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REVIEW

Non-pharmacological Methods to Prevent Delirium in Pediatric Intensive Care Units: A Systematic Review

Pediyatrik Yoğun Bakım Ünitelerinde Deliryumu Önlemek için Farmakolojik Olmayan Yöntemler: Sistematik Bir İnceleme

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Abstract

Delirium is a syndrome of acute-onset cerebral dysfunction characterized by impaired attention, awareness, and consciousness. Considering the adverse consequences for children, prevention and effective management of delirium are important. This systematic review aimed to determine the effectiveness of non-pharmacological methods for preventing delirium in pediatric intensive care units. This systematic review was designed and reported according to the PRISMA guidelines. Ten databases, including Cochrane, Cinahl, Clinical Key, EBSCO, PubMed, Science Direct, Wiley, Scopus, Web of Science, and Google Scholar, were searched using the keywords ("pediatric" or "child" or "children") and ("delirium" or "confusion" or "disorientation") and "intensive care unit" and "non-pharmacologic". The database search identified 2,390 studies. Five studies met the inclusion criteria and were included in the systematic review. The designs of the included studies were randomized controlled trials and quasi-experimental studies. The interventions evaluated to prevent delirium in children aged 0-21 included nursing bundle, massage therapy, reading books, and listening to music. The delirium levels of the children were assessed using the Cornell delirium assessment tool, the state-trait anxiety inventory for children, and the Sophia observation withdrawal symptoms-pediatric delirium scale. Nursing bundles and massage in pediatric intensive care units effectively prevent delirium.

Keywords: Child, delirium, intensive care unit, nursing, critical care

Öz

Deliryum, dikkat, farkındalık ve bilinç düzeyinde bozulma ile karakterize, akut başlangıçlı serebral işlev bozukluğu sendromudur. Çocuklar üzerindeki olumsuz sonuçları göz önünde bulundurulduğunda, deliryumun önlenmesi ve etkin yönetilmesi oldukça önemlidir. Bu sistematik derleme, pediyatri yoğun bakım ünitelerinde deliryumu önlemeye yönelik uygulanan non-farmakolojik yöntemlerin etkinliğini belirlemek amacıyla gerçekleştirilmiştir. Bu araştırma sistematik derleme niteliğindedir. Bu amaçla ("pediatric" or "child" or "children") and ("delirium" or "confusion" or "disorientation") and "intensive care unit" and "non-pharmacologic" anahtar kelimeleri kullanılarak Cochrane, Cinahl, Clinical Key, EBSCO, PubMed, Science Direct, Wiley, Scopus, Web of Science, Google Scholar olmak üzere 10 veri tabanı taranmıştır. Bu araştırmada veri tabanlarının taraması sonucunda toplam 2.390 yayına ulaşılmıştır. Araştırmaya dahil edilme kriterlerine uygun olan toplam 5 yayın araştırma kapsamına alınmış ve sonuçlar açısından değerlendirilmiştir. Dahil edilen çalışmaların tasarımları randomize kontrollü çalışmalar ve yarı deneysel çalışmalardı. Araştırma kapsamında deliryumu önlemek için 0-21 yaş arasında olan çocuklara bakım paketi, masaj uygulaması, kitap okuma ve müzik dinletme müdahaleleri yapılmıştır. Çocukların deliryum düzeyleri "Cornell deliryum değerlendirme arac", "çocuklar için durumluk sürekli kaygı envanteri" ve "Sophia yoksunluk ve pediatrik deliryum ölçeği" ile değerlendirilmiştir. Yoğun bakım ünitelerinde çocuklara uygulanan bakım paketinin ve masajın deliryumu önlemede etkili olduğu sonucuna ulaşılmıştır.

Anahtar Kelimeler: Çocuk, deliryum, yoğun bakım, hemşirelik, kritik bakım

Introduction

Delirium is a syndrome of acute-onset cerebral dysfunction characterized by impaired attention, awareness, and level of consciousness. It occurs as a result of a medical condition and often manifests as a severity that fluctuates throughout the day (1). The diagnostic and statistical manual of mental disorders defines delirium as "a disturbance in attention or consciousness that a pre-existing neurocognitive disorder cannot explain occurs for a medical reason, and shows acute and severe fluctuations with an additional disturbance

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in cognitive disorders such as memory, orientation, language, visuospatial competence or perception" (2). The pathophysiology of delirium is complex and not fully explained. However, it may develop due to changes in neurotransmitter function, decreased cerebral blood flow, increased energy metabolism, or cellular homeostasis disturbances (3,4).

The prevalence of delirium among hospitalized children varies between 10% and 60%. In critically ill children in the pediatric intensive care unit, this rate increases to 80% (4-7). Risk factors for delirium in childhood include age younger than 2 years, developmental delay, presence of comorbidities, respiratory failure, systemic inflammation, major surgery, hospital stay longer than 48 hours, benzodiazepine use, inability to control pain, physical fixation, sleep interruption, and immobility (8). Delirium in children leads to prolonged hospital stay, increased cost of care, and increased mortality and morbidity (9,10). In addition, post-traumatic stress disorder has been reported in one-third of children who develop delirium in intensive care units (11,12).

Considering the negative consequences of delirium, prevention and effective management are important. Preventing delirium in children is possible with a holistic and multidisciplinary approach focusing on eliminating the medical conditions that cause it. However, eliminating the causative medical conditions is not always possible or takes time. Therefore, non-pharmacological methods that minimize the risk of developing delirium are recommended to prevent delirium (13). These methods include supportive approaches, such as early mobilization, family-centered care practices, regulation of environmental factors, such as sound and light, and implementation of bundles (8). Studies have reported that these methods reduce delirium by supporting a healthy sleep-wake cycle and maintaining children's routines (14-16).

Nurses play a crucial role in managing pediatric delirium, particularly in intensive care units, where they are responsible for early detection, prevention, and therapeutic intervention. They continuously monitored children for subtle changes in behavior, cognition, and awareness using validated tools for the early detection of delirium. Preventive care includes strategies to maintain a regular sleep-wake cycle, reduce environmental stimuli, manage pain effectively, and involve family members in care. When delirium occurs, nurses administer and monitor medications and tailor non-pharmacological interventions to the child's needs. They communicate and educate families about their condition, work with a multidisciplinary team, advocate for the child's well-being, and provide emotional support to the child and the family. In addition, nurses provide ongoing monitoring and follow-up care to address any recurrent symptoms or long-term effects and contribute to the child's overall well-being during and after the delirium episode (1,3,4,13,17). Therefore, this systematic review aimed to determine the effectiveness of non-pharmacological methods for preventing delirium in pediatric intensive care units.

Material and Method

Study Questions

Study questions were determined according to the PICOS [P: (Participants) I: (Interventions) C: (Comparators) O: (Outcomes) S: (Study designs)] criteria.

P: Children being treated in the pediatric intensive care unit

I: Non-pharmacological interventions to prevent delirium

C: Comparison of the effects of interventions to prevent delirium

O: Decreased incidence of delirium

S: Randomized controlled trials and quasi-experimental designs.

Study questions;

- What non-pharmacological interventions can prevent delirium?

- Which non-pharmacological interventions are effective in preventing delirium?

Study Design

A retrospective literature review was conducted to identify non-pharmacological methods for preventing delirium in children treated in intensive care. The systematic review used the preferred reporting items for systematic reviews (PRISMA) standards. The literature search was conducted between April 1, 2023 and May 1, 2023 using the keywords ("pediatric" or "child" or "children") and ("delirium" or "confusion" or "disorientation") and "intensive care unit" and "non-pharmacologic".

Databases Used in the Study

The Cochrane, Cinahl, Clinical Key, EBSCO, PubMed, Science Direct, Wiley, Scopus, Web of Science, and Google Scholar databases were used.

Inclusion Criteria

The inclusion criteria for this study were non-pharmacological interventions to prevent delirium, a randomized controlled or quasi-experimental design, patients aged 25 years in intensive care units, published in English, and available full text.

Exclusion Criteria

The exclusion criteria of this study were not including non-pharmacological interventions, samples not consisting of children [aged 25 years and over (18)], no randomized controlled or quasi-experimental design, non-English language, and no available full text.

Study Selection

As a result of the search, a total of 2390 articles were reached. In total, 2000 articles were excluded because the title and abstract did not cover the keywords searched, and 20 articles were excluded because the publication language was not English. The number of articles decreased to 370. After excluding the same 85 articles repeated in different databases, the remaining 285 articles were evaluated according to title, abstract, and access to full text. We excluded 247 articles that did not include non-pharmacological intervention, 18 articles due to the use of different research designs [descriptive (n=65), cross-sectional (n=34), retrospective (n=19), methodological (n=16), and review (n=113)], and 15 articles due to inaccessibility of the full text. When evaluated by the inclusion and exclusion criteria, five articles suitable for the study were included and analyzed (Figure 1).

Results

The systematic review was conducted per the PRISMA standard, and 2,390 articles on the subject were identified based on the literature review. Data from five published articles were included in the review when limited according to the inclusion criteria (Table 1). All the studies were written in English. Three of the articles were quasi-experimental

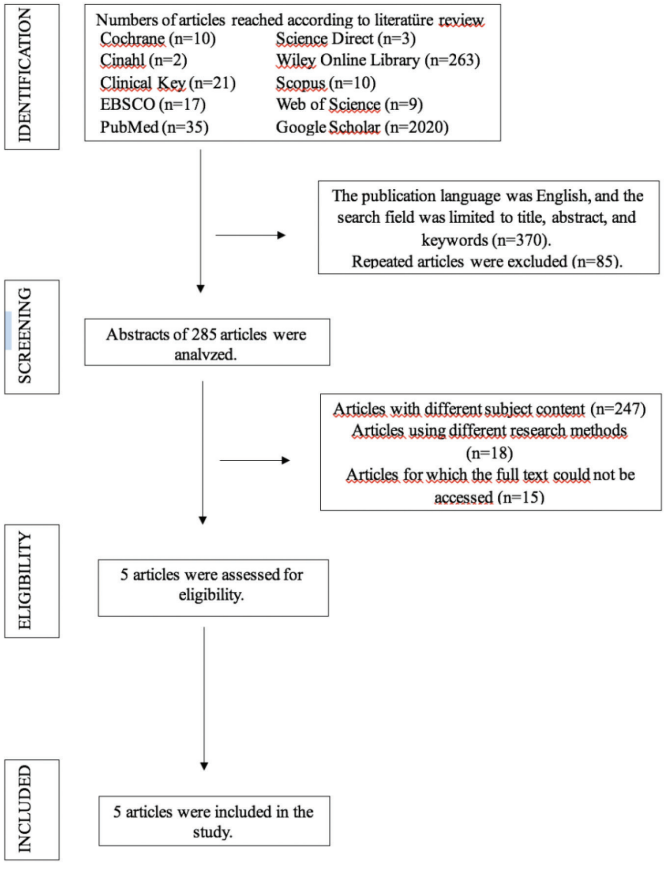


Figure 1.
PRISMA Literature Review Process Flow Diagram
PRISMA=preferred reporting items for systematic reviews

(15,19,20), and two were randomized controlled experimental (21,22) designs. Research was conducted in the United States (15,19,21), Canada (22), and the Netherlands (20).

Characteristics of the Sample Group

The study sample consisted of children being treated in intensive care units. In one study, children aged 18-21 in late adolescence were also included (15). In three studies, only children treated in the pediatric intensive care unit were included in the study (15,19,20), whereas in two studies, children treated in the pediatric cardiac surgery intensive care unit were also included (21,22). The sample size in each study evaluated within the scope of the study varies between 60 and 792. The total sample size obtained due to the systematic review was 1306.

Characteristics of the Analyzed Studies

Sixty percent (n=3) of the studies included in the systematic review were conducted in pediatric intensive care units, 20% (n=1) in cardiac surgery intensive care units, and 20% (n=1) across both pediatric and cardiac surgery intensive care units. Regarding study design, 40% (n=2) were randomized controlled trials that evaluated the effects of interventions such as massage, reading, music and headphone use on delirium and anxiety levels. The remaining 60% (n=3) were quasi-experimental studies that assessed the impact of nursing bundles on delirium. The continuous ambulatory peritoneal dialysis (CAPD) (60%, n=3) (23), state-trait anxiety inventory for children-state form (STAIC) (20%, n=1) (24), and Sophia observation withdrawal symptoms-pediatric delirium (SOS-PD) (20%, n=1) (25) groups were used to evaluate the effectiveness of the interventions. The measurement tools considered the parameters of the sample group that would affect delirium (15,19-22). CAPD was applied to children aged 0-21. The scale comprises eight items, each scored between 0 and 4. The Cronbach α value of the scale was 0.90. A score of 9 indicates a positive delirium assessment is positive (23). STAIC is applied to children aged 9-12. The scale, consisting of 20 items, measures the psychological effects of anxiety in children. This study aims to evaluate feelings related to state anxiety, such as tension, uneasiness, agitation, and nervousness. Cronbach α value is 0.81. The scale scores 20-60 points, with higher scores indicating greater anxiety (24). SOS-PD is applied to children aged 0-18. The scale comprises 17 items evaluated as "Yes" or "No". A score of 4 or higher on the delirium scale indicates positive delirium assessment is positive (25).

Most studies (15,19,20) used "nursing bundles" as a non-pharmacological intervention. After intensive care nurses were trained on nursing bundles, implementation was started. These bundles include ensuring day and night awareness, cognitive stimulation, presence of familiar person-object, ensuring orientation, supporting the use of devices such as glasses-headphones, creating rest periods during the day, reviewing the necessity of catheters, and keeping the noise level under control (15,19,20). In the studies by Simone et al. (15) and Michel et al. (20), early

Table 1.
Characteristics and Results of Studies Included in the Systematic Review

Author, year, country	Design	Purpose	Age group, sample	Method	Data collection tool	Result
Franken et al. (19) United States	A quasi-experimental design with a pre-test post-test control group in non-randomized groups	To evaluate the effect of an evidence-based non-pharmacological nursing bundle on delirium	Children aged 2-18 who were treated in the pediatric intensive care unit for >48 hours (n=266)	**Bundle implementation:** - Familiar person-object presence - Ensuring patient orientation - Ensuring day and night awareness - Protecting sound and light with the use of masks, headphones - Support the use of assistive devices (glasses, etc.) - Establishment of rest periods - The necessity of invasive catheters - Postponement of treatment and care at night	CAPD	The nursing bundle implementation did not affect the delirium score.
Michel et al. (20)	One-group pre-test post-test quasi-experimental design	To evaluate the effect of a nursing bundle consisting of non-pharmacological methods	Children aged 0-18 who were treated in the pediatric intensive care unit for >48 hours (n=792)	**Bundle implementation:** Part I (Care of sedated children) - Protecting sound and light with the use of masks, headphones Part II (Care of awake or intubated children) - Ensuring day and night awareness - Early mobilization - Cognitive stimulation - The presence of acquaintances - Ensuring patient orientation	SOS-PD	The delirium scores of patients who received the nursing bundle were low.
Simone et al. (15) United States	One-group pre-test post-test quasi-experimental design	To evaluate the effect of a nursing bundle consisting of non-pharmacological methods	Children aged 0-21 receiving mechanical ventilation support in the pediatric intensive care unit (n=144)	**Bundle implementation:** - Application of standard sedation protocol - Early mobilization	CAPD	The delirium scores of patients who received the nursing bundle were low.

Table 1. Continued

Author, year, country	Design	Purpose	Age group, sample	Method	Data collection tool	Result
Staveski et al. (21) United States	Randomized controlled experimental design	To evaluate the effect of massage and reading sessions within the first 24 hours after cardiac surgery on postoperative pain and anxiety levels and opioid and benzodiazepine exposure.	Children aged 6-18 who have undergone cardiac surgery in the intensive care unit (n=60)	**Massage practice:** - The procedure was implemented within 24 hours after the operation and continued as long as the patient remained in the hospital. - It was applied two or three times a week for a minimum of 15 minutes and a maximum of 30 minutes. - The massage protocol was developed in line with the requests and reactions specific to each patient. - Practitioners received "Massage Practitioner Certificate". - The practitioners selected a range of massage techniques to suit the patient's condition, preferences, and responses. - These techniques included classical massage, craniosacral therapy, myofascial release, energy-based modalities (e.g., Reiki and/or healing touch), acupressure, shiatsu, and neuromuscular therapy. - Massage was applied to the body's soft tissues with rhythmic hand movements. - The most frequently massaged areas included the extremities (legs and feet), head, face, neck, shoulders, and back. - The application was performed on the patient's bed in the supine position. Reading book: - The procedure was implemented within 24 hours after the operation and continued as long as the patient remained in the hospital. - The patients read the books for 30 minutes twice a week. - "The Lorax", "Horton Hears a Who!" and "Oh, the Places You will Go!" were selected as reading books.	STAIC	The anxiety scores and benzodiazepine exposure of children who received massage were significantly decreased. Therefore, we predicted that it would contribute to reducing delirium scores.

Table 1. Continued

Author, year, country	Design	Purpose	Age group, sample	Method	Data collection tool	Result
Garcia Guerra et al. (22) Canada	Randomized controlled experimental design	To evaluate the effect of music therapy on delirium in intensive care units	Children aged between 1 month and 16 years receiving mechanical ventilation support in the intensive care unit for >24 hours and hospitalized for 48 hours (n=60)	**Music practice:** - Classical music with 60 beats and a short tempo in the 45-55 dB sound range was played for 30 minutes thrice daily. - The music therapist selected the appropriate music. - The music selection process was meticulous, avoiding any disturbing chords or melodies that could evoke negative emotions. - The application was performed three times: once between 7:00 and 12:00, once between 12:00 and 16:00, and once between 16:00 and 20:00. Noise canceling headphones implementation: - This study aimed to reduce ambient noise by using noise-canceling headphones for 30 minutes three times a day. - A silent recording was played for half an hour using headphones. - The application was performed three times: once between 7:00 and 12:00, once between 12:00 and 16:00, and once between 16:00 and 20:00.	CAPD	The music and use of noise-canceling headphones did not affect the delirium scores.

CAPD=continuous ambulatory peritoneal dialysis, SOS-PD=Sophia observation withdrawal symptoms-pediatric delirium, STAIC=state-trait anxiety inventory for children-state form

mobilization with a standard sedation protocol was included in the nursing bundles.

Staveski et al. (21) used massage as a non-pharmacological intervention to determine its effect on delirium. Massage therapy was started within 24 hours after cardiac surgery and continued during the children's hospital stay. Massage was applied twice a week for a maximum of 30 minutes. The massage therapist selected a suitable massage technique for the patient. These techniques included classical massage, craniosacral therapy, myofascial release, energy-based modalities (e.g., Reiki and/or healing touch), acupressure, shiatsu, and neuromuscular therapy. Massage was applied to the body's soft tissues with rhythmic hand movements. The most frequently massaged areas included the extremities (legs and feet), head, face, neck, shoulders, and back. Masage was performed in the patient's bed in the supine position. Another non-pharmacological intervention used in the same study was book reading. Similar to the massage intervention, book reading sessions started within 24 hours after cardiac surgery and continued throughout the children's hospital stay. As a result of a literature review and collaboration with health professionals, "The Lorax", "Horton Hears a Who!" and "Oh, the Places You'll Go!" were selected as reading books. Patients read the book they preferred among the three books by themselves. The books were read twice a week for 30 minutes (21).

Garcia Guerra et al. (22) aimed to determine the effects of music listening and noise-canceling headphones on delirium in intensive care units. Short classical music pieces with a tempo of approximately 60 beats per minute, avoiding dramatic moments, disturbing chords, and discordant keys that may be associated with sadness, were played at a controlled volume of 45-55 dB, ensuring the safety of the patients' hearing. The music was selected by the music therapist. The group wearing noise-canceling headphones listened to a silent recording without any noise. The playlists of both groups began with a minute of silence to ensure blinding. The interventions were performed three times a day: In the morning, midday, and evening (22).

Discussion

Delirium, which is frequently observed in pediatric intensive care units, is a vital syndrome leading to prolonged hospital stay, increased cost of care, unplanned extubation,

and increased morbidity and mortality (6). To prevent the negative consequences of delirium, it is recommended to ensure a healthy sleep-wake cycle, regulate environmental factors, provide family-centered care, and use anxiety-reducing techniques such as music and massage (4). This systematic review examined non-pharmacological interventions to prevent pediatric delirium, aiming to guide healthcare professionals and transfer their knowledge to clinical practice. According to the results obtained from the five studies examined within the scope of the research, nursing bundles, listening to music, wearing headphones, reading books, and massage applications were used to prevent pediatric delirium in intensive care units. Despite the differences in the results of the studies, the potential of these non-pharmacological interventions, particularly when validated by future randomized controlled trials, is a source of inspiration for the future of pediatric care.

Effect of Nursing Bundles on Delirium

Multi-component delirium interventions, such as nursing bundles, are effective for adult and pediatric patients in various clinical areas because they directly target the elimination of delirium risk factors (26-28). The findings of this systematic review similarly show that nursing bundles are generally associated with reduced delirium scores. The outcomes of the nursing bundles differed despite the similarity of the sample group and inclusion criteria. Franken et al. (19), Michel et al. (20), and Simone et al. (15) applied a nursing bundle to determine its effect on delirium in pediatric intensive care units. Michel et al. (20) and Simone et al. (15) found that the delirium scores of children who received nursing bundles were lower, whereas Franken et al. (19) found that the nursing bundle did not affect delirium. In all three studies, nursing bundles were implemented after providing nursing training (15,19,20). However, in the studies of Michel et al. (20) and Simone et al. (15), delirium assessment tools were integrated into the nurse observation form, and the screening rate performed by nurses was reported to be >95%. Franken et al.'s (19) study reported that nurses forget to perform delirium screening. Therefore, the nursing bundle was considered ineffective because delirium monitoring was not sustainable (19). Intensive care nurses are ideal health professionals for assessing, preventing, and effectively managing delirium because they are constantly in contact with patients. Therefore, it is of great importance for clinicians to have knowledge and awareness about the importance of delirium screening and early intervention to reduce the negative consequences of delirium in children (29). Future studies should consider the practical training of nurses for the nursing bundles to treat pediatric delirium.

Michel et al. (20) and Simone et al. (15), the nursing bundle was implemented with a multidisciplinary approach. A standard protocol was established for sedated children, and early mobilization was included in the nursing bundle (15,20). These parameters were not included in the nursing bundle used by Franken et al. (19). Early mobilization in intensive care units reduces the duration of hospital stay and the need for mechanical ventilation, improves the sleep-wake cycle, and reduces the incidence of delirium (30). Similarly, the findings of these studies showed that nursing bundles, including early mobilization, were more effective. The duration of hospitalization and mechanical ventilation support was shortened, and delirium scores decreased (15,20). In the standard sedation protocol, morphine, fentanyl, and clonidine were used by limiting benzodiazepine exposure, which is the primary risk factor for pediatric delirium (6,7,31). Mody et al. (32) examined the relationship between benzodiazepine use and pediatric delirium and found that delirium was four times more common in children exposed to benzodiazepine, and daily increase in benzodiazepine dose increased the risk of delirium by 43%. The decrease in benzodiazepine exposure as a result of the application of the standard sedation protocol increased the effect of the nursing bundle by decreasing delirium scores.

Di Nardo et al. (33) evaluated the feasibility and safety of a nursing bundle in a pediatric intensive care unit and reported that children's need for sedation and analgesics decreased. The incidence of delirium after the application was found to be 23%, but no comparison could be made because delirium was not evaluated beforehand (33). Parallel to the results obtained from the studies reviewed in this systematic review (15,20), the nursing bundle, including a limited sedation protocol and early mobilization, was emphasized as feasible and safe (33).

Effects of Massage, Music, Headphones, and Reading on Delirium

In the study comparing massage and book reading methods, anxiety scores and benzodiazepine exposures of children who received massage decreased significantly. However, this was not observed in children who read boks (21). Therefore, we predicted that the application of a massage method would contribute to reducing children's delirium scores. Staveski et al. (13) reported that classical massage is the most commonly used technique. This massage was performed by certified practitioners two or three times a week for at least 15 and at most 30 minutes. Classical massage consists of effleurage, kneading, friction, tatman, and vibration techniques and is known for having the fewest side effects and high reliability (34). Similarly, Staveski et al. (21) found that classical massage had the best physiological stress responses and the lowest anxiety scores. In a study examining the effect of classical massage on delirium in patients who were followed up in the intensive care unit, the effect of massage on delirium could not be proven (35). Studies with a high level of evidence from a large sample group are needed to determine the effect of massage on delirium in pediatric populations and to establish best practices standards. Staveski et al. (21) found that the benzodiazepine exposure and anxiety scores of children who read books did not decrease. In another study, it was determined that reading animated books decreased children's anxiety scores (36). In both studies, the reading time was limited to 30 minutes and was continued until discharge from the hospital. However, in the study by Sekhavatpour et al. (36), the follow-up period

was short, and patients were followed up for an average of 2 days.

In a study comparing the methods of playing music and using noise canceling headphones were compared, it was determined that both methods had no effect on the delirium score (22). Classical music with a tempo of approximately 60 beats per minute, selected by the music therapist, was played three times a day at a range of 45-55 dB. Noise-canceling headphones were used, and a fake playlist containing silent recordings was created and played three times a day. Studies have shown that playing music and using headphones can prevent delirium by improving sleep quality among adult patients (37,38). However, it was emphasized that there was limited evidence to support the use of music or headphones in these studies and that randomized controlled trials are needed to determine whether music and headphones are effective in pediatric patients and, if effective, to determine good practice standards (22,37).

Study Limitations

The limitations of this study include the scarcity of RCTs on the topic and the absence of the research protocol in some RCTs included in the study.

Conclusion

As a result of the studies reviewed, the delirium scores of pediatric patients to whom nursing bundles, including early mobilization and standard sedation protocols, were low, and nurses should receive training before applying the nursing bundle. At the same time, while the application of massage had a positive effect on delirium, reading books, listening to music, and using noise-canceling headphones had no significant effect on delirium. Increasing the number of randomized controlled studies on pediatric delirium will help determine the best-practice standards of the methods used.

Footnotes

Author Contributions: Concept - İ.E.K., D.G.; Design - İ.E.K., D.G.; Analysis and/or Interpretation - İ.E.K., D.G.; Literature Review - İ.E.K.; Writing - İ.E.K., D.G.

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