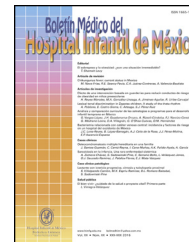




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REVIEW ARTICLE

Ages and Stages Questionnaire: a global screening scale



Ajay Singh^{a,*}, Chia Jung Yeh^b, Sheresa Boone Blanchard^b

^a College of Education and Technology, Eastern New Mexico University, Portales, New Mexico, USA

^b Department of Human Development and Family Science, College of Health and Human Performance, East Carolina University, Greenville, North Carolina, USA

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Cuestionario de Edades y Etapas (ASQ);
Tamiz a escala global

Abstract With standardized screening tools, research studies have shown that developmental disabilities can be detected reliably and with validity in children as young as 4 months of age by using the instruments such as the Ages and Stages Questionnaire.

In this review, we will focus on one tool, the Ages and Stages Questionnaire, to illustrate the usefulness of developmental screening across the globe.

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Ages and Stages Questionnaire: una escala de evaluación global

Resumen Mediante el uso de herramientas de evaluación estandarizada, algunos estudios de investigación han demostrado que discapacidades de desarrollo se pueden detectar con fiabilidad y validez en niños desde los 4 meses de edad mediante el uso de los instrumentos estandarizados como el *Ages and Stages Questionnaire* (Cuestionario de las Edades y Etapas).

Para ilustrar la utilidad de la evaluación del desarrollo infantil a escala global, en este trabajo se revisará la herramienta *Ages and Stages Questionnaire*.

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* Corresponding author.

E-mail address: ajaysingh363@gmail.com (A. Singh).

1. Introduction

Early childhood is a critical period because the first five years of life are fundamentally important, and early experiences provide the base for brain development and functioning throughout life.^{1,2} Early intervention services can provide educational and therapeutic services to children who are at risk.^{2,3} Early identification of developmental disabilities is essential for timely remedial intervention and leads to early treatment and ultimately improved long-term outcomes.⁴⁻⁶ It has been estimated that only about half of the children with developmental problems are detected before they begin school.⁷⁻⁹ Early intervention for children with developmental delay is crucial for enhancing their outcomes.^{10,11} To meet the needs of children during the most important phase of their growth, many countries have established programs and facilities designed to mitigate disabilities.¹² Early intervention (EI) and early childhood special education (ECSE) serve a growing number of young children with developmental delays and their families.¹³⁻¹⁷ It has been shown that high-quality EI and ECSE improve children's developmental outcomes.¹⁸⁻²⁰

2. Developmental screening

Optimal development and early identification and detection of delays rely on developmental screening.^{19,21} To emphasize the importance of developmental screening in early childhood, the American Academy of Pediatrics (AAP) developmental screening policy has included the following strong statement: "Early identification of developmental disorders is critical to the well-being of children and their families."^{22,23} Developmental screening can be thought of as a preliminary step in the identification of risk at school-age children.²⁴ An effective screening tool should be inexpensive, simple, accurate, valid, reliable, culturally appropriate, easy, and quick to administer.²⁵⁻²⁷ To be eligible for Individuals with Disabilities Education Act (IDEA) services, children must qualify in terms of impairment or delay. Approximately 10 to 20% of young children will experience delays²⁸⁻³⁰ with significantly higher rates among children who live in poverty.^{31,32} It has been estimated that only about half of the children with developmental problems are detected before they join the school.³³⁻³⁵ Developmental screening and developmental surveillance constitute ongoing processes of monitoring the status of a child by gathering information about his development from multiple sources, including skillful direct observation from parents/caregivers and relevant professionals.^{26,36,37} The AAP and the British Joint Working Party on Child Health Services recommend developmental surveillance as an effective means to identify children with developmental delay.³⁸ Parents' reports of current attainment of developmental tasks have been shown to be accurate and reliable.^{39,40} In keeping with recommendations from the American Pediatric Association (USA), National Screening Committee (NSC) UK: Child Health Sub-Group Report 1999 and Best Health for Children (Ireland) consideration should be given to the use of parental reports as a part of the process of assessment.

The AAP⁴¹ policy statement set forth screening algorithms and methods, including those that use standardized

parent-completed tools, such as the Parental Evaluation of Developmental Status (PEDS),^{39,40} the Ages and Stages Questionnaire (ASQ),⁴² and the Child Development Inventories (CDI).⁴³ These have the benefit of good psychometric properties (70-80% specificities and sensitivities), and require much less time than direct developmental assessment by a professional. A parent-completed screening questionnaire can decrease costs and increase accuracy, and parents can report successfully at regular intervals.^{19,44,45}

Developmental screening identifies those who are in need of further evaluation for eligibility for specialized services.⁴⁶⁻⁴⁸ Eligibility assessment assists in identifying the nature of the delay and connecting children and families to appropriate services and supports. Several screening tests have been recommended for accurate ongoing developmental screening, including the PEDS, CDI, ASQ. The ASQ will be highlighted in the review as a preferred screening test that works well in a variety of screening settings.

3. Ages and Stages Questionnaire

The Ages and Stages Questionnaire (ASQ) is a parent-completed questionnaire that may be used as a general developmental screening tool. The ASQ was designed and developed by J. Squires and D. Bricker^{42,49,50} at the University of Oregon and can be completed by parents in 12-18 minutes. The ASQ-3 is a parent reported initial level developmental screening instrument consisting of 21 intervals, each with 30 items in five areas: (i) personal social, (ii) gross motor, (iii) fine motor, (iv) problem solving, and (v) communication for children from 2-66 months. In most cases, these questionnaires accurately identify young children who are in need of further evaluation to determine if they are eligible for early intervention services.^{42,50} The ASQ is cost-effective and widely used in the United States and other countries.⁵¹⁻⁵³ The ASQ has been translated into several languages, such as Spanish, French, Dutch, Chinese, Norwegian, Hindi, Persian, and Turkish. Furthermore, the number of international studies on its psychometric properties with diverse cultural environments is increasing (e. g., Australia, Brazil, Canada, Chile, China, Denmark, Ecuador, France, Ghana, India, Iran, Korea, Lebanon, Netherland, Norway, Republic of Macedonia, Spain, Taiwan, Thailand, Turkey). It has excellent psychometric properties, test-retest reliability of 92%, sensitivity of 87.4% and specificity of 95.7%. Validity has been examined across different cultures and communities across the world.⁵¹⁻⁵⁴ The ASQ-3 is designed to be an in-depth general screening instrument with a reading level from fourth to eighth grade and illustrations assist in providing a clear, user-friendly format. The ASQ is available in several languages, including Turkish, Norwegian, Dutch, Persian, Arabic, English, Hindi, French, Thai, Korean, Spanish, Chinese, and Vietnamese. Another advantage of the ASQ is its flexibility. Evidence has shown that the ASQ is very useful in a wide variety of settings: home, doctors' office, head starts, early intervention units, preschools, early childhood, health clinics, and teen parenting programs. The ASQ can be completed by parents/caregivers independently or with the assistance of professionals or administered by a trained professional who

Table 1 ASQ studies in the United States, including original normative studies.

Country	Sample	Year	Age (months)	Keywords	References
USA	224	1995 ^a	4-48	Infant/Child Monitoring Questionnaires, children, ASQ, families from low-income backgrounds	Bricker et al. ⁵⁰
USA	7,000	1997	4-48	Developmental screening, infants at risk, early identification, early intervention	Squires et al. ⁴⁹
USA	96	1998	4-36	Early identification, parents, developmental screeners, developmental questionnaire	Squires et al. ⁶⁷
USA	112	1999	4-60	Infants, child development, testing, development, diagnosis	Bricker et al. ⁶⁶
USA	1,428	2007	12-24	Ages and Stages Questionnaire, developmental delay, developmental screening, developmental surveillance, early intervention, parent-completed screening	Hix-Small et al. ⁶⁴
USA	18,000	2009	4-60	Family-friendly, developmental delay, developmental scanner, screen children	Squires et al. ⁶⁸
USA	53	2010	24	Child development, developmental screening, diagnostic tests, sensitivity, and specificity	Gollenberg et al. ⁶⁵
USA	1,363	2009	12-24	Ages & Stages Questionnaire, developmental delay, developmental screening, developmental surveillance, early intervention	Marks et al. ⁶⁹
USA	798	2012	9-30	Culturally sensitive assessments, families, young children, Spanish ASQ-3	Pomes ⁷⁰
USA	2,103	2013	< 30	Child development, primary care, randomized controlled trial, screening, urban	Guevara et al. ⁷¹
USA	26	2013	4-48	Developmental screening, developmental delay, neurocognitive delay, Ages and Stages Questionnaires-3 [®] (ASQ-3)	Quigg et al. ⁷²

^a Formerly called the Infant/Child Monitoring Questionnaires (series of 11 questionnaires designed to be completed by parents at 4, 5, 8, 12, 16, 18, 20, 24, 30, 36, 48 months; each questionnaire contains 30 items).

is familiar with the child. Scores are normed to indicate whether children are developing in an age-appropriate manner.

Psychometric parameters of the ASQ have been examined based on completion of 18,000 respondents.⁴² Evidence shows that the ASQ is an accurate, cost-effective, parent-friendly instrument for screening and monitoring of preschool children. In addition, it is recommended for early detection of autism by the Joint Committee on Screening and Diagnosis of Autism as well as for general developmental follow-up and screening and developmental surveillance in office settings. Furthermore, research shows that the ASQ has been successfully used for follow-up and assessment of premature and at-risk infants and children in the public health,^{55,56} and follow-up of infants born after assisted reproductive technologies. The ASQ can also be used for teaching medical students in higher education and research about early intervention.⁵⁷ In 2006, the ASQ was used for evaluating the developmental surveillance and screening

algorithm by AAP (2001, 2006). Also, the ASQ was used to determine the prevalence of late language emergence and to investigate the predictive status of maternal, family, and child variables. Finally, the ASQ have been translated and used cross-culturally with success.⁵¹⁻⁵⁴

4. Comparison or agreement with other developmental instruments

The agreement between the ASQ and Developmental Assessment Scale for Indian Infants (DASII) was studied.^{58,59} The overall sensitivity of the ASQ in detecting delay was 83.3% (n = 200) and specificity was 75.4% (n = 200). All correlations were found to be acceptable (r 0.76-0.80). The sensitivity was higher in the high-risk group whereas specificity was higher in the low-risk group. There was a solid correlation between the domain scores of ASQ and DASII.^{42,58} Australian

Table 2 ASQ International research results compared with those in the United States.

Country	Sample	Year	Age (months)	References
USA and Canada	67	2009	2.5-12.5	Westcott et al. ⁷³
USA and Norway	1,341	2004	4-60	Janson and Squires ⁷⁴
USA, Norway, Spain (Galicia), Korea, Iran	34-1,380	2013	4-60	Vameghi et al. ⁵¹
Guatemala, Pakistan, Democratic Republic of Congo, Zambia	1,050	2011	3-4	Krebs et al. ⁷⁵

studies showed similar results while evaluating the ASQ in a medically at-risk for developmental delay population.^{60,61}

The agreement between the ASQ and the Battelle Developmental Inventory, 2nd Edition (BDI-2) was also examined.⁶² The ASQ accurately identified and classified children as being eligible or those in need of further evaluation for eligibility status when the classification criterion was the BDI-2, with the ASQ accurately identifying over 90% of eligible children. Interobserver reliability was also strong, with most correlations over 0.70.⁶³

The agreement between the ASQ and pediatrician estimates of development (i.e., Pediatric Developmental Impression (PDI)) was studied in 2007. Findings showed that the agreement between PDI and ASQ was 81.8%. The ASQ results indicated that 78.4% (n=548) were typically developed, while the PDI indicated that 89.4% (n=625) were typically developed.⁶⁴

The agreement between the ASQ and the Bayley Scales of Infant Development II (BSID-II) was studied. The researchers calculated the sensitivity and specificity of the ASQ. They

reported a sensitivity of 100% and a specificity of 87% for children of 24 months of age.⁶⁵

5. ASQ study samples

The ASQ has been used internationally in a variety of settings and contexts. The following tables summarize the overall results: research studies in the United States (Table 1);⁶⁶⁻⁷² comparison of results from international research studies with those from the United States (Table 2);⁷³⁻⁷⁵ international research studies (Table 3);⁷⁶⁻¹⁰¹ and some international research studies using the ASQ in different settings (Table 4).

6. Cross-cultural adaptation, validation, and standardization of the ASQ

Results from the ASQ studies in North America (USA), South America (Ecuador), Europe (Norway, Spain), and Asia (Korea,

Table 3 International ASQ research studies.

Country	Sample	Year	Age (months)	References
Australia	167	2001	12-48	Skellern et al. ⁶¹
Australia	55	2008	12-14	Lindsay et al. ⁶⁰
Brazil	45,640	2013	6-60	Filgueiras et al. ⁷⁶
Canada	317	2006	18	Rydz et al. ^{77,78}
Canada	236	2012	12-24	Simard et al. ⁷⁹
Chile	306	2013	8-30	Schonhaut et al. ⁸⁰
China	269	2010	3-31	Yao et al. ⁸¹
China	519	2012	3-66	Bian et al. ⁵
Denmark	230	2006	26-27 weeks	Plomgaard et al. ⁸²
Denmark	298	2012	9-21	Østergaard et al. ⁸³
Ecuador	283	2007	3-61	Handal et al. ^{84,85}
France	703	2011	24	Flamant et al. ⁸⁶
France	339	2011	12, 36	Troude et al. ⁸⁷
Ghana	330	2013	3-5	Bello et al. ⁸⁸
India	200	2012	4-24	Juneja et al. ⁵⁸
India	422	2013	12-36	Kvestad et al. ⁸⁹
India*	100	2014	4-24	Gulati et al.
Iran	100	2013	4-60	Vameghi et al. ⁵¹
Japan	240	2013	2-69	Hashimoto et al. ⁹⁰
Korea	3,220	2008	4-60	Heo et al. ⁵³
Korea	129	2010	8-39	Kim and Kim ⁹¹
Korea	226	2011	4-60	Ga and Kwon ⁹²
Lebanon	733	2013	4-60	Charafeddine et al. ⁹³
Mexico	2,843	2012	14-59	Angeles et al. ⁹⁴
Netherlands	927	2011	32-49	Kerstjens et al. ⁹⁵
New Zealand	1,848	2010	> 48	Wills et al. ⁹⁶
Norway	2,392	2003	4-60	Janson ⁹⁷
Republic of Macedonia*	100	2014	4-24	Vladimir et al.
South Africa	65	2011	6	Silva ⁹⁸
Spain	222	2008	24	Eixarch et al. ⁹⁹
Spain	615	2011	4-42	Sarmiento-Compos et al. ⁵²
Taiwan	112	2006	36	Tsai et al. ¹⁰⁰
Thailand	267	2009	24-36	Saihong ⁵⁴
Turkey	978	2010	3-72	Kapci et al. ¹⁰¹
UK	2,046	2007	12-60	Yu et al. ⁵⁶

* Ongoing research.

Table 4 Comparative results of ASQ at different ages among samples from different countries.

ASQ (months)	Sample	N	Communication	Gross motor	Fine motor	Problem solving	Social-personal
			Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
24-35	Ecuador	52	41.2(13.5)	39.9(10.7)	38.6(14.9)	38.8(12.4)	42.7(12.6)
24	USA	820	50(11)	54(9)	53(8)	51(10)	52(8)
24	Norway	128	53(10)	56(6)	53(8)	50(9)	51(8)
24	Spain	56	44(17)	50(12)	53(11)	48	48(10)
24	Thailand	55	51.27(11.23)	50.18(10.05)	39.73(11.80)	41.55(14.56)	47.82 (10.17)
24	Korea	144	48.9	55.3	48.3	48.8	48.5
24	Iran	554	53.9	52.4	47.4	50.4	51
30	USA	562	56(9)	51(10)	50(12)	51	53(8)
30	Norway	134	57(7)	56(6)	50(13)	52	53(7)
30	Spain	86	54(10)	53(8)	53(11)	49	51(8)
30	Thailand	102	53.77(9.02)	51.52(9.69)	43.28(12.38)	46.67(13.97)	50.25(9.50)
30	Korea	223	53.2	53.4	49.5	51.1	49.8
30	Iran	498	55.3	53.2	47.9	53.7	52.3
36	USA	512	54(8)	55(10)	52(11)	55	53(7)
36	Norway	126	54(7)	56(7)	52(10)	54	53(8)
36	Spain	70	54(9)	52(11)	54(9)	48	51(9)
36	Thailand	110	53.41(9.62)	52.60(11.71)	47.14(13.35)	52.09(9.12)	51.50(7.15)
36-47	Ecuador	44	37.6(12.7)	46.6(11.3)	45.9(11.9)	37.3(10.4)	39.6(11.6)
36	Korea	226	54.8	55.2	53.3	53.2	50.1
36	Iran	548	54.9	53	49.1	53.7	49.6
36	Taiwan	96	53.6(11.6)	52.8(11.4)	46.7(15.8)	49.8(13.1)	52.6(9.7)

Taiwan) are summarized for selected groups of age. ASQ study results including children's mean scores and standard deviation are included for studies conducted in Ecuador, USA, Norway, Spain, Thailand, Korea, Taiwan, and Iran (Table 3).^{51-54,74,84,85,100}

These samples followed a distribution pattern and very closely resembled the North American, South American, Asian, and European profiles. These results suggest that the ASQ performance did not diverge significantly from performance data collected in any other studies.

To demonstrate the usefulness of developmental screening across the globe, the authors of this paper have reviewed the ASQ as one example of a recommended tool that has a worldwide use for the goal of early detection and identifying developmental disabilities. It is important to promote early detection efforts using a valid and reliable global screening scale to control the healthy children population < 5 years of age. These studies reflect that the ASQ is very useful for early identification of the at-risk population and used to improve the early identification of young children and improve outcomes before disabilities become more established.^{12,26,27,102} Within only a few years, the ASQ has become widespread and increasingly used worldwide as a parent-completed questionnaire, a *global screening scale*. International studies yielded standardized parent-completed scores that were effective and comparative across languages and cultures. The ASQ has shown to be reliable and cost-effective as well as correlate well with pediatricians' and service providers' assessment.¹⁰² International interest has been building based on demonstrated benefits of the ASQ. Since some of the research studies reported here are ongoing, a number of additional international publications concerning the ASQ can be expected in the near future. Collaboration across the world will further

enhance the utility of the ASQ because the establishment of norms from datasets with specified characteristics allows for cross-country comparisons of developmental outcomes in diverse cultures.

Conflict of interest

The authors declare no conflicts of interest of any nature.

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