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Research

The Effect of Chest Physiotherapy on Children's Quality of Life with Acute Lymphoblastic Leukemia and Pneumonia at Dr. Moewardi Hospital, Surakarta

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ABSTRACT

Background: Acute lymphoblastic leukemia (ALL), a malignancy that is the most common form of leukemia found in children, accounting for about 30 percent of all pediatric cancer. The incidence of pneumonia is often found in children undergoing treatment for ALL. Complications of ALL and the side effects of its treatment can affect children's quality of life. This study aimed to the effect of chest physiotherapy on children's quality of life with acute lymphoblastic leukemia and pneumonia.
Subjects and Method: This was a quasi-experiment study conducted at the pediatric ward of Dr. Moewardi Hospital Surakarta, from February to August 2021. A number of 60 children aged 2-18 years with lymphoblastic leukemia and pneumonia was selected for this study. These children were divided into two groups, (1) 30 children with chest physiotherapy (intervetion group) and (2) 30 children received standard care (control group). Patients and parents were asked to fill out a quality of life assessment using the PedsQLTM 4.0 generic module. Mean difference of quality of life before and after chest physiotherapy between intervention and control group was examined using independent t test.
Results: After intervention of chest physiotherapy, quality of life score in the intervention group (Mean= 68.91; SD= 12.30) was higher than control group (Mean= 60.12; SD= 7.72), with p= 0.002.
Conclusion: Chest physiotherapy improves the quality of life in children with acute lymphoblastic leukemia and pneumonia.

Keywords: quality of life, chest physiotherapy, pneumonia.

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BACKGROUND

Leukemia, a malignant cancer that is common in patients aged 0 to 18 years, represents 25-35% of all pediatric cancers. Leukemia almost always appears in an acute form in children. Acute lymphoblastic leukemia (ALL) represents 70-80% of all cases (Sulastriana, 2016).

The incidence of pneumonia is often found in children who underwent initial treatment of ALL. The incidence of pneumonia is highest in the initial period of chemotherapy treatment, which is 2 to 20 days and 40 to 80 days after starting anti leukemic chemotherapy agents (Garcia et al., 2013). In addition, there is direct effect

on the lung due to radiation and certain chemotherapeutic agents, such as methotrexate, high-dose cyclophosphamide, *arabinosyl cytosine* (araC), a*nthracyclines*, dexamethasone and 6-thioguanine, drugs used in the treatment of leukemia, and their combinations, can cause pulmonary toxicity and make the patient susceptible to infection (Mantadakis, 2020).

Studies report that lung function in patient with leukemia may decrease, however, it is not known whether these changes are present during chemotherapy only or can occur in the long term. The role of chest physiotherapy is needed to minimize the side effects of treatment (Macedo et al., 2014). Previous studies reported that there is a benefit of chest physiotherapy in improving lung function in patients with asthma, obstructive pulmonary disease, pulmonary fibrosis, bronchiectasis, etc. improve the patient's quality of life (Khan et al., 2018; Duymaz et al., 2020).

Chest physiotherapy programs can reduce the risk of cardiopulmonary complications and health-related costs, shortening the length of hospital stay; increase exercise capacity, pulmonary function test results, and partial arterial oxygen pressure values, as well as improve psychological symptoms such as anxiety and depression as well as quality of life (Kendall et al., 2017). There has never been a study on the effect of chest physiotherapy in ALL patients on changes in lung function in these patients and their benefits in improving patient's quality of life. In recent years, diagnosing quality of life in malignancy diseases has become an important concern (Kızılocak and Okcu, 2019).

Quality of life was very important to the patients with ALL and pneumonia because they tend to be hospitalized more frequently and had long treatment for chemotherapy. These might cause changes such as growth and development impairment (motoric skill and changes in developmental of sexual identity and gender-appropriate roles), cognitive disorder (forgetfulness, inability to concentrate, and anxiety), children would often be absent from school, had emotional disorder and social activity disorder. There were several ways to measure the children's quality of life. One of them was by using Pediatric Quality of Life Inventory (PedsQL). PedsQL was a validated questionaires and was adapted internationally and had been converted to English, Germany, Spain, and Indonesian language (Wardin, 2016). These questionaires could be used by children from 2 - 18 years old. Therefore, the author planned to analyze the quality of life of children with ALL and pneumonia using the PedsQL in Dr. Moewardi Hospital, Surakarta.

SUBJECTS AND METHOD

1.Study Design

This was a quasi-experimental research with pretest-posttest control group design that conducted in the pediatric ward at Dr. Moewardi Hospital Surakarta in February-August 2021.

2.Population and Samples

The Study population were children aged 2-18 years old who was diagnosed with ALL and pneumonia who underwent chemotherapy at pediatric ward of Dr. Moewardi Hospital Surakarta. The exclusion criteria were patients who have conditions that prevent them from answerring the questionare, patient with sepsis, poor nutritional status (Z-score <-3 SD), congenital heart disease that proved by echocardiography, cerebral palsy and down syndrome. A sample of 30 patients was selected by consecutive sampling.

3. Study Variable

The Dependent variable was the quality of life. The independent variable was chest physiotherapy.

4. Variable Operational Definition

Chest physiotherapy, consist of percussion, vibration, postural drainage, deep breathing exercises, effective cough exercises. The duration of chest physiotherapy treatment in this study was carried out for 6 sessions, with 1 session per day, for 30-45 minutes and was done by professional physiotherapist.

Acute lymphoblastic leukemia, the diagnosis was obtained from the medical record.

Pneumonia, cough and accompanied by fever with temperature >38°C, with signs and symptoms: (1) tachypnea: children aged 0-2 months: >60 times/minute; age 2-11 months: >50 times/minute; age 1-5 years: >40 times/minute; >5 years old: >30 breaths/ minute. (2) Moaning/ grunting sounds in young infants. (3) On auscultation crackles were heard, decreased breath sounds, bronchial breath sounds. In very severe conditions, patient can be found unable to breastfeed or drink/eat or vomit everything, convulsions, lethargy or unconsciousness, cyanosis, diarrhea and severe respiratory distress and/or chest X-ray showing pneumonia (WHO, 2014).

Quality of life, PedsQL™ questionaire were used to measure the quality of life. The questionaire were grouped by the age of patients. Questionaire consists of parent's report from the children age 2-4 yo, 5-7 yo, 8-13 yo, and 13-18 yo. There were 4 domains in this questionaire, physical, social, emotion, school. Every domain consists of 5 response scales (0= never, 1= rarely, 2= sometimes, 3= often, 4= always). Score from every domain will be converted to 0-100, with conversion rate (0= 100, 1= 75, 2= 50, 3= 25, 4= 0). Children who have a total score above 70 means that their quality of life were good. While they who have a total score below 70 means their quality of life were poor (Wardin, 2016).

Age were obtained from the medical records.

Gender were differentiated to male and female.

Number of family member were differentiated to ≤2 persons and ≥2 persons.

Duration of illness was how long the patient had chemotherapy, differentiated into two group, ≤ 7 weeks and ≥ 8 weeks.

Parent's educational level was obtained by interviewing the parents. Education were differentiated to group who had not completed 9-year compulsory education or even less and group of those who had completed 9-year compulsory education according to the Republic of Indonesia Law No. 47/2008.

Family income level was differentiated to under regional minimum wage (<Rp 1,500,000 /month) and above regional minimum wage (>Rp 1,500,000 month) in accordance with the regional minimum wage in Central Java Province (Central Java Government, 2020).

5. Study Instrument

Demographical data was acquired interviewing the parents of the patients. The medical condition of the patients was acquired from the medical record and the patients' quality of life was acquired from the PEDSQL™ questionnaire.

6. Data Analysis

Mean difference of quality of life before and after chest physiotherapy between intervention and control group was examined using independent t test.

7. Research ethics

This study was approved by the Health Research Ethics Committee of Dr. Moewardi Hospital, Surakarta.

RESULTS

1. Sample of Characteristics

Table 1 showed the sample characteristics. It is known that there was no difference of child between treatment group (Mean= 7.13;

SD= 5.10) and control group (Mean= 7.27; SD= 4.83). The number of male and female gender between two groups were equal. There was no difference of family income between groups.

Table 1. Sample characteristics

Characteristics	Group		p
	Treatment (n=30)	Control (n=30)	
Age (year) (mean±SD)	7.13 ±5.10	7.27 ±4.83	0.783
Sex			
Male	16 (53.3%)	13 (43.3%)	0.438
Female	14 (46.7%)	17 (56.7%)	
Duration of treatment			
≤ 7 weeks	16 (53.3%)	14 (46.7%)	0.606
≥ 8 weeks	14 (46.7%)	16 (53.3%)	
Family history with cancer			
No	23 (76.7%)	22 (73.3%)	0.766
Yes	7 (23.3%)	8 (26.7%)	
Number of family members			
1-2 people	1 (3.3%)	3 (10.0%)	0.612
>2 people	29 (96.7%)	27 (90.0%)	
Father's educational level			
≤ 9 years	9 (30.0%)	7 (23.3%)	0.559
> 9 years	21 (70.0%)	23 (76.7%)	
Mother's educational level			
≤ 9 years	7 (23.3%)	6 (20.0%)	0.754
> 9 years	23 (76.7%)	24 (80.0%)	
Family income level			
< Rp 1,500,000	23 (76.7%)	20 (66.7%)	0.390
≥ Rp 1,500,000	7 (23.3%)	10 (33.3%)	

2. Effect of chest physiotherapy on children's quality of life with acute lymphoblastic leukemia and pneumonia

a. Children's quality of life (total)

Table 2 showed the effect of chest physiotherapy on the quality of life of children with acute lymphoblastic leukemia and pneumonia. Table 2 showed that there was no significant difference between intervention (Mean= 56.95; SD= 12.73) and control groups (Mean= 54.42; SD= 8.60) before intervention, with p= 0.371. After intervention of chest physiotherapy, quality of life score in the intervention group (Mean= 68.91; SD= 12.30) was higher than control group (Mean= 60.12; SD= 7.72), with p= 0.002.

Table 2. Effect of chest physiotherapy on children's quality of life with acute lymphoblastic leukemia and pneumonia

Group	Mean	SD	p
Pre intervention			
Intervention	56.95	12.73	0.371
Control	54.42	8.60	
Post intervention			
Intervention	68.91	12.30	0.002
Control	60.12	7.72	

b. Physical Functioning

Table 3 showed the effect of chest physiotherapy on the physical functioning of children with acute lymphoblastic leukemia and pneumonia. Table 3 showed that there was no significant difference between intervention (Mean= 53.10; SD= 17.30) and control groups (Mean= 49.17; SD= 16.31) before intervention, with p= 0.369. After intervention of chest physiotherapy, physical functioning score in the intervention group (Mean= 70.20; SD= 15.55) was higher than control group (Mean= 56.07; SD= 14.41), with p< 0.001.

Table 3. Effect of chest physiotherapy on physical functioning of children with acute lymphoblastic leukemia and pneumonia

Group	Mean	SD	p
Pre intervention			
Intervention	53.10	17.30	0.369
Control	49.17	16.31	
Post intervention			
Intervention	70.20	15.55	<0.001
Control	56.07	14.41	

c. Emotional Functioning

Table 4 showed the effect of chest physiotherapy on the emotional functioning of children with acute lymphoblastic leukemia and pneumonia. Table 4 showed that there was no significant difference between intervention (Mean= 46.77; SD= 15.86) and control groups (Mean= 45.37; SD= 13.63) before intervention, with p= 0.715. After intervention of chest physiotherapy, emotional functioning score in the intervention group (Mean= 63.50; SD= 17.35) was higher than control group (Mean= 51.70; SD= 11.84), with p= 0.003.

Table 4. Effect of chest physiotherapy on emotional functioning of children with acute lymphoblastic leukemia and pneumonia

Group	Mean	SD	p
Pre intervention			
Intervention	46.77	15.86	0.715
Control	45.37	13.63	
Post intervention			
Intervention	63.50	17.35	0.003
Control	51.70	11.84	

d. Social Functioning

Table 5 showed the effect of chest physiotherapy on the social functioning of children with acute lymphoblastic leukemia and pneumonia. Table 5 showed that there was non-significant difference between intervention (Mean= 71.50; SD= 15.66) and control groups (Mean= 72.93; SD= 13.84) before intervention, with p= 0.709. After intervention of chest physiotherapy, there was no difference of social functioning score in the intervention group (Mean= 76.57; SD= 16.71) and control group (Mean= 75.70; SD= 12.29), with p= 0.819.

Table 5. Effect of chest physiotherapy on the social functioning of children with acute lymphoblastic leukemia and pneumonia

Group	Mean	SD	p
Pre intervention			
Intervention	71.50	15.66	0.709
Control	72.93	13.84	
Post intervention			
Intervention	76.57	16.71	0.819
Control	75.70	12.29	

e. School functioning

Table 6 showed the effect of chest physiotherapy on the school functioning of children with acute lymphoblastic leukemia and pneumonia. Table 6 showed that there was non-significant difference between intervention (Mean= 56.43; SD= 23.83) and control groups before intervention, with p= 0.233. After intervention of chest physiotherapy, mean of school functioning score in the intervention group (Mean= 65.37; SD= 20.76) was higher than control group (Mean= 57.00; SD= 15.21) and it was statistically marginally significant (p= 0.080).

Table 6. Effect of chest physiotherapy on the school functioning of children with acute lymphoblastic leukemia and pneumonia

Group	Mean	SD	p
Pre intervention			
Intervention	56.43	23.83	0.233
Control	50.20	15.32	
Post intervention			
Intervention	65.37	20.76	0.080
Control	57.00	15.21	

3. Bivariate analysis

Table 7 showed the effect of chest physiotherapy on children's quality of life with acute lymphoblastic leukemia and pneumonia. Table 7 showed that chest physiotherapy increased physical function (r= 0.43; p= 0.001) and emotional function (r= 0.38; p= 0.003) of quality of life in children with acute lymphoblastic leukemia and pneumonia.

Chest physiotherapy increased school function of quality of life in children with acute lymphoblastic leukemia and pneumonia and it was statistically marginally significant (r= 0.23; p= 0.080).

Chest physiotherapy increased social function of quality of life in children with acute lymphoblastic leukemia and pneumonia, but it was statistically non-significant (r= 0.03; p= 0.820).

Table 7. Effect of chest physiotherapy on children's quality of life with acute lymphoblastic leukemia and pneumonia

Aspects of Quality of Life	r	p
Physical functioning	0.43	0.001
Emotional functioning	0.38	0.003
Social functioning	0.03	0.820
School functioning	0.23	0.080

DISCUSSION

All of the four aspects of the children's quality of life, the strongest relationship was found in physical functioning and emotional functioning. Chest physiotherapy had the strongest relationship to physical functioning (r= 0.43; p=0.001) with the highest correlation value, and followed by emotional functioning (r=0.375; p=0.003). This means that chest physiotherapy is significantly related to physical functioning and emotional functioning.

The results of this study are similar to those carried out in Turkey, which chest physiotherapy can increase respiratory function, oxygen saturation, functional capacity, quality of life, and a decrease in the severity of dyspnea in patients. Chest physiotherapy is the most important treatment approach for the prevention of pulmonary complications. Patients who had undergone chest physiotherapy experienced an increase in inspiratory muscle strength on day 2. Patients who underwent chest physiotherapy experienced an increase in vital lung capacity of 39% and an increase in the FEV1/FVC ratio of 57% (Duymaz, Karabay and Ural, 2020).

Fleck et al. (2004) and Xavier et al. (2010) reported that quality of life and respiratory functioning could improve 6 months after bariatric surgery in patients with comorbid obesity. However, Duymaz et al. (2020) reported an improvement in respiratory functioning and functional capacity in patients undergoing early chest physiotherapy. According to the results of the Duymaz study, the quality of life of patients undergoing chest physiotherapy increased by 33.5%.

A study supporting the results of this study was also conducted in Pakistan, where it was reported that chest physical therapy is a commonly used intervention in patients with airway compromise (Khan et al., 2018). Previous studies reported that pulmonary rehabilitation is effective in increasing endurance and minimizing complications in patients with chronic obstructive pulmonary disease (COPD) (Pehlivan et al., 2011). Some literature mentions the effect of chest physiotherapy in improving quality of life and reducing length of hospital stay in COPD patients. Furthermore, Khan et al (2018b) explained that chest physiotherapy combined with standard medical care therapy had a more beneficial effect on improving functional status including reducing pain levels and improving functioning of activities of daily living and quality of life compared to standard therapy alone. The reason behind it is that chest physiotherapy exercises not only improve the breathing pattern but also strengthen the chest breathing muscles (Stark et al., 2015).

This is slightly different from the results of a study conducted by Göngör et al. (2021) who reported a significant improvement after chest physiotherapy postural exercises in terms of emotional status and medication adherence in patients with pulmonary cystic fibrosis. However, these changes did not last more than six weeks, which is when the treatment program ended. On the other hand, conventional chest physiotherapy alone did not significantly change the quality of life parameters. In line with these findings, the study by Schmidt et al. (2011) showed that, in patients with cystic fibrosis, a physical exercise program could improve the emotional status and medication adherence of patients. Improvements in emotional status and medication adherence can also have additional positive effects on treatment outcomes, such as lung function. The effect of increased medication adherence and emotional status of course then affects the frequency of relapse and the need for

hospitalization in patients (Schmidt et al., 2011).

Another study conducted in America stated that chest physiotherapy can improve medication adherence in pediatric patients with cystic fibrosis who undergo long-term treatment. There were positive changes reported related to medication adherence, parameters of physical improvement, family function and emotional function of patients during monitoring (Stark et al., 2015).

Apart from the effects of cancer itself, there are many reasons for cancer-related fatigue such as anemia, medications, metabolic changes, infections, dehydration, loss of muscle strength and coordination, decreased physical condition, emotional stress, difficulty sleeping, inactivity, pain, depression nutrition, and other co-morbidities or medical conditions other than cancer. Cancer-related fatigue is a complex issue with both physical and psychosocial influences. Therefore, therapies and strategies to be used to reduce fatigue should be considered comprehensively (Ozalevli, 2013). Thus, fatigue can be reduced by regular exercise and physical exercise. It had been shown in COPD patients that physical exercise for at least 4 weeks, with or without education and/or psychological support, can reduce clinically significant levels of fatigue, as well as improve dyspnea, emotional function, and a patient's sense of control, which overall is also can improve the patient's quality of life in general (Ozalevli et al., 2010; Ozalevli, 2013).

Managing the pattern of breathing from the chest or from the stomach greatly affects the body and mind. Learning and using proper breathing techniques is one of the most beneficial things you can do for short-and long-term physical and emotional health (Zach and Oberwaldner, 2008). During times of emotional stress, the nervous system is stimulated and influences a number of physical responses. During this process the heart rate increases, muscles tense up, digestion slows down, the body begins to sweat, and breathing becomes rapid and shallow. Normally, the nervous system is able to restore balance. However, under conditions of chronic stress, the nervous system becomes over-stimulated, causing a system imbalance that can lead to inflammation, high blood pressure, and muscle pain, among other adverse effects. By taking deep breaths, the nervous system regains balance by slowing and deepening the breath.

Simply changing the breathing pattern can directly counteract the physical changes caused by the nervous system during the stress response. This means that regular breathing exercises can improve heart rate, blood pressure, digestion, sleep, and nervous system stability and stimulate a general relaxation response that results in less tension and an overall sense of well-being (Zach and Oberwaldner, 2008).

Lillian et al. (2011) revealed that generally healthy children have a higher quality of life than children with leukemia. This is in line with this study where the patient's quality of life scores decreased in all domains, especially in the physical, emotional and school domains. This finding is thought to be because children who received maintenance therapy should be able to integrate better into the school environment overtime (Earle and Eiser, 2007). Pediatric patients who suffer from ALL and have chemotherapy treatment will generally experience fatigue, the adverse effects of the disease and treatment that have an impact on physical activity, including difficulties in socializing and interacting with their surroundings or in this case social functioning (Sung *et al.*, 2011).

Children who underwent maintenance phase chemotherapy appeared significantly

better than those who underwent the previous phase of therapy that preceded it. Previous research found that physical and emotional functioning improved over time, whereas there was no change in social functioning (Sung *et al.*, 2011). This is in line with this research. In addition, other studies that were also conducted in Indonesia also had the same findings (Sitaresmi *et al.*, 2008).

Previous research conducted in Turkey stated that social function in assessing the quality of life of children with cancer was higher than in other regions (Arslan, Basbakkal and Kantar, 2013). This is in line with this study where it was found that children's quality of life scores in social functionings were higher than in other functionings. In our country, pediatric patients and their families are fully socially supported due to the influence of traditional culture and structures so it is estimated that the quality of life of children is better than in other areas. Meanwhile, in the study, quality of life scores for school functioning and emotional functioning were found to be lower (Arslan, Basbakkal and Kantar, 2013). The results are also in accordance with our research. The reason for the low score on school functioning is thought to be due to the need for hospitalization to had cancer therapy thereby interrupting teaching and learning activities in schools to continue treatment. Similar results were presented in a study conducted in Singapore where duration of treatment had a significant effect on school functioning (Choo et al., 2019).

Thus, the results of our study is in line with some of the results of previous studies that have been described. This can be seen from the results of a decrease in the quality of life of children in the aspects of the quality of life in the physical and emotional fields, but it is not very meaningful in other fields. This could be due to our hospital as a tertiary referral hospital that has the availability of the necessary medicines, adequate facilities, and medical personnel in the fields of surgery, nutrition, psychiatry and medical rehabilitation.

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This study was self-funded.

AUTHORS' CONTRIBUTION

Aisya Fikritama Aditya was the main author who conducted the study, processed data analysis, and wrote the manuscript. Ismiranti Andarini examined the background and discussion of the study dan Sri Lilijanti formulated the framework of study.

CONFLICT OF INTEREST

There is no conflict of interest in this study.

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