



Validity and internal consistency of the Ages and Stages Questionnaire 60-month version and the effect of three scoring methods[☆]

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ABSTRACT

Background: The Ages and Stages Questionnaire (ASQ) is currently the most used parent-completed developmental screener consisting of different age-specific questionnaires. Psychometric evaluation of the ASQ 60-month version (ASQ-60) is limited. Furthermore, it is unclear which of the available scoring methods of the ASQ is most useful in the identification of children with potential developmental problems.

Aim: To evaluate the internal consistency and construct validity of the ASQ-60 with a large sample size, and to assess the effects of three scoring-methods on this validity.

Study design: Parents of 394 term-born and 1063 preterm-born children from the prospective cohort-study Lollipop completed the ASQ-60 and a general questionnaire on school-problems.

Outcome measures: Internal consistency and construct validity of the ASQ-60 were determined using the ASQ total score. Construct validity was also determined using two other types of scoring-methods based on low domain-scores ('ASQ domain score') and parental concerns ('ASQ total score with parental concerns').

Results: Cronbach's alpha for total score was 0.86, confirming internal consistency. Male gender, prematurity, low paternal education, low family income and small-for-gestational-age were associated with low 'ASQ total scores,' confirming construct validity. Regarding construct validity with special education as criterion, sensitivity was best using the 'ASQ domain score' or the 'ASQ total score' with parental concerns (both 0.96). However, the specificity was best (0.93) using the ASQ total score.

Conclusion: The ASQ-60 has a good internal consistency and validity to screen for developmental problems in the general population. The 'ASQ total score' has the best performance, the 'ASQ domain score' is recommended in case of preferred high sensitivity.

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1. Introduction

Approximately 5–15% of all children in the general population show developmental problems [1,2], but at present only 30% are recognized as such before school entry [3]. The identification of developmental problems at early school age and subsequent treatment may prevent larger problems and ameliorate the children's chances at school [3–6]. However, screening all children with an extensive test battery is impossible because these tests are expensive and time consuming. Therefore,

simple and short but yet valid screening instruments could be helpful to detect children at risk for developmental problems.

The parent-completed Ages and Stages Questionnaire is used in this context [7]. The ASQ is the most commonly used parent-completed developmental screener worldwide [8,9]. The ASQ is inexpensive to use, easy to understand, and fast to complete (approximately ten to fifteen minutes) [6,7]. Nineteen age-adequate ASQ versions are available from the age of 4 to 60 months. Each ASQ version consists of five domains: communication, gross motor, fine motor, problem solving, and personal-social. Each domain is assessed using six questions about reaching milestones. The response format is 'yes,' 'sometimes,' or 'not yet,' by which respectively ten, five, or zero points are accredited. In this way, scores for each domain and an overall score can be calculated [7]; these scores are the basis for the various scoring methods. At the end of the questionnaire, parents can indicate yes or no—if they have concerns about development and the current skills of the child compared with other children. When they have concerns, the parents can describe these concerns in an additional open-ended question.

The psychometric properties of most age forms of the ASQ are confirmed in a wide range of studies, but strong evidence for the 60-

Abbreviations: ASQ, Ages and Stages Questionnaire; ASQ-60, ASQ 60-month version; CI, Confidence intervals; Early preterms, Early preterm births (born at less than 32 weeks gestational age); NICUs, neonatal intensive care units; Preterms, Preterm births (less than 36 weeks gestational age); SD, Standard deviation.

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month version (ASQ-60) is lacking [7,10–13]. Previous ASQ-60 studies in the US (original version), Korea and Norway had relatively small samples, especially concerning the sample sizes regarding the validity [7,10–13]. Evidence is thus too weak to support use of the ASQ-60 in routine well-child care.

A more general gap in evidence concerns the most useful scoring method when interpreting ASQ outcomes. Three ASQ scoring methods have been used in clinical practice; the 'ASQ total score,' the 'ASQ domain score,' and the 'ASQ total score with parental concerns' [1,7,9,14]. The 'ASQ total score' is defined as low score if the total score deviates [1,11,14], the 'ASQ domain score' is low if at least one domain score deviates, and the 'ASQ total score with parental concerns' is defined as low score if the 'ASQ total score' is low or parents report general concerns or an abnormal development compared to peers [1,7,9,14]. The manual of the ASQ mostly discusses the use of scores per domain ('ASQ domain score') [7,9], but several authors have combined domains to compute an 'ASQ total score' [1,14]. Such a total score has the advantage that it provides a measure of the overall development of the child regarding the domains covered by the ASQ. Obviously, this goes at the disadvantage of potentially missing less severe problems that are restricted to one domain. This disadvantage of the 'ASQ total score' could be undermined by adding the parental concerns in the interpretation of the ASQ results; the 'ASQ total score with parental concerns.'

In 2009, the third edition of the ASQ was published [15]. We used the second edition of the ASQ because at the moment of our study (2007), the third edition was not available. Differences between the second and the third version concerned four points. First, in the third edition of the ASQ-60, some items have been changed at details regarding wording, illustrations, or examples. Second, the age range for administration was widened. It now concerns 57 through 66 months. Third, in the section about parental concerns, behavioral concerns and intelligibility for others were added as topics. Fourth, the cutoff points for some domains were slightly revised (maximal difference four points). All changes in the third edition, in comparison with the second edition, were labeled as minor by its editors [15].

In summary, the ASQ-60 is highly promising but requires an additional validation and evidence is needed on the best method to score the ASQ-60. This study therefore aims to evaluate the internal consistency and construct validity of the ASQ-60 with a large sample size and to assess the effects of three scoring-methods on this validity.

2. Methods

2.1. Study population

Data were collected within the framework of the Longitudinal Preterm Outcome Project (Lollipop) study, which focused on the growth and development of preterm-born children, particularly moderately preterm-born children. The Lollipop study cohort concerned a community-based sample of children born in 2002 and 2003, obtained via twelve preventive healthcare organizations in the Netherlands and five neonatal intensive care units (NICUs), the latter to obtain additional early preterm-born children (<32 weeks gestational age) [1].

From the original sample of 2072 children, 1457 were included in the current study. Children, whose parents completed the ASQ-60 within 3 months around their child's fifth birthday, were included in our current study. Participating and non-participating children differed with statistical significance ($p < 0.001$) regarding rates of low maternal education (39.9% vs. 24.8%), non-Dutch country of birth of the mother (4.0% vs. 10.7%), and one-parent family (5.0% vs. 10.7%). The Lollipop study received approval from the local Medical Ethical Committee. Written informed consent was obtained from all parents. The study sample consisted of 1063 preterm-born children (<36 weeks gestational age) and 394 term-born children (38–42 weeks gestational age). Demographical backgrounds are summarized in Table 1.

Table 1
Socio-demographic characteristics of the study population by gestational age category.

	<36 weeks	38–42 weeks	<i>p</i> -value
<i>N</i> total	1063	394	
<i>Birth characteristics</i>			
Male gender, <i>n</i> (%)	582 (55.2)	187 (47.0)	0.005
<i>Gestational age</i>			
Mean (SD)	32.3 (2.58)	39.5 (2.18)	<0.001
Range	25 - 35	38 - 41	
Small for gestational age < p10, <i>n</i> (%)	144 (13.7)	28 (7.0)	<0.001
Multi parity, <i>n</i> (%)	342 (30.8)	260 (62.7)	<0.001
Multiples, <i>n</i> (%)	286 (27.1)	5 (1.3)	<0.001
<i>Socio-economic background</i>			
Low maternal education level,* <i>n</i> (%)	265 (25.3)	87 (21.9)	0.186
Low paternal education level,* <i>n</i> (%)	306 (30.1)	101 (26.0)	0.130
Low total family income, <i>n</i> (%)	50 (4.9)	11 (2.8)	0.084
One parent family, <i>n</i> (%)	65 (6.2)	8 (2.0)	0.001
Non-Dutch mother, <i>n</i> (%)	41 (3.9)	10 (2.5)	0.206
Mother's age <20 years, <i>n</i> (%)	3 (0.3)	0 (0.0)	0.287
<i>Characteristics at age five</i>			
Child age completing the ASQ-60 [#]			
Mean (SD)	58.7 (1.38)	58.7 (1.36)	0.792
Range	57- 62	57- 62	

[#]Not corrected for prematurity.

* Low, primary school, or less and/or low-level technical and vocational training.

3. Procedure

Parents received a questionnaire including the ASQ-60 (second edition) and questions on socio-demographic background, school type, and birth characteristics approximately 8 weeks before the child's fifth birthday (first, we sent the ASQ 8–10 weeks before their child's fifth birthday, but because of a more rapid completion by parents than expected, we changed the time of sending to 2–6 weeks before their birthday later in the study). The ASQ-60 was translated into Dutch using the Guilléman method [16], i.e., with three independent translations from English to Dutch and another three independent translations back from Dutch to English. The final version was reached in a consensus discussion of an expert panel that discussed cultural and lingual appropriateness of the final version. This panel consisted of a preventive care pediatrician, a general pediatrician, a neonatologist, and a community physician.

The background characteristics concerned were as follows: school type (mainstream education versus special education), special educational needs within mainstream education, socio-economic background (education level of parents, income, family situation, birth country of mother, mother's age at birth), and birth characteristics (gestational age, small for gestational age, parity, multiple pregnancies). Categories are described in Table 1.

4. Analyses

First, we assessed the background characteristics of the sample and compared these between the preterm-born and term-born group, as described in Table 1. Mean scores and standard deviations (SDs) were calculated after weighing the sample for age at assessment because the mean age of completing the ASQ-60 in our study was 58.7 instead of 60 months. In this way, ASQ results of the children that completed the ASQ-60 nearer to 60 months have more impact on the mean ASQ score than those farther away from the 60 months. The means, SDs and cutoff points were only calculated based on the term-born group. The cutoff points for the domains and total score were determined at two SD below the mean of the domain score and total score, conform the manual [7]. The 'ASQ total score with parental concerns' was determined when the 'ASQ total score' was low, or if parents reported general concerns or abnormal development compared with peers. We used a 3-month time frame around age 60 months, whereas the time frame

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