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**Original Article**

# Cross-Cultural Adaptation, Validation and Standardization of Ages and Stages Questionnaire (ASQ) in Iranian Children

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**Abstract**

**Background:** To provide the validated and standardized form of the Persian version of the Ages and Stages Questionnaires as an appropriate developmental screening tool for evaluation of Iranian children's development.

**Methods:** This was a cross- sectional study. Translation and back-translation, content validity determination, cultural and lingual modifications, pilot study on 100 parents and inter-rater reliability determinations were performed, respectively. The national and final stage was carried out 11000, 4-60 month- old children in selected cities throughout the country in order to determine the validity, standard deviation, reliability, sensitivity, specificity, and mean scores points of the test.

**Results:** The reliability, determined by cronbach's alpha ranged from 0.76 to 0.86 and the inter-rater reliability was 0.93. The validity determined by factor analysis was satisfactory. The mean scores of Iranian children were identified and compared with those of the normative sample as well as with three other populations of children. The developmental status of Iranian children was higher in the communication, problem-solving and personal-social domains, especially under the age of 24 months, after which their developmental status seems to deteriorate, especially in the motor domains.

**Conclusion:** The Persian version of the ASQ has appropriate validity and reliability for screening developmental disorders in Iran.

**Keywords:** Screening tools, Developmental delay, Standardization, Child, Validity

## Introduction

The short and long-term benefits of early intervention for childhood developmental disorders have been demonstrated in numerous studies (1-6) and an increasing urge has been developed for their early identification (6). However, it is now well-known that relying on a clinician's clinical instincts and experience can be misleading in the early differentiation between normal and abnormal development (1, 6-10). Several studies have supported the observation that parents can give accurate information about their child's development (10-13) and thus there is increasing tendency for production and application of questionnaires that are based on parents' reports and some authors have confirmed their use (14).

In the present study the ASQ, a parent-report questionnaire, was chosen because it has been proven to be a valid and/or reliable screening test, even in its translated and culturally adapted versions in different populations of children (7, 14-

22). However, few studies have examined the psychometric properties of ASQ in cultures outside the United States. This test has not been validated and standardized before in Iran.

This study was conducted for the purpose of cultural adaptation, validation and standardization of the ASQ questionnaire for 4-60 months-Old Iranian children and children with similar socio-cultural backgrounds, such as all those living in the Middle East.

## Materials and Methods

The questionnaire was translated to the Persian language and then back-translated by two independent native translators who also had experience in the field of child development. By comparing the two, the discrepant parts were identified and corrected. The resulting Persian questionnaire was then assessed in terms of content validity by a panel of seven, including four pediatricians, a psychologist, a speech pathologist, and a psychometrist. Cultural and lingual adaptations were also performed by the expert team. It was tried hard to maintain the meaning of the original items, however some changes were inevitable for improving clarity of meaning in the Persian language or for adapting culturally.

A pilot study was carried out on 100 parents of 4-60 month-old Iranian children, recruited by convenient sampling in Tehran, in order to determine the degree of 'clarity' of items, cultural appropriateness, to detect ambiguous items and to identify dilemmas in the process of test implementation.

After identifying and resolving problematic issues in the previous phase, the revised version of the Persian test was performed for 38 children, two from each of the 19 age groups, once by the mother and once by the father, in order to determine the inter-rater reliability.

In order to perform the test on a national sample, we trained a group of physicians from selected cities in the country, which were selected purposively, trying to provide a widespread and an evenly-spread selection, covering the main socio-cultural and geographic divisions of the country, and also based on the presence of skilled physicians in health care centers willing to supervise the implementation of the research. .

For implementation of the test at the national level the sample was determined to be 11000 children but turned out to be 10516 children actually. The average response rate was 95 %. Our inclusion criteria were 4-60 months age, Iranian nationality, lacking gross developmental disorders, and parents' educational level at least elementary school. . Informed consent was acquired from parents of children.

For assessment of psychometric properties of the test, the cronbach's alpha coefficient was calculated for each of the five domains and then totally, in all nineteen age groups for determining reliability.

In order to determine the construct validity of the questionnaires using factor analysis, first the KMO (Kaiser-Meyer-Olkin measure of sampling adequacy) was measured and was calculated to be 0.865 meaning the sampling was adequate for performing the factor analysis. In order to prove the correlation matrices between test items did not equal zero, the Bartlett's Test of Sphericity was utilized. Chi square was calculated to be 34409.383 with a significance of $P<0.001$. Therefore, performing the factor analysis based on correlation matrices between items of the questionnaire was explicable. Then, factor analysis was performed using the Principal Components analysis (PC) method. In order to determine that the items of the ASQ questionnaires were saturated with significant factors, the Eigen value and the percentage of explained variance for each factor was considered. After extraction of significant factors and performing the varimax rotation, the factor loadings (correlation of test items with the extracted factors) were calculated and the percentage of explained variances was determined.

To arrive at cut-off values for the Iranian sample, the mean scores minus 2SDs for each domain in every age-specific questionnaire were determined (15).

We were unable to assess the criterion-referenced validity of the questionnaire using a gold standard

diagnostic developmental test because no such tests were available in Iran.

## Results

Among the 10516 children studied, 5035 (47.87%) were girls. The minimum number of children belonged to the 60- month's age group [481] and the maximum number belonged to the 12-month olds [672].

In terms of the cronbach's alpha values of reliability, the lowest values for reliability appeared at 22-months in the problem-solving (0.55) and at 18-months in the social-personal domains (0.55). Conversely, the highest values were detectable at 14-months in the gross motor (0.80) and at 36 and 60 months in the fine motor domains (0.80). The highest and lowest total reliability values belonged to the 36-months (0.86) and 18 months (0.76) questionnaires, respectively.

The inter-rater reliability values obtained were 0.88, 0.91, 0.88, 0.89, and 0.86 for the communication, gross motor, fine motor, problem-solving, and social-personal domains, respectively, and 0.93 totally. The results of the Principal Component Analysis (PC) are demonstrated in Table 1 which shows the calculated factor loadings with values larger than 0.3, along with the rotated Eigen value and the percentage of explained variance by each significant extracted factor. These figures for factor loadings of the test items demonstrate that the extracted factors are capable of assessing the five different developmental domains in Iranian children.

**Table1:** Results of the Principal Component Analysis (PC)

| | Factors | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Gross motor | | Fine motor | | Communication | | Problem-solving | | Social-personal | |
| | CI[a] | FL[b] | CI | FL | CI | FL | CI | FL | CI | FL |
| | Q[c]6 | 0.662 | Q4 | 0.612 | Q6 | 0.624 | Q5 | 0.649 | Q6 | 0.584 |
| | Q3 | 0.633 | Q2 | 0.590 | Q5 | 0.622 | Q6 | 0.613 | Q5 | 0.583 |
| | Q4 | 0.612 | Q3 | 0.589 | Q2 | 0.595 | Q3 | 0.584 | Q2 | 0.554 |
| | Q2 | 0.564 | Q6 | 0.546 | Q4 | 0.555 | Q2 | 0.462 | Q4 | 0.532 |
| | Q5 | 0.517 | Q5 | 0.546 | Q3 | 0.498 | Q1 | 0.458 | Q3 | 0.455 |
| | Q1 | 0.516 | Q1 | 0.529 | Q1 | 0.474 | Q4 | 0.433 | Q1 | 0.352 |
| Rotated eigenvalue | 6.304 | | 5.144 | | 4.125 | | 2.841 | | 1.778 | |
| Percentage of explained variance | 11.681 | | 11.147 | | 11.085 | | 10.137 | | 9.926 | |
| Cumulative Percentage of total explained variance | 11.681 | | 22.828 | | 33.913 | | 44.050 | | 53.976 | |

[a]CI: Content of the Item/ [b]FL: Factor Loadings/ [c]Q: Question

Table 2 demonstrates the results of the Iranian children's mean scores in comparison to the mean scores in the normative sample and those derived from three studies conducted in Norway, Spain (Galicia), and Korea. The results of only 10 age groups have been presented here because in the normative sample, data have been provided only on these 10 age groups. Also, for the purpose of easier comparison, the standard error (SE) results in the Korean study have been converted and demonstrated as standard deviation (SD) results (using the formula: $SE = SD/\sqrt{n}$).

In Table 2, when we consider significant differences that are occurring repeatedly uni-directionally between Iranian mean scores and those of at least three of the four other countries, the results are:

**Table 2:** Mean scores: comparative results for five countries

| Months | Sample | *N* | Communication | | Gross motor | | Fine motor | | Problem-solving | | Social–personal | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Mean | *P*-value | Mean | *P*-value | Mean | *P*-value | Mean | *P*-value | Mean | *P*-value |
| | U[a] | 1380 | 51 | .00 | 55 | .00 | 49 | .61 | 53 | .42 | 51 | .27 |
| | N[b] | 176 | 50 | .50 | 55 | .00 | 50 | .18 | 55 | .00 | 50 | .07 |
| 4 | S[c] | | | | | | | | | | | |
| | K[d] | 99 | 51.9 | .02 | 51 | 1 | 45.9 | .02 | 53.3 | .52 | 48.6 | .01 |
| | I[e] | 657 | 49.5 | | 51 | | 48.7 | | 52.6 | | 51.6 | |
| | U | 1285 | 54 | .00 | 50 | 1 | 54 | .00 | 52 | .00 | 51 | .00 |
| | N | 165 | 53 | .00 | 47 | .00 | 56 | .88 | 52 | .00 | 51 | .01 |
| 8 | S | | | | | | | | | | | |
| | K | 82 | 43.7 | .00 | 48.4 | .28 | 47.5 | .00 | 47.5 | .00 | 47.6 | .00 |
| | I | 586 | 51.1 | | 50 | | 56.1 | | 55 | | 53 | |
| | U | 1091 | 42 | .00 | 49 | .32 | 49 | .00 | 49 | .00 | 45 | .03 |
| | N | 145 | 42 | .00 | 46 | .01 | 52 | .23 | 51 | .01 | 44 | .03 |
| 12 | S | 34 | 39 | .00 | 40 | .00 | 46 | .00 | 49 | .04 | 38 | .00 |
| | K | 125 | 43.2 | .00 | 51.6 | .15 | 48.8 | .00 | 47.8 | .00 | 41.2 | .00 |
| | I | 672 | 48.3 | | 49.7 | | 53 | | 53 | | 46.5 | |
| | U | 976 | 49 | .23 | 55 | .65 | 52 | .00 | 50 | .00 | 48 | .00 |
| | N | 146 | 42 | .00 | 57 | .01 | 54 | .00 | 54 | 1 | 48 | .02 |
| 16 | S | 34 | 38 | .00 | 52 | .13 | 45 | .00 | 46 | .00 | 46 | .07 |
| | K | 131 | 38.9 | .00 | 55.9 | .29 | 46.8 | .00 | 46.6 | .00 | 44.1 | .00 |
| | I | 556 | 48.2 | | 54.7 | | 50.5 | | 54 | | 50.2 | |
| | U | 845 | 48 | .00 | 55 | 1 | 54 | .00 | 49 | .00 | 53 | .18 |
| | N | 138 | 47 | .00 | 57 | .00 | 52 | .00 | 50 | 11. | 51 | .19 |
| 20 | S | 56 | 38 | .00 | 52 | .08 | 50 | .67 | 44 | .00 | 47 | .00 |
| | K | 144 | 39.3 | .00 | 55.7 | .46 | 45.3 | .00 | 45.4 | .00 | 50.4 | .06 |
| | I | 494 | 50.9 | | 55 | | 49.4 | | 51.4 | | 52.2 | |
| | U | 820 | 50 | .00 | 54 | .00 | 53 | .00 | 51 | .29 | 52 | .09 |
| | N | 128 | 53 | .38 | 56 | .00 | 53 | .00 | 50 | .66 | 51 | 1 |
| 24 | S | 56 | 44 | .00 | 50 | .15 | 53 | .00 | 48 | | 48 | .04 |
| | K | 144 | 48.9 | .00 | 55.3 | .00 | 48.3 | .28 | 48.8 | .08 | 48.5 | .00 |
| | I | 554 | 53.9 | | 52.4 | | 47.4 | | 50.4 | | 51 | |
| | U | 562 | 56 | .23 | 51 | .00 | 50 | .00 | 51 | .00 | 53 | .22 |
| | N | 134 | 57 | .02 | 56 | .00 | 50 | .09 | 52 | .06 | 53 | .36 |
| 30 | S | 86 | 54 | .27 | 53 | .84 | 53 | .00 | 49 | | 51 | .18 |
| | K | 223 | 53.2 | .01 | 53.4 | .82 | 49.5 | .10 | 51.1 | .00 | 49.8 | .00 |
| | I | 498 | 55.3 | | 53.2 | | 47.9 | | 53.7 | | 52.3 | |
| | U | 512 | 54 | .11 | 55 | .00 | 52 | .00 | 55 | .01 | 53 | .00 |
| | N | 126 | 54 | .25 | 56 | .00 | 52 | .00 | 54 | .73 | 53 | .00 |
| 36 | S | 70 | 54 | .44 | 52 | .48 | 54 | .00 | 48 | - | 51 | .24 |
| | K | 226 | 54.8 | .90 | 55.2 | .01 | 53.3 | .00 | 53.2 | .48 | 50.1 | .52 |
| | I | 548 | 54.9 | | 53 | | 49.1 | | 53.7 | | 49.6 | |
| | U | 336 | 56 | .00 | 52 | .30 | 44 | .01 | 57 | .00 | 49 | .00 |
| | N | 100 | 56 | .00 | 54 | .00 | 50 | .41 | 54 | .00 | 56 | .00 |
| 48 | S | | | | | | | | | | | |
| | K | 224 | 52.6 | .04 | 52.5 | .06 | 51.1 | .00 | 52.1 | .00 | 53.9 | .00 |
| | I | 545 | 53.9 | | 51.2 | | 46.5 | | 49.6 | | 51.8 | |
| | U | 125 | 50 | .00 | 52 | .08 | 51 | .00 | 51 | .00 | 54 | .53 |
| | N | 82 | 55 | .46 | 55 | .14 | 51 | .00 | 52 | .00 | 56 | .00 |
| 60 | S | | | | | | | | | | | |
| | K | 321 | 50.6 | .00 | 53.2 | .40 | 52.7 | .00 | 55.1 | .00 | 54.1 | .39 |
| | I | 481 | 54.5 | | 53.8 | | 43.7 | | 46 | | 53.5 | |

a. U: US, b. N: Norway, c. S: Spain (Galicia), d. K: Korea, e. I: Iran

- Iranian children demonstrate significantly higher scores at12 months in all domains except the gross motor; at16 months in the communication, problem-solving, and social-personal; at 8 months in the problem-solving and social-personal and at 20 months in the communication and problem-solving domains.

Iranian children demonstrate significantly lower scores at 24 and 36 months in the gross and fine motor, at 48 months in the problem-solving and at 60 months in the fine motor and problem-solving domains. In the communication domain, the Iranian mean scores are significantly higher at 12, 16, 20, and 24 months; in gross motor they are significantly lower at 24 and 36 months; in fine motor they are significantly lower at 12, 24, 36, and 60 months; in problem-solving s they are significantly higher at 8, 12, 16, and 20, and significantly lower at 48 and 60 months; and finally in the social-personal domain they are significantly higher at 8, 12, and 16 months.

At other age ranges than those mentioned above, significant differences between Iranian figures and those of the other four countries seem to be randomly distributed and no specific pattern can be detected.

When comparing only with the normative sample results, at 8 and 12 months, Iranian children demonstrated significantly higher scores in at least three domains (including the fine motor, problem-solving and social-personal domains). Whereas at 36 months they showed significantly lower scores in the same domains as well as the gross motor. At other age ranges, the significant differences did not seem to follow any specific pattern. When considering each domain separately across all age groups, one considerable result is the significantly lower Iranian mean scores in the fine motor domain in six different age groups of 16, 20, 24, 30, 36 and 60 months.

## Discussion

In terms of cultural and linguistic appropriateness for Iranian children, several items underwent modifications, most of which were in the 'communication' domain. A similar process of item modifications took place in two studies performed on Korean (21) and Turkish children (22). Conversely, in two separate studies performed on Norwegian and Dutch children no needs for modifications in the contents of the test were reported (18, 23). Unlike the authors of the Turkish study who have concluded that despite the modifications, their study supports the idea of cultural independence of the test (25), we believe that considering the several modifications that were needed in order to prepare ASQ for implementation in the Iranian society as well as the Korean and Turkish studies, it cannot be considered totally culture-free, especially considering countries outside the Western zone.

In terms of validity and reliability, our findings show a satisfactory level for each. This finding is consistent with several other studies (7, 14-23) which have generally shown the test validity and /or reliability lying in the range of 70% to 100%. In the two studies that have covered the full age range of 4 to 60 months, the figures reported for sensitivity, specificity and reliability respectively have been 75.8%, 87.5%, and94% in the US study (15), and 94%, 85%, 82.1%(test-retest reliability) and 87%(inter-rater reliability) in the Turkish study (22).

One pattern that can be noted when comparing the mean scores of the Iranian children with that of the other four countries is that Iranian children seem to be at a higher developmental level than children of the other four countries are at ages below 24 months, after which they seem to decline developmentally and demonstrate lower developmental status.

A similar phenomenon was reported after developmental assessment of Filipino infants using the Griffiths Mental Development Scales and comparing the results with those of British infants. The researchers suggested that differences in such factors as: genetics, nutrition and breastfeeding, environmental stimulation and mother-child interaction, socio-economic status and maternal intelligence quotient played a role (24).

In another study, scores obtained on the revised Bayley Scales of Infant Development II by children from low-income families were compared

with those of the normative sample. This study showed that in infants, scores were consistent in the two groups, whereas the toddlers of the former group obtained lower mental, motor and behavioral scores. Black concluded that this was either explained by a lack of enriching care-giving practices for toddlers in low-income families which did not development is guided by species-specific self-righting processes that protect infants from fulfill the requirements of toddlerhood, or the canalization theory in which early many environmental influences (25).

The same explanations can be offered for our finding. In addition, it must also be noted that in Iran, the ministry of health has continuously promoted exclusive breast-feeding from about 20 years ago. The Iranian and Islamic cultures themselves are also supportive of this practice. It may be possible that after complete weaning, that is at about 24 months, the Iranian children's nutritional requirements are not ideally met which may also affect their development.

Another pattern that was noted when comparing the mean scores is that Iranian children seem to be at a better-off situation in terms of the communication, problem-solving and social-personal domains respectively, especially before 24 months. The domain showing the least signs of significant differences with children in other countries appears to be the gross motor domain, and the fine motor domain seems to be the domain at which Iranian children are the weakest developmentally.

Our finding is not consistent with the findings of the Korean study, which showed significantly lower mean scores in the communication and problem-solving domains at several age intervals (21). Our finding is also inconsistent with the findings of the Dutch study performed only at 48-months, which showed that problem-solving scores were higher in the US sample (17), while fine motor scores were higher in the Norwegian samples (24). A major strength of this study was that it was based on prospective data acquired from a very large and random nation-wide sample including the diverse cultures and socio-economic groups existing in the Iranian population and that it included all of the 19 age-specific questionnaires of the ASQ. The major limitation of this study however, was our inability to determine concurrent validity of the test with a gold standard due to inaccessibility, as explained before.

## Conclusion

The reliability of ASQ ranged from 0.76 to 0.86, and the validity was satisfactory. The developmental status of Iranian children tended to be higher in the communication, problem-solving and personal-social domains, especially under the age of 24 months, after which it seemed to deteriorate, especially in the gross and fine motor domains.

## Ethical considerations

Ethical issues (Including plagiarism, Informed Consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc) have been completely observed by the authors.

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