The Effects of Chronic Otitis Media on Motor Performance in 5- and 6-Year-Old Children

Therese Von, Jean C. Deitz, John McLaughlin, Suzette DeButts, Mark Richardson

Key Words: child development disorder • ear diseases • motor skills

During sensory integration screenings at the Children's Hospital and Medical Center in Seattle, Washington, it was noted that children with chronic ear infections (otitis media) often had low scores in motor planning. When this was discussed at the Seattle Sensory Integration Special Interest Group, other occupational therapists said that they had made similar observations.


The studies of children with a history of chronic otitis media have, for the most part, focused on the language, cognitive, and educational development of these children. These studies were based mainly on the pilot study of Holm and Kunze (1969), in which children 5 to 9 years old with a history of chronic otitis media were compared with normal controls on the Illinois Test of Psycholinguistic Abilities (ITPA). In this study, the children with chronic otitis media scored lower, though not significantly lower, than the normal controls on the Visual Motor Association and the Motor Encoding subtests of the ITPA. Some studies (Kaplan, Fleshman, Bender, Baum, & Clark, 1973; Lewis, 1976; Ling, McCoy, & Levinson, 1969) focused on Native American children and found a history of chronic otitis media to be adversely related to educational performance. Needleman (1977), Cook, and

Two 16-member groups of 5- and 6-year-old children, one group with a history of chronic otitis media and one without such a history, were tested on three measures of motor performance. These were the Motor Accuracy Test-Revised, the Stott Test of Motor Impairment, and measures of duration of standing balance. These instruments assess, respectively, fine motor coordination, overall motor skills, and balance. On each of these measures, children with a history of chronic otitis media scored lower than children without such a history. However, when these scores were compared statistically, no significant differences were found between the two groups. Because the results of this study were inconclusive, routine motor performance evaluation of children with a history of chronic otitis media is not advocated at this time.

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Teel (1979), and Masters and Marsh (1978) found a higher than normal incidence of language delay in children with a history of chronic otitis media. However, Brookhouser, Hixson, and Matkin (1979) and Starke (1978) did not find that chronic otitis media was as strong a predictor of language delay as were other childhood illnesses.

Gottlieb, Zinkus, and Thompson (1979) and Zinkus, Gottlieb, and Scharpio (1978) found a higher than normal incidence of language delay in children with learning disabilities who had a history of chronic otitis media. Zinkus et al. (1978) grouped children as severe or mild according to the number and severity of their infections. Children in the severe group scored significantly lower on the section of the Wechsler Intelligence Scale for Children-Revised (WISC-R) (Wechsler, 1974) that measures visual motor coordination.

Paradise (1976) and Hubbard, Paradise, McWilliam, Elster, and Taylor (1985) studied children with cleft palate, in whom chronic otitis media is almost universal. In these studies, follow-up care seemed to be the deciding variable in the language developmental status of the children. Studies by Rinas and Kavanagh (1986), Bess (1985), and Horowitz and Leake (1980) suggest that children with a history of chronic otitis media should be routinely assessed for language and educational delay.

In summary, the literature documents a relationship between a history of chronic otitis media and performance on measures of intelligence and language. A similar relationship between a history of otitis media and motor development is not well documented. The purpose of our study was to examine that relationship to determine whether children with a history of chronic otitis media should be routinely assessed for motor delay.

In our study, the motor development of children with a history of chronic otitis media was investigated by comparing their scores on three measures of motor performance with scores on these measures obtained by children without such a history. The measures chosen were the Test of Motor Impairment (Stott, Moyes, & Henderson, 1972), measures of duration of standing balance, and the Motor Accuracy Test-Revised (Ayres, 1980).

The following null hypotheses were tested:

1. There will be no significant difference between scores on the Stott Test of Motor Impairment of children with a history of chronic otitis media and scores of children without such a history.
2. There will be no significant difference between scores on a measure of duration of standing balance with open eyes, after scores for both feet have been combined, of children with a history of chronic otitis media and scores of children without such a history.
3. There will be no significant difference between scores on a measure of duration of standing balance with closed eyes, after scores for both feet have been combined, of children with a history of chronic otitis media and scores of children without such a history.
4. There will be no significant difference between scores on the Motor Accuracy Test-Revised of children with a history of chronic otitis media and scores of children without such a history.

The last hypothesis was tested four times: once each for dominant and nondominant hand accuracy scores, and once each for dominant and nondominant hand-adjusted scores.

Method

Sample

This study involved two groups of 5- and 6-year-old children. The first group, consisting of 16 subjects, was selected from children being seen at the Ear, Nose and Throat (ENT) Clinic at Children's Hospital and Medical Center, Seattle, Washington. This group was composed of children who had undergone placement of tympanotomy tubes within the 20 months preceding testing. Criteria for placement of tympanotomy tubes in children 5 years of age or over at the ENT Clinic included (a) presence of middle ear effusion for longer than 3 months, (b) presence of otitis media that had proved resistant to medical therapy, and (c) six or more episodes of otitis media in any 1 year of life. In addition, 3 subjects had sensory neural hearing losses. Of these, 1 had a unilateral high-frequency loss, and 1 had a bilateral moderate loss.

The second group of children, consisting of 16 subjects, was selected from the Child and Adolescent Medical Clinic (CAM) in the same hospital. These children were being seen for general care. Children in this group did not have a history of chronic otitis media as defined by the following criteria: (a) maximum of three episodes of otitis media during the child's entire life, (b) no history of placement of tympanotomy tubes or of middle ear effusion lasting for longer than 3 months, (c) no history of hearing loss, and (d) no evidence of otitis media or of middle ear effusion at the time of testing. Children with a history of genetic or congenital abnormality or of central nervous system insult were excluded from this study.

Possible subjects were located either through referral by clinic personnel or through review by the principal investigator of clinic registration records for names of children in the appropriate age range. The
Parents of possible subjects were then contacted, first by letter and then by telephone, to set up a testing appointment. In the CAM group, 52 children were identified who met the criteria for inclusion in the study. Of those, 25 were living out of town or could not be found, 12 refused to participate or did not keep their appointments, and 16 participated. The proportions of children in each category in the ENT group were strikingly similar to those in the CAM group. Of the 53 children who were identified and met the criteria for inclusion in the ENT group, 25 were living out of town or could not be found, 12 refused to participate or did not keep their appointments, and 16 participated.

Parents of children participating in this study were asked to complete a short questionnaire to assess whether there were differences in social status between the two groups, as demonstrated by educational level and insurance coverage. Categories of insurance coverage included private insurance, public insurance, and no insurance. Analysis using a chi-square indicated no significant difference either in educational level or insurance coverage between the two groups. Descriptive data for the children in this study are reported in Table 1.

**Measures**

The measures used in this study were the Stott Test of Motor Impairment (Stott et al., 1972), the Motor Accuracy Test–Revised (MAC-R) (Ayres, 1980), and measures of duration of standing balance with open eyes and with closed eyes. The Stott, the MAC-R, and the Southern California Sensory Integration Tests (SCSIT) (Ayres, 1972) subtests (on which the measures of standing balance used in this study were based) have the same norms for both sexes in this age group. The Stott and the MAC-R were administered and scored according to their respective test manuals. Of the three procedures described in the test manual for administering the Stott, the Standard Procedure (1972) was used in this study. For the Stott, scores with greater number values indicate greater impairment.

The measures of duration of standing balance with open eyes and with closed eyes were administered according to the manual instructions for the SCSIT subtests, Standing Balance Eyes Open and Standing Balance Eyes Closed (Ayres, 1972), with the following exceptions. First, the subject was asked to balance three times on each foot with closed eyes. Second, a combined score was obtained by adding the longest duration of standing on the right foot to the longest duration of standing on the left foot. This was done for both the eyes-open score and the eyes-closed score. The total amount of time spent in testing each child was 1 hour or less.

**Examiner**

The examiner for these tests was a registered occupational therapist who was blind to group assignment. Subjects were tested in the occupational therapy clinic at the Children’s Hospital and Medical Center. All children were tested in the same room, which had been modified for the administration of the Stott. Before testing, interrater reliability was established on a separate five-member group of 5- and 6-year-old children. Pearson product-moment correlation coefficients of .92 to .98 were established for interrater reliability on the motor measures prior to testing.

**Data Analysis**

The statistical test used to analyze the data generated by the Stott was the Mann-Whitney U (Siegel, 1975). This is a nonparametric alternative to the t test, and is used with ordinal data such as those generated by this measure. The unpaired t test was used to analyze the data generated by the other measures.

Since the data on duration of standing balance were positively skewed, correction to a normal distribution was achieved with a logarithmic transformation prior to statistical analysis. The significance level used with all statistics was p < .05 (two-tailed test). The Statistical Package for the Social Sciences (Nie, Hull, Jenkins, Steinbrenner, & Bent, 1975) was used to analyze the data.

**Results**

Descriptive statistics for the Stott are presented in Table 2. When the Mann-Whitney U was used to compare the results, the difference was found to be not significant (U = 100, p = .30). On the Stott, scores of 6 and above are seen to indicate possible impairment requiring further observation (Stott et al., 1972). The number of children in each group with such scores is
Table 2
Descriptive Statistics for the Stott Test of Motor Impairment

<table>
<thead>
<tr>
<th></th>
<th>CAM (n = 16)</th>
<th>ENT (n = 16)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>5.6</td>
<td>6.8</td>
</tr>
<tr>
<td>Median</td>
<td>5.0</td>
<td>6.5</td>
</tr>
<tr>
<td>High/low scores</td>
<td>0/13</td>
<td>0/12</td>
</tr>
<tr>
<td>Scores of 6 and above</td>
<td>7 (44%)</td>
<td>11 (69%)</td>
</tr>
</tbody>
</table>

Notes: Scores with greater numerical value are considered to indicate greater motor impairment. CAM = Child and Adolescent Medical Clinic. ENT = Ear, Nose, and Throat Clinic.

Table 3
Descriptive Statistics for the Measures of Standing Balance (in seconds)

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>SD</th>
<th>Median</th>
<th>High/Low Score</th>
<th>Log Score Mean</th>
<th>Log Score SD</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Eyes-Open Scores</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAM$^a$</td>
<td>99.4</td>
<td>93.4</td>
<td>65.5</td>
<td>360/6</td>
<td>1.81</td>
<td>45</td>
<td>-1.53</td>
<td>.136</td>
</tr>
<tr>
<td>ENT$^a$</td>
<td>63.7</td>
<td>72.4</td>
<td>31.5</td>
<td>272/5</td>
<td>1.55</td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Eyes-Closed Scores</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAM$^a$</td>
<td>12.5</td>
<td>10.9</td>
<td>8.0</td>
<td>39/2</td>
<td>96</td>
<td>35</td>
<td>-86</td>
<td>.399</td>
</tr>
<tr>
<td>ENT$^a$</td>
<td>9.1</td>
<td>5.7</td>
<td>7.5</td>
<td>18/2</td>
<td>86</td>
<td>31</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: CAM$^a$ = Child and Adolescent Medical Clinic. ENT$^a$ = Ear, Nose, and Throat Clinic. $^a$ n = 16.

Discussion

In general, the scores of the children from the ENT Clinic were lower than those of the children from the CAM Clinic. However, in no instance were these differences significant for a two-tailed test at the .05 level. The ENT scores tended to concentrate in the lower ranges. As previously noted, 69% of the ENT group had scores in the impairment/cause for concern range on the Stott. However, 44% of the CAM group also had scores in the impairment/cause for concern range. This latter finding was unexpected since the Stott was designed to have a failure rate between 10% and 15% (Stott et al., 1972). This leads to two questions. First, was there a confounding variable influencing the low scores of the CAM group? Second, does the Stott really have a 10% to 15% failure rate when, as is suggested in the manual, 6 is used as a cut-off score (Stott et al., 1972)?

Until we can answer the question regarding the validity of the cut-off score, it would seem prudent, in view of the high percentage of children with otitis media scoring above 6, to test children with otitis media whose parents or teachers report any evidence of motor delay that interferes with classroom or playground function.

Another factor that possibly influenced the results of this study was the gender distribution between the two groups, with a greater number of girls in the ENT group. Though the tests used in this study did not have gender-specific norms, there is evidence in the literature of differences in male and female performance on different motor tasks (Morris, Williams, Atwater, & Wilmore, 1982; Parizkova, Cermak, & Horvat, 1977; Silva & Ross, 1980). It is of interest that in the ENT group, the mean performances of the girls were better than those of the boys. In the CAM group, there were no trends favoring one sex over the other. If there is a true difference in performance between boys and girls at ages 5 and 6 on the specific tests used in this study, the unequal sex distribution could have obscured true differences between the ENT and CAM groups.
Table 4
Results of the Motor Accuracy Test Revised (in standard scores)

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>SD</th>
<th>Median</th>
<th>High/Low Score</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DOMINANT HAND ACCURACY SCORES</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAM(^a)</td>
<td>.61</td>
<td>1.39</td>
<td>.35</td>
<td>3.0/-2.0</td>
<td>-1.13</td>
<td>.269</td>
</tr>
<tr>
<td>ENT(^b)</td>
<td>.11</td>
<td>1.07</td>
<td>.22</td>
<td>1.9/-2.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>DOMINANT HAND-ADJUSTED SCORES</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAM(^a)</td>
<td>.18</td>
<td>1.72</td>
<td>.25</td>
<td>3.1/-4.1</td>
<td>- .57</td>
<td>.575</td>
</tr>
<tr>
<td>ENT(^b)</td>
<td>-.11</td>
<td>.99</td>
<td>.05</td>
<td>1.2/-2.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NONDOMINANT HAND ACCURACY SCORES</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAM(^a)</td>
<td>09</td>
<td>93</td>
<td>.15</td>
<td>1.4/-1.5</td>
<td>.46</td>
<td>.652</td>
</tr>
<tr>
<td>ENT(^b)</td>
<td>22</td>
<td>68</td>
<td>.30</td>
<td>1.5/-1.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NONDOMINANT HAND-ADJUSTED SCORES</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAM(^a)</td>
<td>- .26</td>
<td>93</td>
<td>-.02</td>
<td>1.0/-1.9</td>
<td>.83</td>
<td>.414</td>
</tr>
<tr>
<td>ENT(^b)</td>
<td>- .03</td>
<td>62</td>
<td>-15</td>
<td>0.9/-1.2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: CAM = Child and Adolescent Medical Clinic; ENT = Ear, Nose and Throat Clinic.
\(^a\) \(n = 16\)

Since the results of this study were inconclusive, further efforts should be directed at answering the original research question. Future studies should use different samples, control for gender, and, possibly, use different measures of motor development.

In conclusion, this study found no significant differences between the performances on motor measures of children with a history of chronic otitis media and the performances on motor measures of children with no significant history of otitis media. However, examination of the descriptive data for the ENT group suggests that many of these children are performing below expectation for their age on measures of motor performance. Further research in this area is indicated.

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