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The Effect of Home-Based Pulmonary Rehabilitation on Asthmatic Pediatric Quality of Life

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Abstract

Background: Children with asthma have a low quality of life because they cannot adequately be physically active. Asthmatic children can benefit from home-based pulmonary rehabilitation because it is available, inexpensive, and easy to use.
Objectives: This study aimed to determine the effect of home-based pulmonary rehabilitation on the quality of life of children with asthma.
Methods: This experimental study was conducted in 2022 on 60 asthmatic children in Gorgan, Iran, with two intervention and control groups by convenient method. Children in the intervention group received eight pulmonary rehabilitation sessions at home after randomly assigning the participants to two intervention (30-person) and control (30-person) groups. The data collection tools included a demographic characteristic form and a pediatric quality of life questionnaire (PedsQl).
Results: The mean quality of life before the intervention was 54.6 ± 7.13 in the intervention and 53.76 ± 7.12 in the control group, and the independent *t*-test did not show a significant difference between the two groups. The mean quality of life after the intervention increased to 59.9 ± 7.69 in the intervention and 55.3 ± 7.36 in the control group, and the independent *t*-test showed a significant difference between the two groups (P = 0.01).
Conclusions: Based on the results, home-based pulmonary rehabilitation effectively improved the asthmatic pediatric quality of life. Therefore, the healthcare system should consider home-based pulmonary rehabilitation as part of the treatment protocol.

Keywords: Quality of Life, Asthma, Pediatric, Pulmonary, Home-Based, Rehabilitation

1. Background

In the world, 4.8 million children suffer from asthma, making it the most common chronic disease among children. The prevalence of asthma is increasing in children (1). Childhood asthma is a genuine clinical concern at the global level, which imposes a significant burden on families and society, including missed school days, which can negatively affect children's academic achievement and social activities. Childhood asthma also burdens the health care system significantly, as these children require frequent general practitioner (GP), hospital visits, and a great deal of costly treatment (2, 3). Approximately 40% of children experience asthma attack symptoms, such as wheezing, coughing, shortness of breath, etc., at least once. The prevalence of asthma worldwide is increasing, and according to the World Health Organization, 600 million people will be affected by asthma by 2025 (4). Therefore, it is necessary to conduct systematic studies on the prevalence and prevention of this disease in children and determine the variation of asthma prevalence over time. In a survey in Bushehr, the asthma rate was 5.3%, and in other studies in Babol, Shiraz, and Sari, the asthma rate was 17.5%, 1.2%, and 12%, respectively. The prevalence of asthma in Iranian children is unclear (5-7). The highest prevalence of asthma among children was reported in Babol at 19% and the lowest in Isfahan at 0.7% in 2001 (8). Dean showed asthma profoundly affects school-aged children by affecting their health status and other aspects of life such as school

attendance, group play, physical activity, adapting styles, psychological functioning, sleep, and quality of life (9).

Children with asthma suffer from limited activity because they have problems in breathing, suffer from asthmatic symptoms, and have limited tolerance towards physical activity. As a result, their ability to perform daily activities is decreased. Compared to healthy people, these children do not have optimal physical performance, and they feel worried about participating in sports programs or do not show any desire to participate in physical activity. Further, asthmatic people have problems completing their personal and social responsibilities, which creates a sense of inadequacy, weakness, and lower self-confidence. Subsequently, they experience anxiety, depression, and sadness, disturbed social interactions. Considering the negative effects of asthma, asthma affects various aspects of children's growth and limits their physical, mental, and social activities (10, 11). Anxiety and depression are among comorbidities often associated with childhood asthma and attention-deficit/hyperactivity disorder. In addition, the personality of these children seems to be characterized by shyness and impulsivity, and sometimes psychotic behavior, aggression, and cases of psychosis. The school performance of these children is disrupted, and they are bullied more often. Dysfunctional family relationships and lower socioeconomic status also negatively affect the severity and management of asthma. Briefly, the quality of life in children with asthma is down due to psychological and sociocultural factors (12, 13). Tavakol et al. also showed that children with asthma have a low quality of life (4).

There are different ways to control or improve asthma; one is pulmonary rehabilitation using appropriate and regular exercise to strengthen respiratory muscles. Pulmonary rehabilitation has been shown to reduce respiratory symptoms, shortness of breath, and hospitalization (14). Patients can generally cope better with their daily tasks and activities and participate more in social life by improving and strengthening the respiratory system to improve their quality of life. Strengthening the respiratory muscles also reduces asthmatic symptoms during the day and night and decreases the need for taking bronchodilator drugs during the day (15). Problems such as the unavailability of rehabilitation centers, the cost of rehabilitation, patient mobility restrictions, and transportation create severe challenges for patients and their families. Therefore, developing a home-based pulmonary rehabilitation model can be an effective and necessary solution. Today, healthcare systems emphasize rehabilitation, primarily community-based and inexpensive, as it can improve self-care by increasing patient participation, reducing unnecessary and frequent hospitalizations, and helping to establish a connection between hospitals and communities (16).

Studies have indicated that asthma is the most common cause of children's hospitalization. Many studies have also highlighted the importance of lung function and quality of life in forming children's personalities.

2. Objectives

This study was conducted to determine the effects of home-based pulmonary rehabilitation on asthmatic pediatric quality of life.

3. Methods

This experimental study was conducted 2022 on asthmatic children attending private asthma and allergy clinics in Gorgan, Iran. The sample size of this study was calculated based on a similar study that evaluated pulmonary function, aerobic capacity, and quality of life in children, using G power software with an effect size of 0.05 and a test power of 80%.

The inclusion criteria were 8 - 12 years old and no history of cardiovascular diseases, muscular-skeletal problems, organ defects, or other conditions that interfere with exercising. The exclusion criteria included withdrawing from the study, immigrating to another city, and worse symptoms due to different reasons.

The participants were selected by convenient and non-probability sampling methods among patients attending Gorgan, Iran's private asthma and allergy clinics. All participants were ensured the confidentiality of their personal information and the possibility of withdrawal from the study at any time. The researcher did not know sample allocation to this single-blind study's intervention and control groups. The study method was designed by the researcher and provided to the research assistant for implementation. After obtaining the necessary permission from the university's ethics committee, the research assistant studied the children's files and selected the eligible samples based on the inclusion criteria. Then, the children's parents were contacted to make an individual appointment with those who agreed to participate at the physician's office after explaining the study method and objectives. All the necessary information was given to the parents and children, and written informed consent was obtained from them. Random allocation method was used to divide the samples into two intervention and control groups using the randomization method. The concealment of random allocation was carried out by sealed envelopes given to parents (inside each, a letter X or O indicated pulmonary rehabilitation group or control group).

PedsQL, a questionnaire measuring the quality of life for 8 - 12-year-old children, was completed by children and their parents. The PedsQL has been designed to measure the quality of life in 8 - 12-year-old children. This questionnaire is based on the five-option Likert scale ranging from never to always containing 23 questions in four subscales of physical performance (eight items), emotional performance (five items), academic performance (five items), and social performance (five items). Several forms are included in this questionnaire, including a self-assessment form for 8 - 12-year-olds and a reporting form for their parents to use. The total score of this tool is calculated by determining the mean value of all responses to the 23 questions. The minimum score of this questionnaire is 23, and the maximum score is 115, with higher scores indicating higher quality of life.

The validity of this questionnaire has been confirmed by ten Golestan Islamic Azad University faculty members. The validity and reliability of this questionnaire have also been determined in Mohammadian's study by Cronbach's alpha of 0.82 for the whole questionnaire and 0.65 to 0.77 for different subscales of the questionnaire (17).

Each child in the intervention group received eight exercise sessions for 20 to 40 minutes, an educational CD, and follow-up phone calls at home. The corrective and structural exercises were designed purposefully based on scientific findings such as Lebenson, which included resistance movements to increase the strength of the scapular, chest, and spine muscles (18).

In each session, warm-up exercise was performed with aerobic activity and stretching for 5min in a comfortable position. In this exercise, the person closes his mouth, takes a deep breath into his lungs through his nose, and then exhales so that the exhalation time is twice as long as the inhalation time. In addition, stretching and strengthening movements and takes diaphragmatic breathing are performed according to the following steps in Table 1.

In diaphragmatic breathing, the person first places one hand on the chest and the other on the stomach and then breathes in so the other hand is stretched forward. Then, he closes his lips and breathes, pushing his hand on his stomach. The hand is kept on the chest in the same position. The subjects are asked not to eat or do physical activity three hours before the training. During this period, the control group receives the usual interventions the physician recommends at the clinic. The post-test was completed after the end of the intervention period. Descriptive and inferential statistical tests were used through the SPSS version to analyze the data—16 software at a significance level of 0.05.

4. Results

The mean age of the participants was 9.91 ± 1.31 years in the intervention group and 9.56 ± 1.47 years in the control group, and the independent samples *t*-test did not show a significant difference between the two groups in this regard (P = 0.33). The mean disease duration was 3.7 ± 0.79 years in the intervention group and 3.73 ± 0.69 years in the control group. The independent samples *t*-test showed no significant difference between the two groups (P = 0.86). The chi-square test showed no significant difference between the two groups regarding gender (P = 0.29). In addition, the independent samples *t*-test showed no significant difference between the intervention group (1.96 ± 0.49) and the control group (1.76 ± 0.59) in terms of the number of children in the family (P = 0.25).

The mean quality of life before the intervention was 54.6 ± 7.13 years in the intervention and 53.76 ± 7.12 years in the control group, and the independent samples *t*-test did not show a significant difference between the two groups (P = 0.65). Regarding the quality of life, the results showed no significant difference between the two groups in terms of physical performance (P = 0.87), emotional performance (P = 0.62), social performance (P = 0.63), and school performance (P = 0.52) before the intervention (Table 2).

The mean quality of life after the intervention was 59.9 ± 7.69 years in the intervention group and 55.3 ± 7.36 years in the control group, and the independent samples *t*-test showed a significant difference between the two groups (P = 0.01). Moreover, the independent samples *t*-test after the intervention did not show any significant difference between the two groups regarding social performance (P = 0.15) and emotional performance (P = 0.26), but it showed a significant difference in terms of social performance (P = 0.005) and school performance (P = 0.005) (Table 1).

The paired sample *t*-test did not show a significant difference in the quality of life of asthmatic children in the control group before and after the intervention (P = 0.88). In contrast, a significant difference was observed in the intervention group (P < 0.01). Furthermore, the paired sample *t*-test revealed a significant difference in the intervention group in social performance (P < 0.01) and school performance (P < 0.01) before and after the intervention, but no significant difference was observed in terms of physical (P = 0.62) and emotional performance (P = 0.83).

ANCOVA test showed a significant difference in the quality of life of children by removing the effects of the pre-test (Eta = 0.11, P < 0.01) so that 11% of post-test changes could be attributed to the intervention (Table 3).

Table 1. The Various Exercise Sessions

Exercise	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6	Session 7	Session 8
Strengthening	5 min	5 min	6 min	6 min	8 min	10 min	10 min	10 min
Moving	5 min	5 min	6 min	7 min	7 min	7 min	8 min	10 min
Strengthening	5 min	5 min	5 min	6 min	6 min	6 min	8 min	10 min
Diaphragmatic breathing	6 min	5 min	7 min	7 min	8 min	9 min	10 min	10 min

Table 2. The Aspects of the Quality of Life of Asthmatic Children in the Intervention and Control Groups

Aspect	Before the Intervention			After the Intervention		
	Control	Intervention	P-Value	Control	Intervention	P-Value
Physical	19.2 ± 2.41	19.3 ± 2.25	0.87	19.2 ± 36.34	20.2 ± 41.61	0.15
Emotional	11.93 ± 3.57	12.13 ± 1.56	0.62	12.1 ± 12.69	12.1 ± 96.98	0.26
Social	11.83 ± 1.78	11.1 ± 1.89	0.63	11.2 ± 16.11	14.2 ± 86.17	0.005
School	118 ± 1.1	12.1 ± 1.86	0.52	12.2 ± 36.03	14.3 ± 13.6	0.005
Total	53.7 ± 7.12	54.6 ± 7.13	0.67	55.7 ± 3.36	59.7 ± 96.69	0.01

Table 3. The Effect of Pulmonary Rehabilitation on the Quality of Life of Asthmatic Children

Source of Variance	Sum of Squares	Degree of Freedom	Mean of Squares	F-Value	P-Value	Eta
Modified model	1436.26	2	718.14	18.64	< 0.01	0.35
Post-test separator	88.716	1	1095.45	28.14	0.01	0.23
Group	220.32	1	271.11	7.03	< 0.01	0.11
Error	707.116	47	38			
Sum	32929	50				
Total	1821.423	49				

5. Discussion

The research hypothesis was "Pulmonary rehabilitation increases the quality of life of 8 - 12 years old children with asthma." The findings showed that the intervention improved the quality of life of children with asthma. Hsieh et al. (19), Yu et al. (20), and Kirkby et al. (21) in line with the results of this study, showed that regular breathing exercises can affect the quality of life of asthmatic patients by increasing their breathing capacity. Montes et al also showed that pulmonary function and quality of life of children with asthma improved by the intervention from the perspective of children and their caregivers (22), which aligned with the present study's findings.

In Hadi's et al. study, the findings indicated that pulmonary rehabilitation improved the physical, emotional, and self-image of children aged 6 - 11 with cystic fibrosis, but it did not affect their sense of social limitation. This study's results can align with the present study's findings because social restrictions can affect children's mental health and performance (23).

Mosher et al. demonstrated that pulmonary rehabilitation improves patients' quality of life with pulmonary disorders (24), which aligns with the present study's findings.

Vermeulen et al. stated that physical activity's mean and standard deviation before and after the breathing exercises increased significantly. A significant difference was also observed in participants' mood, social activity, and quality of life before and after the breathing exercises. Breathing exercises affect different aspects of the quality of life of asthma sufferers (25), which aligns with the present study's findings. However, the results of these two studies regarding mood are contradictory, which may be due to the difference in the participants' age range, the difference in questionnaires used in these studies, and the fact that children are more likely to experience emotional distress due to their greater vulnerability to chronic disease.

Abdelbasset et al. revealed that children's activity, symptoms, emotions, and quality of life improved after pulmonary rehabilitation (26). Regarding physical performance, this study's results aligned with the present

study's. However, regarding emotional performance, this study's findings were inconsistent with the current results, which can be due to differences in the culture, health facilities, and psychological interventions used in different countries.

Heidarzade et al. showed significant improvement in asthmatic children's emotional performance, symptoms, and activity after using the peak flow meter device (27, 28), which aligned with the present study's findings.

5.1. Limitations

One of the limitations of this study was the individual characteristics of children with asthma that affected their understanding of quality of life. The children's interest in accepting this method, their emotional and psychological characteristics, and the cultural norms of children and their families were also other limitations of this study, which were beyond our control.

5.2. Conclusions

Based on the results, home-based pulmonary rehabilitation effectively improved the quality of life of children with asthma. Therefore, the children can improve their respiratory and pulmonary function by implementing a home-based pulmonary rehabilitation program. Self-care can be improved, as well as enhancing their cooperation with the treatment team, and they will be more likely to comply with their treatment regimen. Most families can afford this method to improve asthmatic children's quality of life and reduce the care burden on the treatment team and health system. Therefore, home-based pulmonary rehabilitation is recommended by nurses and the healthcare system as a part of the treatment protocol for children with asthma.

Footnotes

Authors' Contribution: R. M. idea presentation, software, writing-original draft, writing review and editing; N. H. supervision, methodology, project administration, data curation. E. M. G; M. G. N. L. and H. H. formal analysis, methodology, preparation of the first draft.

Conflict of Interests: Authors confirm that no relevant financial or non-financial competing interests exist.

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Informed Consent: This study was conducted with the informed consent of the patients and their parents.

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