Motor Development of Native American Children on the Peabody Developmental Motor Scales

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Key Words: cultural characteristics (sociology) • motor skills evaluation

Objective. Native American children have not been widely represented in the normative samples of standardized tests assessing motor development. This study investigated the cultural relevance of the Peabody Developmental Motor Scales (PDMS) in 2-year-old Native American children who are typically developing.

Method. The PDMS was administered to a sample of 44 Pueblo children who were 24 months through 35 months of age and typically developing. Each child’s family also completed a parent questionnaire addressing the child’s development and family demographics. Participant scores were compared with those of the normative sample.

Results. The sample scored significantly lower than the normative sample ($p \leq .001$) on the Fine Motor Scale, and, when gender was taken into consideration, all but the older girls (30 months–35 months of age) had significantly lower scores. All but the younger girls (24 months–29 months of age) scored within the normal range on the Gross Motor Scale.

Conclusion. Our results with this small sample suggest that caution be used when comparing motor performance (especially fine motor abilities) of 2-year-old Native American children against the PDMS normative data.


Because differences in motor development have been found among various ethnic groups (Cintas, 1995), the cultural relevance of standardized developmental tests must be examined. Such a project is especially important because these tests are used to determine whether a child is developing typically or is in some way delayed, requiring special services (Krefting, 1991). Many states, for example, require the administration of standardized motor assessments to determine whether children qualify for early intervention or special education services. The Peabody Developmental Motor Scales (PDMS; Folio & Fewell, 1983) is frequently selected for this purpose.

The PDMS were normed on 617 children, 85% of whom were white and 15% of whom were nonwhite (either African-American or Hispanic). There are 16 age groups for the Fine Motor Scale and 17 age groups for the Gross Motor Scale. Because only 0 to 6 nonwhite children were included within each of the age groups, white children and nonwhite children within age groups were not statistically compared. Because the performance of the nonwhite children as a group was found well within the normal range, the test authors concluded that the PDMS provides valid scores for African-American and Hispanic children, but “whether this is true for other ethnic and/or cultural groups remains to be determined” (Folio & Fewell, 1983, p. 119).

Motor assessments designed for children of the domi-
nant or mainstream culture are not always appropriate for those from other ethnic backgrounds (Lynch & Hanson, 1992). Developmental norms and expectations as well as life experiences may differ from ethnic group to ethnic group. This is especially true for activities that children have not had the opportunity to practice, such as using scissors or riding tricycles, or for gender-associated and culture-associated tasks, such as ball playing or coloring.

The cultural relevance of a motor assessment for a particular ethnic group can be examined by comparing the scores of children from one ethnic group with the scores of the children on whom the test was normed. Few studies have examined motor development in Native American children. It was found that the scores of Navajo infants on the Wolanski Gross Motor Evaluation (WGME) did not correspond with that of the normed population (Stratman, 1992). This suggests that the WGME is inappropriate for use with Navajo infants. When Kerfeld, Guthrie, and Stewart (1997) compared the scores of 102 Alaska Native children 2 weeks to 6 years of age, on the Denver II with the normative data, they found that many of the Alaska Native children performed skills at earlier ages than did the normative sample, especially skills in the gross motor domain. It was hypothesized that the results may be influenced by differences in child-rearing practices: Unlike the normative sample, Alaska Native children have greater freedom to explore their environment, and caregiving is often turned over to an older sibling. The authors concluded that scores of Native American children on the Denver II should be interpreted carefully to avoid misclassifications of these children, which could possibly lead to overreferrals or underreferrals of children for services.

Results of other studies that explored fine motor and perceptual development in older, school-age Native American children reported mixed results, with one study reporting no significant difference on the Berry Developmental Test of Visual-Motor Integration and the Bender-Gestalt Test (Connelly, 1983) and other studies reporting development below age expectations on the Bender-Gestalt Test and the Minnesota Percepto-Diagnostic Test–Revised (Fuller & Vance, 1995; Price, 1976; Taylor & Thweatt, 1972). No studies were found that examined gross motor ability in older Native American children. This study investigated the cultural relevance of the PDMS by comparing the scores of a sample of 2-year-old Native Americans with those of the normative sample.

Method

Sample

A power analysis indicated that a difference as small as .5 standard deviation or 2 to 3 months in development could be detected with a sample size of 30 for 80% power and an alpha equal to .05. Therefore, a convenience sample of more than 30 was sought. Two-year-old Native American children who were typically developing were recruited for the study from one New Mexico pueblo with the assistance of the Pueblo Early Childhood Program, Child Find, and daycare programs and through recruiting posters placed in public locations around the pueblo. The study criteria were (a) parental report as a full-term, single birth with no significant medical history; (b) parental report of typical development assessed by an investigator-developed parent questionnaire; and (c) a passing score on the fine-motor-adaptive and gross motor sectors of the Denver II (Frankenburg et al., 1990). Of the 48 children recruited, 4 were eliminated after screening on the Denver II.

The 44 children were divided into two groups that were based on PDMS age categories. Group A consisted of 22 children (11 boys, 11 girls) 24 through 29 months of age (M = 26 months, SD = 2 months), and Group B consisted of 22 children (13 boys, 9 girls) 30 through 35 months of age (M = 33 months, SD = 1.6 months). Forty-four children completed the Peabody Developmental Fine Motor Scale (PDFMS), and 43 children completed the Peabody Developmental Gross Motor Scale (PDGMS) because the PDGMS was unscorable for 1 child in Group A because of excessive refusals.

Mothers of children in Group A reported the following educational experience: 45% had attended a university, technical school, or community college; 36% had completed 4 years of high school; 5% had received a general equivalency diploma (GED); and 14% had completed fewer than 4 years of high school. Mothers of children in Group B reported that 40% had attended a university, technical school, or community college; 45% had attended 4 years of high school; 5% had received a GED; and 10% had completed fewer than 4 years of high school. Parents and children received a small financial incentive to participate in the study.

Instruments

A 20-item parent questionnaire was developed to address basic demographic information and indications of typical development. Items included parental education, the child’s developmental milestones, and environmental experiences, such as the amount of practice the child has had with stairs or coloring.

The Denver II (Frankenburg et al., 1990) is a normed and standardized developmental screening test, which scores a child as normal, suspect, or untestable. If the score is suspect or untestable, the individual test can be assessed as to which specific sectors (fine-motor-adaptive, gross motor, personal-social, language) contained items that were not passed.

The PDMS is a norm-referenced and standardized motor skill test that consists of a Gross Motor Scale and a Fine Motor Scale (Folio & Fewell, 1983). The normative sample in the 24-month to 29-month age category included 42 Anglo, 5 African-American, and 4 Hispanic children;
in the 30-month to 35-month age category, it included 40 Caucasian, 4 African-American, and 2 Hispanic children. The norms on the PDMS for each of its two scales include percentile ranks, age equivalent scores, and normalized standard scores, including z scores and developmental motor quotients (DMQs). The PDMS items are scored 0 when the child’s performance does not meet the stated criteria, 1 when the performance partially meets criteria, and 2 when the child’s performance meets all of the stated criteria. The more conservative scoring method described by Palisano (1990), which uses scores of 1 less often, was used in this study instead of the more liberal scoring method of Hinderer, Richardson, and Atwater (1989).

**Procedure**

All children’s parents signed a consent form. The developmental testing (including the Denver II and the PDMS) took from 60 min to 90 min, depending on the child’s cooperation. At least one parent or relative, who completed the questionnaire, was present. Sometimes other family members, such as grandparents or siblings, also attended the evaluation. All children were tested by an occupational therapist with more than 20 years of pediatric experience, including 11 years experience testing preschool-age children. Children were tested in rooms provided by the Pueblo’s Division of Early Childhood Education.

Interrater agreement on the PDMS was assessed between the examiner and one of the authors, a physical therapist with more than 20 years of pediatric experience, including 11 years experience testing preschool-age children for a developmental evaluation program. Before data collection, interrater agreement that was tested on three children ranged from 89% to 97% (M = 93.8%). In addition, interrater agreement was examined periodically during the data collection. Interrater agreement on six children who were tested periodically (two tested each time) ranged from 85% to 97.5% (M = 92.4%).

**Data Analysis**

Descriptive statistics of the groups (means, standard deviations, and ranges for z scores, percentile ranks, and DMQs) were calculated for the PDFMS and the PDGMS. Data were compared to the normative data by one-sample t tests of the z scores using age groups. Further comparison of z scores by age and gender were done by two-way analysis of variance (ANOVA).

**Results**

Descriptive data on the PDFMS and the PDGMS for mean DMQ, percentile ranks, and z scores of children in Groups A and B are presented in Table 1.

The analysis of z scores by age groups (one-sample t tests) indicated that there was a significant difference between Group A PDFMS z scores and the normative data (p ≤ .0001) and between Group B PDFMS z scores and the normative data (p ≤ .05). No significant differences were found in either age group for z scores on the PDGMS.

The two-way ANOVA for gender and age group revealed a significant difference between Group A PDFMS z scores for both boys and girls and the normative data (p ≤ .001) and for Group B boys (p ≤ .05) but not for Group B girls (see Table 2). There was a significant difference between Group A PDGMS z scores for girls and the normative data (p ≤ .5) but not between Group B PDGMS z scores for girls and the normative data. There was no significant difference between Group A and Group B boys and the normative data on the PDGMS. A significant (p ≤ .05) gender effect was found for the PDGMS for the younger 2-year-olds (Group A), with boys having higher scores than girls.

The percentage of children in the study with z scores falling above –1.00, and at or below –1.00, –1.50, and –2.05, are presented in Table 3. In the total sample, 36.5% scored at or below –1.5 standard deviations from the normative mean on the PDFMS, and 4% scored at or below 1.0 on the PDGMS.

**Discussion**

When assessing development for the purpose of diagnosis or classification, the primary concern for the pediatric clinician is not whether a child achieves the mean score, but whether the score falls within the range demonstrated by

<p>| Table 1 |
| Descriptive Data for the Peabody Developmental Fine Motor Scale and Gross Motor Scale for Two Groups |</p>
<table>
<thead>
<tr>
<th>Scale</th>
<th>Group A</th>
<th>Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine Motor Scale*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DMQ x (SD)</td>
<td>77.1 (11.7)</td>
<td>90.5 (16.5)</td>
</tr>
<tr>
<td>Low score/high score</td>
<td>65(109)</td>
<td>65/117</td>
</tr>
<tr>
<td>Percentile x (SD)</td>
<td>11.5 (17.6)</td>
<td>35.5 (28.7)</td>
</tr>
<tr>
<td>Low score/high score</td>
<td>1/73</td>
<td>1/87</td>
</tr>
<tr>
<td>z score x (SD)</td>
<td>–1.5 (0.8)**</td>
<td>–0.6 (1.1)*</td>
</tr>
<tr>
<td>Low score/high score</td>
<td>–2.3/0.6</td>
<td>–2.3/1.1</td>
</tr>
<tr>
<td>Gross Motor Scaleb</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DMQ x (SD)</td>
<td>95.0 (13.7)</td>
<td>99.2 (14.3)</td>
</tr>
<tr>
<td>Low score/high score</td>
<td>65/118</td>
<td>79/118</td>
</tr>
<tr>
<td>Percentile x (SD)</td>
<td>40.1 (27.7)</td>
<td>49.3 (31.6)</td>
</tr>
<tr>
<td>Low score/high score</td>
<td>1/88</td>
<td>8/89</td>
</tr>
<tr>
<td>z score x (SD)</td>
<td>–0.5 (0.9)</td>
<td>–0.04 (0.95)</td>
</tr>
<tr>
<td>Low score/high score</td>
<td>–2.3/1.2</td>
<td>–1.4/1.2</td>
</tr>
</tbody>
</table>

Note. Significant differences when compared to Peabody Developmental Motor Scales normative data. DMQ = developmental motor quotient. *n=22 for both groups. b n=21 for Group A and n=22 for Group B. 

<p>| Table 2 |
| Girls’ and Boys’ Mean z Scores (SD) by Group |</p>
<table>
<thead>
<tr>
<th>Scale</th>
<th>Group A</th>
<th>Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine Motor Scale*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td>–1.5 (0.9)**</td>
<td>–0.6 (1.0)*</td>
</tr>
<tr>
<td>Girls</td>
<td>–1.5 (0.7)**</td>
<td>–0.6 (1.2)</td>
</tr>
<tr>
<td>Gross Motor Scaleb</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td>+0.2 (0.6)</td>
<td>+0.3 (0.9)</td>
</tr>
<tr>
<td>Girls</td>
<td>–0.8 (1.0)*</td>
<td>–0.5 (0.8)</td>
</tr>
</tbody>
</table>

Note. Significant differences when compared to Peabody Developmental Motor Scales normative data. 

n= 22 for both groups. b n= 21 for Group A and n = 22 for Group B. 

*p ≤ 0.5. **p ≤ .001. ***p ≤ .0001.
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The PDMS manual notes that "several school districts and states across the country have adopted 1.0 and 1.5 standard deviations below the mean as the cutoff points for identifying moderate and severe deficits respectively" (Folio & Fewell, 1983, p. 125). Fewer than 25% of the younger 2-year-old Native American children from this one New Mexico pueblo scored greater than –1.0 standard deviations below the mean of the PDFMS. It is distressing to note that if the typically developing Native American children in this study had been referred for developmental testing, more than 50% of them might have been labeled at least "mildly or moderately delayed" in fine motor skills because of \( z \) scores less than –1.0, and almost 25% might have been labeled at least "mildly or moderately delayed" in gross motor skills. In addition, 36% of the children might have been labeled "severely delayed" in fine motor skills because of \( z \) scores less than –1.50, with close to 25% scoring below –2.05 on the PDFMS.

When children's scores on standardized tests fall less than –1.0 standard deviation below the mean, professionals seek to discover possible reasons for the "delays." There are several possible factors that may have contributed to the lower scores of the children in this study, including scoring factors, test performance factors, gender differences, cultural expectations, and rate of maturation differences. It should be emphasized that all of the children were judged to be typically developing by their parents and that the children also passed the motor sectors of the Denver II.

The conservative method of scoring the PDMS that was used in this study has been noted to contribute to lower scores of older children on the PDGMS (Green, Deitz, & Brady, 1995), but the extent to which use of the conservative method (Palisano, 1993) versus the more liberal scoring method (Hinderer et al., 1989) would affect the scores of children who are younger is unknown. Aspects of the PDMS 6-month category scoring system also may have contributed to participants' lower scores. Because of the 6-month age categories, participants in each age group (24–30 months, 29–35 months) were scored the same, even though they might have 5 months of developmental difference in their performances. The mean age of Group A was 26 months, and the mean age of Group B was 33 months. The scores of each group might have been higher if the average age was slightly older. However, the mean age in months of the PDMS normative sample was comparable—26 months for the 24-month to 29-month category, and 32 months for the 30-month to 35-month category—suggesting that the mean age was not a major factor influencing the lower scores.

The native American children in this study may not have demonstrated their true abilities because of test performance factors, such as shyness or caution in a new situation. The tester had many years of experience in making children comfortable, and the tests themselves were conducted within the familiar surroundings of the pueblo's community buildings. However, the tester was not Native American, and the children may have been uncomfortable. Indeed, one child refused too many items to score the PDGMS.

The gender differences found in this Native American sample were not expected on the basis of the findings for the normative sample. Gender differences in children of a specific ethnic group or culture may result from differences in genetically endowed physical aptitude or to differences in cultural expectations and environmental practices. Boys in the two age groups that were examined scored lower than the normative data in fine motor skills but not in gross motor skills. Younger but not older girls scored lower than the normative data on both scales. It is possible that gross motor activities, including ball playing, running, and jumping, may be encouraged, expected, and therefore practiced in young boys of the pueblo, whereas young girls may be less encouraged to engage in these activities. Fine motor activities, such as the use of crayons, may not be encouraged as strongly in the boys and may not be culturally expected or practiced in younger children of either gender at the pueblo.

Comparing the results of our Native American participants with those of Alaska Native children in the Kerfeld et al. (1997) study suggests that there may be performance differences among Native American groups. Another interesting clinical finding from this study is that some children that pass the motor sectors of the Denver II may still score at least 1.0 standard deviations below the mean on the PDMS.

**Strengths and Limitations**

Sample selection was limited to one tribal group, in order to control for similarity of cultural experiences, and to a sample of 2-year-old children. These limitations do not permit the results to be generalized either to other Native American tribes or to other age groups. Increases in sample size, incorporation of several age groups, and inclusion of more Native American tribal groups in future studies would allow more generalization of results for more appropriate interpretation of standardized motor tests for Native American children.

**Conclusion**

In general, the results showed several significant differences between the scores of 2-year-old Pueblo Native American children and the scores of the normative sample. The differences suggest that the Pueblo children have lower scores on the PDMS than the normative sample, which is consistent with previous research on Native American children. The results also highlight the importance of considering cultural factors when interpreting standardized test scores for Native American children.
children who are typically developing and the normative sample of the PDMS. Both boys and girls in the 24-month to 29-month age group and boys in the 30-month to 35-month age group scored significantly lower than the normative sample on the PDFMS. Girls in the younger age group scored significantly lower than the normative sample on the PDGMS. It is suggested that occupational therapists and other professionals be cautious when they use the published PDMS normative data to judge motor performance of some 2-year-old Native American children who have not been included in the normative sample. If the data are not used carefully, over-referral for intervention services may result. As pointed out by Kerfeld et al. (1997), pediatric evaluators may never have culture-free screening tools or assessments. This limitation indicates that testers need to be sensitive to cultural needs and be able to elicit and include family perceptions about their child’s development within their community.

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