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The Effect of Spark Physical Program (Sports, Play and Active Recreation for Kids) on Quality of Life and Spirometry in 6-18-Year-Old Children with Cystic Fibrosis

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Abstract

Background: The effect of SPARK physical education program on lung function in cystic fibrosis patients is not yet determined. SPARK (Sports, play and active recreation for kids) includes moving skills, aerobic games, jogging or walking, aerobic dance and jump rope. Regarding the high prevalence of cystic fibrosis and its destructive effects on the lungs, the aim of this study was to evaluate the lung function and quality of life before and after undergoing the SPARK physical education program, in children with cystic fibrosis.

Method: In this quasi-experimental study, all patients with cystic fibrosis aged 6-18 years referred to the cystic fibrosis clinic of Dr. Sheikh Hospital in Mashhad, Iran, were enrolled. The patients attended the 12-week SPARK training program (3 sessions per week, each session 45 minutes). The quality of life questionnaire for patients with cystic fibrosis, including self-examination and parental tests, along with spirometry indices (FEV1, FVC, FEV1/FVC, FEF25-75) were filled out before and after intervention for all patients.

Results: The mean and standard deviation of patients' age were 9.85±2.67 years, and 65% of patients were female. The FEV1 was significantly different before and after the SPARK physical education program (P=0.03), and the respiratory component of quality of life significantly increased after intervention (P=0.002). The overall score of quality of life from parents' point of view was 2.87 ± 0.38 which increased to 2.99 ± 0.38 after the intervention.

Conclusion: SPARK training program may improve the spirometric parameters in children with cystic fibrosis. It also had a significant effect on improving the patients' quality of life, especially in the respiratory component.

Key Words: Cystic fibrosis, Pediatrics, SPARK motor program, Spirometry, Quality of life.

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1- INTRODUCTION

Cystic fibrosis (CF) is an inherited multisystem complication in both children and adults, and is the most wide-spread life-limiting recessive genetic trait in white people (1). The frequency of patients is 1 in 3000 and the frequency of carriers is 1 in 25 people. About 30,000 people in the United States live with the disease (1, 2). So far, accurate statistics on the incidence of the disease in the country have not been provided. Only one study in the population of East Azerbaijan has reported the incidence of the disease about 1 case in 12 to 15 thousand (3).

The malfunction of the cystic fibrosis transmembrane conductance regulator protein (CFTR), known as the primary defect, results in a broad and diverse set of presenting manifestations and issues. CF is associated with most cases of exocrine pancreatic insufficiency in childhood, and is the leading cause of severe chronic lung complication in children (1). Patients with cystic fibrosis have musculoskeletal problems and complications due to respiratory muscle weakness, resulting in difficulty in excreting secretions. These patients lose the ability to empty the lungs properly due to changes in the concentration of mucous secretions, especially in the lungs. These children are highly dependent on chest physiotherapy.

Some patients may have no symptoms for long periods or may experience prolonged but sporadic acute respiratory infections. Others may have a chronic cough in the first few weeks of life, or frequently acquire pneumonia (4). Severe bronchiolitis along with wheezing is a common symptom during early life. Slowly, with the progress of lung disease, other symptoms such as shortness of breath, exercise intolerance, and failure to thrive; i.e., failure to gain weight or grow, are reported. The more frequent pulmonary complications are atelectasis, hemoptysis, pneumothorax, and cor pulmonale (5, 6).

Signs of protein and fat malabsorption from exocrine pancreatic insufficiency have been seen in more than 85% of affected children. CF has usually been diagnosed based on a positive quantitative sweat test (Cl≥60mEq/L) jointly with some of the following features: typical chronic obstructive pulmonary disease, documented exocrine pancreatic insufficiency, and a positive family history (1, 7). Thanks to newborn screening, diagnosis is usually made before the obvious clinical symptoms and signs, such as failure to thrive and chronic cough manifest (10). The findings of obstructive airway disease and limited responses to a bronchodilator are compatible with CF diagnosis at all ages (1). Residual volume and functional residual capacity expand early throughout the course of the lung disease (11).

A key part of the care plan is, therefore, monitoring for these complications and problems (1). Most of these issues should be taken into account and tackled in an anticipatory manner, before the onset of psychosocial dysfunction. Children and adolescents with CF can generally manage this complication well, if they receive appropriate medical and psychosocial support; so, having an independent and productive adulthood seems a realistic objective (1, 12).

Carrying out studies on the quality of life can help patients with chronic diseases along with the diagnosis and evaluation of care and treatment, even for healthy people (13). Quality of life has a range from zero to infinity and should be evaluated from different aspects as the child grows (14).

Therefore, to achieve the most accurate quality of life in children, more attention should be paid to their level of performance based on age. Physicians and researchers have found that exercise, as a

component of treatment in chronic diseases, improves respiratory function in these patients. Also, participation in sports activities can improve the self-esteem of the patients and lead children, from inertia and isolation to life expectancy and provide them with further motivation to continue their treatment.

One of the methods of motion therapy that has recently attracted the attention of sports and rehabilitation specialists and is becoming widespread is the SPARK motion program. The SPARK-based physical education program was performed and evaluated independently in 111 primary schools in seven states of the United States. The SPARK program was designed to enhance physical fitness by maximizing the physical activity of the participants to improve their physical fitness, skill, and enjoyment. These changes may introduce kids to a long, active and dynamic lifestyle. Spark exercise program includes games and entertainment for children. This program is performed in four parts during a 45-minute session; The first 15-minute part is warm up, after that there is 10 minutes of play, including moving skills, aerobic games, jogging or walking, aerobic dance and jump rope, then 10 minutes of play which includes manipulation skills. And finally 10 minutes of cooling (15).

The purpose of the SPARK motion program in this study is to enhance the activities and exercises for children. It is a program designed to provide physical fitness and motor skills along with enjoyment of physical activities, at high levels of activity for children. This program is for the development of children's basic skills and includes active sports games and activities for children (16, 17).

There is little information about age-appropriate programs for children with cystic fibrosis. The present study was the first study to evaluate the effect of Spark exercise program on pediatric cystic fibrosis, children spirometric parameters and quality of life.

2- MATERIALS AND METHODS

In this study, 20 patients with cystic fibrosis diagnosis were studied in the Dr. Sheikh Hospital of Mashhad, Iran, during August 2017 to March 2019. At the beginning, the aim of the study and how to perform spirometry for assessing lung volumes were explained to the patients' parents and then written consent was obtained to participate in the study.

During the study, the Life Quality Questionnaire (CFQ) (children version) was presented to children by researchers and colleagues. They interviewed the parents for the child’s demographic information, and then the parents' version of this questionnaire was completed by parents. The scale of questionnaires' scoring was based on Likert scale in the range of (too much, much, little, not at all). So, score 1 indicated a minimum trend and score 4 showed a maximum positive trend. The parents' questionnaire had 11 different domains of vitality, school, eating, health, body image, and physical, emotional, behavioral, respiratory, digestive, and weight dimensions.

The children's questionnaire had 8 different areas of eating, body image, and physical, social, emotional, behavioral, respiratory and digestive dimensions. CFQ is a specific tool for measuring the quality of life in patients with CF; it has been confirmed by several studies for its reliability and validity (18, 19, 20). The validity and reliability of the Persian questionnaire have been reviewed and confirmed in previous studies. Based on the results of these studies, all the questions in both Persian versions (parents and children) of CFQ had face and content validity. Based on this, the content validity ratio [CVR] score of all questions was calculated above 2.41, content validity

index [CVI] above 2.71, and Impact score of all questions above 1.5 (20). After completing the questionnaires, pulmonary function test and physical examination were performed to assess health status. Measurement of lung volumes was performed through spirometry by one nurse. The spirometer device was CHESTGRAPH HI-105 model. The evaluated pulmonary volumes in spirometry were FEV1, FVC, FEF25-75% and FEV1 / FVC. To perform the Spark exercise program, the physical education instructor, colleagues of the project, two cameramen and two healthy girls aged about 10 years attended several times in the gym for doing the exercise program.

The examples of Active sport recreation are Walking, gym workouts, cycling, running, jogging, and aerobics-exercising activities. The sessions were conducted separately and the educational videos were provided to the patients on the Telegram channel, which included the project facilitator, the physical education instructor, the children participating in the project, and their families. In the mentioned channel, feedback about the sessions were taken from children and their families. The children also sent videos of their exercises to the facilitator and the possible problems were solved. After 24 sessions, the patients referred to the clinic to complete the questionnaires and perform spirometry.

2-1. Inclusion and exclusion criteria

Inclusion criteria were definitive diagnosis of CF based on typical symptoms of the disease with two sweat tests or testing for CFTR gene mutations, age of 6 to 18 years, children and families who tend to perform the study and intend to continue it, satisfaction to do spirometry and exercise program. Exclusion criteria were hospitalization due to CF problems or increasing pulmonary symptoms during the study, patients with severe pulmonary involvement, inability to exercise, and hyper kyphosis. Disease severity in these children was measured based on FEV1.

2-2. Data Analysis

All the extracted and recorded data were entered in SPSS software version 16.0 for analysis. Descriptive data including the age and gender of the patients were reported as mean ± standard deviation (SD). Data normality was checked by shapiro wilk test. Chi-square test was used to examine the relationship between qualitative variables. P-values less than 0.05 were considered statistically significant.

3- RESULTS

Totally, 20 children patients were included in the study with a mean age of the 9.85±2.67 years; among them, 35% (n=7) were male and 65% (n=13) were female. In terms of the level of parents' education in the questionnaires, most of them had diplomas.

Life Quality of children with cystic fibrosis from the perspective of parents was evaluated based on their physical, vitality, emotion, school, eat, body, treat, health, respirator, digest, weight, are presented in **Table 1**. As the results in the table show, the life quality of children with cystic fibrosis from the parents' point of view had significantly improved after the treatment in the respiratory component (P = 0.002). But their status in physical, emotional, vitality, school, eating, health, behavioral, body image, digestive and weight components had not significantly changed (P> 0.05).

Table-1: life Quality of children with cystic fibrosis from the perspective of parents

Variable	Before treatment score (mean±SD)	After treatment score (mean±SD)	P-Value
physical	2.86±1.03	2.85± 0.89	0.96

vitality	3.06±0.52	2.95±0.57	0.44
emotion	3.12±0.53	3.18±0.69	0.70
school	3.19±0.62	3.16±0.62	0.81
eat	2.72±1.04	2.83±0.90	0.29
body	2.35±1.11	2.53±1.14	0.15
treat	2.53±1.14	2.66±0.78	0.50
health	2.970.74	3.21±0.54	0.22
respirator	2.99±0.46	3.28±052	0.002
digest	3.10±0.47	3.29±0.29	0.06
weight	2.50±0.98	2.40±092	0.79
collect	2.87±0.38	2.99±0.38	0.22

Wilcoxon test was used to investigate the changes

Table 2 shows life quality status of children with cystic fibrosis from a children's perspective. As demonstrated in the table, the mean scores before and after the intervention were not significantly different in physical, social, emotional, eating, physical, behavioral, respiratory and digestive components (P<0.05).

Table-2: life Quality status of children with cystic fibrosis from their perspective

Variable	Before intervention score (mean±SD)	After intervention score (mean±SD)	P-Value
physical	3.13±052	3.10±0.48	0.81
Social	2.88±0.43	2.68±0.49	0.09
emotion	2.97±0.38	3.05±0.28	0.30
eat	3.15±0.82	3.20±0.57	0.68
body	2.71±0.92	2.78±0.99	0.56
treat	2.74±0.55	2.70±0.59	0.75
respirat	3.04±0.63	3.14±0.62	0.18
digest	2.62±0.66	2.78±0.64	0.12
collect	2.98±0.29	2.98±0.30	0.98

Wilcoxon test was used to investigate the changes

The changes in spirometer parameters before and after the SPARK motor program in patients are presented in **Table 3**. A Wilcoxon test was used to investigate the changes; and p<0.05 was considered significant. Also, the change of spirometer parameters before and after the SPARK motor program was inspected. As shown in **Table 3**, FEV1 in patients increased significantly after attending the course of the SPARK motor program (P<0.03).

Table-3: Changes in patients' spirometer parameters before and after the SPARK motor program

Variable	Before intervention score (mean±SD)	After intervention score (mean±SD)	P-Value

FEV1	16.30±75.84	16.72±81.55	0.03
FVC	14.08±72.01	14.31±76.36	0.07
FEV1/FVC	7.30±94.49	4.82±94.42	0.95
FEF25-75	30.8±89.10	30.37±96.41	0.31

A Wilcoxon test was used to investigate the changes, and $p<0.05$ was considered significant.

4- DISCUSSION

This study revealed that in regard to spirometric parameters, the SPARK motion program significantly improved the FEV1 level of the patients. However, there was no significant difference in FVC level after intervention, despite the observed increase. Also, in the quality of life questionnaire for cystic fibrosis patients from the parents' point of view, there was a significant improvement in the respiratory component, after the treatment. However, there was no other statistically significant difference in the other components such as physical, vitality, emotion, school, eat, body, treat, health, respirator, digest, and weight; neither in the parents' questionnaire nor in the children's questionnaire. This may be due to the limited time of the training program.

The beneficial role of exercise, especially aerobic exercise, has been studied extensively in patients with cystic fibrosis. Physicians and researchers recommend exercises as part of the therapy in chronic diseases such as lung cancer and cystic fibrosis, to improve the respiratory function in these patients. Regular physical exercises reduce and stop lung function impairment. Also, participation in sports activities can increase the patients' self-esteem and prevent inertia and isolation; they can improve life expectancy and provide them with further motivation to continue their treatment. Children with cystic fibrosis are weaker than normal children in terms of physical strength, aerobic capacity, and many basic motor skills that require these physical fitness factors (15). In a study done in Brazil, in 2017, 55 cystic fibrosis patients aged 6-18 years and 185 healthy subjects in the control group performed a 6-minute walk test. The mean distance traveled was compared between the two groups; in the patients' group, all indicators were lower than the control group (21). That study compared patients with cystic fibrosis with healthy individuals, who naturally have lower respiratory capacity due to possible respiratory problems. In our study, the changes in patients' spirometric parameters and their quality of life were investigated before and after the intervention. Since the physical activity has not been part of the therapeutic process of these children, a little research has been done on the effect of exercise training programs on the quality of life and the spirometric parameters of these children.

In a study conducted in Denmark in 2010, 24 cystic fibrosis patients older than 14 years old who attended a 12-week aerobic exercise were investigated. The quality of life before and after the program was evaluated in these patients and they were compared with a control group. This study reported that exercises improved the maximum oxygen consumption, although there was no significant difference in quality of life (22).

Carrying out studies on patients' quality of life can be effective in helping patients with chronic diseases and even healthy people, for the diagnostic and evaluation of care and treatment (13).In 2003, the first quality of life assessment questionnaire for cystic fibrosis patients was designed and validated by Dr. Henry and his colleagues in France (17).

Another study in 2006, in Queensland, examined the effect of a 4-week hospital

rehab program on patients' quality of life, and reported a significant improvement in the quality of life. Compared to the baseline points, after the rehab, the participants had a higher overall health satisfaction in different areas of life, especially in respiratory and coughing problems, sleeping, daily treatment, recreational activities, general health, and physical conditions, as well as a non-significant decrease in anxiety from the patient's perspective. Therefore, performing in-hospital rehab programs may be a good strategy for improving the quality of life in adolescents and adults with cystic fibrosis (23). The results of the mentioned study were in line with our findings which showed that the patients had a significant improvement in respiratory domain of life quality.

The quality of life in patients with cystic fibrosis was also evaluated in a study in 2009 by Kianifar et al. In this study and similar studies conducted in the cystic fibrosis center of Dr. Sheikh Hospital of Mashhad, a children's general questionnaire was used. According to this study, children with cystic fibrosis experienced a lower quality of life, compared to the control group. This difference was conducted among children between the ages of 5 and 7, and based on the reports of parents and children of all ages regarding the components of social and general attitudes (24).

Patients with chronic illnesses are at a high risk of depression. Recent studies on cystic fibrosis patients show a higher rate of depression in children, adolescents, adults, and parents compared to healthy cases. Also, depression seems to have a negative impact on the treatment, family functioning and quality of life. Considering the importance of identifying and treating depression symptoms, early screening and treatments are recommended. (25). A study in Belgium, in 2008, reported lower levels of life quality in patients with symptoms of depression and anxiety. Early evidence has also shown that anxiety and depression affect the quality of life in patients with cystic fibrosis, a finding which may contribute to the advancement of medical and mental health programs (26).

Investigating the mental and family conditions and quality of life in adolescents with cystic fibrosis has shown that life expectancy in people with cystic fibrosis has now increased to 33 years. Therefore, aspects such as quality of life and mental health, which were previously less important than physical health, are now considered to be prominent factors. A study examined the relationship between the quality of life, family functioning, mental and psychological conditions, and the degree of optimism among adolescents with cystic fibrosis. Adolescents admitted to the clinic completed a few questionnaires, and the results showed that those adolescents were hopeful and happy about their future; and that their behavior was not dependent on their clinical assessments and severity of the disease. In general, those adolescents gained a comparatively high quality of life. Mental and emotional problems and lack of hope for the future were associated with the lower rates of life quality. Family solidarity was also associated with better mental health performance in adolescents. In general, adolescents with cystic fibrosis had a good psychological performance (27).

In a study in Germany, in 2005, the quality of life was investigated in association with age and sex of the patients. The level of life satisfaction in patients was significantly lower compared to the healthy group. Female patients compensated for the health-related constraints with a high satisfaction in housing and marital communications. Women with cystic fibrosis older than 35 years had a low life satisfaction, but men

in this age group had less constraints. It was, therefore, suggested that treatment plans should consider the quality of life from the perspective of patients; and routine monitoring of life quality may better show the patients' specific needs (28). In another study conducted in 2007 in Germany, quality of life was studied among outpatients with cystic fibrosis; 108 adolescent and adult patients aged 15-47 years completed the life satisfaction questionnaire. Statistical analysis showed that physical and psychological factors had a significant impact on patients' quality of life, but pulmonary functions did not affect the life quality score (29).

Despite rapid changes in information and communication technology, the management of chronic diseases has changed very little over the decades. However, the introduction of telemedicine as the use of remote patient-centered clinical services, including the use of video and audio communications, remote monitoring and mobile applications, provides an ideal opportunity for fundamental changes in care.

4-1. Limitations of the study

Among the limitations of this study, there was a lack of direct monitoring of children's exercises, which was partially resolved by the creation of a channel in cyberspace. No information was available on the correct use of drugs during the intervention. A number of patients were excluded from the study due to lack of follow up. In future studies, if possible, a control group should be included and a clinical trial should be performed. To evaluate the long-term effect of exercise on patients' spirometric parameters and quality of life, several months of follow-up is recommended.

5- CONCLUSION

In the present study, the two spirometry parameters of FEV1 and FVC were increased among patients after attending the SPARK motor program, although the FVC increase was not statistically significant in this study.

Aerobic training such as jogging or walking, aerobic dance and jump rope may improve the lung function in patients with cystic fibrosis. Based on this study, children with cystic fibrosis had a good quality of life in general, which could be due to the fact that these patients were under treatment and rehab in a special clinic with special attention. Our findings also showed that, according to the patients' questionnaires, the intervention had a significant effect on improving the patients' quality of life, especially in the respiratory component. Overall, Little research has been done on the effect of training programs on the quality of life and the spirometric parameters of these children, and more research is required to improve the treatment and life quality of these patients.

6- Conflict of interest

None.

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