

Children With Cystic Fibrosis Benefit From Massage Therapy

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Objective: To measure the effects of parents giving massage therapy to their children with cystic fibrosis to reduce anxiety in parents and their children and to improve the children's mood and peak air flow readings.

Methods: Twenty children (5–12 years old) with cystic fibrosis and their parents were randomly assigned to a massage therapy or a reading control group. Parents in the treatment group were instructed and asked to conduct a 20-minute child massage every night at bedtime for one month. Parents in the reading control group were instructed to read for 20 minutes a night with their child for one month. On days 1 and 30, parents and children answered questions relating to present anxiety levels and children answered questions relating to mood, and their peak air flow was measured.

Results: Following the first and last massage session, children and parents reported reduced anxiety. Mood and peak air flow readings also improved for children in the massage therapy group.

Conclusions: These findings suggest that parents may reduce anxiety levels by massaging their children with cystic fibrosis and their children may benefit from receiving massage by having less anxiety and improved mood, which in turn may facilitate breathing.

Key words: *cystic fibrosis; massage therapy; anxiety.*

Cystic fibrosis (CF) is a chronic, life-threatening disease typically diagnosed in early childhood. The prevalence of CF is about 1 of every 3,300 live births; it is the most common genetic disease in the

United States (Cystic Fibrosis Foundation, 1998), characterized by a generalized dysfunction of the exocrine system (particularly affecting the gastrointestinal, pancreatic, hepatic, respiratory, and reproductive systems). Chronic lung infections and pancreatic inadequacy, resulting in deficient digestion and malabsorption of nutrients, are the most common complications of this multisystem disease. The mean life expectancy for those with CF has increased due to improved therapies. More than 25% of patients reach adulthood, and 9% live past 30 years of age (Boucher, 1994).

We thank the children and parents who participated in this study and the massage therapists who trained the parents. Special thanks are also extended to Karen Martinez, RN, Bonnie Dutton, RN, Linda Flores, and William Gregory, CPT. This research was supported by an NIMH Research Scientist Award (#MH00331) and an NIMH Research Grant (#MH46586) to Tiffany Field and a grant from Johnson & Johnson to the Touch Research Institute. All correspondence should be sent to Tiffany Field, Touch Research Institute, University of Miami School of Medicine, Department of Pediatrics, P. O. Box 016820 (D-820), Miami, Florida 33101. E-mail: www.miami.edu/touch-research.

Besides the life-threatening health issues, adjustment problems affect as many as 60% of mothers and 62% of children (Thompson, Gustafson, Hamlett, & Spock, 1992). Distress, mild depression, and conduct disorders have been documented (Burke et al., 1989; Thompson et al., 1992). Not surprisingly, maternal adjustment has been positively associated with symptom reports (Thompson, Gustafson, George, & Spock, 1994; Thompson et al., 1992).

Treatment for CF is focused on clearing airways secretions, controlling infections in the lungs, maintaining nutrition, and preventing intestinal obstruction. Combination therapies include antibiotics to prevent and treat infections, bronchodilators, mucolytics, and corticosteroids (Hodson & Warner, 1992), nutritional management that includes pancreatic enzyme and multivitamin supplements (Parker & Young, 1991) and chest physiotherapy (postural drainage) to remove secretions trapped in the airway (Maayan et al., 1989). Chest physiotherapy may be required one to four times daily and consists of rhythmic pounding and tapping on different sections of the lungs to facilitate loosening of bronchial secretions. Typically, parents are trained to administer the chest physiotherapy.

An additional therapy that has not been explored for children with CF is massage therapy. Studies from our research group reveal numerous benefits for pediatric populations from massage therapy. Premature infants who received 10 hospital days of massage therapy gained 47% more weight, had better reflex responses on the Brazelton Neonatal Behavioral Assessment Scale, and were discharged 6 days earlier from the hospital compared to a standard medical control group (Field et al., 1986). In addition, a reduction in stress hormones (norepinephrine, epinephrine) has been reported for infants receiving daily massages (Field et al., 1996), which suggests decreased sympathetic activation as an underlying mechanism.

Massage therapy has also been shown to benefit children with chronic illnesses. For example, anxious and depressed adolescents showed an increase in positive affect and cooperative behavior following daily massages (Field et al., 1992). In a recent study on asthmatic children, parents were trained to administer massage therapy (Field, Henteleff, et al., 1998). Pulmonary functions improved including forced vital capacity (FVC), forced expiratory volume in 1 second (FEV 1%), forced midexpiratory flows (FEF 25%–75%) and peak expiratory flow rate (PEFR). In addition, the children displayed more

positive attitudes by the end of the study and parents' anxiety levels decreased as a result of giving massage.

Because children with CF present symptoms of distress similar to those experienced by children with other chronic illnesses, and because children with CF show poor outcome measures on pulmonary function tests, they may benefit from massage therapy. Moreover, massage therapy requires little, if any, compliance from the children, unlike chest physiotherapy. In addition, because parental distress has been correlated with symptomology in CF children (Thompson et al., 1992, Thompson et al., 1994) and because parents who massage their children report decreased anxiety (Field, Hernandez-Reif, Seligman, et al., 1997), asking parents of children with CF to massage their children may help parents as well. Massage therapy is expected to be a cost-effective treatment because parents can be trained to conduct massages and it takes approximately half the time of chest physiotherapy.

The present study, therefore, assessed the effects of massage therapy over one month on both parents and their children with CF. One month was chosen as the outcome assessment period because this time frame has been shown to yield significant improvements in mood and in lowering anxiety and stress hormones for children with chronic diseases (Field, Hernandez-Reif, LaGreca, et al., 1997; Field, Hernandez-Reif, Seligman, et al., 1997) and to improve pulmonary functions in asthmatic children (Field, Henteleff, et al., 1998). Children receiving massage therapy were expected to demonstrate less anxiety and improved mood, based on previous massage therapy findings with chronically ill children, and show improved peak air flow readings (Field, Henteleff, et al., 1998). Parental anxiety was also expected to decrease from massaging their children, as reported in other massage therapy studies.

Method

Participants

Twenty-four parents who had children with CF were approached about the study during an office appointment to one of two cystic fibrosis centers. Only one parent, who had two adolescent children with CF, refused to participate, stating that her children's CF was mild. The remaining 23 children and their parents, who were willing to participate, were

randomly assigned to a massage therapy or a reading control group. Three of the 23 families were later dropped from the study due to noncompliance; one child and parent dyad had been assigned to the massage therapy group and the other two parent-child pairs were in the reading control group. The three families had failed to keep their 30-day appointment and admitted to not following the protocol instructions. The final sample was composed of 20 children and their parents, 10 assigned to the massage therapy treatment group and 10 assigned to the reading control group. A power analysis, based on measures of anxiety and peak air flow readings, was conducted and indicated that a sample of 20 subjects would be sufficient to detect medium to large effects, so no other families were approached.

The children ranged in age between 5 and 15 years (M age = 9.9). This wide age range was used because it was most representative of the children attending the day clinics. Parental informed consents and child assents (for children 7 years or older) were obtained prior to the start of the study. All children were informed of the purpose of the study, and for those in the massage therapy group, the children were asked if they were willing to have their parents massage them at night. The children said they understood what massage entailed and all agreed to be in the study.

The sample was predominantly lower to middle socioeconomic status (M = 4.1 on the Hollingshead Two Factor Index). Although CF is predominantly a Caucasian disease, because of the ethnic diversity in South Florida, the sample was 35% Caucasian, 30% African American, and 35% Hispanic. The children's CF condition was classified using the National Institutes of Health (NIH) clinical scoring for cystic fibrosis (revised) (Sockrider, Swank, Seilheimer & Schildow, 1994). Clinical severity (100 = excellent, 0 = poor) for this sample ranged from 47 to 99 (M = 82.2). The scores for the massage therapy (M = 82.2) and the control group (M = 82.0) did not statistically differ (p > .05). Overall, the children's CF condition was mild. Two children (one in the massage therapy and one in the reading control group) had an NIH score of 47 and 62, respectively, suggesting their CF condition was severe. Forty-two percent of the children had not been hospitalized in the past 12 months, whereas 15% had been hospitalized once, 33% had two hospitalizations, and 10% had more than two hospitalizations in the past year. Parents and children in the reading control

group were informed that after the 30-day reading period they would be taught the massage therapy. The groups did not differ on the above variables (all ps > .05).

Procedures

During the study period, the children continued to receive standard medical care, including examinations by their pulmonary clinic. Half of the children were randomly assigned to the massage therapy treatment group and the other half to a reading control group.

Massage Therapy. During a clinic visit, parents were given written instructions and trained by a massage therapist on how to conduct the massages. The children in the massage therapy group received a 20-minute massage from the parent before bedtime, every night for 30 days. In all but one case, the mother performed the massage sessions. The procedure for massage therapy was similar to those described in other massage therapy studies for pediatric chronic illnesses (Field, Hernandez-Reif, La-Greca, et al., 1997; Field, Hernandez-Reif, Seligman, et al., 1997) with the exception that attention in the present protocol was given to positioning for optimal postural drainage and chest and stomach procedures were added. Parents were called bi-weekly to check compliance. They were also asked to perform the massage therapy on the return visit as an additional check on compliance.

Using small pillows under the legs and hips, the child was first positioned lying on the back at a 45-degree angle to assist postural drainage. The massage began by stroking with the flats of fingers the (1) *face/head area*: (a) strokes to forehead starting from the middle with both hands and then moving towards side of face, (b) strokes under cheekbones, using fingertips from nose to jaw (under cheekbones) and back, (c) strokes upward from middle of jaw to sides of face, (d) massage to outer ears, bottom to top, (e) small circles with fingers over entire scalp; (2) *neck*: fingertips and flats of fingers in upward strokes from base of neck to base of skull; (3) *chest*: (a) smooth strokes along the sternum and upper ribs, using flats of fingers and palms, (b) strokes from waist to shoulder along the side of body; (4) *abdomen*: following the colon (a) circular, clockwise strokes over the abdomen, (b) flat, gliding clockwise strokes over the abdomen, (c) strokes to the sides of the trunk, from waist up to the shoulder; (5) *arms*: (a) short and long strokes with thumbs to top of

hand and then to palm, (b) long gliding strokes from wrist to shoulder, (c) rolling arm from wrist to shoulder, using flats of hands; (6) *front of legs*: (a) long strokes from ankle, to outside at hip and back down to foot, first using one hand and then using both hands to deliver strokes, (b) small circles over the knee; (7) *foot*: (a) strokes, using thumbs, to work top of foot from ankle to toes, (b) circles and criss-cross strokes, using thumb, to bottom of foot, (c) squeezes and light pulls to each toe; with the child face down, (8) *back*: (a) crisscross strokes, with flats of hands, from waist to neck, (b) small circles, using fingertips, along side of spine from neck to waist, (c) strokes with flats of hands from spine to side, starting at waist and moving up to neck and back down, (d) strokes down back from neck to waist, using flats of hands; (9) *back of legs*: (a) strokes on outside of legs from ankle to hip, (b) circular movements, using thumbs, to back of knee, (c) large circles over back of calf muscle, moving from ankle to knee and then flat strokes moving back and forth to ankle, (d) continuous circles around the ankles, (e) large circles over bottom of foot, using thumbs, (f) shaking/rocking of leg.

Control Group. The primary care-giving parent (always the mother for this group) of the children in the control group was instructed to read to the child for 20 minutes prior to bedtime. For the older children, (four adolescents) parents read from a novel of the adolescent's choice. This period was presented to parents as an opportunity to unwind with their child before bedtime. The purpose for this group was to control for potential placebo effects that might be attributed to attention from a parent. Parents were telephoned biweekly by a research assistant to check compliance on story reading. Parents were advised not to massage their children during the study period and informed that after the assessments on the 30th day they would be shown how to conduct the massage.

Assessments

Pre- and Postsession Assessments (Immediate Effects)

Assessments were conducted at the pulmonary clinic during the scheduled visit. These assessments were made 20 minutes before and after the massage or control period on days 1 and 30 of the 1-month study. The assessments evaluated the immediate impact of the massage (or control period) on the parent's anxiety levels, and the child's anxiety and

mood levels. Some effects of massage therapy have been documented after one session and have typically included short-term changes in mood, anxiety, and stress hormones. In this study, the short-term assessments included an anxiety scale administered to parents and children and a mood scale administered to the children.

Parent Questionnaire. The parent most involved with the child's care completed the State Anxiety Inventory (STAI; Spielberger, 1973; Spielberger, Gorsuch, & Lushene, 1970) questionnaire and was instructed on how to conduct the massage therapy or to read with their child at night.

The parents completed the STAI, a 20-item scale that assesses how they feel at the present moment. Characteristic items include "I feel nervous," "I feel calm," "I am tense." Responses range from "Not at all" to "Very much so." The STAI scores increase in response to stress. The scores range from 0 to 60 with a higher score reflecting more anxiety. The STAI has acceptable concurrent validity (Spielberger, 1973) and internal consistency ($r = .83$).

Child Questionnaires. A research assistant read the assessments to the children and recorded their answers. To reduce experimenter bias, the researcher was instructed to read all questions in the same tone of voice.

1. State Anxiety Inventory for Children (STAIC; Spielberger, 1973). The children were assessed on the STAIC, which is an adaptation of the STAI for school-age children and adolescents who are below average in reading level. The STAIC consists of 20 questions on present feelings. Children choose from statements such as "I feel very calm," "calm," or "not calm." The STAIC has acceptable internal validity (Montgomery & Finch, 1974; Spielberger, 1973).

2. Profile of Mood States (POMS; McNair, Lorr, & Droppleman, 1971). The children's depressed mood was assessed by the POMS-depression subscale (modified in this study for children), a short questionnaire consisting of 19 adjectives. A previous study on massage effects for anxious children and adolescents suggested that the POMS is a sensitive measure for assessing mood changes in children after therapy (Field et al., 1992). The modified POMS was derived by selecting and simplifying those items that comprised the depressed subscale as listed in the POMS manual. Typical items included "unhappy," "sorry for things done," "sad." If the child had trouble understanding an adjective, it was placed in a sentence. The children responded

Table 1. Means for Pre-Post Measures for Massage and Control/Reading Group for Day 1 and Day 30 of the Study

Measures	Massage (n = 10)				Control (n = 10)				Effect size
	Day 1		Day 30		Day 1		Day 30		
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	
Immediate effects									
Parents' anxiety (STAI)	41.1 ^a (4.1)	36.4 ^{b*} (3.7)	29.7 ^{b*} (5.5)	30.9 ^{b*} (9.3)	37.0 ^a (5.5)	35.5 ^a (6.5)	36.3 ^a (11.2)	40.0 ^a (10.6)	28
Child scales									
Anxiety (STAIC)	32.2 ^a (4.9)	26.1 ^{b**} (4.4)	26.1 ^{b**} (2.9)	24.7 ^{b**} (3.2)	30.8 ^a (2.0)	30.2 ^a (3.1)	33.1 ^a (6.6)	32.9 ^a (5.9)	34
Mood (POMS)	4.6 ^a (2.6)	2.0 ^{b*} (2.5)	3.6 ^a (3.0)	1.7 ^{b*} (2.7)	5.7 ^a (5.2)	6.4 ^a (4.7)	8.5 ^a (5.3)	7.2 ^a (4.6)	26
Effects after 1 month									
Peak air flow (PEFR) ^c	271.5 ^a (87.8)		297.9 ^{b*} (94.1)		255.0 ^a (95.8)		244.0 ^a (125.4)		47

Standard deviations (in parentheses) follow means.

^{a,b}Superscripts indicate significance levels for adjacent numbers in the cast of pre-post massage session changes, and those appearing in column 3 reflect the differences between premessage values on first and last days ($*p < .05$, $**p < .01$). The groups did not differ on baseline measures for any of the above variables.

^cHigher numbers are optimal.

to how they felt “right now” on a 5-point scale ranging from “not at all” to “extremely.” The scale was found to have good face validity for measuring depressed mood in children.

Day 1–Day 30 Peak Air Flow Monitoring. All participants were trained to use peak flow meters by a pediatric respiratory therapist, prior to enrolling into the study. Their personal best values were determined. Peak flow monitoring was performed twice daily. Participants recorded the best of three readings each time.

Peak flow monitoring is a measurement of air flow through larger airways (but not of pulmonary function) and is effort-dependent. Peak flow monitoring was used in this study because it was the only objective pulmonary monitoring available in this preliminary, short-term study and it provided some monitoring of treatment effects. If children felt better, they were expected to show more positive readings, whereas negative readings were expected if the treatment had negative aspects.

Results

Repeated measures by group (massage/reading) MANOVAs and ANOVAs were conducted. The repeated measures were pre- and posttherapy sessions (time) and first (day 1) and last day (day 30) of the study. Post-hoc Bonferroni *t* tests were used to assess interaction effects. Effect sizes were also conducted and are reported in Table I.

Pre- and Postsession Assessments (Immediate Effects)

For the STAI and STAIC, group by session interaction effects for parents in the massage group, $F(1, 17) = 6.28$, $p < .05$, and their children, $F(1, 17) = 5.73$, $p < .05$, revealed a reduction in anxiety following the session on the first day for the parents and for the children (see Table I).

For the POMS, a group by session interaction effect, $F(1, 17) = 7.30$, $p < .05$, revealed improved mood for the massaged children following the first and last day sessions (see Table I).

Day 1–Day 30 Assessments

A group by session by days interaction effect, $F(1, 17) = 6.60$, $p < .05$, for the children and for the parents, $F(1, 17) = 6.28$, $p < .05$, on the STAI suggested a reduction in the massaged children’s and their parents’ anxiety levels on day 30 of the study compared to day one (see Table I).

A group by days interaction effect, $F(1, 17) = 8.04$, $p < .05$, revealed an increase in peak air flow readings for the massage therapy group by day 30 of the study. A moderate effect size was observed for this measure (see Table I).

Discussion

Chronic illness is a potential stressor for sick children and their families (Thompson et al., 1992). In the present study, the immediate effects of massage

therapy for children with CF included reduced anxiety levels and improved mood. The children's self-reports of decreased anxiety were still evident by the 30th day of the study, suggesting that the daily massages reduced their stress levels. These data are consistent with those in other massage therapy studies showing decreased anxiety in children with chronic illnesses, including asthma (Field, Henteleff, et al., 1998), juvenile rheumatoid arthritis (Field, Hernandez-Reif, Seligman, et al., 1997) and diabetes (Field, Hernandez-Reif, LaGreca, et al., 1997).

The reduced anxiety in the parents is also promising in that studies show that decreased maternal anxiety facilitates child adjustment to CF (Thompson et al., 1992). Furthermore, this finding is consistent with results from studies that reveal bidirectional effects for the receiver as well as the giver of massage (Field, Hernandez-Reif, Quintino, Schanberg, & Kuhn, 1998) and with findings from other studies wherein parents report reduced anxiety after massaging their children with chronic illnesses (Field, Hernandez-Reif, LaGreca, et al., 1997; Field, Hernandez-Reif, Seligman, et al., 1997). Moreover, that only one child-parent dyad failed to complete the 1-month massage protocol suggests that massage therapy has general acceptability for families who have children with CF.

The increased peak air flow readings following 1 month of massage therapy are also encouraging. Although peak flow readings do not provide an adequate measure of pulmonary function, they do provide a measure of the flow through the larger airways and how well the children perform. That the readings significantly increased with massage therapy suggests the positive aspects of the treatment with the limited sample and implies that massage therapy may have potential clinical significance for not only reducing psychological distress but also for improving peak airflow in children with CF. The peak expiratory air flow increase in the CF children is also consistent with the increases reported for children with asthma (Field, Henteleff, et al., 1998).

One limitation of the present study, however, was that measures of pulmonary functions were not

obtained. Also, massage therapy was discontinued after 30 days. Longer follow-up is required to determine whether massage therapy may ameliorate the deterioration on pulmonary functioning caused by CF. Future studies might explore longer effects of massage therapy on lung function, which can be studied by following changes in FVC, FEV 1%, FEF 25%–75%, number of respiratory exacerbations, measurement of salivary stress hormones, and metabolites of stress hormones in urine. Daily massage over 3 months, for example, may lead to improved airway tone and decreased irritability due to vigorous coughing and chest physiotherapy (Hodson & Warner, 1992).

Future research might also examine massage therapy for alleviating some of the gastrointestinal symptoms, such as abdominal pain, weight loss, and mealtime behavior problems (Crist, McDonnell, Beck, Gillespie, & Mathews, 1992; Stark et al., 1990; Stark et al., 1991), inasmuch as massage therapy has reduced pain and enhanced weight gain in other studies (see Field, 1996, for a review). Massage therapy may lead to the release of food absorption hormones, such as insulin and gastrin, by vagal nerve stimulation (Uvnas-Moberg, Widstrom, Marchini, & Windberg, 1987). This can be especially beneficial for patients with CF, since this improves nutritional status and muscle strength.

Because the small sample size is a limitation of the current study, replication is necessary with a larger controlled clinical trial. In addition, the mechanism underlying the impact of massage therapy on peak airflow is unclear and requires investigation. Nonetheless, the results of this 30-day study are encouraging. Incorporating massage therapy into the routine of children newly diagnosed with CF or those with mild-to-moderate pulmonary disease may be beneficial, not only in reducing the children's stress level, but also the parent's anxiety. Also, because parents can be easily taught to massage their children and compliance with the massage treatment was high, this form of therapy can be considered a cost-effective treatment.

Received December 15, 1997; accepted August 14, 1998

References

- Boucher, R. C. (1994). Cystic fibrosis. In K. J. Isselbacher, J. B. Martin, E. Braunwald, A. S. Fauci, J. D. Wilson, & D. L. (Eds.), *Harrison's principle of internal medicine* (13th ed., pp. 1194–1197). New York: McGraw-Hill.
- Burke, P., Myer, V., Kocoshis, S., Orenstein, D. M., Chandra, R., Nord, D. J., Sauer, J., Cohen, E. (1989). Depression and anxiety in pediatric inflammatory bowel disease and cystic fibrosis. *Journal of the American Academy of Child and Adolescent Psychiatry*, *28*, 948–951.
- Crist, W., McDonnell, P., Beck, M., Gillespie, C., & Matthews, J. (1992). Behavior at mealtimes and nutritional intake in the young child with CF [summary]. *Pediatric Pulmonary*, *14*, 321.
- Cystic Fibrosis Foundation. (1998). Facts about cystic fibrosis [on-line]. Available: www.cff.org/factsabo.htm
- Field, T. (1996). Massage therapy for infants and children. *Developmental and Behavioral Pediatrics*, *16*, 105–111.
- Field, T., Grizzle, N., Scafidi, F., Abrams, S., Richardson, S., Kuhn, C., & Schanberg, S. (1996). Massage therapy for infants of depressed mothers. *Infant Behavior and Development*, *19*, 107–112.
- Field, T., Henteleff, T., Hernandez-Reif, M., Martinez, E., Mavunda, K., Kuhn, C., & Schanberg, S. (1998). Asthmatic children have improved pulmonary function after massage therapy. *Journal of Pediatrics*, *132*, 854–858.
- Field, T., Hernandez-Reif, M., LaGreca, A., Shaw, K., Schanberg, S., & Kuhn, K. (1997). Massage therapy lowers blood glucose levels in children with diabetes. *Diabetes Spectrum*, *10*, 28–30.
- Field, T., Hernandez-Reif, M., Quintino, O., Schanberg, S., & Kuhn, C. (1998). Elder retired volunteers benefit from giving massage therapy to infants. *Journal of Applied Gerontology*, *17*, 229–239.
- Field, T., Hernandez-Reif, M., Seligman, S., Krasnegor, J., Sunshine, W., Rivas-Chacon, R., Schanberg, S., & Kuhn, C. (1997). Juvenile rheumatoid arthritis: Benefits from massage therapy. *Journal of Pediatric Psychology*, *22*, 607–617.
- Field, T., Morrow, C., Valdeon, C., Larson, S., Kuhn, C., & Schanberg, S. (1992). Massage reduces anxiety in children and adolescent psychiatric patients. *Journal of the American Academy of Child and Adolescent Psychiatry*, *31*, 125–131.
- Field, T., Schanberg, S., Scafidi, F., Bauer, C., Vega-Lahr, N., Garcia, R., Nystrom, J., & Kuhn, C. (1986). Tactile/kinesthetic stimulation effects on preterm neonates. *Pediatrics*, *77*, 654–658.
- Hodson, M. E., & Warner, J. O. (1992). Respiratory problems and their treatment. *British Medical Bulletin*, *48*, 931–948.
- Maayan, C., Bar-Yishay, E., Yaacobi, T., Marcus, Y., Katznelson, D., Yahav, Y., & Godfrey, S. (1989). Immediate effects of various treatments on lung function in infants with cystic fibrosis. *Respiration*, *55*, 144–151.
- McNair, D. M., Lorr, M., & Droppleman, L. F. (1971). *POMS-Profile of Mood States*. San Diego: Educational and Industrial Testing Service.
- Montgomery, L. E., & Finch, A. J. (1974). Validity of two measures of anxiety in children. *Journal of Personality Assessment*, *39*, 409–413.
- Parker, A. E., & Young, C. S. (1991). The physiotherapy management of cystic fibrosis in children. *Physiotherapy*, *77*, 594–586.
- Sockrider, M. M., Swank, P. R., Seilheimer, D. K., & Schidlow, D. V. (1994). Measuring clinical status in cystic fibrosis: Internal validity and reliability of a modified NIH Score. *Pediatric Pulmonology*, *17*, 86–96.
- Spielberger, C. D. (1973). *State Trait Anxiety Inventory for Children*. Palo Alto, CA: Consulting Psychological Press.
- Spielberger, C. D., Gorsuch, R. C., & Lushene, R. E. (1970). *The State Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychological Press.
- Stark, L. J., Bowen, A. M., Mulvihill, M. M., Hovell, M., Knapp, L., Speith, L., Bradbury, C., Evans, S., Passero, M. A., Harwood, L., & Jelalian, E. (1991). Behavioral and environmental factors affecting nutrition in cystic fibrosis. *Pediatric Pulmonary*, *10*, 207.
- Stark, L. J., Bowen, A. M., Tyc, V. L., Evans, S., & Passero, M. (1990). A behavioral approach to increasing caloric consumption in children with cystic fibrosis. *Journal of Pediatric Psychology*, *15*, 309–326.
- Thompson, R. J., Gustafson, K. E., George, L. K., & Spock, A. (1994). Change over a 12-month period in the psychological adjustment of children and adolescents with cystic fibrosis. *Journal of Pediatric Psychology*, *19*, 189–203.
- Thompson, R. J., Gustafson, K. E., Hamlett, K. W., & Spock, A. (1992). Psychological adjustment of children with cystic fibrosis: The role of child cognitive processes and maternal adjustment. *Journal of Pediatric Psychology*, *17*, 741–755.
- Uvnas-Moberg, K., Widstrom, A. M., Marchini, G., & Windberg, J. (1987). Release of GI hormone in mother and infant by sensory stimulation. *Acta Paediatrica Scandinavica*, *76*, 851–860.

