ORIGINAL ARTICLE

Effects of Gamification of Pursed Lips Breathing on Oxygenation Status of Children Suffering from Pneumonia: A Systematic Review

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ABSTRACT

Objective: This review aims to determine the effects of gamification pursed lips breathing (PLB) in children with pneumonia.

Study Design: Systematic Review.

Place and Duration of Study: Universitas Indonesia, 6 months.

Material and Methods: Nine electronic databases, including PubMed, ScienceDirect, Sage Publications, Taylor & Francis, JSTOR, Springer, Google Scholar, ProQuest, and Scopus, were used to search the literature. The database search identified 691 articles, 6 of which fulfilled the inclusion criteria.

Results: Most respondents were school-age and teenagers between 5 and 18 years (65%), and preschool-age (35%). In this study, respondents consisted of more boys (52%) than girls (48%) (n=160). All respondents were children who suffered from pneumonia. Subsequently, gamification for PLB includes blowing: tongue twisters; party whistles; water in bottles with straws; super bubbles; bamboo pinwheels; pinwheels; and blowing pianica. The results of gamification PLB can improve the oxygenation status of children with pneumonia by reducing respiratory rate (RR) and heart rate (HR), increasing forced expiratory volume in one second (FEV1), and increasing oxygen saturation.

Conclusion: Using gamification of PLB can improve the oxygenation status in children with pneumonia.

Key Words: *Pursed lips breathing, Children, Pneumonia*

INTRODUCTION

The occurrence of deaths due to pneumonia is still high in the world, leading to approximately 740.180 deaths in children under the age of 5 in 2019 (equivalent to 14% of all deaths of children under 5 years).[1] In 2018, Indonesia ranked sixth in the world in under-5 deaths due to pneumonia. Other countries with higher death rates included Nigeria, India, Pakistan, Congo, and Ethiopia with 19.000 children under 5.[2] The number of pneumonia cases in Indonesia in 2023 is estimated at 416.435 children under the age of 5.[3] Pneumonia is inflammation affecting the lung parenchyma,[4] which is an organ in the form of a collection of groups of alveoli surrounding the branches of the bronchial tree.[5] Various factors can cause pneumonia, such as viruses, bacteria,

or fungi.[4] Children suffering from pneumonia generally experience symptoms including coughing, rapid breathing, shortness of breath, and nostril breathing.[6] Severe pneumonia occurs when the chest wall contracts or oxygen saturation is below 92%.[7]

One nursing intervention supporting spontaneous breathing is teaching techniques and breathing exercises.[8] Breathing exercises maximize gas exchange in the lungs and increase comfort.[9] The exercises that can be practiced by children with pneumonia are breathing exercises using pursed lips breathing (PLB) technique. Subsequently, PLB is a technique of inhaling through the nose with a closed mouth and exhaling through pursed lips to reduce symptoms of shortness of breath, help breathe effectively, and reduce respiratory rate (RR).[10] The breathing process is carried out slowly; the exhalation process takes longer than inspiration (1:2).[10,11]

Children with severe pneumonia are hospitalized or require hospitalization.[1] Separation, loss of control, physical injury, and pain are major stressors for children when hospitalized.[6] Nurses apply atraumatic care and involve families to achieve healing with comfort.[12]

Using gamification, nurses carry out therapeutic play activities as part of nursing care. Therapeutic play is an important activity to reduce anxiety, increase cooperation in care, and help children overcome stress when undergoing a series of examinations at the hospital.[13] Play activities that are fun for children are known as gamification. Gamification is a game design technique to make things that are considered boring interesting like a game. Gamification is also used in non-formal education, such as in the health sector.[14]

Children are included in therapeutic play preparations, thereby creating an environment that enables them to work together during treatment.[15] The focus of PLB implementation previously was mostly on adult patients, without the use of assistive devices, and on patients with chronic breathing disorders.[16] Therefore, this study aims to conduct a systematic review to obtain scientific evidence regarding the use of gamification in therapeutic play to exercise PLB in pediatric patients with acute respiratory disorders.

MATERIAL AND METHODS

Before starting the research, the researcher applied for an IRB. The IRB was issued by the Ethical Committee of Nursing Research, Faculty of Nursing Universitas Indonesia No. KET-133/UN2.F12.D1.2.1/PPM.00.02/2024.

Study identification and selection: Study is a systematic review of various articles that employ a quasi-experimental design. The literature search was conducted across nine databases including PubMed, ScienceDirect, Sage Publications, Taylor & Francis, JSTOR, Springer, Google Scholar, ProQuest, and Scopus covering the years from 2014 to 2024. The keywords used were: “pursed lips breathing” AND “children” AND “pneumonia”.

Inclusion and exclusion criteria: The selection of articles was carried out using the PICO approach.[17] P=Patient: pediatric patients aged 3-18 years; I=Intervention: PLB using gamification; C=Comparison of the intervention with standards carried out in hospitals; and O=Outcome: the benefits of PLB using gamification. The inclusion criteria are (1) pediatric patients aged 3-18 years, (2) the intervention is PLB, (3) publication year of the journal from 2014 to 2024, (4) design quasi-experiment, (5) articles in English, open access, and full text. The exclusion criteria are (1) the article is not a journal and (2) the article cannot be downloaded.

Study selection: This process was carried out with the selection results showing that there were 691 articles with the following details including PubMed (n=8), Science Direct (n= 24), Sage Publications (n=6), Taylor & Francis (n= 157), JSTOR (n=46), Springer (n=105), Google Scholar (n=166), ProQuest (n=45), and Scopus (n= 134). After removing 6 duplicates, 685 articles remained. Title and abstract screening reduce these to 10, with 675 excluded based on criteria. From the full text, 4 articles were excluded for non-experimental design, leaving 6 articles for review, and the results are shown in fig.1. PRISMA (Preferred Reporting Items of Systematic Reviews and Meta-Analyses).

The final result of the selected literature screening is 6 articles. Then the article was reviewed by two people to assess its suitability using the JBI Critical Appraisal Tool for Quasi-Experimental Studies in table 1.

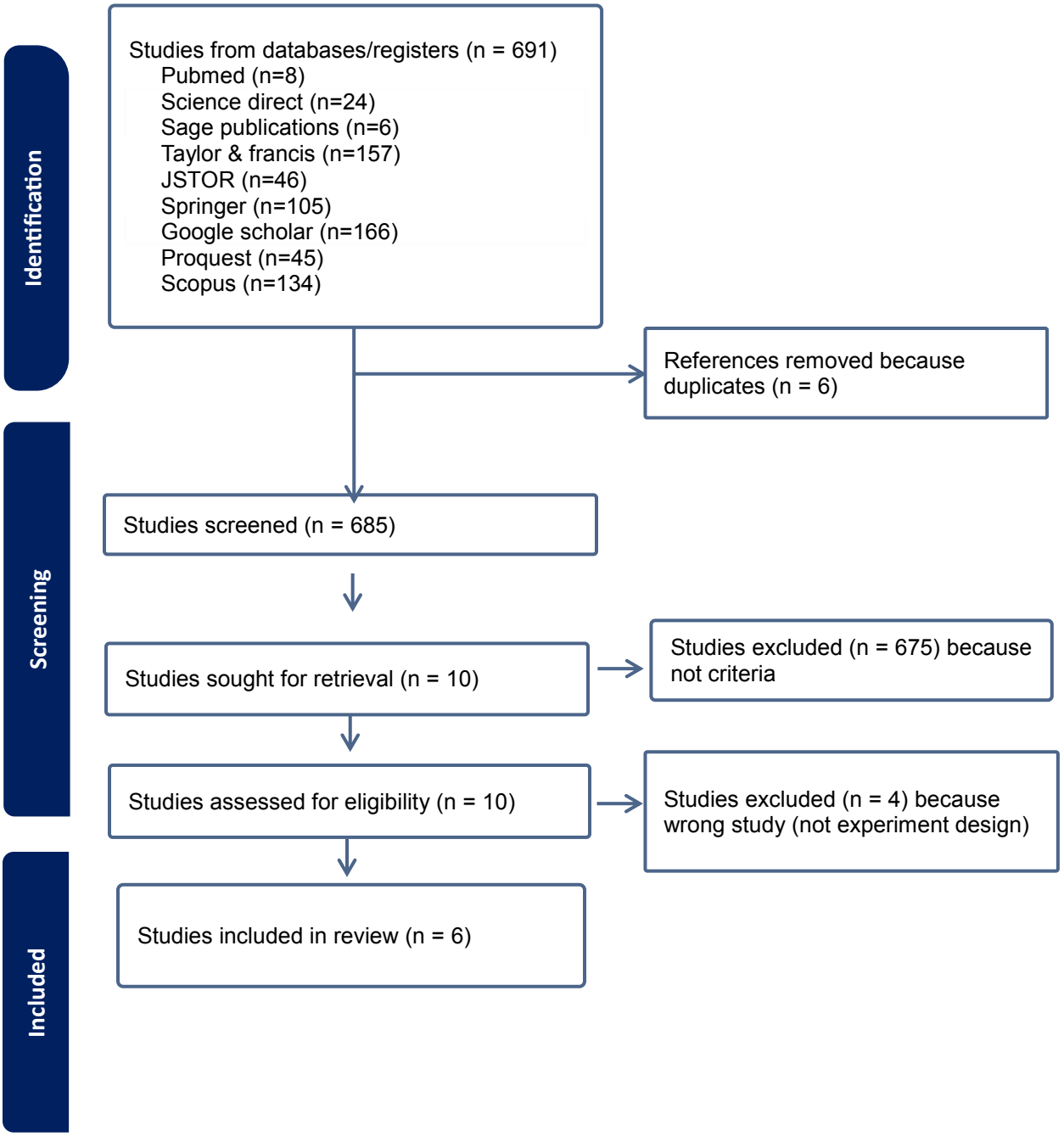

Fig 1: PRISMA

TABLE 1. JBI critical appraisal tool for quasi-experimental studies

Author	JBI critical appraisal tool									
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	% Yes and Interpretation
21	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	0.88 Low risk of bias
22	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	0.77 Low risk of bias

23	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	0.77 Low risk of bias
24	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	0.88 Low risk of bias
18	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	0.77 Low risk of bias
25	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	0.77 Low risk of bias

Notes: Q1 – Q9 indicate questions 1 to 9 based on the JBI risk assessment

The risk of bias was ranked as high when the study reached up to 49% of "yes" scores, moderate when the study reached 50 to 69% of "yes" scores, and low when the study reached more than 70% of "yes" scores

TABLE 2. Summaries of studies

Reference	Study design	Outcome measures	Results
21	Quasi-experiment with control.	- Improve oxygenation status: RR decreased from 28x/minute to 26x/minute. Heart rate (HR) decreased from 114x/minute to 109 x/minute. Oxygen saturation increased from 97,4% to 97,9%. - There is a significant influence between oxygenation status before and after gamification of PLB with tongue-blowing intervention on RR (p-value=0.045), oxygen saturation (p-value=0.037), and HR (p-value=0,036).	PLB by blowing tongue puffs adds an alternative for independent nursing interventions to treat pediatric patients suffering from pneumonia or with impaired oxygenation.
22	Quasi-experiment without control.	- Improve oxygen status: Intervention group I: RR: decreased from 30x/minute to 28x/minute. Oxygen saturation: increased from 96% to 98%. FEV1: increased from 72,5% to 82,5%. Intervention group II: RR: decreased from 30x/minute to 28x/minute. Oxygen saturation: increased from 96% to 98%. FEV1: increased from 80% to 90%. - Gamification PLB by blowing water in a bottle through a straw is more effective in reducing RR (p-value 0,019<0,05) and increasing oxygen saturation (p-value 0,026 < 0,05) compared to gamification PLB by blowing a party whistle. - There was no significant difference in changes in FEV1 between the two groups (p-value 0,087>0,05).	PLB by blowing water in a bottle through a straw can improve the oxygen status of children with oxygenation problems.
23	Quasi-experiment without control.	- Oxygen saturation in the intervention group increased from 92% to 96%. - Gamification PLB by blowing a pinwheel significantly increased	PLB by blowing pinwheel can be used as a treatment for outpatient pediatric patients with pneumonia and at home for preschool children who can perform independently.

		oxygen saturation between the intervention and control groups (p-value=0.018 <0.05).	
[24]	Quasi-experiment with control.	- Reducing RR and HR and increased oxygen saturation in children with pneumonia. RR: decreased from 23x/minute to 19x/minute. HR: decreased from 78x/minute to 75x/minute. Oxygen saturation: increased from 93% to 97%. - Gamification of PLB by blowing water in a straw can significantly reduce RR, HR, and increase oxygen saturation (p-value<0,05).	PLB by blowing water in a straw can be used as a treatment for obstructive lung and restrictive lung diseases in increasing oxygen saturation and reducing RR and HR.
[18]	Quasi-experiment without control.	- Reducing RR and HR and increased oxygen saturation in children with pneumonia. RR: decreased from 23x/minute to 19x/minute. HR: decreased from 78x/minute to 75x/minute. Oxygen saturation: increased from 93% to 97%. - Gamification of PLB by blowing water in a straw can significantly reduce RR and HR, and increase oxygen saturation (p-value<0,05).	PLB by blowing water in straw can be used as a treatment for obstructive lung and restrictive lung diseases in increasing oxygen saturation and reducing RR and HR.
[25]	Quasi-experiment without control.	- Reducing respiratory frequency: RR decreased from 34x/minute to 32x/minute. - There is a significant effect of gamification PLB by blowing pianica on RR (p-value 0,001 <0.05).	PLB by blowing a pianica can be used as additional therapy in children suffering from pneumonia.

RESULTS

The articles reviewed were obtained from Indonesia and India. Children undergo care and treatment in hospitals, both outpatient and inpatient. Table 2 summarizes the results of these investigations.

Respondents: The majority of respondents were school-age and teenagers between 5 and 18 years (65%), and preschool-age (35%). All child respondents suffered from pneumonia.

Intervention: All implemented interventions were gamification of PLB (100%). Gamification of PLB by blowing a tongue puff, but the article doesn't explain the technical implementation. Gamification of PLB by blowing the water in the bottle through the straw and blowing the whistle the party is held once/day, 4 cycles, each cycle consists of 10 blows, and the time is about 10 minutes. Gamification of PLB by blowing super bubbles and bamboo propellers, but technicalities are not explained in the article. Gamification of PLB by blowing a pinwheel is carried out once/day, 3 cycles, each cycle consists of 10 blows, and time is about 5 minutes. Gamification of PLB by blowing water in a bottle through a straw is performed during breaks, once/day, 4 x/minute for 10 minutes. Gamification of PLB by blowing the

pianica 1 time, 3 cycles, each cycle blowing the piano 17 seconds, rest 2 minutes.

Outcome measures: Gamification is twice as often used in implementation PLB is blowing water in a bottle using a straw (33%). Gamification of PLB can improve oxygenation status in children with pneumonia (100%).

DISCUSSION

Based on the results of the systematic review carried out, researchers used the results of publications using articles from the last 6 years; thereby, the findings obtained could be updated and used during this study.

PLB technique is analogous to breathing exercises with therapeutic play. The toys used include blowing up: balloons, blowing water with straws, pinwheels, feathers, whistles, harmonicas, party blowers, paper, cotton balls, marbles, ping pong balls, and others.[6] PLB is part of the breathing exercises required for patients who are experiencing respiratory problems because it has a good effect on the respiratory system. PLB is useful for improving breathing patterns, releasing air trapped in the lungs, increasing relaxation, holding the airway longer,[11] and lengthening the breath. PLB encourages the expansion of the alveoli in each lung lobe, increases airway secretions during breathing, and normalizes breathing patterns.[18] PLB effectively improves RR and increases oxygen saturation.[19] PLB intervention is one of the nurses' independent actions that reduce RR in children with pneumonia.[20]

PLB, which is carried out using the tongue blowing technique, can help increase the expansion of the alveoli in all lobes, and the pressure in the alveoli also increases. High pressure in the alveoli and lobes can activate the cilia in the airways to evacuate secretions out of the airways, reduce airway resistance, and increase ventilation, which has an impact on the oxygen perfusion process to the tissue.[21] The strength of a child's blowing is related to their ability to breathe deeply. Children who cannot breathe deeply show signs of problems with the respiratory system. Gamification of PLB with tongue blowing is not only fun for sick children, but it is also beneficial for children to practice deep breathing. Children blowing with a tongue will try to breathe to the limit of their ability and blow out air maximally.[21]

Gamification of PLB by blowing water in a bottle using a straw and blowing a party whistle can be used as a distraction medium to increase relaxation to improve respiratory status. This media makes the children's breathing process longer, and more relaxed, and reduces shortness of breath.[22] The other gamification of PLB with super bubbles and bamboo propellers can be used as therapeutic play media, which have a distraction and relaxation effect when children blow slowly.[23]

The use of pinwheel facilitates therapeutic play and optimizes the children's oxygenation. Gamification of PLB using a pinwheel as a therapeutic play medium makes children happy and cooperative when implementing PLB compared to not using therapeutic play tools.[24] Gamification of PLB by blowing into the water in the bottle using a straw can be used as a game to divert children's attention regarding PLB.[18] Gamification of PLB by blowing on the pianica can make things easier for children and help children be more cooperative when doing breathing exercises.[25]

The benefits of PLB by blowing the tongue can improve oxygenation status.[21] The intervention was carried out with PLB using an inspiratory to expiratory ratio of 1:2. The benefits of PLB by blowing water in a bottle with a straw and blowing a party whistle increased oxygenation status.[22] The benefits of PLB by blowing super bubbles improved oxygenation status. The benefits of PLB intervention by blowing bamboo propellers improved oxygenation status.[23] The benefits of PLB by blowing a pinwheel can improve oxygenation status.[24] The benefits of PLB by blowing water in a bottle using a straw can improve oxygenation status.[18] The benefits of PLB by blowing on the pianica can improve oxygenation status.[25]

Based on this study, all forms of gamification of PLB can improve oxygenation status. The media used include tongue-blowing, blowing a party whistle, blowing water into a bottle using a straw, blowing super bubbles, blowing a bamboo propeller, blowing a windmill, and blowing a

pianica. The results show that RR can be reduced by 4x/minute when blowing water into a bottle using a straw.[18] The method that can most effectively reduce HR is blowing the tongue 5x/minute.[21] The study also shows that saturation can increase by 4% when blowing water into a straw pinwheel.[24]

CONCLUSION

In conclusion, based on the results of the systematic review carried out, gamification of PLB can bring significant benefits to children. PLB in children with pneumonia can improve oxygenation status, namely by reducing RR and HR, and increasing oxygen saturation and FEV1. Gamification of PLB is: blowing a tongue, blowing water in a bottle with a straw, blowing a party whistle, blowing super bubbles, blowing a bamboo propeller, blowing a pinwheel, and blowing a pianica.

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