Effect of Virtual Reality Technology on Sleeping Pattern and Its Effect on Physiological Parameters among Critical Ill Children

Asmaa Awad Helmy[(1)], Hanan Elsayed Metwally Mansour[(2)], Eman Abd-Elaziz Mohamed[(3)], Manal Mohamed Ahmed Ayed [(4)]

(1) Pediatric Nursing Department, Faculty of Nursing, Helwan University, Egypt
(2) Pediatric Nursing Department, Faculty of Nursing, Benha University, Egypt
(3) Pediatric Nursing Department, Faculty of Nursing, South Valley University, Egypt
(4) Pediatric Nursing Department, Faculty of Nursing, Sohag University, Egypt

Abstract

Background: Critical ill children in critical care units (CCUs) require adequate sleep to sustain their mental and physical health. **The aim:** of the study was to evaluate the effect of virtual reality technology on sleeping patterns and its effect on physiological parameters among critically ill children in CCUs. **Subject and Methods: Design:** To achieve the study's aim a quasi-experimental research design was utilized. **Setting:** The study was conducted in the Pediatric Critical Care Units affiliated at Sohag University Hospital**. Sample**: A purposive sample of 100 critically ill children was included, randomly assigned equally into a study and control group (Study group involved 50 critically ill children, they used virtual reality technology and 50 critically ill children in the control group not using virtual reality technology. **Three tools were used to collect data**: (I) Demographic characteristics of critically ill children (II) ST Mary's Hospital Sleep questionnaires and (III) physiological parameters assessment tool (Temperature, Pulse, Respiration, and Blood Pressure). **Results:** The study result showed that the majority of critically ill children have significant sleep disturbance pre using virtual reality technology, but post virtual reality technology intervention the majority of critically ill children did not have sleep disturbance compared to one fifth in the control group had only mild sleep disturbance, which associated positively with improving physiological parameters. In critically ill children in CCUs, poor sleep quality causes significant alterations in Temperature, Pulse, Respiration, and Blood Pressure. **Conclusion**: The study concluded that virtual reality technology had positive effects that improved sleeping pattern and physiological parameters among critically ill children in the study group than those in the control group. **Recommendations**: The present study recommended that virtual reality distraction technology should be integrated as a part of the routine care of critically ill children in CCUs.

Keywords: Critically ill children, physiological parameters, sleep pattern, virtual reality technology.

Introduction:

In the fast eye movement stage, critically ill children, particularly youngsters, frequently complain of sleep difficulties in the form of sleep fragmentation and shallow sleep (**Pisani et al, 2015; Devlin et al, 2018; Khalil et al, 2019**). Invasive evaluation approaches have resulted in several factors associated with sleep disturbances for young children, including non-circadian light, noise from the health care team, monitoring machines, and discomfort (**Aitken et al., 2017; Telias and Wilcox, 2019; Honarmand et al, 2020; Miranda-Ackerman et al, 2020**). Furthermore, several symptoms have been linked to cardiovascular, pulmonary, endocrine, renal, and neurological illnesses that interfere with the beginning and maintenance of sleep quality (**Gay, 2010; Pisani et al., 2015; Drouot and Quentin, 2016; Rittayamai et al., 2016; Kimia et al, 2020).**

Sleep disturbance can cause a variety of physiological and psychological problems, including cardiovascular, respiratory, and immunological disorders, post-traumatic stress disorder, anxiety, and lower quality of life, all of which can lead to an increase in mortality. The numerous systems that respond to sleep disruption show that the impacts of sleep disruption extend beyond the central nervous system to include complete body functioning **(Finan et al., 2015; Medrzycka-Dabrowska et al, 2018; Chaudhary et al, 2020).**

Because of the sympathetic nervous system's activation and the release of adrenaline and noradrenaline, sleep disruption has a deleterious impact on cardiovascular functions. Blood pressure, pulse, myocardial

oxygen demand, and cardiac dysrhythmia all rise when adrenaline and noradrenaline are released. These factors can aggravate myocardial ischemia and increase the risk of repeated heart attacks. For several nights, sleep deprivation boosts the release of inflammatory cytokines linked to atherosclerosis, hypertension, and acute coronary artery syndrome (**Honarmand et al, 2020**). The respiratory system is influenced by sleep disturbances. Sleep disturbance has an impact on respiratory system function, increasing oxygen use and carbon dioxide production, hypoventilation, lowering forced vital capacity, and maximal inspiratory pressure (**Medic et al, 2017).**

Critically ill children in the pediatric CCUs are exposed to multiple physical, environmental, and pharmacologic factors which increase the propensity for sleep disruption. Nurse's observation and polysomnography are two methods used to assess sleep in the CCUs. Polysomnography is invasive and technically challenging, and traditional scoring makes interpretation difficult (**Drouot et al., 2012; Watson et al., 2013; Menear et al., 2017**).

As a result, subjective nurse's sleep evaluation is considered a viable alternative for determining sleep quality. For children who are competent of self-reporting, structured interviews, questionnaires, or rating scales may be utilized to examine child-reported sleep quality or amount **(Storti et al., 2015; Ritmala- Castren et al., 2016).**

The St Mary's Hospital Sleep Questionnaire (SMHSQ) is a dependable systematic sleep questionnaire that was created for analyzing a child's previous night's sleep quality and is designed to be used multiple times (**Ellis et al., 1981& Leigh et al., 1988)**. Understanding of sleep cycles, diverse causes of sleep disturbance, and objective or subjective techniques of sleep evaluation are all crucial factors for critical care nurses to consider when promoting sleep for critically ill children (**Aitken et al., 2017; Herscher et al, 2021).**

Both pharmaceutical and non-pharmacological therapies are used to treat sleep disturbances in children. Distraction is one method of non-pharmacological pain management for children. Distraction is a technique in which children's attention is diverted from medical operations or sleep disruption to a more neutral stimulus (**Scapin et al., 2018)**.

There are two types of distraction: active and passive. The active distraction encourages a child's participation by including him or her in an activity such as video games that stimulates the audio-visual and tactile senses during the treatment. Another cognitive-behavioral strategy for assisting critically ill children in achieving a state of calm is guided imagery. The critically ill child is passively distracted when he or she observes stimuli rather than actively participating in an activity such as audio-visual stimulation (listening to music & watching television or videos). The most common technique to reduce distress and suffering in children undergoing medical procedures is to use distracting activities such as bubbles, music, and video goggles. One of the most common technology-based distractions for children aged is a computer tablet that includes movies, music, interactive games, books, and puzzles (**Arane**, **et al., 2017).**

Virtual Reality is one of the most important developing technologies that help children, especially those who are enduring painful procedures, to divert their attention. It's a device that uses technology to divert a child's attention away from video animation and away from cognitive and sensory stimuli. However, it restricts their cognitive thinking in the direction of sleep. Furthermore, just wearing a head-mounted display, allows children to experiment with real experiences that help them overcome their phobias and be calm **(Kothgassner et al., 2019).**

Virtual reality is a supplemental method that has shown to be effective in diverting the attention of children, particularly critically ill children. The children wear a head-mounted helmet that allows them to see and hear a genuine environment. It offers a high degree of seclusion from external stimuli as well as the ability to interact with virtual reality videos. There were no negative effects reported as a result of using it **(Sharar et al., 2016).**

Poor sleep quality causes various physical, cognitive, and psychological complications. The nursing role for hospitalized children should be directed to manage children's needs, but sleeping quality did not have a standardized guideline to help nurses during their child's care **(Bevan et al., 2016).**

Nurses should focus on sleep quality and quantity, cardiac monitoring, and maintaining appropriate oxygenation. And being a key component contributing to good health and wellness, sleep quality which frequently underreported by members of the health care team (**Astin et al, 2020)**.

Significance of the study:

Sleep deprivation has been shown to have a negative impact on all physiological systems, including improper emotional processing, impaired immunological function, delayed wound healing, and an increased risk of hypertension, heart attack, hypoxia, hypercapnia, and stroke **(Wu and Sun, 2017).**

Therefore, concentration distraction by using virtual reality technology reduces the child's perception which is associated with sleep pattern. Therefore, using virtual reality technology intervention for critically ill children is necessary to improve both sleep pattern and physiological parameters. On the other hand, there is limited evidence on the effect of sleep disturbance and physiological parameters among critically ill children in CCUs. So, this study aimed to evaluate the effect of virtual reality technology on sleep pattern and its effect on physiological parameters among critically ill children.

Operational definition:

Sleep disturbance: This is defined as insufficient duration and poor quality of sleep which was measured in this study by the St Mary's Hospital Sleep Questionnaire (SMHSQ).

Physiological parameters: Physiological parameters, such as Temperature, Pulse, Respiration, and Blood Pressure.

Virtual reality technology: It is an instrument, which consists of a mobile phone that generates a 3D real-time animation and a head-mounted device **(Chan, 2017**). In this study, it means using this artificial construction of a 3D environment via mobile technology. It includes a head-mounted device (HMD) with 3D-enabled goggles, as well as sensory input devices and headphones, all of which work together to create a multisensory experience that can be used to divert a child's attention.

Aim of the study

This study aimed to evaluate the effect of virtual reality technology on sleeping pattern and its effect on physiological parameters among critically ill children through:

- Assessing sleep patterns among critically ill children.
- Assessing physiological parameters among critically ill children.
- Determine the effect of virtual reality technology on sleeping pattern and its effect on physiological parameters among critically ill children.

Research hypothesis:

Critically ill children who use virtual reality technology exhibit better sleep pattern which affect their physiological parameters positively after the intervention than children in the control group.

Subject and Methods:

Research design:

To achieve the study's aim a quasi-experimental research design was utilized (study and control group).

Setting:

The study was conducted in the Pediatric Critical Care Units affiliated at Sohag University Hospital. This setting is present on the third floor of the pediatric department at Sohag University Hospital. It consisted of two rooms, the first room included 5 beds and the second room included 6 beds. The previous setting was selected because it is considered one of the largest public teaching hospitals in Egypt, with a high prevalence of children from various socio-economic and educational levels coming from all over regions to receive health care.

Subject:

A purposive sample of 100 critically ill children was included; they were followed within five days from admission. Randomly

assigned equally into a study and control group (Study group involved 50 critically ill children, they used virtual reality technology and 50 critically ill children in the control group did not use this virtual reality technology).

Sample calculation:

The sample size was calculated through Raosoft (2004), with a 5% margin of error and 95% confidence level from a population size of 80. The calculated sample size was 97. However, data were collected from 100 subjects as they met inclusion and exclusion criteria.

Inclusion criteria included:

- All critically ill children whose age from 3 to 10 years.
- From both gender.
- Agree to participate in the study.

Exclusion criteria included:

- Cognitive impairment.
- Visual impairment.

Tools of data collection:

Three tools were used to collect data:

Tool I: A Demographic characteristics of critically ill children**:** It was developed by the researchers after reviewing related literature: It includes demographic characteristics related to age, gender, residence, previous admission to CCUs, history of other diseases, and history of analgesic consumption.

Tool II: The St Mary's Hospital Sleep Questionnaire (SMHSQ): It was adapted by the researchers. The St Mary's Hospital Sleep Questionnaire included fourteen items (both Likert type and open-ended type questions) for evaluating an individual's previous night's sleep quantity and quality **(Ellis et al., 1981; Leigh et al., 1988).**

Scoring system:

This questionnaire does not have a defined scoring system. The SMHSQ questionnaire was assessed in this study based on expert judgment. This questionnaire was separated into two portions; the first featured questions (1,2,3,4,7,8, and 14) that depicted sleep quantity, while the second featured questions (5,6,9,10,11,12, and 13) that depicted sleep quality. Section two of this questionnaire yielded scores ranging from 6 to 38. A severe sleep disturbance was defined as a score of 6 to 16; a moderate sleep disturbance was defined as a score of 17 to 27 and a little sleep disturbance was defined as a score of 28 to 38.

Tool III: Physiological parameters' assessment tool:

This tool was developed by the researchers after reviewing the related literature **(Aitken et al, 2017; Medic et al, 2017**) to collect data related to assessing physiological parameters of the studied children. This tool was used to assess physiological parameters included Temperature, Pulse, Respiration, and Blood Pressure.

Data collection procedure:

Fieldwork:

- Official permission was obtained from the administrators of the previously mentioned setting and the researchers were meeting the administrators to obtain permission for conducting the research and explained the aim and expected outcome of the study.
- The actual fieldwork started in September 2021 and ended in November 2021.
- The researchers assessed each child from the first day of admission and recorded children's demographic data before any data collection.

Tool development:

The researchers develop these study tools by using books, evidence-based articles, periodicals, and magazines of line reference to review local and international related literature related to the research topic.

Content validity:

To examine the tools content validity, tool II and tool III were given to five panels of experts in critical care medicine and pediatric nursing. Two professors from the critical care medicine department, one from pediatric nursing, and two from other nursing departments from Sohag University's Faculty of Nursing; examined the tools for relevance, thoroughness, clarity, and applicability, and no changes based on their findings. Tool II had a 0.87 % content validity, whereas tool III had an 89 % content validity score.

Tool reliability:

The internal consistency and stability of the evaluation tools were assessed using Cronbach's alpha coefficients (tool II and tool III, r = 0.834 and 0.831 respectively) to determine the reliability.

Administrative and ethical considerations:

Official permission from the responsibility of hospital authorities was obtained. Following an explanation of the study's aim, written consent was taken from all mothers of children before participating in the study, with confidentiality and anonymity guaranteed, they were promised that might withdraw from the study at any moment for any reason.

A pilot study:

A pilot study was done on 10% of the sample (10 critically ill children) of the overall sample to examine the clarity and feasibility of the research study. There were no changes made to the tools in its final version. Critically ill children who participated in the pilot were included in the study.

In the intervention group:

Intervention: it included three stages:

Stage one: Pre-intervention stage:

- The researchers introduced themselves to the parents and critically ill children and explained the aim of the study.
- Critically ill children assessment was done for both the study and control group at the beginning of the study.
- Demographic characteristics of studied children were obtained and recorded by the researchers (pretest).
- Critically ill children were assessed for their sleeping pattern using ST Mary's Hospital Sleep questionnaires (pretest).
- Critically ill children's physiological parameters were assessed and recorded by the researchers (pretest).

Stage two: Intervention Stage (Implementation):- it included:

1- Prepare the needed equipment:

- Virtual reality (VR) 3D glasses.
- VR selected video according to children's age.
- Mobile with VR support system.

2- Children in the intervention group received training on the VR equipment to be familiar with the VR sets.

Virtual reality headset

- Critically ill children fully immersed in the VR concentration distraction method.
- Critically ill children engaged in 20 minutes of immersive virtual reality environment before bedtime for five days of the intervention at night.

Critically ill children reassessed for:

- **The sleep quality and quantity**: were assessed by the researcher at CCUs every morning between 8 and 10 a.m., using ST Mary's Hospital Sleep questionnaires to assess children's sleep from the previous night. Data was collected for five days (the first day of admission to the CCUs, the first night of sleep in the CCUs, and four days in a row). The questionnaires took roughly 15-20 minutes to complete.
- **Physiological parameters**: The physiological parameters (Temperature, Pulse, Respiration, and Blood Pressure) for five days, data from bedside cardiac monitors were collected every two hours for each child.

Stage three: Post-intervention stage:

- Critically ill children reassessed by using ST Mary's Hospital Sleep questionnaires (posttest).
- Critically ill children were reassessed for their physiological parameters (posttest).

In the control group:

Critically ill children in the control group received only routine care in Pediatric Critical

Care Units and were assessed by the same previous tools.

Statistical analysis:

Data were statistically analyzed by SPSS version 22. Percentage, mean scores, standard deviation, and t-test were used for parametric data. Qualitative data were presented in the form of frequency distribution tables, numbers, and percentages. To evaluate significance, qualitative variables were compared using the chi-square ($\chi 2$) test. When P was less than 0.05, the critical value of the test's "P" was judged statistically significant. The effect of sleep disruptions on Temperature, Pulse, Respiration, and Blood Pressure was assessed using Pearson correlation.

Results:

As shown in **Table 1,** the distribution of children in virtual reality and control group according to their demographic characteristics. The table revealed that more than half of studied children their age ranged from 6 ≤ 10 years old in both groups and 56% of them were boys compared to 66% in the control group. Concerning residence, 74% of the studied children in the virtual reality group were living in an urban area compared to 70% in the control group. There was no statistically significant difference between the virtual group and control group in terms of age, gender, and residence (p > 0 .05).

Table (2) showed that (96%) of critically ill children had not previously been admitted to CCU in the virtual reality group compared to 98% in the control group, (92 % and 94%) of them didn't have a history of other diseases in virtual reality group and the control group respectively. In addition, it is observed from the same table that (66%) of critically ill children didn't have a history of analgesic consumption in the virtual reality group compared to 62% in the control group.

Table (3) illustrated that there is a gradual improvement in the mean duration of studied critically ill children's night sleep in the virtual reality group from the 1st to 5th night after admission (1.13±1.04 & 4.89 ±1.78) respectively compare to (1.12±1.03&2.30±1.53) in the control group. There was a statistically significant difference between the virtual reality and control group at the p=0.001** level of statistical significance.

Figure (1): Demonstrated that more than one-third of the studied critically ill children (37%) in the virtual reality group suffered from severe sleep disturbance on the first night of hospitalization and this percentage declined to (8%) on the fifth night of hospitalization. While the control group 47% of them suffered from severe sleep disturbance on the first night of hospitalization which decreased to 36% on the fifth nightof hospitalization.

Table 4 represented the means and standard deviation of physiological parameters in the virtual reality and control group. The findings revealed declines in means of pulse, respiration, and diastolic blood pressure in the virtual reality group. There were statistically significant differences between means of pulse, respiration, and diastolic blood pressure except for temperature and systolic blood pressure in the virtual reality and control group.

Table (5): Portrayed that the majority (87%) of the studied critically ill children who suffered from mild and moderate sleep disturbance did not have a history of admission to CCU with a highly statistically significant relationship at p<0.0001 level.

Table 6: Illustrates that there was a significant statistical correlation between total sleep quality and physiological parameters among critically ill children in the virtual reality group (P < 0.05).

Table (1): Distribution of the critically ill children according to their demographic characteristics in study and control group (n=100)

Demographic characteristics	Virtual reality Group (n=50)		Control Group (n=50)		X^2(P)
	No	%	No	%	
Age (Yrs.)					
• 3 ≤ 6	22	44.0	23	46.0	2.63
• 7 ≤10	28	56.0	27	54.0	0.113
Gender					
• Boy	28	56.0	33	66.0	3.94
• Girl	22	44.0	17	34.0	0.139
Residence:					
• Urban	37	74.0	35	70.0	2.84
• Rural	13	26.0	15	30.0	0.137

Table (2): Distribution of the critically ill children regarding their medical data in study and control group (n=100)

Medical data	Virtual reality Group (n=50)		Control Group (n=50)		X^2 (P)
	No	%	No	%	
Previous admission to CCU:					
• **Yes**	2	4.0	1	2.0	0.613
• **No**	48	96.0	49	98.0	(0.744)
History of other diseases:					
• **Yes**	4	8.0	3	6.0	0.513
• **No**	46	92.0	47	94.0	(0.643)
History of analgesic consumption**:**					
• **Yes**	17	34.0	19	38.0	0.713
• **No**	33	66.0	31	62.0	(0.932)

Table (3): Mean total score of the duration of sleep among critically ill children in study and control group (n=100)

Duration of night sleep	1st night	2nd night	3rd night	4th night	5th night
Virtual reality group	1.13±1.04	3.37±1.56	3.99±1.47	4.23±1.13	4.89 ±1.78
Control group	1.12±1.03	1.33±1.54	1.83±1.28	2.10±1.03	2.30±1.53
X^2(P- value)	**X^2= 16.78** **P- value**=0.001**				

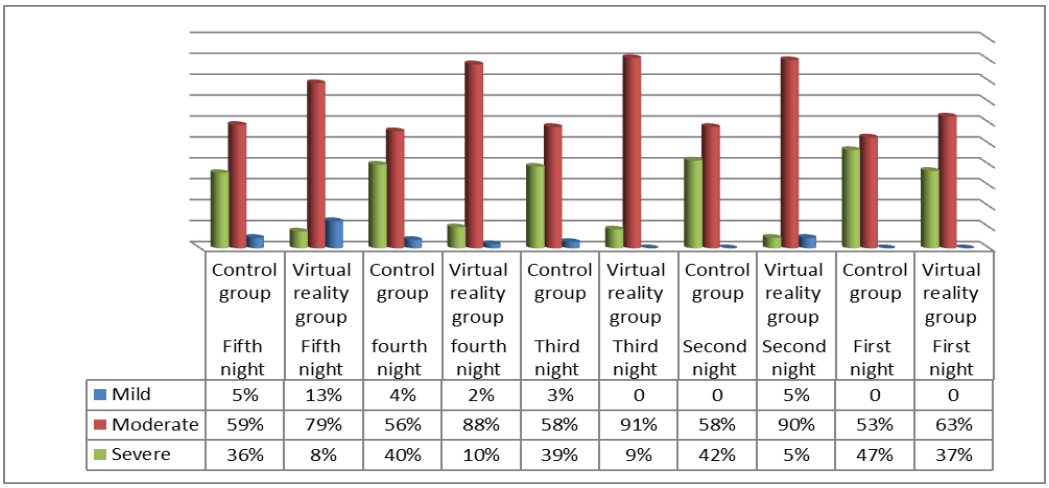

Figure 1: Percentage distribution of sleep quality score of the studied critically ill children in study and control group (n=100).

Table (4): Means and Standard deviation of physiological parameters in the virtual reality group and control group (n=50).

Physiological Parameters	Virtual reality Group	Control Group	t-test
	Mean ± SD	Mean ± SD	
• Temperature	37.1±0.06	37.4±0.14	0.51ns
• Pulse	93.8±9.58	101.09±2.66	8.7**
• Respiration	21.7±0.3	26.3±0.4	1.97*
• Systolic blood pressure	97.5±2.7	97.7±4.4	0.96ns
• Diastolic blood pressure	62.0±3.1	66.5±1.9	1.96*

Table (5): The relationship between the sleep quality scale and past critical care unit admissions among critically ill children in the virtual reality group (n=50).

Variable	Sleep quality				X^2	P-value
	Severe sleep disorder(no=4)		Mild and moderate sleep Disorder (no=46)			
	No	%	No	%		
History of the previous admission to the critical care unit						
▪ No	4	100.0	40	87.0	0.475	0.000
▪ Yes	0	0.0	6	13.0		

(**) statistically significant at p<0.0001**

Table (6): Correlation between sleep quality score and physiological parameters of the studied critically ill children in the virtual reality group (n=50).

Physiological Parameters	Sleep quality score	
	r	P-value
• Temperature	0.574	0.013*
• Pulse	0.427	0.001*
• Respiration	0.416	0.013*
• Systolic blood pressure	0.524	0.001*
• Diastolic blood pressure	0.423	0.001*

P-value <0.05 statistically significance

Discussion:

Sleep is defined as a physiological condition of reversible unconsciousness, and it accounts for roughly one-third of a person's life. More than 61 percent of hospitalized children reported poor sleep quality, according to several sources. The causes of poor sleep quality are numerous. Primary illness and its pathophysiology have a crucial part in proving poor sleep quality among hospitalized children, especially in CCUs. Constant close monitoring, diagnostic testing, and medical support such as mechanical ventilation or medicines were also high in the CCU environment **(Salandin et al., 2019).**

The main reasons for sleep disturbance in critically ill children are the loud environment, disease severity, and drugs. Sleep disruption has several negative consequences for physical and psychological systems **(Aitken et al., 2017).** So, distraction techniques are commonly used to obviate a child's attention from distress during treatment procedures **(Jones et al., 2016).**

The current study hypothesized that sleep quality among critically ill children improved post using virtual reality technology for distraction in the study group than those in the control group. Also, for children in the virtual reality group, their physiological parameters have been improved than children in the control group. So, these results of the current study supported the study hypotheses.

The present study findings revealed that more than half of critically ill children in the virtual reality group compared to

approximately in the control group were boys. These findings are supported by **Abd El Khalik et al., (2020)** who studied "The Effectiveness of Using Breathing Exercise on Sleep Quality among Hospitalized Children" and reported that the majority of the study groups were male.

Findings of the current study highlighted that, there was no statistically significant difference between the virtual reality group and control group regarding their demographic data ($p > 0.05$). This reflected the similarity of the characteristics in the virtual group and control group.

Findings of the present study highlighted that there is a gradual improvement in the mean duration of studied critically ill children's night sleep in the virtual reality group than control group from the 1^{st} to 5^{th} night after admission with a statistically significant difference between both groups. From the researchers' point of view, this is reflected the effectiveness of virtual reality technology intervention which reflected on improving sleep duration score of the studied critically ill children in the virtual reality group.

Concerning sleep quality score, the result demonstrated that more than one-third of the studied critically ill children in the virtual reality group were suffered from severe sleep disturbance on the first night of hospitalization and this percentage declined to eight percent on the fifth night of hospitalization. From the researchers' point of view, this indicated the improvement in sleep quality score of the critically ill children in the virtual reality group and the positive effect of virtual reality technology application.

These results are supported by **Miller et al, (2018)** that stated to use of multi-model distraction virtual reality as a distraction method in an outpatient burns clinic improves sleep quality. Similary, **Demeter, et al, (2015)** conducted a study about "Who can benefit from virtual reality to reduce experimental pain" and found that virtual reality can be used as an effective manipulation for improving sleep quality in children with efficient conditioned modulation.

Concerning physiological parameters in the virtual reality and control groups, the findings showed declines in means of pulse, respiration, and diastolic blood pressure in the virtual reality group post-intervention. This result is not in the same line with **Miller et al, (2018)** who studied the effect of using technology to combat pain in young injured children and reported that there is no difference regarding physiological measurement between different children with injuries and control group. This means that improvement in sleep quality due to virtual reality technology is associated with declines in means of pulse, respiration, and blood pressure to normal, but hasn't strong direct effect on injured tissue.

The present study findings revealed that the majority of the studied critically ill children suffer from mild and moderated sleep disturbance, which is correlated positively with physiological parameters (Temperature, Pulse, Respiration, and Blood Pressure). This can be explained by the fact that frequent sleep disturbance had a great effect on physiological parameters. These findings are backed up by **Sauvet et al., (2016),** who investigated the "Effect of Acute Sleep Deprivation on Vascular Function in Healthy Subjects" and found that sleep disruption stimulates sympathetic tone, which raises blood pressure and heart rate.

These findings are supported by **Menear et al, (2017)** conducted a study about "Repeated sleep-quality assessment and use of sleep-promoting interventions in ICU" and reported that poor sleep quality causes significant changes in heart rate, blood pressure, and respiration. Similary**, Yue, et al, (2017)** conducted a study about "Association between sleep quality and arterial blood pressure among Chinese" and found the same positive effect.

The results of the current study revealed that the majority of the studied critically ill children who suffering from mild and moderate sleep disturbance did not have a history of admission to CCU. It's related to the physiological and psychological stress of being admitted to the CCU lowers sleep quality.

In a study by **Daneshmandi et al., (2012)** titled "Effect of Eye Mask on Sleep Quality in Children with Acute Coronary Syndrome"

which included 60 children, it was discovered that more than half of the study sample was admitted for the first time, and stress caused by admission to the CCU could be the cause of poor sleep quality. **Magdy et al., (2019),** in their study "Study of Sleep Quality among Children Hospitalized to The Respiratory Intensive Care Unit," found that more than two-thirds of the children evaluated were admitted for the first time to the respiratory intensive care unit.

Findings from the current study showed a positive significant correlation between sleep quality score and physiological parameters among critically ill children in the virtual reality group. This may be due to the effectiveness of the virtual reality distraction role experienced during the procedure. This study comes in agreement with **Chan, et al., (2017):** who conducted a study about "Application of a virtual reality prototype for pain relief and improving the sleep of pediatric in Taiwan" and stated that a significant difference in the children's reported in the intervention group post virtual reality application.

This result isin the same line with a study done by **Kamdar et al., (2018)** who studied "Sleep Deprivation in Critical Illness: Its Role in Physical and Psychological Recovery" and found that sleep deprivation was observed to cause significant increases in respiratory muscle fatigue and respiratory rate.

From the researchers' point of view, it reflected the importance, strong effect, and success of the implementation of the virtual reality technology which had a positive effect on improving sleep quality and physiological parameters which improving sleep scores led to improving physiological parameters mean scores.

Conclusion:

Based on the findings of the present study and research hypothesis it concluded that virtual reality technology had a positive effect that improved sleeping pattern and physiological parameters among critically ill children in the study group than those in the control group.

Recommendations:

The following recommendations were suggested based on the results of the present study:

- Virtual reality distraction technology should be integrated as a part of the routine care of critically ill children in CCUs.
- Further research is required on a larger sample of children to be generalized.

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