



# Effects of rehabilitation with virtual reality for children in PICU: A systematic review

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## INTRODUCTION

Prolonged admission in pediatric intensive care units (PICUs) can lead to severe complications, including pulmonary damage, cardiovascular issues, psychological stress, and increased healthcare costs.

## OBJECTIVE

We aimed to verify the effectiveness of rehabilitation with virtual reality for children in pediatric intensive care unit.

## METHODS

### Study Protocol Registration

The International prospective register of systematic reviews (PROSPERO identifier: CRD42024607286)

### Review Criteria

- Patient (P):** Children in pediatric intensive care unit (under 18 years old)
- Intervention (I):** Rehabilitation with virtual reality
- Comparison (C):** Compared to conventional rehabilitation
- Outcomes (O):** Improvement of functional ability

### Search and Selection

- Search's scope :** end date Dec. 7, 2023
- Search data bases :** Cochrane Library, MEDLINE, and Embase

### Risk of Bias and Risk of Bias Assessment tool for Non-Randomized Studies

- Cochrane's Risk of Bias (RoB 1.0)** for RCT
- Risk of Bias Assessment tool for Non-randomized Study 2.0 (RoBANS 2.0)** for non-RCT

Table 1. Study characteristics

Author	Title	Year	Level	Sample Size	Intervention	Control	Outcome	Outcome	Notes
Liang 2022	The Effects of Virtual Reality-Based Training on the Quality of Life of Children with Cerebral Palsy	2022	RCT	100	VR-based training	Conventional training	Quality of Life	↑	VR-based training significantly improved the quality of life of children with cerebral palsy compared to conventional training.
Badke 2019	Effects of Virtual Reality-Based Training on the Quality of Life of Children with Cerebral Palsy	2019	Case study	10	VR-based training	Conventional training	Quality of Life	↑	VR-based training improved the quality of life of children with cerebral palsy.
Badke 2022	Effects of Virtual Reality-Based Training on the Quality of Life of Children with Cerebral Palsy	2022	Case study	10	VR-based training	Conventional training	Quality of Life	↑	VR-based training improved the quality of life of children with cerebral palsy.
Thomas 2020	Effects of Virtual Reality-Based Training on the Quality of Life of Children with Cerebral Palsy	2020	Case study	10	VR-based training	Conventional training	Quality of Life	↑	VR-based training improved the quality of life of children with cerebral palsy.



Figure 2. RoB and RoBANS for the included studies.

### Summary

- One RCT : Virtual reality with rehabilitation group **improved functional deficits.**
- 3 non-RCTs : Highly engaged with and consistently enjoyed. **Calming, consistent with inpatient intervention physiologic improvements.**
- 2 case studies : Encouraged to **participate the rehabilitation session** for greater durations, and directly address barriers to discharge.

## Discussions

We expected this study to find the improvement of pulmonary function, but there was no outcome for pulmonary function in this dataset. Training to improve pulmonary function in VR has been conducted in sports science and medical therapy. Research has also been conducted on breathing training using pulmonary function measured in VR as a variable, and the relationship between stress and movement-oriented and breathing-oriented yoga practice. One study found that implementing breathing as a game in a VR environment significantly impacted users' sense of presence, fun, challenge, and success when interacting with the controller and breathing. Previous two systematic reviews presented that VR and AR for highly variable purposes within clinical interventions and patients in ICU might benefit from VR during invasive interventions and ICU stay by alleviating stress or pain.

## RESULTS

### Study Selection

- Total screened literatures : **23,913**
- Final selected literatures : **6 studies** (1 RCT, 3 non-RCTs, 2 case studies)

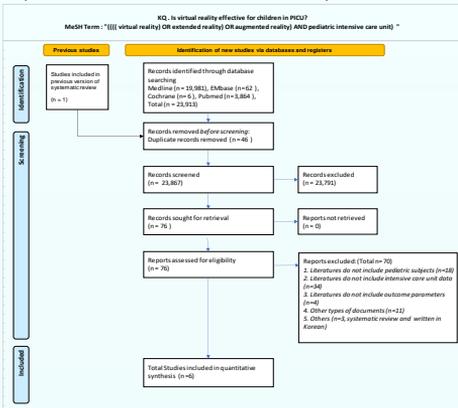


Figure 1. Preferred reporting items for systematic reviews and meta-analysis flow diagram. KQ; key question

## CONCLUSION

VR-based rehabilitation for pediatric patients in intensive care units offer a promising approach to addressing the challenges associated with functional improvement. Future research should focus on expanding the sample size and validating the long-term benefits of VR-based rehabilitation. This innovative approach could significantly enhance the quality of care and rehabilitation for pediatric patients in PICU.