Qigong Massage for Motor Skills in Young Children With Cerebral Palsy and Down Syndrome

Louisa M. T. Silva, Mark Schalock, Jodi Garberg, Cynthia Lammers Smith

In this article, we present a small randomized controlled study evaluating the effect of a dual parent- and trainer-delivered qigong massage methodology on motor skills and sensory responses in 28 children under age 4 with developmental delay and motor tone abnormalities. Fourteen children had high motor tone as a result of cerebral palsy (CP), and 14 children had low motor tone as a result of Down syndrome. Multivariate analysis and post hoc analysis of variance showed large effect-size improvements in Peabody Gross Motor Scale (PGMS) Object Manipulation scores ($p < .01$) and large effect-size improvements in overall PGMS scores ($p < .04$) in treatment versus control groups after 5 mo intervention. Follow-up evaluation 10 mo from the start indicated continued improvement. Sensory responses showed no treatment effect. The results suggest further investigation of qigong massage as a promising avenue for research to improve motor skills in young children with CP and Down syndrome.


Youth children with developmental disabilities receiving early childhood special education (ECSE) services for motor delays in state-sponsored programs fall into two broad clinical categories: (1) children with low motor tone and Down syndrome (DS) and (2) children with high motor tone and cerebral palsy (CP). Services generally include fitting with appropriate orthopedic devices and ≥1 hr physical and consultative therapy per month in accordance with federal disability education law.

Children with motor delays often have a high prevalence of abnormal sensory responses characterized by hyporeactivity and hyperreactivity to ordinary stimuli (Cheung & Siu, 2009); these responses are thought to affect the acquisition of motor skills. A systematic review of 34 studies evaluating the effect of early intervention treatments on children with motor delays listed 4 studies targeting the sensory nervous system (Blauw-Hospers & Hadders-Algra, 2005). Of the four studies, none demonstrated improvement in motor skills. Two more recent reviews suggested that treatment with a sensory integrative approach yielded positive outcomes in sensorimotor skills, although reviewers recommended replication of findings with methodologically and theoretically sound studies (May-Benson & Koomar, 2010; Polatajko & Cantin, 2010).

Massage has also been used to treat children with developmental disabilities and motor delays. Two British studies evaluating the outcomes of a simple, parent-delivered home massage program in children with disabilities reported improved mobility in children with high and low tone (Barlow, Powell, Gilchrist, & Fotiadou, 2008; Powell, Barlow, & Cheshire, 2006). A comprehensive review of community-based interventions to optimize early childhood development in

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low-resource settings reported that massage was useful but that more rigorous research is needed before advocating for it in community-level interventions (Maulik & Darmstadt, 2009).

For the past 10 yr, our group has been researching a qigong (pronounced “chee-gong”) massage methodology in young children with autism, known as Qigong Sensory Training (QST). In two randomized controlled trials (RCTs), treatment resulted in improved sensory and self-regulation as well as measures of autism (Silva, Schalock, Ayres, Bunse, & Budden, 2009; Silva, Schalock, & Gabrielsen, 2011). The methodology is based on Chinese medical theory and postulates a primary factor in autism to be impairment of peripheral sensory nerve function associated with poor capillary circulation to the skin and sensory receptors along with immature autonomic nervous system function (Silva, Schalock, & Ayres, 2011). The massage is designed, among other things, to restore normal capillary circulation and awareness to the skin by means of normalization of sympathetic and parasympathetic nervous system function. Occupational therapists delivering the treatment to children in the research studies suggested that the methodology be adapted for children with orthopedic impairment and motor delays. Chinese medical theory postulates that children with high or low muscular tone will have decreased circulation to the affected muscles. Subsequently, a small pilot study using an adapted version designed to enhance circulation and muscle function demonstrated encouraging results for motor skills (Silva, Schalock, & Ayres, 2008).

We conducted a small RCT to evaluate the effect of the adapted methodology on motor delays in the two groups most commonly presenting for services: (1) children with low tone and DS and (2) children with high tone and CP. We also evaluated the effect of the methodology on abnormal sensory responses in the two groups. Given the much lower abnormal sensory response scores seen in children with DS and CP compared with children with autism (Silva & Schalock, 2012) and the presence of fixed central and genetic factors to account for them, we did not expect sensory scores to change significantly after qigong massage treatment. Our three hypotheses were as follows:

1. A qigong massage methodology will improve measures of motor development in two groups: (1) children with high motor tone and CP and (2) children with low motor tone and DS.
2. Stability of motor improvement will occur by 10 mo.
3. Motor improvement will not be accompanied by concurrent sensory improvement.

Method

Participants

Children receiving services from ECSE programs serving two geographic areas in Oregon, one urban and one rural, were recruited to participate in the study. Parents of children meeting eligibility criteria were given information about the study by trained QST therapists working in these programs. Parents varied in age, education, and socioeconomic level. Eligibility criteria were (1) < age 4, (2) receiving ECSE services for low motor tone as a result of DS or high motor tone as a result of CP, (3) willingness on the part of the parents not to initiate new sensory or motor therapies for the duration of the study unless medically indicated, and (4) willingness on the part of the parents to give a daily massage for 5 mo and attend all training and support meetings.

Louisa Silva, the principal investigator, conducted clinical evaluations and confirmed that eligibility criteria were met. As is characteristic of people with CP, the high motor tone group was heterogeneous and included children with unilateral and bilateral spasticity; joint contractures of the upper extremities, lower extremities, or both; gait disturbances; and muscle weakness. Participant demographics are included in Table 1.

Table 1. Participant Demographics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Treatment</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>25</td>
<td>14</td>
</tr>
<tr>
<td>Boys, n</td>
<td>15</td>
<td>7</td>
</tr>
<tr>
<td>Girls, n</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>Cerebral palsy, n</td>
<td>16</td>
<td>9</td>
</tr>
<tr>
<td>Down syndrome, n</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>Age, yr; mean (standard deviation)</td>
<td>2.44 (1.36)</td>
<td>2.36 (1.22)</td>
</tr>
</tbody>
</table>

*Includes initial and wait-list control treatment groups.
regulation scores range from 0 to 99. This instrument has demonstrated relatively high levels of internal consistency (α = .87). We used the Sensory domain part of this evaluative tool in this study.

Peabody Gross Motor Scale (PGMS) evaluation is a reliable test of motor skills that is sensitive to change after 3 mo (Fewell & Folio, 2000). The composite scores have good test–retest reliability (intraclass correlation coefficient = 0.88–1.00), the sensitivity-to-change coefficients range from 1.6 to 2.1, and the responsiveness coefficients range from 1.7 to 2.3 (Wang, Liao, & Hsieh, 2006). We tested three domains:

1. **Stationary**: This 30-item subtest measures a child’s ability to sustain control of his or her body within its center of gravity and retain equilibrium.

2. **Locomotion**: This 89-item subtest measures a child’s ability to move from one place to another. The actions measured include crawling, walking, running, hopping, and jumping forward.

3. **Object Manipulation**: This 24-item subtest measures a child’s ability to manipulate balls. Examples of the actions measured include catching, throwing, and kicking. Because these skills are not apparent until a child has reached age 11 mo, this subtest is only given to children ≥ age 12 mo.

**Design and Procedures**

The study was carried out with institutional review board approval from the Teaching Research Institute, Western Oregon University. Children from each geographic area who met entry criteria were randomly assigned to Group A (n = 14) or Group B (n = 14) conditions separately using a random number generator. Separate assignments by geographic area were performed to facilitate adequate training and support. Group B functioned as a wait-list control group, and participants were informed that they would receive treatment 5 mo from the start of the study. Three children dropped out of Group B at the end of 5 mo for diverse reasons.

Both groups received a qigong massage intervention delivered by trained staff and parents for 5 mo. The trainer version is given weekly and designed to advance the progress of the child from week to week. The parent version is given daily and designed to maintain and support progress and strengthen the child on a daily basis.

Group A (n = 14) received 5 mo of treatment. Pretesting and posttesting of sensory abnormalities and gross motor skills was carried out for both Group A and Group B. A single experienced evaluator who was not blind to group conducted the motor evaluations. At the end of 5 mo, Group B (n = 11) began receiving treatment, and another set of posttreatment data was collected. A final data set to evaluate the maintenance effect for both groups was collected 10 mo after the start of treatment (n = 21). Four children were not available for final testing at that time. Parents of 13 of the 21 children (61.9%) indicated that they were continuing to implement the massage to some degree at the time of this final assessment. Throughout the study, both groups received ECSE services for which they were eligible.

**Parent Training and Support Program.** Parent training began with a 3-hr group session that was attended by one or both parents or caregivers and their assigned trainer. The research and reasoning behind the intervention was explained, and then parents and caregivers practiced each of the 12 parts of the treatment on each other under the trainer’s guidance until they could do each movement correctly. They were also given an introduction to the predictable changes that children experience in response to treatment and how to modify their manual technique and parenting approach accordingly. In addition, they received a booklet (Silva, 2008) and a chart covering the didactic material given in the 3-hr training.

After the 3-hr group training, the ongoing training and support program was delivered in 20 weekly half-hour meetings; parents and caregivers brought the child to the clinic for these sessions. During these support meetings, the trainer provided support and ongoing training to the parent on the parent version of the massage and gave the child the trainer version of the massage. Within the first 3 wk of the study, on two separate occasions, trainers observed the parent give the massage and evaluated and recorded fidelity with procedures. Review of these fidelity evaluations showed that within 3 wk, all parents had learned to give the massage correctly and were incorporating it into the child’s daily routine.

During the second half of the study, two families did not continue to give the daily treatment after the last coaching session. All trainers participating in the research program had previously graduated from the 80-hr QST training and supervision program (Silva, Ayres, & Schalock, 2008).

**Parent Qigong Massage Protocol.** The parent protocol, as described in the parent curriculum for autism (Silva, 2011), is given every day and takes about 15 min to deliver. It consists of a sequence of 12 patting, pressing, and gentle shaking movements with the following actions according to Chinese medicine:

- **Movements 1, 2, and 3:** Open and clear the channels to the brain and five senses; open up the circulation to the skin of the back of the body.
• **Movement 4**: Clear additional functional impediments to hearing
• **Movements 5, 6, and 7**: Promote social interaction, speech, and self-soothing; improve circulation to the arms and hands
• **Movements 8 and 9**: Strengthen digestion and elimination, improve circulation to the legs, improve overall physical strength and vitality
• **Movements 10, 11, and 12**: Calm the child, improve sleep, and improve circulation to the brain.

The manual techniques are modified according to each child’s physical responses, and alternative techniques are available for the hands and feet in the event of discomfort. The techniques are based on principles of Chinese medicine and applied in the direction of arterial circulation rather than lymphatic return, as in Western massage. In the methodology for autism, techniques were directed more superficially to improve circulation to the skin (patting). In the adapted methodology used in this study, the same 12 movements were used, but manual techniques were directed more deeply to improve circulation to muscles (gentle pressure).

**Trainer Training and Supervision.** Trainers were experienced occupational and physical therapists working in state-sponsored ECSE programs who had previously graduated from or were currently enrolled in the 80-hr QST skill-based curriculum and training program (Silva et al., 2008). The program teaches a theoretical and practical understanding of the child with developmental delay resulting from autism, according to concepts important to Chinese science: yin, yang, qi, channels, toxicity, block, and deficiency (Yanchi, 1988). In addition, clinical supervision is provided to allow skill development in adapting the manual techniques to the individual child’s responses according to these concepts.

For this study, the principal investigator provided additional training and supervision to trainers to allow them to address the motor tone issues presenting in each child within the context of the 12 movements, according to the Chinese medical concepts listed earlier. As part of the 20 parent support meetings, trainers gave the child a trainer version of the adapted qigong massage protocol.

**Data Analysis.** Data analyses were conducted in several sequences. Initially, we analyzed preassessment scores for treatment and control groups to determine equivalence, a step that was important in determining the appropriate analyses to conduct to test the main hypotheses of the study.

To test for pretreatment equivalence, we used analyses of covariance (ANCOVAs) and multivariate analyses of covariance (MANCOVAs) with group as the independent variable. Preassessment scores on the main outcome measures were used as dependent variables and age in months was used as the covariate for parent- and teacher-generated data separately. Post hoc univariate ANCOVA and Bonferroni-adjusted individual t tests for independent samples were conducted to further test group equivalence on the preassessment outcome measures. This procedure more precisely documented any differences that might exist on more specific impairments and abilities.

The next set of analyses tested the changes that occurred in the scores from pre- to postintervention assessments. We conducted these analyses to document any changes exhibited from pre- to postintervention in both treatment groups (Group A and treated Group B) and the control group (Group B) and determine whether these changes were statistically significant. The paired t test and the nonparametric equivalent Wilcoxon signed-rank test were used to conduct these analyses.

To test the hypothesis that the QST intervention would have a significant main effect, we conducted an ANCOVA and MANCOVA separately on parent data (Sensory domain) and trained assessor–generated (PGMS) data. Postassessment scores were used as the dependent variable, group as the independent variable, and preassessment scores as covariates. We used this approach because of the deviations from full random assignment as discussed previously, even though groups were not significantly different on preassessment scores. We used univariate follow-up tests with Bonferroni adjustments when overall MANCOVAs or ANCOVAs were significant to identify specific differences in outcomes by group. SPSS Version 18 (IBM, Armonk, NY) generates \( \eta^2_p \) as an effect size estimate in the generalized linear model (Haase, 1983; Tabachnick & Fidell, 1989); \( \eta^2_p \) is equivalent to \( R^2 \). Using the formula for deriving \( r \) from Cohen’s \( d \) (Hedges, 1982), establishing ranges in \( \eta^2_p \) that coincide with Cohen’s original small, medium, and large classifications (Cohen, 1988) is possible: \( \eta^2_p \) values in the .01–.06 range indicate a small effect size, \( \eta^2_p \)'s in the .06–.14 range indicate a medium effect size, and \( \eta^2_p > .14 \) indicate a large effect size.

Finally, to determine whether treatment effects were maintained over time, we conducted one-way repeated-measures analyses of variance (ANOVAs) and multivariate analyses of variance (MANOVAs) on Sensory domain and PGMS pretest–posttest follow-up data from an intact cohort of participants from Group A and treated Group B. Within-group one-way repeated-measures ANOVAs using post hoc pairwise Bonferroni-corrected comparisons were conducted to further test equivalence over time on each outcome measure.
Results

Preassessment Equivalence

We conducted separate analyses of the parent- and trained assessor–generated preassessment data for participants completing the study using ANCOVA and MANCOVA. Group was used as the dependent variable and age as a covariate on the preassessment outcome scores. We adopted the Pillai’s trace criterion as the most conservative test statistic (Olson, 1979). For Sensory domain data, this analysis revealed no overall statistical differences between groups at preassessment, \( F(1, 39) = 0.004, p = .952 \). For groups, children in the treatment and control groups were not different in regard to their sensory impairment before treatment. For the trained assessor PGMS data, this analysis also revealed no overall statistical differences between groups at preassessment, Pillai’s trace = 0.085, \( F(3, 37) = 1.141, p = .345 \). A Bonferroni-adjusted post hoc univariate ANOVA revealed no significant difference by domain. Although the two groups were not statistically significant in terms of motor impairment before treatment, the presence of median effect-size group differences and the deviations from full random assignment indicated that MANCOVA would be preferable to test for main treatment effects and control for initial differences.

Preassessment to Postassessment Changes

We assessed sensory impairments and aspects of motor development both before and after the intervention. A change in the negative direction indicated improvements in the Sensory domain. A change in the positive direction indicated improvement on motor development domains. Paired \( t \)-test results for all children indicated positive yet statistically insignificant improvements for children in the treatment group on sensory impairment and stationary body control. We saw positive and statistically significant improvements in the Locomotion/Movement domain. We analyzed sensory impairment using one-way MANCOVA and Motor domains separately using ANCOVA and MANCOVA to test for the intervention effects related to sensory impairment and motor development. Analyses were conducted for children with CP and children with DS both together and separately to determine whether differential effects were found for the intervention by group. Overall results for sensory impairment indicated no treatment effect, \( F(1, 36) = 1.28, p = .265, \eta^2_p = .034 \), which was also the case when the results from the two groups of children were analyzed separately. These results are shown in Table 2.

Pre–Post Intervention Effects

When we compared children in the treatment and control groups, we found no statistical differences in their sensory outcomes. We did find significant and meaningful differences in motor outcomes, specifically in the Object Manipulation domain.

We analyzed the Sensory and Motor domains separately using ANCOVA and MANCOVA to test for the intervention effects related to sensory impairment and motor development. Analyses were conducted for children with CP and children with DS both together and separately to determine whether differential effects were found for the intervention by group. Overall results for sensory impairment indicated no treatment effect, \( F(1, 36) = 1.28, p = .265, \eta^2_p = .034 \), which was also the case when the results from the two groups of children were analyzed separately. These results are shown in Table 3.

For motor development, we found a large and significant overall treatment effect, \( F(3, 33) = 3.119, p = .039, \eta^2_p = .221 \). A Bonferroni-adjusted post hoc univariate ANCOVA found a significant treatment effect for the Object Manipulation domain, \( F(1, 35) = 8.974, p = .005, \eta^2_p = .204 \). When the results from both groups were analyzed separately, we found no overall treatment effects for either group, although we found a significant and large treatment effect for children with DS for the Object Manipulation domain, \( F(1, 9) = 6.455, p = .032, \eta^2_p = .418 \). These results are shown in Table 3. These findings were consistent when we compared the original 14-participant treatment Group A with the original 14-participant control Group B. Adding the treatment outcomes for Group B did not change the findings.

Maintenance of Treatment Effect 5 Mo After Study Completion

When we compared preintervention, postintervention, and 10-mo follow-up outcomes for the cohort of 21 children receiving treatment, we found that sensory outcomes did not change over time. We did find significant changes over time and maintenance of effects for both the Locomotion/Movement and the Object Manipulation domains. Descriptive data on the intact cohorts are shown in Table 4.

We analyzed sensory impairment using one-way repeated-measures ANOVAs. Overall univariate results on sensory impairment were not significant, Wilks’ A
Table 2. Preassessment to Postassessment Results for the Qigong Sensory Training Treatment

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group Main Intervention Effect</th>
<th>Univariate Parent Measure</th>
<th>Post Hoc Analysis of Covariance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>df</td>
<td>p</td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>n²</td>
<td>F</td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>n²</td>
<td>df</td>
</tr>
<tr>
<td>Sensory impairment</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>All</td>
<td>1.280</td>
<td>1.36</td>
<td>.265</td>
</tr>
<tr>
<td>Cerebral palsy</td>
<td>0.164</td>
<td>1.22</td>
<td>.689</td>
</tr>
<tr>
<td>Down syndrome</td>
<td>2.380</td>
<td>1.11</td>
<td>.151</td>
</tr>
<tr>
<td>Multivariate analysis: PGMS</td>
<td>3.119</td>
<td>3.33</td>
<td>.039</td>
</tr>
<tr>
<td>Cerebral palsy</td>
<td>1.221</td>
<td>3.19</td>
<td>.330</td>
</tr>
<tr>
<td>Down syndrome</td>
<td>2.768</td>
<td>3.7</td>
<td>.121</td>
</tr>
<tr>
<td>Statical Body Control</td>
<td>1.071</td>
<td>1.35</td>
<td>.308</td>
</tr>
<tr>
<td>Cerebral palsy</td>
<td>1.121</td>
<td>1.21</td>
<td>.302</td>
</tr>
<tr>
<td>Down syndrome</td>
<td>0.240</td>
<td>1.9</td>
<td>.636</td>
</tr>
<tr>
<td>Locomotion and Movement</td>
<td>1.221</td>
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<td>.227</td>
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<tr>
<td>Cerebral palsy</td>
<td>0.149</td>
<td>1.21</td>
<td>.703</td>
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<tr>
<td>Down syndrome</td>
<td>3.808</td>
<td>1.9</td>
<td>.083</td>
</tr>
<tr>
<td>Object Manipulation</td>
<td>8.974</td>
<td>1.35</td>
<td>.005</td>
</tr>
<tr>
<td>Cerebral palsy</td>
<td>3.327</td>
<td>1.21</td>
<td>.082</td>
</tr>
<tr>
<td>Down syndrome</td>
<td>6.455</td>
<td>1.9</td>
<td>.032</td>
</tr>
</tbody>
</table>

Note. PGMS = Peabody Gross Motor Scale.

H(2, 19) = 1.719, p = .141. Bonferroni adjusted t tests revealed no significant differences in scores among the three times of measurement.

We also analyzed PGMS gross motor measures using one-way repeated-measures MANOVAs. Overall multivariate results on motor development measures were significant, Wilks’ Λ (6, 13) = 3.517, p = .027. Repeated-measures one-way ANOVA on each outcome revealed significant differences in scores between the three times of measurement for Locomotion/Movement and Object Manipulation. Sphericity assumptions (Mauchly’s test) were violated for Locomotion/Movement (p = .031) and Object Manipulation (p = .002). We used the Greenhouse–Geisser ε to correct degrees of freedom. With these corrections, the results were as follows: Locomotion/Movement, F(1.49, 26.93) = 13.6, p = .001, and Object Manipulation, F(1.32, 23.68) = 11.3, p = .001.

Post hoc pairwise Bonferroni-corrected comparisons revealed significant differences across all pairwise comparisons for the Locomotion/Movement domain. That is, outcomes improved significantly from preintervention to postintervention and again from postintervention to follow-up. We found significant differences between follow-up scores and both preintervention and postintervention scores for Object Manipulation. That is, outcomes improved significantly from preintervention to follow-up and also from postintervention to follow-up.

We found no differences in longitudinal results between children with CP and children with DS in two-way repeated-measures analyses.

Discussion

This small study comprised two clinical groups: The DS group was relatively homogeneous and had low motor tone; the CP group was relatively heterogeneous and had
Muscular function can be targeted and improved in children with autism spectrum disorders (Silva et al., 2011); the current study shows that muscular function can be targeted and improved in children with motor delay. For occupational therapists interested in augmenting their practice with alternative therapies, the qigong massage paradigm of improving function by optimizing circulation offers an alternative way to lessen the impact of disability.

Although the intervention period of this study, 5 mo, was short considering the nature and reasons for motor delay, the improvements were significant and lasting. Because any motor improvement beyond that seen in the control group is to be greeted with enthusiasm, we conclude that this pilot study deserves to be replicated. The limitations of this study are those of a small pilot study: small sample size, short period of intervention, and the need for a wider battery of outcomes measures administered by blinded examiners. These limitations can readily be addressed in a larger study.

An unanticipated consequence of this study was that shortly after beginning treatment, we observed an unexpected jump in language skills in the children with DS, much as we have reported previously in our work with children with autism (Silva et al., 2009). Children without receptive language acquired receptive language, and children with expressive language acquired more. This consequence was not captured in the outcomes data because speech and language testing was not part of the study design. Given that some children with DS never learn to speak and that this outcome has often been accepted as part of the genetic limitation, these anecdotal observations suggest that qigong massage may offer a way to stimulate language acquisition in young children with DS. A larger study with a cohort of children with DS is underway.

Implications for Occupational Therapy Practice

Our study has the following implications for occupational therapy practice:

- A parent-delivered home program of daily qigong massage showed promising improvement of motor outcomes in young children with motor delays.
- For occupational therapists interested in augmenting their practice with alternative therapies, qigong massage home programs can improve functional skills and offer families an alternative way to lessen the impact of disability.

Acknowledgments

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References


