Attitudes Toward Physical Activity in Adolescents With Cystic Fibrosis: Sex Differences After Training: A Pilot Study

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Abstract:

This study compared the attitudes of 16 adolescents (8 males and 8 females) with cystic fibrosis (CF) toward exercise and physical activity (PA) before and after a 6-week exercise program. Although the boys and girls had similar ages (12–18 years), the boys were fitter and leaner and had higher pulmonary function. Subjects reported both positive exercise attitudes of self and perceived attitudes of parents/friends that remained essentially unchanged after strenuous training. Boys reported higher vigorous activities at baseline than girls, but all subjects increased participation in very hard PAs after training. Girls had small but nonsignificant increases in PA at each (mild–vigorous) level. Results emphasize that adolescents with a mild to moderate lung disease can significantly increase PA in a nursing intervention.

Article:

Among Adolescents in the United States, participation in physical activity (PA) continues to drop at an alarming rate, especially as they age. Physical activity decreases by 12% from the 9th to 12th grades and is lower in girls than in boys (Center for Disease Control [CDC], 2003). A similar decline also occurs in chronically ill individuals; participation in vigorous PAs by adolescents with cystic fibrosis (CF) was similar to healthy control subjects and declined between the ages of 17 and 19 years (Britto, Garrett, Konrad, Majure, & Leigh, 2000). Adolescence is when the development of a physically active lifestyle is most likely to be sustained into adulthood (Barnekow-Bergkivist, Hedberg, Janlert, & Jansson, 1998; Freedman, Dietz, Srinivasan, & Berenson, 1999). The longterm health consequences of a sedentary lifestyle in healthy people are significant risks for obesity, hypertension, coronary artery disease, diabetes mellitus, and other chronic diseases (Raitakari, Porkka, Taimela, Telama, & Rasanen, 1994; U.S. Department of Health and Human Services [USDHHS], 1996). Lack of habitual moderate to vigorous PA is of particular concern for adolescents with a chronic illness when PA is part of self- management, helps prevent complications, slows disease progression, and lengthens survival.

The physiological benefits of PA are important for adolescents as exercise enhances energy, strength, endurance, bone mass, and ability to participate with peers in sports (Bailey & Martin, 1994; Morrow & Freedson, 1994). To achieve health benefits, adolescents should spend at least 20–30 minutes three times a week in a moderate to vigorous exercise that makes them sweat and breathe hard (Sallis & Patrick, 1994; USDHHS, 1996). In those with a chronic illness, a moderately intensive exercise program (40–60% V˙ V˙o2max) may enhance the interleukin-2/natural killer cell immune system and improve glucose metabolism (Sothern, Loftin, Suskind, Udall, & Blecker, 1999). The psychosocial benefits of exercise may be even greater by reducing negative mood states (mental stress, pain, anxiety, and depression) and improving self-esteem, body image, and self-satisfaction (Biddle & Armstrong, 1992). Sports and exercise provide opportunities for increased autonomy, independence, and social interactions (Coakley & White, 1992). Adolescents who exercise rate their health more positively than do their sedentary peers and are less likely to participate in risky behaviors such as smoking cigarettes and drinking alcohol (Thorlindsson & Vilhjalmsson, 1991). However, despite the many benefits of exercise, nearly 50% of 12- to 21-year-old youth are not vigorously active on a regular basis (USDHHS, 1996).

Cystic fibrosis is the most common fatal genetic disease occurring in Caucasians of northern European descent. The median survival for people with CF is now 31.6 years, 31.8 years for males and 30.8 years for females (Cystic Fibrosis Foundation, 2002). The lungs of individuals with CF are normal at birth, but trapped viscous airway secretions cause obstruction, bacterial infection, and airway inflammation, eventually leading to an irreversible decrease in pulmonary function and exercise intolerance (Boat & Boucher, 1994). Although chronic lung infection, with a decline in pulmonary function (FEV1 %) as patients age, remains the primary cause of morbidity and death, multiple other factors predict mortality, such as female sex, low exercise capacity, and malnutrition (Demko, Byard, & Davis, 1995; Kerem, Reisman, Correy, Canny, & Levison, 1992; Moorcroft, Dodd, & Webb, 1994). A higher exercise capacity is directly related to pulmonary function levels and is associated with a better prognosis and survival (Nixon, Orenstein, Kelsey, & Doershuk, 1992; Ramsey & Boat, 1994). As occurs in healthy adolescents, males with CF have a greater exercise capacity than females (Boucher, Lands, Hay, & Hornby, 1997). Higher mortality in adolescent girls may be related to lower levels of lung function, nutritional status, and exercise capacity as compared with boys of the same age (Rosenfeld, Davis, Pepe, & Ramsey, 1995).

PHYSICAL ACTIVITY IN CF

The importance of PA in the self-management of CF has been reported for more than 20 years. In 1983, Orenstein, Henke, and Cerny found that patients with CF could exercise safely and that PA was as beneficial as chest physiotherapy in secretion removal. Physical activity has been shown to improve pulmonary gas exchange, exercise capacity, and overall clinical condition (Blomquist, Freyschuss, Wiman, & Strandvik, 1986; Stanghelle, Michalsen, & Skyberg, 1988). In a review of short-term and long-term exercise studies, Stranghelle (1988) found that physical symptoms and muscle strength improved with exercise, that the incidence of respiratory infections was reduced, and that trained patients with CF could safely perform even vigorous, prolonged exercises. Kolberg (1988) concluded that evidence supported PA as an essential component of the CF care regimen. Although PA is generally recommended, teaching patients safe and specific procedures is highly variable between CF centers and precise PA guidelines for CF adolescents by age, sex, and disease severity are not available.

In 2001, Nixon, Orenstein, and Kelsey compared habitual PA and aerobic fitness in 30 children and adolescents with CF to healthy control subjects. Control and CF subjects were similar in age and sex, but the CF subjects were smaller and less fit. Total metabolic equivalent (MET)- hours of PA did not differ between the groups, but the CF subjects participated in fewer hours of vigorous PA per week. Higher oxygen requirements for respiratory muscles, patients' reduced aerobic fitness, higher total energy expenditure, and discouragement from parents might have explained the lower participation of CF subjects in vigorous PA. In the children with lower lung function (FEV1 $<$ 80% predicted), hours spent in vigorous PA and MET-hours were significantly related to the level of pulmonary function and aerobic fitness.

ATTITUDES TOWARD PA IN ADOLESCENTS

Studies since the 1970s have suggested an improved attitude toward exercise when patients with CF participated in PA and exercise training (Edlund et al., 1986; Scott, 1977; Stranghelle, Winnem et al., 1988). Kolberg (1988) suggested that PA gives pleasure to a chronically ill patient, enhances social contacts, increases self-esteem, and promotes better psychological adaptation; thus, it should have a positive impact on quality of life. However, he stated that there were limited data regarding the long-term effects of exercise on quality of life.

Various authors have developed and tested models of health promotion to identify predictors of exercise behavior; one of these is attitudes (values)/ beliefs (thoughts). In a study on 1,131 healthy adolescents aged 15 and 16 years, Vilhjalmsson and Thorlindsson (1998) identified five sets of correlates of PA: attitudes/beliefs, socialization, lifestyle, health status, and sociodemographic factors. Attitudes were related to behavior and, in particular, to exercise behavior. They found that those who valued sports and thought that exercise improved health were more physically active.

Stanghelle, Winnem et al. (1988) studied the attitudes of 18 children and adolescents with CF who participated in a variety of vigorous outdoor physical activities during a winter and summer 2-week training camp in Norway. Subjects rated their enjoyment of 30 activities at home and at camp on a 5-point scale; a control group of 19 healthy adolescents completed the home questionnaire. The patients with CF gave higher scores for most individual sport activities. The attitude toward PA of the CF children was very positive both during camp and at home and was the same or better as compared with that of healthy children. In addition, the training intensity in the children with CF was high enough to improve fitness. To our knowledge, this is the only study that has reported the attitudes and beliefs of adolescents with CF toward PA, but sex differences were not reported. In the general population, adolescent boys usually remain more physically active than adolescent girls as they mature (CDC, 2003); therefore, sex differences in attitudes toward PA could also differ in healthy adolescents as well as in those with CF. Because being active is so important for health maintenance in adolescents with CF, it is essential to further explore sex differences in attitudes toward PA and their relationship to performance.

This study compared attitudes toward exercise and PA of male and female adolescents with CF before and after a 6-week progressive exercise training program and examined (1) sex differences in self-reports of habitual PA, measured as MET- hours of light, moderate, hard, and very hard; (2) adolescents' attitudes toward exercise and the perceived attitudes of parents and peers toward their exercise participation; and (3) the relationships between attitudes toward exercise and MET- hours of PA and between attitudes toward exercise and aerobic capacity (peak $\dot{V}o_2$).

METHODS

Design and Sample

The study used a one-group pretest–posttest design, with subjects serving as their own controls. Observations were made at baseline and after a 6-week exercise training program. Permission to recruit subjects from the University of North Carolina–Chapel Hill (UNC-CH) CF Center was obtained from the director. All eligible 12- to 18-year-old patients from more than 100 adolescents in the center were asked to participate; approximately equal numbers of males and females were in this age group, and 94% were Caucasian. Exclusion criteria included having an acute pulmonary infection requiring intravenous antibiotics within the past month. A convenience sample of 16 adolescents who had a mild (FEV1 > 70% predicted) to moderate (FEV1 >_ 40–69% predicted) pulmonary disease was recruited. Subjects who became ill during the study were treated and then completed the study after their pulmonary function returned to baseline.

Instruments

Physical Activity

Habitual PA was measured by calculating the MET levels of each activity in hours (METS x Frequency) from an interviewer-administered checklist. Because PA instruments were not specific or sensitive to adolescents with a chronic pulmonary disease, the first author developed a 30-day PA recall (PAR) to include a greater variety of PAs and accommodate changes in activity during illness episodes. This instrument was adapted from two others: the 7-day PAR by Sallis, Buono, Roby, Micale, and Nelson (1993), consisting of intensive activities and tested on 5th-, 8th-, and 11th-grade students, and the 1-day PAR by Sallis et al. (1996). The 1-day PA was a checklist of 21 moderate–vigorous activities (3–10 METS) and was tested on 5th-grade children. Both instruments were tested in large populations of healthy children and maximized specificity by assessing four components of PA: type, intensity, frequency, and duration. The 1-day PA checklist was scored using METS of activities from the Compendium of Physical Activities (Ainsworth et al., 1993), counting the frequency and duration of activities lasting 5 minutes or longer and estimating intensity using an ordinal scale. The concurrent validity of the 1-day PA checklist was established by a significant correlation with two objective measures of PA (heart rate response and an accelerometer) in girls and boys (Sallis et al., 1996).

In a format similar to that by Sallis et al. (1996), the interviewer-administered self-report questionnaire used in this study asked respondents to identify the number of times in the past 30 days (frequency) they had participated in any of 43 individual or group activities (type) for at least

Table 1. Metabolic Equivalents of Energy Costs of Four Levels of PA (Ainsworth et al., 1993). Compendium of Physical Activities

Light (<3 METS)	MET Level	Moderate (3–5.9 METS)	MET Level	Hard (6–8.9 METS)	MET Level	Very Hard (≥9 METS)	MET Level
Group meetings	1.5	Walking	3.5–4.0	Basketball	6.0	Jogging/Running	8–≥10
Arts/Crafts (singing)	2.0	Gardening/Mowing	4–4.5	Biking (slow)	6.0	Swimming laps	8–10
Homework	1.0	Dancing	3–5.5	Hockey/Football	8.0	Push-ups/Jump rope	8–10
Indoor jobs (dishes)	2.5	Volleyball/Marching band	4.0	Trampoline/Tumbling	6–8.0	Soccer game	10
Table games	1.5	Boating, water play	3.5	Climbing trees/Rock climbing	6–8.0	Biking (fast)	8–10
TV/Computer	1.0	Outdoor games/ roller blades	5–5.5	Exercise machine	6–9.0	Racket ball	7–10
Fishing	2.5	Bowling	3.0	Weight lifting	6.0	Cross-country skiing	8–≥10

Data from Ainsworth et al., 1993.

15–20 minutes at a time (duration) and to rate each activity as light, moderate, hard, or very hard in difficulty (intensity). Intensity levels were defined and examples were given based on the criteria by Godin, Jobin, and Bouillin (1986). (See Appendix A for the questionnaire.)

Scoring

MET values for PA of adults were used from the Compendium of Physical Activities (Ainsworth et al., 1993) because values for adolescents were unknown (Table 1). For each subject, the MET value of every activity performed was multiplied by the times it occurred over 30 days to yield a MET-hour score. The 43 physical activities were grouped according to four intensity levels: light (<3 METS), moderate (3.0–5.9 METS), hard (6.0– 8.9 METS), and very hard (≥9 METS). Subtotals for each intensity level were summed and a total MET-hour score was obtained for each subject. Sums, means, and standard deviations of subtotal and total MET-hours were obtained overall and by sex group before and after training. The concurrent validity of the 30-day PAR vigorous subscale was established by a moderate positive correlation ($p = .05$) to a maximal exercise test.

Attitudes Toward PA

Attitudes toward PA were measured by 14 items related to exercise from the Youth Health Survey developed by Harrell, McMurray, Bangdirvala, and Lenne (1996) to assess cardiovascular health habits in middle school students. The Attitudes Toward Exercise–Self subscale contains 10 items reflecting positive and negative attitudes toward exercise.

Positive items are rated on a Likert scale from 4 (strongly agree) to 1 (strongly disagree); negative items are reverse scored and all responses are summed. Scores range from 10 to 40. Higher scores indicate more positive attitudes toward exercise. Gilmer, Speck, Bradley, Harrell, and Belyea (1996) reported that factor analysis yielded one factor with loadings greater than .40, indicating a unidimensional scale; Cronbach's α was .80 and the test–retest reliability was .73. In the current study, Cronbach's α reliability of the 10- item Self scale was .84 at baseline and .86 at posttest. The 4-item subscale What Others Believe is the adolescents' perception of attitudes toward exercise of their parents and friends. Subscale scores range from 4 to 16; a higher score indicates more positive attitudes. Factor analysis on the Others subscale by Gilmer et al. identified one factor with loadings greater than .40; Cronbach's α was .82.

Descriptive variables included age, sex, pulmonary function, body mass index (BMI), percentage of body fat, and physical fitness. Severity ofpulmonary disease was assessed by pulmonary function tests (forced expiratory volume in 1 second [FEV1] and forced vital capacity). Nutritional status was assessed by measuring height with a stadiometer and weight with a calibrated kilogram scale; then, BMI was calculated (BMI = weight kg/height m2). Percentage of body fat was assessed by dual- energy X-ray absorptiometry (DEXA) using a Hologic 1000W densitometer (Hologic, Inc., Beford, MA). Physical fitness was assessed as peak V˙o2 in milliliters per kilogram per minute on a Sensormedics gas analyzer and cycle ergometer

Table 2. Physiological Characteristics of the Subjects

	Males (n = 8) [M (SD)]	Females (n = 8) [M (SD)]	Total (N = 16) [M]
Age (years)	13.9 (1.83)	14.3 (2.21)	14.1
BMI	18.37 (2.36)	18.29 (1.53)	18.33
DEXA % body fat	14 (0.05)	21 (0.041)	17.5
FEV_1 % predicted	88.4 (12.1)	71.5 (19.9)	80
FVC % predicted	101.6 (11.0)	90.5 (12.1)	96
Peak $\dot{V}O_2$ (ml/kg per minute)	39.3 (4.72)	30.5 (4.35)	34.9

Note. Body composition: BMI, a calculation of weight in kg/height in m^2; DEXA, used to measure body fat and lean mass.
Pulmonary function: parameters based on predicted percentage of the population by sex, age, and BMI; FVC indicates forced vital capacity.
Peak $\dot{V}O_2$, maximal exercise capacity assessed in ml/kg per minute by continuous, open-circuit indirect calorimetry.

(SensorMedics, Yorba Linda, CA). All episodes of illness were described and recorded.

Procedure

Recruitment and Data Collection

Subjects were recruited from a CF clinic and their consent was obtained. Routine pulmonary function tests were performed in the CF clinic by a respiratory spirometry technician using standard clinical procedures and forced expiratory attempts; the best attempt was recorded. Information about subjects' lung functions and physical conditions were obtained from chart records. Height and weight assessments were done at the Verne S. Caviness General Clinical Research Center (GCRC). The DEXA was performed in the radiology department; the peak V˙o2, in the pulmonary function laboratory. The first author interviewed subjects about their habitual PAs using the 30-day PAR checklist. Subjects identified all physical activities lasting longer than 15 minutes performed before, during, or after school: leisure, sports, or work. Activities were identified by week, beginning with the most recent week through the past 4 weeks. Parents were present and added PA information if omitted by subjects. After completing the PAR, subjects were instructed on the Attitudes Toward Exercise Questionnaire and completed it by themselves.

Intervention

Each subject selected two to three leisure or school-related physical activities that were hard or very hard for him or her, including walking, running, swimming, biking, playing soccer, and roller blading, that he or she would like to do at home. The exercise prescription was a planned progression of increasing frequency and duration of exercise, from three times a week for 20 minutes (60%max heart rate) to five times a week for 30 minutes (80%max heart rate) over a 6-week period. Subjects kept a daily diary of the type and duration of all physical activities that they performed each day. They were called weekly for support and to report their PAs and signs of illness. After 6 weeks, they returned to the GCRC for posttesting using the same protocol as that for pretesting, and they brought their PA diary.

Data Analysis

Descriptive statistics were calculated for all measures. Independent observations for the 16 subjects were made, obtaining difference scores between pretest and posttest findings. Paired t tests were performed to assess evidence of differences in pre- and post-MET-hour scores across subjects. Two-sample pooled variance t tests were performed to assess evidence of difference between males and females with respect to attitudes. Correlations with Pearson r were done to measure the associations between attitudes, PA, and physical fitness.

RESULTS

Sample Characteristics

Sixteen Caucasian adolescents with CF (8 males and 8 females) between the ages of 12 and 18 years (M = 14 years) were enrolled in the study. At baseline, pulmonary function was considerably lower for girls (mean FEV1% = 71.5% [41– 101%]) than for boys (88.4% [67–104%]) despite similar height, weight, age, and BMI. Seven boys (87.5%) had an FEV1 greater than 80% (normal); three girls' FEV1 was 64–72% (mild disease) and that of two girls was lower than 45% (moderate disease; Frangolias, Holloway, Vedal, & Wilcox, 2003). Boys were leaner than girls (14% vs. 21% body fat, respectively) and had a higher aerobic capacity (boys 39.3 [34–48] vs.

Table 3. Sex Differences in Average 30-Day Metabolic PA Scores (MET Levels) at Baseline

MET Level	Males (n = 8) Mean METS at Baseline	Females (n = 8) Mean METS at Baseline	Z*	p
Light (<3)	117.38	130.87	–0.735	.462
Moderate (3.0–5.9)	147.77	130.78	–0.210	.834
Hard (6.0–8.9)	318.75	97.44	–2.838	.005
Very hard (≥9)	212.89	196.06	–0.105	.916
Hard/Very hard (6.0–≥9.0)	531.64	293.50	–2.100	.036
Total METS	796.78	555.15	–1.785	.074

*Mann–Whitney *U* Test.

girls 30.5 [26–39] ml/kg per minute, respectively; see Table 2).

Metabolic Equivalent PA Scores by Sex

To assess evidence of differences in MET-hours for boys versus girls at baseline, we used the Mann–Whitney U test. Mean MET-hour scores were higher for girls at light intensity and were higher for boys at moderate and very hard intensities, but they were not significantly different (p = .462–.916; see Table 3). However, MET-hour scores of hard-intensity PAs were significantly higher for boys than for girls (318.8 vs. 97.4, respectively; Z = 2.838, p = .005). When MET-hour scores for hard and very hard intensities were combined to reflect total vigorous activity, METS were significantly higher in boys than in girls (531.6 vs. 293.5, respectively; Z = 2.1, p = .036). Also, boys had higher total MET-hours as compared with girls at baseline (796.8 vs. 555.2, respectively), and the difference approached significance (Z = 1.785, p = .074).

Subjects varied considerably in their PAs prior to the study. Three girls participated in team sports (soccer and swimming) whereas the others were essentially sedentary. Although the boys were not engaged in team sports, one was in marching band and all reported being physically active, by playing basketball or football with friends, running, or biking. To assess evidence of differences in MET-hour scores after the 6 weeks of progressive, vigorous exercise, we used the Wilcoxon's signed ranks test to analyze pretest– posttest PA scores (Table 4). There was a significant increase in mean very hard MET-hours across all subjects after training (204.5 to 293.3; Z = 2.43, p = .015). When sex differences were compared, boys reported significant decreases in light MET-hours (-18.9; Z = —2.24, p = .025) and in hard MET-hours (-115.6; Z = —2.10, p = .036). However, there was a significant increase in very hard MET-hours as the boys increased their exercise intensity (+101.1; Z = 1.96, p = .05) by running, biking, or using roller blades and exercise equipment; the net change in total MET-hours was minimal but remained high at posttest (779.8). Conversely, girls increased MET-hours at each level (light, +3.6; moderate, +17.06; hard, +23.75; and very hard, +76.48) by walking, running, playing soccer, or swimming. However, pretest–posttest changes were relatively small, and none were significant (p = .161–l.0; see Table 5).

This increase in PA calculated from the 30-day PAR parallels the results observed for the maximal exercise test (peak V˙o2) reported elsewhere. Peak

Table 4. Average Metabolic PA Scores (MET Levels) for 30 Days

MET Level	Total Sample (*N* = 16) MET Pre Mean Values	MET Post Mean Values	METS Mean Differences	Z*	*p*
Light (<3)	124.12	116.48	–7.64	–1.241	.215
Moderate (3.0–5.9)	139.27	155.97	16.7	–0.827	.408
Hard (6.0–8.9)	208.09	162.19	–45.9	–1.267	.205
Very Hard (≥9)	204.48	293.27	88.79	–2.43	.015
Hard/Very hard	412.57	455.45	42.88	–1.396	.163
Total METS	675.97	727.91	51.94	–1.293	.196

*Wilcoxon's signed ranks test.

Table 5. Average Metabolic PA Scores (MET Levels) by Sex

	Males (*n* = 8)				Females (*n* = 8)			
MET Level	MET Pre Mean Values	MET Post Mean Values	Z*	*p*	MET Pre Mean Values	MET Post Mean Values	Z*	*p*
Light (<3)	117.38	98.5	–2.24	.025	130.87	134.47	0.00	1.00
Moderate (3.0–5.9)	147.77	164.09	–0.56	.575	130.78	147.84	–0.98	.327
Hard (6.0–8.9)	318.75	203.19	–2.10	.036	97.44	121.19	–0.491	.624
Very hard (≥9)	212.89	313.99	–1.96	.050	196.06	272.54	–1.40	.161
Hard/very hard	531.64	517.18	–0.280	.779	293.5	393.73	–1.402	.161
Total METS	796.78	779.78	–0.14	.889	555.15	676.04	–1.40	.161

*Wilcoxon's signed ranks test.

V˙o2 is the gold standard measure of aerobic capacity; in this study, it was used as a measure of concurrent validity. At baseline, boys had significantly higher fitness levels than girls (39.3 vs. 30.5 ml/kg per minute, respectively) and reported higher MET levels. There was a moderate positive correlation between MET-hours of vigorous (hard/ very hard) PA and peak V˙o2 across all subjects (r = .49, p = .05); a similar moderate correlation was maintained after 6 weeks of exercise training (r =.6,p =.01), supporting the validity of the 30-day PAR in the reporting of vigorous PA by adolescents.

The value for the hard/very hard MET-hours from the 30-day PAR was also positively correlated with a commonly used subscale developed by Godin et al. (1986). Subjects were asked the number of times they performed strenuous exercise (heart beats rapidly; i.e., running, hockey, soccer) for longer than 15 minutes during free time. A moderate correlation was significant for all subjects at baseline (r = .686, p = .003). Similarly, moderate correlations of peak V˙o2 and the Godin et al. strenuous subscale were also significant at baseline (r = .639, p = .008) and at posttest (r= .617, p = .025).

Attitudes Toward PA

At baseline, all subjects reported a positive attitude toward PA on the 10-item scale, with a mean score of 31.7 of possible scores ranging from 10.00 to 40.00. Of the 6 items describing positive benefits (positive attitudes) of PA, the overall mean score was 19.24 of a possible 24.00; girls had slightly more positive attitudes (19.85) than boys (18.62; see Table 6). Girls noted that exercise improved their appearance and outlook on life, and they believed in doing hard PA three times a week. Boys felt that exercise improved their energy; all said they liked to exercise. The 4 items describing barriers to PA (negative attitudes) were reverse scored, revealing an overall mean score of 12.47 of a possible 16.00; girls had a higher score (13.06)

Table 6. Attitudes of Self Toward PA: Mean Values by Item

Attitudes	Boys (*n* = 8)		Girls (*n* = 8)	
	Pre	Post	Pre	Post
Positive/Benefits (4 = strongly agree; 1 = strongly disagree)				
Exercise improves the way I look	3.13	3.37	3.25	3.38
Exercise improves my outlook on life	2.87	3.13	3.13	3.0
Exercise increases my ability to keep going	3.5	3.25	3.15	3.25
I like to exercise	3.25	3.0	3.31	3.0
I believe I should play sports every week	3.0	3.13	3.38	2.94
I believe I should do hard PA three times a week	2.87	3.0	3.63	3.31
Subtotal	18.62	18.88	19.85	18.88
Negative/Barriers (1 = strongly agree; 4 = strongly disagree)				
Exercise is too much hard work	2.88	3.25	3.25	3.0
I am too embarrassed to exercise	3.5	3.37	3.75	3.56
Exercise takes too much of my time	2.75	3.0	3.19	3.12
Exercise makes me feel too tired	2.75	3.0	2.87	3.13
Subtotal	11.88	12.62	13.06	12.81
Total: Attitudes of Self	30.5	31.5	32.91	31.69

Table 7. Perceived Attitudes of Parents and Friends Toward PA: Mean Values by Item

4 = strongly agree; 1 = strongly disagree	Boys (n = 8)		Girls (n = 8)	
	Pre	Post	Pre	Post
Attitudes of parents				
My parents think I should play sports every week	2.75	3.13	3.13	2.88
My parents think I should do hard PA three times a week	3.25	3.13	3.13	3.38
Subtotal	6.0	6.26	6.26	6.26
Attitudes of friends				
My friends think I should play sports every week	2.75	3.0	2.75	2.75
My friends think I should do hard PA three times a week	3.0	2.88	2.75	2.75
Subtotal	5.75	5.88	5.50	5.50
Total: Attitudes of Parents and Friends	11.75	12.14	11.76	11.76

and reported fewer barriers to PA than boys (11.88). Although at baseline girls had slightly better attitudes toward exercise (32.91) than boys (30.5), the difference by sex was not significant (p = .38).

After participating in the 6-week exercise program, overall mean attitude remained essentially the same (31.6) as compared with baseline (p = .88). When stratified by sex, change in mean attitude increased to 31.5 for boys (+1.0); their positive attitudes increased and their negative attitudes decreased. In girls, the opposite change occurred. Attitude decreased from 32.91 to 31.69 (-1.22); they felt fewer benefits from PA and
barrier attitudes increased. However, these changes were small and nonsignificant for both boys (p = .36) and girls (p = .28).

Subjects were also asked to rate perceived attitudes of their parents and friends toward their engagement in PA. At baseline, the mean attitudes of parents were rated positively by both boys and girls (M = 6.13 of a possible 8.00), and they remained essentially unchanged at posttest (+0.13, p = .69). Mean attitudes of friends were rated a little lower at baseline (M = 5.63), and they also remained essentially unchanged at posttest (+0.06, p = .79). Results stratified by sex were similar (p = .6–l.0; see Table 7).

Relationship of Attitudes Toward PA and MET-Hours

Pearson r correlations were used to examine the relationship between attitude and MET-hours of PA. There was no relationship between baseline attitude and total MET hours of PA for the sample as a whole (r = .2, p = .47), nor was there any when the sample was separated by sex (r = .45, p = .27 for boys; r = .30, p = .47 for girls). Correlations between attitude and hard/very hard PA were also not significant for the group as a whole (p = .59) or when divided by sex (p = .23 for boys and p = .54 for girls).

Relationship of Attitudes Toward PA and Aerobic Capacity

At baseline, there was a significant relationship between self-reported attitudes toward PA and peak V˙o2 in boys (r = .73, p = .04), and this relationship remained significant after 6 weeks of exercise (r = .72, p = .04). A similar relationship was not observed in girls, either at baseline (r = .49, p = .21) or after 6 weeks of exercise (r = .03, p = .95).

DISCUSSION

The major findings of this study are that the adolescents with mild to moderate CF significantly increased their participation in very hard PAs (60–80% peak aerobic capacity) over the 6-week training program. Although, initially, the boys' participation in hard and very hard PAs was greater than the girls', overall, the adolescents increased their participation in PAs that were vigorous for them by the end of the program. Attitudes toward PA were positive at baseline, and they remained essentially unchanged at the completion of training.

Sex Differences in PA

Sex differences were found at baseline in physical fitness, PA, and health status of these adolescents with CF. Overall, the boys in this study were as physically fit as healthy adolescent boys of the same age. All reported high levels of hard and very hard PAs at baseline. Many had a specific goal that the exercise training program would help them accomplish, such as tryouts for team sports at school, exercising with their family or friends, or gaining weight and muscle strength. Except for periodic episodes of respiratory infection and treatment with antibiotics, they were quite healthy. Their lung function was considered normal (FEV1 >_ 80%). The boys had very low body fat (14%), and this may have been related to their higher level of habitual PA as well as to malabsorption that can occur with CF.

The girls were the same age as the boys but overall were much less physically active and fit, as is found in the general population. When compared by sex, inactivity in boys increases from 24% to 32% from the 9th to 12th grades; in girls, inactivity increases from 33% to 48% by the 12th grade (CDC, 2003). There was also greater variability in the girls' PA levels; three participated in team sports, but the others were relatively inactive. Goals for the exercise program were nonspecific, such as to get in shape for summer. The girls' overall percentage of body fat was higher and approached normal levels (21%), indicating adequate nutrition. However, their over-all lung function was only moderate at 71% (FEV1 = 50–79% predicted); two girls bordered on having severe lung disease (FEV1 < 40% predicted). Other studies on PAs in CF have evaluated activity levels according to lung function and nutritional status. In general, habitual PA levels for adults with CF were similar to those for control subjects, except for those with a predicted FEV1 lower than 50% (Moorcroft, Abbott, Dodd, Gee, & Webb, 1996). A study on 36 children and adolescents with CF reported that boys were more physically active (8.1 hours) than girls (7.5 hours). But in those with a more severe lung disease (FEV1 < 75% predicted), a decrease in PA time was significantly related to nutritional status, not lung function (Boucher et al., 1997). Reduced pulmonary function in the girls in this study may have affected their choice to participate in habitual PAs.

The high rates of inactivity and sedentary behavior in adolescents are well known, especially in girls, as they enter middle to older adolescence. In a self-report of habitual PA in adolescents with CF (N = 116), matched by age, race, and sex to healthy adolescents, participation in vigorous PA was similar for both groups (Britto et al., 2000). Males were more likely to be in team sports than females, and males in the healthy group reported more vigorous activities. However, PA declined in both groups between the ages of 17 and 19 years. This overall decline in PA was not related to sex or health status.

By the end of this program, both boys and girls reported increased MET-hours spent in vigorous PAs. Boys had a minimal change in total MET score; this finding was probably related to their higher level of aerobic conditioning and report of greater time spent in hard PAs at baseline. In addition, most boys selected very vigorous activities such as running and biking as their preferred PA. Thus, although the time spent in hard PAs decreased, the time spent in very hard PAs increased by 47%. Girls were much less fit and more physically inactive on average than boys at baseline (METS were 70% of boys); therefore, participation in an exercise training program increased the amount of time spent in all levels of PAs. Although the girls' total MET-hour score increased 22% at posttest, their score was only 87% of the boys' total posttest score.

Attitudes and Other Correlates of PA

Several studies have investigated correlates of PA; one of these significant correlates is attitude. [versus 2000]: Sallis, Prochaska, and Taylor (2000) reviewed 54 studies on healthy adolescents (aged 13–18 years) published between 1970 and 1998 and found 48 variables that significantly correlated with PA. The variables were categorized as demographic (male sex, young age, White race), psychological (achievement oriented, perceived competence, intend to be active, lack of depression, self-efficacy, attitudes, body image, and knowledge), behavioral (sensation seeking, previous PA, participation in community sports, and sedentary behavior after school), social (support and direct help from parents and others and active siblings; perceived support from peers and attitudes of significant others were indeterminate), and environmental (opportunities to exercise). Given such a wide array of predictors, attitude toward exercise may only partially predict PA.

In this study, each subject was given the opportunity to self-select one or more vigorous PAs for their exercise intervention. The ability to control the choice of the activity should positively affect their attitudes. The popular activities with most adolescents in this study were individual sports; only three participated in team or group activities (soccer, swimming, and marching band). The choice of individual sports may reflect personal preferences, unavailability of team sport options, conflicting demands for time spent on disease management versus team sports, or the inability to qualify for a school team. Stanghelle, Winnem et al. (1988) reported similar findings from an exercise study on children and adolescents with CF (9–21 years old). At pretest, they reported positive attitudes toward exercise, and had participated in individual sports (swimming, canoeing, and biking) rather than in team sports prior to the study. During a 2-week camp, they preferred recreational activities such as horseback riding, canoeing, and self- training rather than endurance-type exercises such as jogging. A preference for individual sports may be an adolescent's choice. It may also reflect parental concern about ill effects that a child could encounter by being in highly competitive sports and/or pressure from the coach or peers to perform at high intensity levels despite disease limitations.

Surprisingly, the girls in this study had somewhat more positive attitudes toward exercise than boys initially, although only three of them participated in organized PAs outside of school. It would be expected that adolescents already engaged in sports would have positive attitudes. Although there was minimal change in attitudes after training, positive attitudes remained in subjects who were either active or relatively inactive prior to the study. There was a slight trend for boys to increase and girls to decrease their positive attitudes as an exercise became progressively more difficult, which may reflect prior expectations, worse lung disease, and/ or poorer conditioning. As a group, the girls were much less physically fit; poor aerobic conditioning is common in healthy girls as they reach middle adolescence (Britto et al., 2000; CDC, 2003). The girls also had worse lung disease than the boys, a common finding among other adolescent girls with CF (Rosenfeld et al., 1995). However, their positive attitudes about exercise and their willingness to participate in an exercise training study may be reflective of their anticipation that exercise could have a positive effect on personal factors as well as their disease status.

The significant change in self-report of very hard MET-hours of PA for both boys and girls after training was one indication that they were adhering to the exercise program. Although a correlation between PA and attitude would be expected, none was found. Possible explanations for this finding could be that the initial attitude toward exercise was positive and, therefore, was unlikely to change after engaging in a short-term, vigorous exercise program that became progressively more demanding. The four-point range of possible scores on the attitude scale was small, allowing for less differentiation. Perhaps a seven-point Likert scale would have increased the sensitivity of the instrument. Also, the small number of items may not have completely represented other attitudes held by the adolescents. An important finding was that attitude toward exercise remained constant as the difficulty of exercise increased. Attitudes toward exercise may be acquired as part of life experience and social support and may be less responsive to short-term events such as exercise training.

Cognitive factors (beliefs about behavioral consequences, evaluations of outcomes, and intentions) and affective or emotional factors (liking or disliking the behavior, fear, and excitement) are components of attitudes (Vilhjalmsson and Thorlindsson (1998). Intention to exercise has been shown to be affected by attitudes (Bouchard, 2001; Dishman et al., 2002; Motl et al., 2001; Motl et al., 2002). Motl et al. (2002) developed and tested a social– cognitive model that explained intention and expectation to engage in moderate or vigorous PA among 8th-grade adolescent girls. The model included four predisposing variables: self-efficacy, attitude, subjective norms (peers), and behavioral control (external factors). Self-efficacy and behavioral control were primary correlates of PA. Self- efficacy was independently related to moderate and vigorous PA. Attitude and subjective norms were related to intention, but intention was unrelated to engaging in PA. In the current study, the effect of subjective norms from peers is unknown because only some of the subjects exercised or played with friends.
Although not measured in this study, clinical observation indicated that all subjects had strong parental support and encouragement to participate; this may be an especially important factor in a chronic illness such as CF. At recruitment, parents often urged their child to take part in the hope that exercise might improve their clinical condition. Parental support and role modeling may be a major factor in children and adolescents learning to enjoy and develop a physically active lifestyle. Although some parents admitted that their family engaged in primarily sedentary activities when together, they encouraged their child to exercise. Of the 16 subjects, 9 (56%) regularly exercised with a buddy, such as a parent, sibling, friend, or pet. Some parents actively supported their child's PA by taking them to soccer matches or swim meets or by helping them plan their week to include exercise time. Others actually exercised with their child during the training program by walking, running, biking, swimming, or engaging in gym workouts and had their own goals such as losing weight or getting in shape. Other parents did not participate and their child did the program independently. One girl was in a competitive team sport with peers;

any personal support from this activity is unknown. Four had been active previously and exercised alone by running, and two had minimal support or structure in their PA.

Analysis Considerations

Although there was no control group, each subject served as his or her own control. Equal numbers of boys and girls at one developmental stage participated in the study, similar to the sex distribution of the CF population. The convenience sample was of average sample size (16% of adolescents) for a study in one CF center. Considerable variability existed among the subjects in physical fitness, activity level, and health status at baseline; thus, the standard deviations of the means of variables were relatively large for a sample of 16 subjects. Although a nonparametric statistical analysis was used, the p values are only approximate and should be interpreted with some caution. It is possible that the sample was biased in favor of adolescents and their parents who were interested in exercise, were hopeful of positive personal or health benefits, and/or were unafraid of adverse responses to exercise. Thus, those patients who volunteered may have been aware of the benefits of PA for management of illness and more motivated to participate in regular PAs. Because MET values of PA intensity were only available for adults, the assessment of METS may be approximate for adolescents with a chronic lung disease. Adolescents can accurately report their habitual PA, especially if they know about the interview, but a shorter time span of 7 days including weekends would facilitate an accurate PAR.

Implications for Clinical Practice

The results of this study emphasize the importance of a nursing intervention in maintaining positive attitudes toward exercise while increasing habitual PA in both male and female adolescents with a mild to moderate lung disease. As in healthy adolescents, sex differences were clearly evident as the boys engaged in more PAs and were more aerobically fit than girls of the same age. In most CF populations, girls have a lower pulmonary function than boys of the same age; thus, girls may be more vulnerable to complications from a sedentary lifestyle. With the support of the intervention and the parents, the girls as well as the boys continued to actively participate in the exercise program throughout and significantly increased their habitual vigorous PAs. These subjects and their parents had positive attitudes toward exercise prior to the study, enhancing their willingness to participate. Because the adolescents chose their preferred activity according to their goals and the intensity of the exercise was based on fitness levels, this individualized approach may have contributed to their maintaining positive attitudes toward PA. A greater challenge for nursing practice is to engage chronically ill adolescents who are sedentary and have negative attitudes toward exercise in a PA program.

CONCLUSIONS

Although the lifestyle of adolescents is increasingly sedentary, very few studies have been done on attitudes of chronically ill adolescents toward vigorous PAs. This study examined attitudes toward PA and MET-hours spent in vigorous exercise training. The study found that adolescents with a mild to moderate chronic pulmonary disease can safely and significantly increase their amount of time, intensity, and duration spent in vigorous PAs over 6 weeks. The adolescents clearly valued the health benefits of exercise by volunteering to participate in a vigorous training program, and their positive attitudes remained after training. The psychological and social benefits of exercise have been described in athletes and in some healthy populations, but few studies have been done on chronically ill populations. Future research will examine the effect of

PA and its correlates on quality of life, psychosocial outcomes of self- esteem and self-efficacy, and the physiological effects of a long-term exercise training program in adolescents with CF.

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APPENDIX A. PHYSICAL ACTIVITY RECALL QUESTIONNAIRE

ID____________________ Date____________ Visit No.________

Mark the number of times over the past 30 days each activity was performed >15–20 minutes.

	MET Levels*	No. of Days per Month	Duration (minutes)	Intensity (L M, H, VH)
Aerobics: dance–6.0, water–4.0	4.0–6.0			
Arts and crafts (draw, paint, sew)	1.8			
Badminton or ping pong	4.5			
Baseball or softball	5.0			
Basketball (team sport)	8.0–10.0			
Basketball (not a game)	6.0			
Bicycling (<10 mph) slow	6.0			
Boating: sailing, canoeing	3.5			
Bowling	3.0			
Calisthenics: push-ups, jumps	8.0			
Climbing: trees, rope, or rocks	6.0–8.0			
Dancing (general–4.5); slow–3.0, fast–5.5	3.0–5.5			
Exercise machines: bike–6.0, treadmill–6.0, Nordic Track–9.0	6.0–9.0			
Fishing	2.5			
Frisbee or ball throwing	3.0			
Football, touch, general	8.0			
Games outdoors: tag, hopscotch, hide and seek	5.0			
Group meetings: clubs	1.5			
Gym class (PE)______________________________	3.0–6.0			
Gymnastics: general–4.0, tumbling, trampoline–6.0–8.0	4.0–8.0			
Hiking cross-country	6.0			
Hockey	8.0			
Homework, reading, typing	1.8			
Indoor jobs: (dishes, cooking–2.5)	2.5–3.5			
Jogging or running – 5.0–8.0 mph	5–10			
Jumping rope – slow–8.0	8–10			
Karate or judo (martial arts)	4.0–10.0			
Marching in band	4.0			
Music: instrument, horn–2.0; piano–2.5; drums–4.0	2.0–4.0			
Outdoor jobs: mowing, raking, gardening	4.5			
Singing in choir or small group	2.0			
Skateboarding	5.0			
Skating: roller, roller blades–7.0, ice–5.5	5.5–7.0			
Skiing: water, downhill	6.0			
Cross-country	≥8.0			
Soccer: practice–8.0, game–10.0	8.0–10.0			
Swimming laps	8.0–10.0			
Table games: cards, computer	1.5			
Tennis	6.0–8.0			
Or racket ball	7.0–10.0			
Volleyball	3.0–4.0			
Walking	3.0–4.0			
Watching TV/Video	1.0			
Water play: swim pool, slides	3.0			
Weight lifting: describe	≥3.0			
Total				

* MET levels: Metabolic equivalents for physical activities have ONLY been determined for adults (Ainsworth et al., 1993).

Intensity scale (Godin et al., 1986)

L = light: "mild activity, minimal effort."
Ex.: watching TV, reading, fishing from bank, golf, easy walking, singing.

M = moderate: "nontiring exercise."
Ex.: badminton, fast walking, easy cycling, volleyball, popular dancing, baseball, bowling, raking lawn, outdoor games.

H = hard: "breathe heavily and your heart beats fast."
Ex.: jogging, aerobic dance or ballet, throwing baskets, baseball, tennis, swimming, bicycling at 10 mph at some grade, marching band.

VH = very hard–exhausting–strenuous: "breathe very heavily, very sweaty, heart pounds."
Ex.: running, cross-country skiing, hockey, football, soccer, vigorous swimming, competitive basketball, rock climbing, vigorous long-distance cycling.

During a normal week, how many hours a day do you watch television and videos or play a computer or video games before or after school?

____

During the past 12 months, how many team or individual sports or activities did you participate in on a competitive level, such as varsity or junior varsity sports, intramural programs, or out-of-school programs ____________________? List activities ____________________________.

Comments:

REFERENCES

Ainsworth, B. E., Haskell, W. L., Leon, A. S., Jacobs, D. S., Montoye, H. J., Sallis, J. F., et al. (1993). Compendium of physical activities: Classification by energy costs of human physical activities. Medicine and Science in Sports and Exercise, 25, 71–80.

Bailey, D., & Martin, A. (1994). Physical activity and skeletal health in adolescents. Pediatric Exercise Science, 6, 330–347.

Barnekow-Bergkivist, M., Hedberg, G., Janlert, U., & Jansson, E. (1998). Prediction of physical fitness and physical activity level in adulthood by physical performance and physical activity in adolescence—An 18-year follow-up study. Scandanavian Journal of Medicine & Science in Sports, 8, 299–308.

Biddle, S., & Armstrong, N. (1992). Children's physical activity: An exploratory study of psychological correlates. Social Science & Medicine, 34, 325–331.

Blomquist, M., Freyschuss, U., Wiman, L. G., & Strandvik, B. (1986). Physical activity and self-treatment in cystic fibrosis. Archives of Disease in Childhood, 61, 362–367.

Boat, T. F., & Boucher, R. C. (1994). Cystic fibrosis. In J. F. Murray, & J. A. Nadel (Eds.), Textbook of respiratory medicine (pp. 1418–1450). Philadelphia: WB Saunders.

Bouchard, C. (2001). Physical activity and health: Introduction to the dose–response symposium. Medicine and Science in Sports and Exercise, 33, S347–S350.

Boucher, G. P., Lands, L. C., Hay, J. A., & Hornby, L. (1997). Activity levels and the relationship to lung function and nutritional status in children with cystic fibrosis. American Journal of Physical Medicine & Rehabilitation, 76, 311–315.

Britto, M. T., Garrett, J. M., Konrad, T. R., Majure, J. M., & Leigh, M. W. (2000). Comparison of physical activity in adolescents with cystic fibrosis versus age-matched controls. Pediatric Pulmonology, 30, 86–91.

Center for Disease Control. (2003). Percentage of students who did not participate in at least 20 minutes of vigorous physical activity on three or more of the past seven days and who did not do at least 30 minutes of moderate physical activity on five or more days of the past seven days. Retrieved 6/21/2004 from http://apps.nccd.cdc.gov/yrbss/QuestYearTable. asp?cat=6&Quest=509&Loc=NC&year=2003.

Coakley, J., & White, A. (1992). Making decisions: Gender and sport participation among British adolescents. Sociology of Sport Journal, 9, 20–35.

Cystic Fibrosis Foundation. (2002). Patient registryfor 2001. Annual Report. Bethesda, MD: Author.

Demko, C. A., Byard, P. J., & Davis, P. B. (1995). Gender differences in cystic fibrosis: Pseudomonas aeruginosa infection. Journal of Clinical Epidemiology, 48, 1041–1049.

Dishman, R., Motl, R., Saunders, R., Dowda, M., Felton, G., Ward, D., et al. (2002). Factorial invariance and latent mean structure of questionnaires measuring social– cognitive determinants of physical activity among Black and White adolescent girls. Preventive Medicine, 34, 100–108.

Edlund, L. D., French, R. W., Herbst, J. J., Ruttenberg, H. D., Ruhling, R. O., & Adams, T. D. (1986). Effects of a swimming program on children with cystic fibrosis. American Journal of Disabled Children, 140, 80–83.

Frangolias, D., Holloway, C., Vedal, S., & Wilcox, P. (2003). Role of exercise and lung function in predicting work status in cystic fibrosis. American Journal of Respiratory Critical Care Medicine, 167, 150–157.

Freedman, D., Dietz, W., Srinivasan, S., & Berenson, G. (1999). The relation of overweight to cardiovascular risk factors among children and adolescents: The Bogalusa Heart Study. Pediatrics, 103, 1175–1182.

Gilmer, M. J., Speck, B. J., Bradley, C., Harrell, J. S., & Belyea, M. (1996). The Youth Health Survey: Reliability and validity of an instrument for assessing cardiovascular health habits in adolescents. Journal ofSchool Health, 66, 106–111.

Godin, G., Jobin, J., & Bouillin, J. (1986). Assessment of leisure time exercise behavior by self-report: A concurrent validity study. Canadian Journal of Public Health, 77, 359–362.

Harrell, J., McMurray, R., Bangdirvala, S., & Lenne, A., (1996). Youth Health Survey, Cardiovascular Health in Children and Youth: CHIC. National Institute of Nursing Research 5-NR 01837.

Kerem, E., Reisman, J., Correy, M., Canny, G., & Levison, H. (1992). Prediction of mortality in patients with cystic fibrosis. New England Journal of Medicine, 326, 1187–1191.

Kolberg, H. (1988). Cystic fibrosis and physical activity: An introduction. International Journal of Sports Medicine, 9, 2–5.

Moorcroft, A. J., Dodd, M. E., & Webb, A. K. (1994). Exercise testing and prognosis in adult cystic fibrosis. Thoracic Society, 94, 1075–1076.

Moorcroft, A. J., Abbott, J., Dodd, M. E., Gee, L., & Webb, A. K. (1996). Assessment of habitual levels of physical activity in cystic fibrosis. Pediatric Pulmonology, 13, 305–306.

Morrow, J., & Freedson, P. (1994). Relationship between habitual physical activity and aerobic fitness in adolescents. Pediatric Exercise Science, 6, 315–329.

Motl, R., Dishman, R., Saunders, R., Dowda, M., Felton, G., & Pate, R. (2001). Measuring enjoyment of physical activity in adolescent girls. American Journal of Preventive Medicine, 21, 110–117.

Motl, R., Dishman, R., Saunders, R., Dowda, M., Felton, G., Ward, D., et al. (2002). Examining social– cognitive determinants of intention and physical activity among Black and White adolescent girls using structural equation modeling. Health Psychology, 21, 459–467.

Nixon, P. A., Orenstein, D. M., & Kelsey, S. F. (2001). Habitual physical activity in children and adolescents with cystic fibrosis. Medicine and Science in Sports and Exercise, 21, 177.

Nixon, P. A., Orenstein, D. M., Kelsey, S. F., & Doershuk, C. F. (1992). The prognostic value of exercise testing in patients with cystic fibrosis. New England Journal of Medicine, 327, 1785–1788.

Orenstein, D. M., Henke, K. G., & Cerny, F. J. (1983). Exercise and cystic fibrosis. Physician and Sportsmedicine, 11, 57–63.

Raitakari, O., Porkka, K., Taimela, S., Telama, R., & Rasanen, L. (1994). Effects of persistent physical activity and inactivity on coronary risk factors in children and young adults. American Journal of Epidemiology, 140, 195–205.

Ramsey, B. W., & Boat, T. F. (1994). Outcome measures for clinical trial in cystic fibrosis: Cystic Fibrosis Foundation Consensus Conference. Journal of Pediatrics, 124, 177–192.

Rosenfeld, M., Davis, R., Pepe, M., & Ramsey, B. (1995). Differences in survival by gender among US cystic fibrosis patients. Pediatric Pulmonology Supplement, 12, 286.

Sallis, J., Buono, M., Roby, J., Micale, F., & Nelson, J. (1993). Seven-day recall and other physical activity self-reports in children and adolescents. Medicine and Science in Sports and Exercise, 25, 99–108.

Sallis, J., & Patrick, K. (1994). Physical activity guidelines for adolescents: Consensus statement. Pediatric Exercise Science, 6, 302–314.

Sallis, J., Prochaska, J., & Taylor, W. (2000). A review of correlates of physical activity of children and adolescents. Medicine and Science in Sports and Medicine, 32, 963–975.

Sallis, J., Strikmiller, P., Harsha, D., Feldman, H., Ehlinger, S., Stone, E., et al. (1996). Validation of interviewer- and self- administered physical activity checklists for fifth grade students. Medicine and Science in Sports and Exercise, 28, 840–851.

Scott, J. K. (1977). Camp coaching—Four summers. Canadian Nurse, 79, 14–19.

Sothern, M. S., Loftin, M., Suskind, R. M., Udall, J. N., & Blecker, U. (1999). The health benefits of physical activity in children and adolescents: Implications for chronic disease prevention. European Journal of Pediatrics, 158, 271–274.

Stanghelle, J. K. (1988). Physical exercise for patients with cystic fibrosis: A review. International Journal of Sports Medicine, 9, 6–18.

Stanghelle, J. K., Michalsen, H., & Skyberg, D. (1988). Five- year follow-up of pulmonary function and peak oxygen uptake in 16-year-old boys with cystic fibrosis, with special regards to the influence of regular physical exercise. International Journal of Sports Medicine, 9, 19–24.

Stanghelle, J. K., Winnem, M., Roaldsen, K., de Wit, S., Notgewitch, J. H., & Nilsen, B. R. (1988). Young patients with cystic fibrosis: Attitude toward physical activity and influence on physical fitness and spirometric values of a 2-week training course. International Journal of Sports Medicine, 9, 25–31.

Thorlindsson, T., & Vilhjalmsson, R. (1991). Factors related to cigarette smoking and alcohol use among adolescents. Adolescence, 26, 399–416.

U.S. Department of Health and Human Services. (1996). Physical activity and health: A report of the Surgeon General. Washington, DC: Author.

Vilhjalmsson, R., & Thorlindsson, T. (1998). Factors related to physical activity: A study of adolescents. Social Science and Medicine, 47, 665–675.