

## ORIGINAL ARTICLE / ОРИГИНАЛНИ РАД

# The effects of complications and comorbidities on physical therapy duration in children with pneumonia

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**Introduction/Objective** Physical therapy aims to improve airway clearance, breathing, and enhance gas exchange. It is widely used as an additional therapy in children with pneumonia. The aim of this study was to assess the effects of complications and comorbidities on physical therapy duration in children with pneumonia.

**Methods** We conducted a retrospective descriptive study including 40 children with pneumonia admitted to a tertiary children's hospital. Study participants were divided into two groups – a group with and without complications and a group with and without comorbidities. All children received physical therapy one time daily five days a week plus standard treatment for pneumonia. Physical therapy procedures that were applied were chest physical therapy and kinesiotherapy.

**Results** Chest physical therapy ( $p < 0.001$ ) and kinesiotherapy ( $p = 0.024$ ) were applied significantly longer in the group with complications versus those without complications. Chest physical therapy was applied significantly longer in the group with comorbidities versus the group without comorbidities ( $p < 0.001$ ), while there was no difference regarding duration of kinesiotherapy in the group with and without comorbidities ( $p = 0.239$ ).

**Conclusion** Our results show that the presence of complications and/or comorbidities significantly prolongs the duration of chest physical therapy in children with pneumonia.

**Keywords:** children; pneumonia; physical therapy

**INTRODUCTION**

Community-acquired pneumonia is an acute disease caused by an infection of the lung parenchyma acquired outside of a hospital setting [1]. Childhood pneumonia is still a significant clinical and public health problem and one of the leading causes of morbidity in children [2, 3]. Physical therapy is widely used as additional therapy in children with pneumonia. Currently in clinical practice different physical therapy techniques are available that aim to improve evacuation of inflammatory exudates and tracheobronchial secretions, remove airway obstruction, decrease airway resistance, improve gas exchange, and reverse pathological progression [4, 5]. However, strong scientific evidence is missing to support those beneficial effects in children with pneumonia and lack of data showing that physical therapy may contribute to patients' recovery. Authors of systematic review have concluded that there was insufficient evidence to make a clear recommendation for clinical practice and consequently reject or accept chest physical therapy as a standard treatment option in children with pneumonia [6]. However, to our knowledge, there are no studies investigating the effects of complications

and comorbidities on physical therapy duration in this population. Therefore, the primary aim of this study was to assess the effects of complications and comorbidities on physical therapy duration in children with pneumonia. Additionally, we wanted to evaluate treatment outcome in study group regarding presence of complications and comorbidities.

**METHODS**

The study was based on a sample of 40 children (22 male and 18 female, mean age  $34.5 \pm 18.5$  months, range 1 month to 10 years) hospitalized due to pneumonia. Pneumonia was defined as the presence of fever, acute respiratory symptoms (cough, tachypnoea, difficult breathing) or both, plus presence of new infiltrate on chest radiography or consolidation not attributable to some other etiology [7]. Exclusion criteria were severe concomitant disease (chronic pulmonary disease, cerebral palsy, immune deficiency), hemodynamic instability, chest drain, bone fragility or rib fractures [4]. The study was approved by the Ethics Committee of the University Children's Hospital in Belgrade (number 017 16/53).

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**Table 1.** Duration of physical therapy procedures with regard to the presence of complications and pleural effusion

Tested parameters		Group with complications/ pleural effusion	Group without complications/ pleural effusion	p
Complications	Chest physical therapy (MV ± SD), days	11.82 ± 5.71	4.39 ± 1.64	< 0.001*
	Kinesiotherapy (MV ± SD), days	10.13 ± 6.26	4 ± 2.55	0.024*
Pleural effusion	Chest physical therapy (MV ± SD), days	10.83 ± 5.71	6.14 ± 5.6	< 0.001**
	Kinesiotherapy (MV ± SD), days	8.91 ± 5.49	8.4 ± 7.11	0.428*

MV – mean value; SD – standard deviation;

\*Student's t-test;

\*\*Mann–Whitney U test

**Table 2.** Duration of physical therapy procedures with regard to the presence of comorbidities

Tested parameters		Group with comorbidities	Group without comorbidities	p
Comorbidities	Chest physical therapy (MV ± SD), days	11.4 ± 6.1	6.27 ± 4.51	< 0.001*
	Kinesiotherapy (MV ± SD), days	9.7 ± 6.18	7.73 ± 6.26	0.239**

MV – mean value; SD – standard deviation;

\*Mann–Whitney U test;

\*\*Students t-test

**Table 3.** Duration of physical therapy procedures with regard to the presence of complications and comorbidities

Tested parameters		Group with complications and comorbidities	Group without complications and comorbidities	p
Complications and comorbidities	Chest physical therapy (MV ± SD), days	12.63 ± 6.21	4.19 ± 1.5	< 0.001*
	Kinesiotherapy (MV ± SD), days	10.75 ± 6.41	3 ± 1.73	0.038*

Out of 40 children with pneumonia, 17 had complications. The most common complications were pleural effusion in 12 children, empyema in three children, and necrotizing pneumonia in two children. Among 40 children with pneumonia, comorbidities were present in 10 children. Five children had congenital heart defects, two had repaired esophageal atresia with tracheoesophageal fistula, and one child had epilepsy, celiac disease, and Hirschsprung disease.

All the children received physical therapy one time daily with standard treatment for pneumonia (antibiotic therapy, fluid therapy, and oxygen, if needed, administered by the attending pediatrician) until discharge. Regarding physical therapy procedures, two modes were evaluated: chest physical therapy and kinesiotherapy. Each session of physical therapy was about 30 minutes and consisted of postural drainage, thoracic squeezing, chest percussion, vibration, cough stimulation, aspiration of secretions (if needed), and kinesiotherapy [4, 8]. The positions for postural drainage were directed by the chest radiograph to provide more effective drainage of secretions and exudates from the most affected areas [4, 8]. The decision to discharge from hospital was made by the attending pediatrician. Regarding treatment outcome two categories were assessed: discharge and prolonged hospitalization. Prolonged hospitalizations in this study were defined as those lasting 14 days or longer.

### Statistical analysis

Results were presented as whole numbers (N) and percentages (%), while continuous values were presented as mean values (MV) with standard deviation (SD). Student's t-test and Mann–Whitney U test were used to compare continuous variables depending on the normality of distribution, and  $\chi^2$  test or Fishers exact test were used for categorical

variables. Spearman rank correlation was used to measure the degree of association between the presence and number of complications or comorbidities and the duration of physical therapy. A value of  $p < 0.05$  was considered to be statistically significant.

### RESULTS

In the group of children with complications, chest physical therapy ( $p < 0.001$ ) and kinesiotherapy ( $p = 0.024$ ) were applied significantly longer compared to children without complications (Table 1). Moreover, it was shown that chest physical therapy was applied significantly longer in the group of children with pleural effusion compared to children without pleural effusion ( $p < 0.001$ ), whereas there was no difference regarding the duration of kinesiotherapy in children with and without pleural effusion ( $p = 0.428$ ) (Table 1).

In the group of children with comorbidities, chest physical therapy was applied significantly longer compared to children without comorbidities ( $p < 0.001$ ) while there was no difference regarding the duration of kinesiotherapy in children with and without comorbidities ( $p = 0.239$ ) (Table 2).

In addition, when we analyzed patients who had comorbidities and complications, we noticed that in those children both chest physical therapy ( $p < 0.001$ ) and kinesiotherapy ( $p = 0.038$ ) were applied significantly longer compared to children without comorbidities and complications (Table 3).

There was a statistically significant correlation between the presence and number of complications and the duration of chest physical therapy ( $p < 0.001$ ) as well as with the duration of kinesiotherapy ( $p < 0.001$ ) (Table 4). Furthermore, there was statistically significant correlation between the presence and number of comorbidities and the duration of chest physical therapy ( $p < 0.001$ ), while

**Table 4.** Correlations between the duration of physical therapy modes and the presence and number of complications and comorbidities

Tested parameters		Duration of physical therapy	
		r	p
Presence and number of complications	Chest physical therapy	0.827	< 0.001
	Kinesiotherapy	0.673	< 0.001
Presence and number of comorbidities	Chest physical therapy	0.522	< 0.001
	Kinesiotherapy	0.274	0.229
Presence and number of complications and comorbidities	Chest physical therapy	0.781	< 0.001
	Kinesiotherapy	0.746	0.008

r – correlation coefficient

**Table 5.** Treatment outcome in tested patients regarding the presence of complications and comorbidities

Presence of complications and/or comorbidities	Treatment outcome	Patients		p
		N	(%)	
Complications				
Yes	Discharge	7	41.2	< 0.001*
	Prolonged hospitalization	10	58.8	
No	Discharge	23	100	
	Prolonged hospitalization	0	0	
Comorbidities				
Yes	Discharge	4	40	0.007**
	Prolonged hospitalization	6	60	
No	Discharge	26	86.7	
	Prolonged hospitalization	4	13.3	
Complications and comorbidities				
Yes	Discharge	2	25	< 0.001**
	Prolonged hospitalization	6	75	
No	Discharge	21	100	
	Prolonged hospitalization	0	0	

\* $\chi^2$ ;

\*\*Fisher's exact test

no statistically significant correlation between the presence and number of comorbidities and the duration of kinesiotherapy ( $p = 0.229$ ) was found (Table 4). Moreover, there was statistically significant correlation between the presence of comorbidities and complications and the duration of chest physical therapy ( $p < 0.001$ ) as well as with the duration of kinesiotherapy ( $p = 0.008$ ) (Table 4).

More than half of tested patients with complications had prolonged hospitalization (58.8%), while none of those without complications had prolonged hospitalization (0%). Regarding comorbidities, also more than half of children with comorbidities (60%) had prolonged hospitalization, while only 13.3% of those without comorbidities had prolonged hospitalization. Patients with complications and comorbidities had the highest proportion of prolonged hospitalization (75%), while none of those without complications and comorbidities had prolonged hospitalization (0%) (Table 5).

## DISCUSSION

In this study we assessed the application of physiotherapy in children with pneumonia. There are very few studies of physical therapy in children with pneumonia and the

results of those studies are controversial. A randomized trial from Brazil found that chest physical therapy as supplementary to standard treatment did not hasten the clinical resolution of children hospitalized with acute pneumonia and that physical therapy may prolong duration of coughing and rhonchi [9]. Another randomized study from Brazil demonstrated that the chest physical therapy had no beneficial effects in children hospitalized with community-acquired pneumonia [10]. In contrast, the authors of a more recent study from Egypt concluded that chest physical therapy showed significant improvements in children hospitalized with pneumonia. They reported that children treated with standard treatment for pneumonia and chest physical therapy had shorter time to clinical resolution and greater improvement in respiratory rate and arterial oxygen saturation compared to children treated with standard treatment for pneumonia alone, without chest physical therapy [11]. Moreover, the authors from Portugal studying adult outpatients with lower respiratory tract infections, recently found that adding respiratory physical therapy to the pharmacological treatment results in greater recovery of symptoms and function parameters [12]. Given the observations of above-mentioned studies, it should be pointed out that physical therapy particularly chest physical therapy in patients with pneumonia could lead to elimination and reduction of mucus in lung airways, thus affecting recovery and onset prevention and further deterioration of present complications [13].

Bearing in mind that pediatric population consists of very young infants up to the patients 18 years of age, modifications to physical therapy procedures are applied [13]. Susan and Hintz [14] pointed out that chest physical therapy used in infants was associated with improved oxygenation and secretion clearance and improvements in respiration and chest sound. Furthermore, Leelarungrayub et al. [15] reported that chest physical therapy possibly reduces oxidative stress and enhance oxygenation status in infants with pneumonia. These findings clearly demonstrate the importance of chest physical therapy in children, particularly infants with pneumonia.

According to the literature, there is still a lack of scientific evidence to make a clear, justified recommendation for the clinical practice, supporting or refusing physical therapy in children or adults with pneumonia. Authors of a recent systematic review on chest physical therapy in children with pneumonia emphasized that no reliable conclusions can be drawn concerning the use of chest physical therapy for children with pneumonia due to the small number of included trials with differing study characteristics and statistical presentation of data [16]. Moreover, a recently concluded systematic review stressed that current evidence was very uncertain about the beneficial effect of chest physical therapy in adults with pneumonia [17].

To our knowledge, this is the first study to present effects of complications and comorbidities on physical therapy duration in children with pneumonia. Our results showed that among children with pneumonia, those with additional complications had significantly longer chest physical therapy and kinesiotherapy than those without complications. Another important finding in our study is that we observed a statistically significant correlation between the presence and number of complications and the duration of chest physical therapy and duration of kinesiotherapy procedures. This is expected, since pneumonia with complications should be treated longer to gain improvements and the resolution of complications. Additionally, we found that children with complicated pneumonia more often had prolonged hospitalization, which is in agreement with data in literature [18, 19].

Furthermore, children with comorbidities, had significantly longer chest physical therapy versus those without comorbidities, while there was no difference regarding the duration of kinesiotherapy. Moreover, there was statistically significant correlation only between the presence and number of comorbidities and the duration of chest physical therapy. These findings demonstrate that the role of chest physical therapy is important in children with pneumonia and additional comorbidities, and this is further supported by the findings that comorbidities alone or with complications are significantly more frequent in the one with prolonged hospitalizations. In contrast, authors from Brazil did not find longer hospital stays in children with community-acquired pneumonia and comorbidities [20].

However, it should be considered that the results in our study might be influenced by the fact that the evaluated group of patients were presenting to a tertiary medical facility – a university children's hospital – therefore, patients with more severe infections may have been

overrepresented, some of which could affect the production and elimination of secretions.

The present study has some limitations that should be considered in the analysis and interpretation of the results. Firstly, the study design included a retrospective collection of information. We did not have a control group due to ethical reasons, considering that respiratory physical therapy is often prescribed in children with pneumonia in our institution. In addition, the prolonged hospitalization was used as an endpoint in this study, although it is known that the decision about the duration of hospitalization varies among doctors and hospitals [10]. However, our study was conducted at a single institution; therefore, the doctor/facility profiles were unlikely to have biased length of hospitalization.

## CONCLUSION

Our results suggest that the presence of complications and/or comorbidities significantly prolongs the duration of chest physical therapy and prolongs hospitalization in children with pneumonia.

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**Conflict of interest:** None declared.

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## Утицај компликација и коморбидитета на трајање физикалне терапије код деце са пнеумонијом

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### САЖЕТАК

**Увод/Циљ** Физикална терапија има за циљ да побољша мукоцилијарни клиренс дисајних путева, дисање и размену гасова. Често се користи као додатна терапија у лечењу деце са пнеумонијом.

Циљ овог истраживања био је да се процени утицај компликација и коморбидитета на трајање физикалне терапије код деце са пнеумонијом.

**Метод** Ова ретроспективна дескриптивна студија је обухватила 40 деце са пнеумонијом која су лечена у терцијарној болници. Испитаници су били подељени у две групе – у групу са компликацијама и без компликација и у групу са коморбидитетом и без коморбидитета. Код све деце физикална терапија је примењивана једном дневно, пет дана у недељи уз стандардну терапију за лечење пнеумоније.

Програм физикалне терапије је подразумевао респираторну рехабилитацију и кинезитерапију.

**Резултати** У групи испитаника са компликацијама у односу на испитанике без компликација значајно дуже су примењиване респираторна рехабилитација ( $p < 0,001$ ) и кинезитерапија ( $p = 0,024$ ). Такође, респираторна рехабилитација примењивана је значајно дуже у групи испитаника са коморбидитетима у односу на испитанике без коморбидитета ( $p < 0,001$ ). Разлика у дужини кинезитерапије између ове две групе испитаника није утврђена ( $p = 0,239$ ).

**Закључак** Наши резултати показују да присуство компликација и/или коморбидитета значајно повећава трајање респираторне рехабилитације код деце са пнеумонијом.

**Кључне речи:** деца; пнеумонија; физикална терапија