

# Validity of the Ten Questions Screen for Childhood Disability: Results from Population-Based Studies in Bangladesh, Jamaica, and Pakistan

Maureen S. Durkin,<sup>1,2</sup> Leslie L. Davidson,<sup>1,3</sup> Patricia Desai,<sup>4</sup> Z. Meher Hasan,<sup>5</sup> Naila Khan,<sup>6</sup> Patrick E. Shrout,<sup>7</sup> Marigold J. Thorburn,<sup>4</sup> Wei Wang,<sup>1,8</sup> and Sultana S. Zaman<sup>9</sup>

An international study to validate the Ten Questions screen for serious childhood disability was undertaken in communities in Bangladesh, Jamaica, and Pakistan, where community workers screened more than 22,000 children ages 2-9 years. All children who screened positive, as well as random samples of those who screened negative, were referred for clinical evaluations. Applying comparable diagnostic criteria, the sensitivity of the screen for serious cognitive, motor, and seizure disabilities is acceptable (80-100%) in all three populations, whereas the positive predictive values range from 3

to 15%. These results confirm the usefulness of the Ten Questions as a low-cost and rapid screen for these disabilities, although not for vision and hearing disabilities, in populations where few affected children have previously been identified and treated. They also show that the value of the Ten Questions for identifying disability in underserved populations is limited to that of a screen; more thorough evaluations of children screened positive are necessary to distinguish true from false-positive results and to identify the nature of the disability if present. (*Epidemiology* 1994;5:283-289)

**Keywords:** child development disorders, cross-cultural comparison, disability, epidemiologic methods, predictive value of tests, questionnaires, reproducibility of results, sensitivity, specificity, screening.

Although the vast majority of children in the world today live in less developed countries, most epidemiologic research on childhood disability is confined to populations in developed countries. As a result, little is known about the frequency and causes of disability

in the less developed world.<sup>1,2</sup> The Ten Questions screen was developed as a rapid, low-cost method to assist in the identification of children with serious disabilities in populations where professional resources are extremely scarce. If validated, this method would permit epidemiologic studies in populations not previously studied and would facilitate referral of children to programs now being developed throughout the world for early intervention and community-based rehabilitation.<sup>3-6</sup>

From the <sup>1</sup>Gertrude H. Sergievsky Center and <sup>2</sup>Department of Pediatrics, Faculty of Medicine, and Divisions of <sup>3</sup>Epidemiology and <sup>4</sup>Biostatistics, School of Public Health, Columbia University, New York, NY; <sup>5</sup>Department of Social and Preventive Medicine, University of the West Indies, Mona, Jamaica; <sup>6</sup>Department of Neuropsychiatry, Jinnah Postgraduate Medical Centre, Karachi, Pakistan; <sup>7</sup>Child Development Center, Dhaka Shikhu Children's Hospital, Dhaka, Bangladesh; <sup>8</sup>Department of Psychology, New York University, New York, NY; and <sup>9</sup>Department of Psychology, University of Dhaka, Dhaka, Bangladesh.

Address reprint requests to: Maureen Durkin, Columbia University, Sergievsky Center, 630 W. 168 Street, New York, NY 10032.

This work was supported by the BOSTID Program of the National Academy of Sciences (USA), the Epilepsy Foundation of America, the National Institute of Neurological Diseases and Stroke (Grants R29 NS2:7971-01, R29 NS2:7971-02, R29 NS2:7971-03, and R29 NS2:791-04), the New York State Psychiatric Institute, and the Gertrude Sergievsky Center of Columbia University.

Submitted September 21, 1992; final version accepted September 13, 1993.

© 1994 Epidemiology Resources Inc.

Pilot studies in nine countries<sup>7</sup> suggested that the Ten Questions is a sensitive screen for serious cognitive disability in 3- to 9-year-old children. These studies were not definitive, however, owing to the small number of children screened in each country (about 1,000) and to the unstructured nature of the clinical evaluations (the criteria for assessing sensitivity). In addition, they did not address the validity of the screen for disabilities other than mental retardation.

This paper reports the results of a large, collaborative study to validate the Ten Questions among 2- to 9-year-olds in communities in Bangladesh, Jamaica, and Pakistan. Initial results from this study in one subpopulation (Dhaka, Bangladesh) showed excellent sensitivity of the Ten Questions for detecting serious disabilities.<sup>8</sup> Analyses of the results from Jamaica concluded

that the screen is sensitive for serious motor, seizure, vision, and hearing disabilities, but less so for serious cognitive disability.<sup>9,10</sup> In addition, the Ten Questions has been shown to have good and comparable reliability in all three populations (communities in Bangladesh, Jamaica, and Pakistan).<sup>11</sup> The present paper evaluates and compares across the three populations the overall validity of the Ten Questions for screening serious childhood disability (cognitive, motor, seizure, vision, and hearing).

### Subjects and Methods

Community samples of 2- to 9-year-old children were screened in Bangladesh, Jamaica, and Pakistan in 1987-1989. Details of the study design and methods have been reported previously,<sup>5-18</sup> and are summarized here. The samples are representative of 2- to 9-year-old children in Bangladesh (country as a whole); the parish of Clarendon, Jamaica; and greater Karachi, Pakistan. A standard two-phase study design was implemented in all three countries. Phase 1 involved screening all 2- to 9-year-old children in the target communities by community workers trained for this project using the Ten Questions. Participation rates greater than 98.5% were achieved in all three populations. The Ten Questions is a brief parent/guardian interview that was designed for use in any culture to screen for serious cognitive, motor, seizure, vision, and hearing disabilities among children in community populations.<sup>7</sup>

In phase 2, all children with positive screening results plus a random sample of those with negative results were referred for clinical evaluations. Between 81.8 and 86.4% of those referred actually participated in the clinical evaluations (Table 1). We found no systematic differences between those evaluated and not evaluated among those referred, except that the per-

centage with positive screening results was higher among those evaluated than among those referred but not evaluated. The main reasons for failure to be evaluated after referral were inability of the family to bring the child for the examination, or inability of the evaluation team to make contact with the family.

The evaluations were performed without knowledge of the screening results by local psychologists and physicians. Independent assessments of mental ability were made for each child by a psychologist and a physician. In Bangladesh and Pakistan, the psychologists used nonverbal scales of the Stanford-Binet Intelligence Scales,<sup>19</sup> an adaptive behavior scale developed for this study,<sup>20,21</sup> and, for children who could not be tested with the Stanford-Binet, the Denver Developmental Screening Test.<sup>22</sup> A modified Child Disability Questionnaire<sup>23</sup> was administered for each child. Classification of children as mentally retarded was done according to internationally recognized guidelines, which specify that mental retardation implies deficits in both cognitive function and adaptive behavior.<sup>24</sup> Severity of mental retardation was classified by the psychologist according to intelligence quotient: 50-70 for mild, 35-49 for moderate, and below 35 for severe mental retardation. In Jamaica, the psychologist used different tests of cognition for 6- to 9-year-old children,<sup>25-27</sup> used the Denver Developmental Screening Test<sup>22</sup> for 2- to 5-year-olds, and did not specifically assess adaptive behavior.<sup>10,13</sup> In all three countries, the physician's assessment of mental retardation was based on developmental history and a structured observation of functioning in language, following instructions, motor skills, and behavior. The results reported here for mental retardation are based on consensual diagnoses by the psychologists and physicians.

In comparing the data, we noticed that children given the diagnosis of serious cognitive disability were

TABLE 1. Number and Characteristics of Children Screened, Frequency of Positive Screening Results, and Number of Children Clinically Evaluated in the Three Populations

	Bangladesh		Jamaica		Pakistan	
	Number	%	Number	%	Number	%
Children Screened	10,299		5,461		6,365	
Boys	5,417	52.6	2,687	49.2	3,424	53.8
2-5 years	4,944	48.0	2,862	52.4	3,373	53.0
6-9 years	5,355	52.0	2,599	47.6	2,992	47.0
Screened positive	845	8.2	852	15.6	936	14.7
Referred for evaluation	1,916		1,215		1,576	
Clinically evaluated	1,626	84.9*	994	81.9	1,363	86.4

\* Percentage of those referred.

more severely affected in Bangladesh and Pakistan than in Jamaica. The mean Child Disability Questionnaire scores (higher indicates more severe disability) for children diagnosed as seriously mentally retarded were similar in Bangladesh (33.0) and Pakistan (33.5) and much lower (22.9) in Jamaica. Also, the proportions with other disabilities (seizures, motor, sensory) among children diagnosed with serious mental retardation were similar in Bangladesh and Pakistan (0.67 and 0.70, respectively) and much lower (0.21) in Jamaica. Serious mental retardation is often complicated by other disabilities, whereas mild mental retardation is not.<sup>5,28</sup>

Thus, the sensitivity and other indicators of validity results for serious cognitive disability cannot be readily compared across the three countries. To enable three-population comparisons, a separate subcategory of children was defined that includes children given the diagnosis of serious cognitive disability who had at least one other disability (mild or serious motor, seizure, vision, or hearing disability). This definition results in groups of children in all three countries that appear to have similar levels of disability (mean Child Disability Questionnaire scores range from 32 to 35). The validity results for cognitive disability are given both for all children diagnosed with serious cognitive disability and for the more comparable subgroup of the cases who had other disabilities.

Standard and comprehensive medical assessment procedures and criteria with a structured form, developed for this study, were used in all three countries. Diagnoses were given as far as possible using *International Classification of Diseases*, 9th revision,<sup>29</sup> codes as well as ratings of disability. The analyses reported here are restricted to moderate and severe (serious) disabilities.

All forms used in the study were precoded to facilitate comparability and computerized data entry. Forms administered as interviews were translated from English into Bangla for use in Bangladesh and Urdu for use in Pakistan. Translated forms were back-translated, pretested, and revised before arriving at the final versions.

### Statistical Analysis

The validity of the Ten Questions as a screen for serious disability is evaluated against the professional assessment information. Because only a sample of those screened negative was evaluated, it is necessary to compute adjusted estimates of prevalence, sensitivity, specificity, positive predictive value, negative predictive value, and the variances of these parameters.<sup>30</sup> Symmetric confidence intervals for the sensitivity and spec-

ificity estimates were constructed using Taylor's series approximation to estimate standard errors. The upper bound is given as 1.0 when the sum of the point estimate and 196% of the standard error exceeded 1.0. Symmetric confidence intervals for the estimates of positive and negative predictive values were constructed using the standard error of the binomial probability. Logistic regression is used to evaluate predictors of true-positive vs false-negative screening results using PC CARP,<sup>31</sup> a computer program developed for analysis of data from multiphase studies.

### Results

More than 22,000 children were screened in the three populations: 10,299 in Bangladesh, 5,461 in Jamaica, and 6,365 in Pakistan (Table 1). The age and gender distributions of these children are similar across populations, but the proportions screening positive vary considerably, from 8.2% in Bangladesh to 14.7% in Pakistan and 15.2% in Jamaica (Table 1). The numbers of children evaluated include most of the children screened positive and a random sample of 6-10% of those with negative screening results.

The estimated specificity of the Ten Questions as a screen for serious disability is high in all three populations and constant across types of disability (0.92 in Bangladesh, 0.85 in Jamaica, and 0.86 in Pakistan). This high specificity is due to the relative rareness of serious disability and the fact that most children screened negative. Sensitivity, on the other hand, shows marked variations by type of disability as well as between populations (Table 2).

Sensitivity for serious cognitive disability is given overall and stratified by whether the cognitive disability was complicated by other disabilities, and by whether it was rated severe or moderate. Overall sensitivity for cognitive disability is similar in Bangladesh and Pakistan (0.82 and 0.84, respectively), but only 0.53 in Jamaica, where children with relatively mild levels of cognitive disability appear to have been classified as moderately mentally retarded. Restricting the analysis to cases with serious cognitive and at least one other disability increases sensitivity to 1.00 in Jamaica. This restriction has less effect on sensitivity in Bangladesh and Pakistan. (In Bangladesh, the sensitivity is actually lower for serious cognitive disability complicated by other disability than for serious cognitive disability alone. This is because there was only one false-negative case for cognitive disability in Bangladesh—a child with multiple disabilities. Restricting the definition to cognitive with one or more other disabilities reduces the denominator but not the numerator of the sensitivity

TABLE 2A. Sensitivity (95% Confidence Intervals) of the Ten Questions for Detecting Serious Disabilities among 2- to 9-Year-Old Children: Three Populations

	Bangladesh	Jamaica	Pakistan
Cognitive total	0.82 (0.40-1.0)	0.53 (0.20-0.86)	0.84 (0.55-1.0)
Cognitive + other disability*	0.74 (0.23-1.0)	1.0 (0.33-1.0)	0.89 (0.55-1.0)
Cognitive only (not accompanied by other disability)	1.0 (0.35-1.0)	0.41 (0.09-1.0)	0.70 (0.14-1.0)
Cognitive—severe	1.0 (0.13-1.0)	1.0 (0-1.0)	1.0 (0.53-1.0)
Cognitive—moderate	0.78 (0.32-1.0)	0.49 (0.17-0.83)	0.76 (0.41-1.0)
Motor total	1.0 (0.54-1.0)	1.0 (0.13-1.0)	0.84 (0.55-1.0)
Seizure total	1.0 (0-1.0)	1.0 (0-1.0)	1.0 (0.48-1.0)
Vision total	0.57 (0-1.0)	1.0 (0-1.0)	0.59 (0.28-0.89)
Hearing total	0.46 (0.12-0.80)	1.0 (0.35-1.0)	0.70 (0.14-1.0)

\* Other disabilities include mild or serious motor, seizure, vision, or hearing disabilities.

TABLE 2B. Numbers of True-Positive, True-Negative, False-Positive, False-Negative, and Unclassified Responses

	Bangladesh	Jamaica	Pakistan
Screened positive, unclassified	88	145	119
Screened negative, unclassified	8,585	4,316	4,883
Cognitive total			
True-positive	45	44	88
True-negative	870	287	543
False-positive	710	660	730
False-negative	1	3	2
Motor total			
True-positive	35	10	91
True-negative	871	290	543
False-positive	720	694	727
False-negative	0	0	2
Seizure total			
True-positive	3	2	28
True-negative	871	290	545
False-positive	752	702	790
False-negative	0	0	0
Vision total			
True-positive	13	4	49
True-negative	870	290	541
False-positive	742	700	769
False-negative	1	0	4
Hearing total			
True-positive	25	18	20
True-negative	868	290	544
False-positive	730	686	798
False-negative	3	0	1

estimate.) In all three populations, sensitivity is 1.00 for severe cognitive disability.

For serious motor and seizure disabilities, sensitivity is good in all three populations. The sensitivity results for vision and hearing disability show a different pattern. In Jamaica, the screen appears to have perfect

sensitivity for serious vision and hearing disability, whereas in the other two populations, the sensitivity is relatively poor ( $\leq 0.70$ ) for both sensory disabilities.

The mixed sensitivity estimates for vision and hearing disability raise the question of whether children with these disabilities in Jamaica were more likely than