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Testing the Cross-Cultural Clinical Utility of the VMI for Palestinian, Israeli, and American Typically Developing Kindergarten Children

Tamara Avi-Itzhak[1*], Doris R Obler[2], Taisir M. Abdallah[3], Batya Engel-Yeger[4] and Naomi Josman[4]

[1]*Department of Occupational Therapy, York College, The City University of New York, 94-20 Guy R. Brewer BLVD. Jamaica, New York ,USA*

[2]*Department of Occupational Therapy, Long Island University-Brooklyn, Brooklyn, New York , USA*

[3]*Department of Psychology & Child Center, Al-Qudes University, Jerusalem, Israel*

[4]*Department of Occupational Therapy, Joint program, Faculty of Social Welfare & Health Sciences, University of Haifa and Technion, Haifa, 31905, Israel*

[*]**Corresponding author:** Tamara Avi-Itzhak, Associate Program Director, Associate Professor, Department of Occupational Therapy, York College, The City University of New York, 94-20 Guy R. Brewer BLVD. Jamaica, New York 11451, USA, Tel: 718-262-3761; Fax: 718-262-2767; E-mail: taviitzhak@york.cuny.edu

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Abstract

Purpose: To assess the cross-cultural clinical utility of the Visual Motor Integration (VMI) standardized U.S. norms for typically developing Palestinian, Israeli, and American kindergarten children. The cross-cultural comparisons tested the extent to which the VMI standardized U.S. norms for all three tests (a) are appropriate for use with the aforementioned groups without the need for cross-cultural adaptations, and (b) have adequate rates of test sensitivity and specificity such that study classification results are comparable with those obtained using the VMI U.S. norms.

Methods: The sample was comprised of 134 typically developing kindergarten children. Results: The observed mean performance scores were not significantly different from the published U.S. norms on all three tests for the Palestinian group and significantly higher for the Israeli group on all three tests. For the American group, scores were higher on the Visual Motor Integration and Visual Perception tests, but lower on the Motor Coordination test. The sensitivity rates for eight of the nine calculations resulted in perfect agreement between the study classification results and the VMI standardized classification of true positive cases. The specificity rates for the Palestinian group demonstrated perfect agreement between the study classification results and the VMI standardized U.S. norms. The specificity rates obtained for the Israeli and American groups were moderate.

Conclusions: These exploratory findings merit additional research to further assess the clinical utility of employing the VMI U.S. norms with or without cross-cultural adaptations for these specific or any other cultural groups.

Keywords: Cross-cultural effects; Standardized test; Classification agreement

Introduction

Currently, there is considerable worldwide commitment among clinicians to become responsible stewards of best practice and to apply evidence-based practice in providing services [1]. As part of this trend, clinicians worldwide have begun using standardized U.S. tools with strong psychometric properties for clinical purposes with or without appropriate cross-cultural adaptations. The use of standardized normative American data for purposes of local practice with local populations, as well as the translation and adaptation of American instruments for use with populations speaking other languages and from different cultures, are issues drawing increased attention in health-related research and practice [2,3,4]. Findings from cross-cultural studies [5], suggest that differences in performance on developmental tests among subjects from different cultural backgrounds may be attributed to different preferred languages [2,6-7], cultural practices [8,9], test materials and procedures [10,11], race and socioeconomic status [7,12], and environmental and biological factors. These findings highlight the need to ensure that the norms for all tests are appropriate for the specific cultural groups being assessed.

Visual-motor integration is the ability to coordinate visual perception and motor skills [12-14]. Having adequate visual-motor skills is important in and of itself and as a prerequisite to the development of academic skills and learning aptitude [15-18]. Visual-motor skills were found to be effective predictors of handwriting legibility for school-aged children [19-22], learning readiness, reading and math academic performance and behavior [23,24], and participation in sport activities [25,26]. Research has shown that visual-motor skills can be improved and enhanced with therapy. Early identification of children with motor impairment is critical so that remedial intervention can be offered to facilitate full participation in school [9,25,27-31,]. Evaluating visual-motor skills has become one of the most prevalent reasons for referrals to clinicians providing pediatric services [31,32].

The Beery VMI [13], is one of the most extensively utilized standardized tests in the U.S. for assessing visual perception and motor skills in school-aged children who may need treatment [17,19,24,28,31,33]. This test has also been adopted worldwide as a means of assessing visual perception and motor skills in school-aged children [4,28]. Prior testing required cross-cultural adaptation of the test in studies performed in Taiwan [34], and in India [9], where typically developing Indian children ages ten to 14 years attained a

mean Beery VMI raw score at a younger age than the U.S. published norms. The researchers suggest that specific cross-cultural attributes, using fine prehension more than American children when eating with fingers instead of using spoons attributed to the difference. A Turkish translation was found to be valid and cross-cultural testing showed that the test did not require any cross-cultural adaptation [4,9,14]. A noteworthy number of studies have been conducted in Brazil [28], Italy [35], and more recently in Norway [36] and the Netherlands [37,38]. The Beery VMI has been translated into Hebrew and Arabic and used quite extensively in Israel. While assessing cultural effects on children's visual-motor performance, these studies mainly described the differences between the cultural groups. [39], compared the perceptual, motor, and cognitive performance abilities of Bedouin and mainstream Israeli children, using the Beery VMI and found that mainstream Israeli children scored significantly higher than the Bedouins on most of the tests. In another study, [40], compared the visual-motor organization of Ethiopian immigrants, Bedouins, and mainstream Israeli children. The results showed that the Ethiopian and the Bedouin children performed significantly lower than the mainstream Israeli children [41], compared the perceptual and motor skills of Israeli immigrant children from Ethiopia and Israeli-born children aged 6-12 years. Their results showed no significant difference between veteran and recent immigrants. Yet, both these groups performed lower than the Israeli-born children, with the largest gap found between the recent immigrants and the Israeli-born children. In a study using the Beery VMI to compare the visual-motor performance of Israeli and Palestinian children [42], reported that the Palestinian children demonstrated lower performance than the Israeli children. The translation of the VMI was validated in this study. While the Beery VMI has been widely used in Israel for research its applicability in research and practice is limited as currently there are no documented studies evaluating whether differentiated norms of the test are needed for the local cultural groups under investigation.

The aim of this exploratory study was twofold; (a) assess and compare the validity psychometric properties of test sensitivity and test specificity of the Visual Motor Integration (VMI) normative U.S. data for typically developing Palestinian, Israeli and American kindergarten children; and (b) evaluate its cross-cultural clinical utility for the local cultural groups under investigation. The specific cross-cultural testing proposed in this study evaluates the clinical utility of employing the Berry VMI without cross-cultural adaptation for a screening decision by estimating and comparing the ability to obtain true positive classifications (test sensitivity) and true negative classifications (test specificity) between the study (when utilizing the observed cutoff scores) and the published (when utilizing the published cutoff scores) classification results. Practitioners are required to make use of current best practice in making clinical decisions under the universal evidence-based practice paradigm; therefore, the results of the present research would fill an important clinical knowledge gap [43]. These exploratory results extend previously published studies employing the Beery VMI without cross-cultural adaptation.

Methods

Participants

A total of 134 typically developing kindergarten children participated in the study. The average age was 5.47 + 1.784 years. Children with known neurological, developmental or learning disabilities were excluded from the study. A convenience sample of 58 (43%) American children were drawn from an elementary school with which the second author was associated. The school is located in a middle-class neighborhood on Long Island, NY. In addition, 40 (30%) Palestinian and 36 (27%) Israeli kindergarten children were part of the cohort. These participants constituted a representative sample corresponding to the Israeli census [42]. Forty five (34%) resided in cities, 26 (19%) in villages, 5 (4%) in refugee camps and 58 (43%) in suburban areas.

Design

The study was quantitative and cross-sectional of typically developing Palestinian, Israeli, and American kindergarten children.

Instrument

The Berry VMI [13] is a U.S. standardized test with geographic, ethnic and gender representation. Its purpose is to assess the extent to which individuals can integrate their visual and motor abilities, following the perceptual-motor theories claiming that higher levels of thinking and behavior require the ability to integrate sensory inputs and motor action [13,17,44,45]. The measures include the visual-motor integration (VMI) test assessing visual perception and finger-hand movements; the visual perception (VP) test, assessing visual analysis and visual spatial skills in a motor-reduced way; and the motor coordination (MC) test, assessing the ability to control finger and hand movements.

Measures

Visual-motor Integration (VMI) test: Subjects are shown 24 geometric figures, progressing from simple to complex. Possible scores range from 1 to 27. The test is terminated when the subject copies three items in a row incorrectly [13].

Visual Perception (VP) test: Subjects are shown geometrical figures and are given two to seven alternatives from which they are asked to choose the correct one for each figure presented. Possible scores range from 1 to 27. The test is terminated with three consecutive incorrect items or at the 3-minute time limit [13].

Motor Coordination (MC) test: Subjects trace a trail within progressively smaller paths while staying within the confines of a boundary derived from geometrical figures. Possible scores range from 1 to 27. The test is terminated at the 5-minute time limit [13].

Procedures

Upon receiving written consent from a parent or guardian and the local educational authorities, each participant was individually administered the Berry VMI test. For the American sample, the evaluation and scoring of the tests were performed by four occupational therapy graduate students who were trained by the second author in the administering and scoring of these tests according to the test protocols. Data collection was started when the students and the faculty reached almost complete agreement.

Fourteen Israeli occupational therapists and four Palestinian graduate students from Al-Quds University who were trained to administer the test collected the data on the Israeli and the Palestinian samples. At the time of the study, there were no occupational therapists in the Palestinian Authority [42].

Data analysis

Raw scores were converted into standard scores according to the manual's protocol. Descriptive statistics were computed to describe the distributions of the test's three standardized scores. 2x2 contingency tables were used to calculate for the sensitivity and specificity of the observed and published performance scores [46](Portney and Watkins, 2008). Following clinical applications and published procedures, the observed and the published cutoff for predicting performance below normal functional limits was a score < -2 SD. Scores were submitted to preliminary checks for meeting the assumption of normal distribution and were found to be adequately normally distributed. Statistical analyses were carried out employing SPSS/PC Version 18.0.

Results

The observed mean performance scores in comparison with the published U.S. norms on all three Berry VMI tests are presented in Table 1. The VMI observed mean performance score of the Palestinian children was slightly higher than the published U.S. norms (105 vs. 100, respectively). In regard to the Israeli sample, the observed mean performance scores were higher than the published U.S. norms on all three tests (VMI: 112 vs. 100; VP: 115 vs. 100; and MC: 112 vs. 100, respectively). In regard to the American sample, the observed mean performance scores were higher than the published U.S. norms on the VMI and VP tests (VMI: 109 vs. 100; and VP: 106 vs. 100, respectively), but lower on the MC test (92 vs. 100).

Performance			
Test		Observed	Publisheda
Cultural Group	N	M (SD)	M (SD)
VMI			
Palestinian	40	105 (19)	100 (15)
Israeli	36	112 (15)	100 (15)
American	58	109 (10)	100 (15)
VP			
Palestinian	40	100 (23)	100 (15)
Israeli	36	115 (15)	100 (15)
American	58	106 (17)	100 (15)
MC			
Palestinian	40	100 (26)	100 (15)
Israeli	36	112 (13)	100 (15)
American	58	92 (13)	100 (15)
Note. a VMI published U.S. norms (Beery, 1997). VMI= Visual Motor			
Integration Test; VP=Visual perception Test; MC=Motor Coordination Test			

Table 1: Comparing Observed Performance to U.S Published Norms of developmental Test of Visual Motor Integration (VMI) by Cultural Groups.

Results pertaining to the comparability of the observed classification results (utilizing the observed cutoff scores) with those obtained using the published U.S. norms (utilizing the published cutoff scores) for the VMI, VP, and MC tests are presented in Table 2. For the Palestinian group, the sensitivity rates (true positive classification) on the VMI and MC tests were in 100% perfect classification agreement. The same number of children who were classified below the VMI and MC normal functional limits according to the published U.S. cutoff scores received a similar study classification using the study cutoff scores. The sensitivity rate on the VP test was less strong at 75%. Of the eight children classified below the VP normal functional limits by the published U.S. norms, two were classified within the normal functional limits according to the observed performance scores. The specificity rates (classification of true negative cases) on all three tests were in 100% perfect classification agreement. All children who were classified within the normal functional limits by the VMI standardized norms received a similar study classification.

For the Israeli group, the sensitivity rates on all three tests were in 100% perfect classification agreement. No children were classified below the VMI and MC normal functional limits according to the published U.S. cutoff scores or below the study classification cutoff scores. On the VP test, one child who was classified below the normal functional limits according to the published U.S. norms was also classified below the normal functional limits by the observed performance score. The specificity rate on the MC test was strong at 92%. As listed on Table 2, three of the 36 children who received normal classifications according to the published U.S. norms were also classified below the normal functional limits by the study classification. The specificity rates on the VP and VMI tests were slightly lower at 88% and 86%, respectively. On the VP test, four of the 35 children classified within the normal functional limits by the published U.S. cutoff scores were also classified below the normal functional limits by the study cutoff scores. On the VMI test, five of the 36 children who were classified within the normal functional limits by the VMI published norms were classified below the normal functional limits by the observed performance scores.

VMI				**VP**			**MC**		
Classification				Classification			Classification		
	Below[1]	Normal	Total	Below[1]	Normal	Total	Below[1]	Normal	Total
Observed Palestinian Group	Published2 Norms			Published2 Norms			Published2 Norms		
Below[1]	4(3%)	0(0%)	4(10%)	6(15%)	0(0%)	6(15%)	0(0%)	0(0%)	0(0%)
Normal	0(0%)	36(90%)	36(90%)	2(5%)	32(80%)	34(85%)	10(25%)	30(75%)	40(100%)

Total	4(3%)	36(90%)	40(100%)	8(20%)	32(80%)	40(100%)	10(25%)	30(75%)	40(100%)
Sensitivity=100%		Sensitivity=100%		Sensitivity=75%		Sensitivity=100%	Sensitivity=100%		Sensitivity=100%
Observed Israeli Group	Published[2] Norms			Published[2] Norms			Published[2] Norms		
Below[1]	0(0%)	5(14%)	5(14%)	1(3%)	4(11%)	5(14%)	0(0%)	3(8%)	3(8%)
Normal	0(0%)	31(86%)	31(86%)	0(0%)	31(86%)	31(86%)	0(0%)	33(92%)	33(92%)
Total	0(0%)	36(100%)	36(100%)	1(3%)	35(97%)	36(100%)	0(0%)	36(100%)	36(100%)
Sensitivity=100%		Sensitivity=86%		Sensitivity=100%		Sensitivity=88%	Sensitivity=100%		Specificity=92%
Observed American Group	Published[2] Norms			Published[2] Norms			Published[2] Norms		
Below[1]	0(0%)	12(21%)	12(21%)	4(7%)	6(10%)	10(17%)	0(0%)	0(0%)	0(0%)
Normal	0(0%)	46(79%)	46(79%)	0(0%)	48(83%)	48(83%)	5(9%)	53(91%)	58(9%)
Total	0(0%)	58(90%)	58(100%)	4(7%)	54(93%)	58(100%)	5(9%)	53(91%)	58(100%)
Sensitivity=100%		Sensitivity=79%		Sensitivity=100%		Sensitivity=89%	Sensitivity=100%		Sensitivity=100%
Note. [1] Observed and published performance below the normal functional limits was									
defined as a score < -2 SD below the mean.									
[2] VMI (Beery-Buktenica, 1997). VMI= Visual Motor Integration Test; VP=Visual									
perception Test; MC=Motor Coordination test									

Table 2: Sensitivity and Specificity for the Developmental Test of Visual Motor. Integration (VMI) Using Observed and Published Performance Classification Scores by Cultural Groups.

For the American group, the sensitivity rates on all three tests were in 100% perfect agreement. No children were classified below the VMI and MC normal functional limits of the published U.S. norms or below the study classification results. On the VP test, four children were classified below the normal functional limits by the published U.S. norms and according to the study classification. The specificity rate on the MC test was in 100% perfect agreement. As shown in Table 2, the same numbers of children were classified within the normal functional limits by the published U.S. norms and by the observed performance scores. The specificity rates on the VP and VMI tests were lower at 89% and 79%, respectively. On the VP test, six of the 54 children who were classified within the normal functional limits by the published U.S. norms were classified below the normal functional limits by the observed performance scores. On the VMI test, 12 of the 58 children who were classified within the normal functional limits by the VMI published norms were classified below the normal functional limits by the observed performance scores.

Discussion

The first aim of this exploratory study was to assess and compare the rates of the validity psychometric properties of test sensitivity and test specificity of the Beery VMI [13], normative U.S. data when applied to typically developing Palestinians, Israeli and American kindergarten children. Sensitivity and specificity measure two possible outcomes attesting to the clinical utility of the Beery VMI in screening visual perception and motor skills in children. Using the Beery VMI without cross-cultural adaptation for screening performance generated very strong sensitivity (true positives) rate and slightly weaker specificity (true negatives) rate. Consequently, the test was more effective in correctly classifying children whose performance was below normal functional limits (true positives) than children whose performance was within functional limits (true negatives) [46,47]. The specificity rates revealed varying levels of classification agreement reflecting cultural differences. The specificity rate obtained for the Palestinian group demonstrated perfect agreement between the study classification results and the Beery VMI standardized U.S. norms for true negative classifications. Meaning that all the children whose performance was within the normal functional limits identified as such using the study and the published U.S. cutoff scores. However, five of the six specificity calculations performed for the Israeli and American groups resulted in moderate specificity rate, therefore in moderate classification agreements. A number of Israeli and American kindergarten children whose performance was within the normal functional limits on all three tests according to the study cutoff scores were classified below the normal functional limits by the published cutoff scores. These findings support findings by [9], that Indian children ages ten to 14 years attained a mean Beery VMI raw score at a younger age than typically developing American children. The ability to correctly classify Israeli and American children whose performance is within normal functional limits (true negatives) when using the Beery VMI without cross-cultural adaptation was lower than the ability to correctly classify Palestinian "true negative" children.

These findings also address the second aim of the study, namely, to evaluate the cross-cultural clinical utility of the test for the local

cultural groups under investigation. The findings indicate that this test is a useful diagnostic or screening test for clinical or research applications in assessing the motor and perceptual skills of typically developing Palestinian, Israeli and American kindergarten children without cross-cultural adaptations. Using the Beery VMI without cross-cultural adaptation did not appear to compromise clinical decisions. However, further research is needed to replicate these exploratory findings with different and larger samples. These findings highlight the potential of the test to become a useful diagnostic tool for clinical or research applications for assessing deficiencies in the motor and perceptual skills of typically developing Palestinian and Israeli kindergarten children.

Review of the descriptive data indicated that when compared to the standardized U.S. norms, the observed mean performance scores for the Israeli and the American groups were higher on all the tests, with only two exceptions. The observed mean performance score for the Palestinian group was similar to the published U.S. norm. That the observed mean performance of the American group outscored the published U.S. norms is noteworthy, yet calls for a cautious interpretation. Because the American sample was a convenience sample drawn from an elementary school located in a middle-class, neighborhood, it is not unreasonable to suggest that many of these children may have attended preschools where they had the opportunity to increase their motor and perceptual skills.

The Beery VMI, like other diagnostic or screening tools, is used to make clinical decisions according to whether performance assessed is within or below the normal functional limits, based on cutoff scores that justify an intervention or a discharge [47]. Selecting an appropriate diagnostic tool is a crucial part of the identification process and needs to be geared toward the cultural values and characteristics of the child being tested [48].

Limitations

The study has a number of limitations. First, the sample sizes of all three cultural groups small. Moreover, the American sample was a convenience sample and as such has limited external validity. Finally, the low prevalence rate of children whose performance was below the normal functional limits may have increased the sensitivity rate. However, for populations of typically developing kindergarten children, such low prevalence is inescapable.

Clinical implications

The findings of the study have universal clinical implications. As noted earlier, under the universal evidence-based practice paradigm, clinicians are required to make purposeful use of current best evidence in making clinical decisions [43], when evaluating motor and visual skills. This requirement has led clinicians to use the Beery VMI standardized U.S. data for purposes of local practice with local populations, either with or without cross-cultural adaptations [1-4,49]. Such use of standardized tests is a cause for concern among clinicians and researchers who question the clinical usefulness of adapting tests developed in the U.S. for use in other cultures [5,50]. The evidence-based paradigm requires that clinicians not only know how to provide appropriate intervention, but also know the likelihood of its effectiveness [43]. Currently, evidence-based policies and strategies for best-practice in cross-cultural use of the Beery VMI are limited. The present exploratory study represents the first attempt to test the clinical validity of Beery VMI normative data for use in the specific cultural groups under investigation. These findings fill an important clinical knowledge gap by providing clinicians with the awareness and ability to assess the clinical utility of the Beery VMI, or for that matter any U.S. standardized norms for local practice, and its impact on clinical decisions.

Conclusions

Results of the study provide encouragement that cross-cultural adaptations of the Beery VMI are useful strategies for employing standardized assessment tools for children of different cultural backgrounds. The validity of the Beery VMI for differentiating between the cultural groups under investigation should be further studied in order to better understand whether the differences between the observed and published mean performance scores represent an accurate assessment of performance. Future research is needed to identify those areas of the Beery VMI that require cross-cultural adaptation and those which do not.

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