QSNICH is a tertiary health institute, the demographic group is more prone to delayed development. The present study was also done specifically among children aged 12, 30, and 36 months old, which may result in different sensitivity, specificity, PPV, NPV, and validity. Furthermore, the present study showed that the validity of the ASQ-3 Thai with the Bayley-III among children at the age of 30 months was 0.81 to 1 (very high or almost perfect), and the validity among children aged 12

and 36 months old was 0.61 to 0.80 (substantial). In comparison with the previous studies in Thailand, the agreement rates were moderate due to the differences between each screening tools. Other international studies that aimed to determine the validity of the ASQ-3 with the Bayley-III selected a group of 306 children at the age of 8, 18, and 30 months who were at risk of delayed development, the agreement of the validity was modest (Kappa agreement 0.69 to 0.91)<sup>(2,18)</sup>. The sensitivity was at 75% and the specificity at 81%. These figures proved that this screening tool can be used to monitor and screen normal children and children at risk of developmental problems effectively and close to the figures in the present study.

### Suggestions

- 1) The clinical demographic group in the present study is only children at the QSNICH only. The target group could be broader by including primary and secondary hospital setting for more generalization.
- 2) Parent satisfaction survey for the ASQ-3 Thai should be taken in addition to the validity of the tool and the convenience of staff.
- 3) Time should be recorded once parents receive the questionnaire, review, and complete the survey.

### Further application

The ASQ-3 developmental questionnaire can be a substitute for the Bayley-III developmental assessment for its convenience and time efficiency when evaluating child development under limited personnel. The ASQ-3 also educates parents and encourages them to participate in monitoring and providing support to improve child development. Factors that associate with the length of time to complete the developmental questionnaire have been identified. This will help the staff to be more aware and provide tips before the parents start answering the questions. Various methods to fill in the questionnaire have been introduced such as interview, mail, email, or application. In some countries, the ASQ-3 system of developmental screening is highly flexible and can be provided in many channels such as post, online, telephone interview, home visit, or on-site visit.

### Conclusion

The ASQ-3 Thai developmental screening tool is feasible for clinical developmental screening of children at 12, 30, and 36 months old under limited time and personnel. The validity of the ASQ-3 Thai is acceptable when comparing to the standardized Bayley-III developmental assessment. The validity

of the ASQ-3 Thai for 30-month children is very high and has almost perfect kappa agreement, and the validity among children at 12 and 36 months old is substantial.

### What is already known on this topic?

The past studies on the ASQ-3 Thai screening test aimed to determine the agreement with the Denver II developmental screening test alone, which did not prove validity. However, the results<sup>(12-16)</sup> show that the agreement with the Denver II is at an acceptable level. The time duration to complete both types of assessments were also recorded and compared.

### What this study adds?

This research was conducted to determine the validity of the ASQ-3 Thai developmental screening tool in comparison with the Bayley-III, a standardized developmental assessment for children from 0 to 42 months old. The length of time needed to complete both types of assessments were recorded and compared. This research shows factors associated with less time spending on the questionnaire. The ASQ-3 can be substituted for the use of the Bayley-III for more convenience and time efficiency when evaluating child development with limited amount of time and personnel.

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### Conflicts of interest

The authors declare no conflict of interest.

### References

1. American Psychiatric Association. Intellectual disabilities. In: Diagnostic and statistical manual of mental disorders. 5th ed. Washington, DC: American Psychiatric Association; 2013. p. 1-2.
2. Council on Children with Disabilities; Section on Developmental Behavioral Pediatrics; Bright Futures Steering Committee; Medical Home Initiatives for Children with Special Needs Project Advisory Committee. Identifying infants and young children with developmental disorders in the medical home: an algorithm for developmental surveillance and screening. *Pediatrics* 2006;118:405-20.

3. Thomas SA, Cotton W, Pan X, Ratliff-Schaub K. Comparison of systematic developmental surveillance with standardized developmental screening in primary care. *Clin Pediatr (Phila)* 2012;51:154-9.
4. Wilks T, Gerber RJ, Erdie-Lalena C. Developmental milestones: cognitive development. *Pediatr Rev* 2010;31:364-7.
5. Small JW, Hix-Small H, Vargas-Baron E, Marks KP. Comparative use of the ages and stages questionnaires in low- and middle-income countries. *Dev Med Child Neurol* 2019;61:431-43.
6. McCoy DC, Peet ED, Ezzati M, Danaei G, Black MM, Sudfeld CR, et al. Early childhood developmental status in low- and middle-income countries: National, regional, and global prevalence estimates using predictive modeling. *PLoS Med* 2016;13:e1002034.
7. Squires J, Twombly E, Bricker D, Potter L. *The ASQ-3 User's guide for ages and stages questionnaires*. 3rd ed. Baltimore, MD: Paul H. Brookes Publishing; 2009.
8. Saihong P. Evaluating reliability and use of the ages and stages questionnaires: Thai in Northeast Thai early child care settings [dissertation]. Eugene, OR: University of Oregon; 2009.
9. Pichairakporn S, Ularntinon S. Concurrent validity of the ages & stages questionnaires, third edition, Thai version (ASQ-3 Thai) with the Denver Developmental Screening Test II (DDST-II) in developmental screening of 36, 48, and 60 months old. *Thai J Pediatr* 2013;52:336-47.
10. Srinithiwat B, Ularntinon S. Concurrent validity of the Ages & Stages Questionnaires, Third Edition, Thai-version (ASQ-3 Thai) with the Denver Developmental Screening Test II (DDST-II) in developmental screening of 18, 24, and 30 months old children at Queen Sirikit National Institute of Child Health. *J Med Assoc Thai* 2014;97 Suppl 6:S6-13.
11. Fuengfoo A. Concurrent validity of the ages & stages questionnaires, third edition, Thai version (ASQ-3 Thai) with the Bayley-III in developmental screening of 9, 18 and 24 months. *Thai J Pediatr* 2018;56:114-25.
12. Kvestad I, Taneja S, Kumar T, Bhandari N, Strand TA, Hysing M. The assessment of developmental status using the Ages and Stages questionnaire-3 in nutritional research in north Indian young children. *Nutr J* 2013;12:50.
13. Visser M, Nel M, Bronkhorst C, Brown L, Ezendam Z, Mackenzie K, et al. Childhood disability population-based surveillance: Assessment of the Ages and Stages Questionnaire Third Edition and Washington Group on Disability Statistics/UNICEF module on child functioning in a rural setting in South Africa. *Afr J Disabil* 2016;5:265.
14. Elbers J, Macnab A, McLeod E, Gagnon F. The Ages and Stages Questionnaires: feasibility of use as a screening tool for children in Canada. *Can J Rural Med* 2008;13:9-14.
15. Shahshahani S, Vameghi R, Azari N, Sajedi F, Kazemnejad A. Validity and reliability determination of Denver developmental screening test-II in 0-6 year-olds in Tehran. *Iran J Pediatr* 2010;20:313-22.
16. Ga HY, Kwon JY. A comparison of the korean-ages and stages questionnaires and denver developmental delay screening test. *Ann Rehabil Med* 2011;35:369-74.
17. Squires J, Nickel RE, Eisert D. Early detection of developmental problems: strategies for monitoring young children in the practice setting. *J Dev Behav Pediatr* 1996;17:420-7.
18. Jaeschke R, Guyatt GH, Sackett DL. *Users' guides to the medical literature*. III. How to use an article about a diagnostic test. B. What are the results and will they help me in caring for my patients? The Evidence-Based Medicine Working Group. *JAMA* 1994;271:703-7.