

Commentary

Use of virtual reality gaming systems for children who are critically ill

Commentary on: “Wii-Hab” in Critically Ill Children: A Pilot Trial

Yasser Salem^{a,b,*} and Ahmed Elokda^{b,c}

^aDepartment of Physical Therapy, University of North Texas Health Science Center, Fort Worth, TX, USA

^bFaculty of Physical Therapy, Cairo University, Cairo, Egypt

^cFlorida Gulf Coast University, Fort Myers, FL, USA

Abstract. Children who are critically ill are frequently viewed as “too sick” to tolerate physical activity. As a result, these children often fail to develop strength or cardiovascular endurance as compared to typically developing children. Previous reports have shown that early participation in physical activity in is safe and feasible for patients who are critically ill and may result in a shorter length of stay and improved functional outcomes. The use of the virtual reality gaming systems has become a popular form of therapy for children with disabilities and has been supported by a growing body of evidence substantiating its effectiveness with this population. The use of the virtual reality gaming systems in pediatric rehabilitation provides the children with opportunity to participate in an exercise program that is fun, enjoyable, playful, and at the same time beneficial. The integration of those systems in rehabilitation of children who are critically ill is appealing and has the potential to offer the possibility of enhancing physical activities. The lack of training studies involving children who are critically ill makes it difficult to set guidelines on the recommended physical activities and virtual reality gaming systems that is needed to confer health benefits. Several considerations should be taken into account before recommended virtual reality gaming systems as a training program for children who are critically ill. This article highlighted guidelines, limitations and challenges that need to be considered when designing exercise program using virtual reality gaming systems for critically ill children. This information is helpful given the popular use of virtual reality gaming systems in rehabilitation, particularly in children who are critically ill.

Keywords: Exercises, video gaming, pediatric rehabilitation

1. Introduction

Improved critical care has resulted in decreased mortality and increasing numbers of post intensive care unit survivors [1]. Children who are critically ill are at a greater risk of decline in physical functions and low level of physical fitness, not only from the medical condition itself, but also from changes associated

with their medical conditions such as weakness, lack of activity, and reduced mobility. The synergy of these associated conditions increases the likelihood of deterioration of function and quality of life [2,3]. Children who are critically ill are frequently viewed as “too sick” to tolerate physical activity, particularly in the early phases of their critical illness. The consequences of physical inactivity are particularly detrimental to these children. Physical inactivity could contribute to secondary debilitating impairments and may lead to additional decline in functional status. Early physical activity for children who are critically ill aims to decrease the detrimental effect of long-term immobility

*Corresponding author: Yasser Salem, Physical Therapy, University of North Texas Health Science Center, 3500 Camp Bowie Blvd., MET 537, Fort Worth, TX 76107, USA. Tel.: +1 817 735 2982; Fax: +1 817 735 2518; E-mail: yasser.salem@unthsc.edu.

and may improve physical functions. Previous reports have shown that early participation in physical activity in intensive care units is safe and feasible for patients who are critically ill [4,5] and may result in a shorter length of stay and improved functional outcomes [5].

Video gaming is a popular recreational activity for children across the world [6]. Progress in the fields of virtual reality and video gaming technology has offered, and continues to offer, the possibility of incorporating these games into the field of rehabilitation. Video gaming technology using virtual reality systems has enabled users to become active participants in the virtual environment. The incorporation of physical activity into video gaming facilitates the integration of this technology into rehabilitation therapies. Previously, the use of virtual reality technology developed specifically for rehabilitation was limited by substantial cost and decreased access. The availability of low-cost commercial gaming systems has significantly increased the use of virtual reality video gaming for rehabilitation [7,8]. The publicity and use of virtual reality gaming systems as rehabilitation tools have gained momentum in the recent decade. Virtual reality gaming systems are used in nearly every clinical setting and for a variety of clinical conditions.

The use of these virtual reality gaming systems has become a popular form of therapy for children with disabilities and has been supported by a growing body of evidence substantiating its effectiveness within this population. Research on the effects of virtual reality gaming systems for children with disabilities has reported positive effects on flexibility, range of motion, functional strength, balance, walking, cardiovascular endurance, and gross motor development. These improvements have been demonstrated in a variety of pediatric conditions, including developmental delay, cerebral palsy, autism, attention deficit hyperactivity disorder, developmental coordination disorders, traumatic brain injury, and Down syndrome.

The integration of virtual reality gaming systems in pediatric rehabilitation is appealing and has the potential to enhance physical activities. One of the potential advantages of using virtual reality gaming systems in rehabilitation is that these gaming systems incorporate essential elements of motor learning. When used as a rehabilitation tool, virtual reality gaming systems provide not only real time practice of tasks and activities, but also opportunities to engage in intensive, meaningful, enjoyable, and purposeful tasks related to the real-life environment [9,10]. Virtual environment provides unique, multidimensional media where the individual

interacts with virtual scenarios consistent with real-life situations [11]. Physical activity in these games includes a great deal of movements and tasks that involve a wide range of sensory feedback, adjustable movement amplitudes, speed, precision levels, and incorporation of a variety of visual-spatial, cognitive, and attention tasks. Another potential advantage of virtual reality gaming systems is the availability of games and difficulty levels among those games that provide more tools to match individual abilities [12] and tailor the training program. Lack of motivation and interest in physical activities are identified barriers to compliance and may lead to less than optimal rehabilitation outcomes. The games and activities used in virtual reality gaming systems involve high levels of enjoyment and motivation. The practice of these activities may be promising in increasing participation and motivation of children participating in physical activities.

Despite the promise for virtual reality technologies in rehabilitation, there is lack of information regarding its use in children who are critically ill. The study "Wii-Hab in critically ill children: a pilot trial" provides valuable information about the safety and feasibility of using virtual reality gaming systems as an acute rehabilitation intervention in a Pediatric Critical Care Unit setting. This is the first study to examine the use of virtual reality gaming systems during acute rehabilitation in critically ill children. The results of this study show that the use of virtual reality gaming systems appear to be safe and result in improvements in upper limb activity during the intervention. This study highlights many limitations and challenges that must be considered when designing future studies on the use of virtual reality gaming systems for critically ill children. This information is helpful given the popular use of virtual reality gaming systems in rehabilitation, and particularly in children. Readers should be mindful that this study explores the potential of using virtual reality gaming systems rather than recommending the use of virtual reality gaming systems as an acute rehabilitation intervention for children who are critically ill. Readers should remember that this is the first step in validating the use of virtual reality gaming systems in this population during acute rehabilitation. More steps must be taken in order to validate its use with specific guidelines regarding how to apply in terms of selection of activities, intensities, frequency, and duration. More importantly, despite the consensus from the literature that gaming systems are valid tools to augment rehabilitation, there is a lack of evidence that examines if the use of gaming systems is superior to traditional

approaches, or if it can be an adequate substitute for traditional rehabilitation [9].

Recommending physical activity for children who are critically ill is challenging. The lack of research on “best practice” with regard to “type” of intervention and “dose” can be overwhelming and may lead to uncertainty for clinicians working with children who are critically ill. Before recommending virtual reality gaming systems as a training program, the child must be medically stable, even if still ventilator dependent. When designing exercise programs using virtual reality gaming systems for children who are critically ill it is important to consider the child’s age, medical diagnosis, medical complications, fatigability, extent of motor impairments, and physical abilities. A medical evaluation before commencing a formal virtual reality gaming systems rehabilitation can determine the baseline level, identify risk factors, and provide opportunity to discuss training goals. The choice of games or activities should be based on the child’s associated medical conditions, fitness level, age, and interest. Games and activities that involve the use of large-muscle groups, such as games that involve walking, running, and jumping, are most effective in improving cardiovascular endurance and conditioning. Games and activities that involve the use of small-muscle groups may not offer cardiovascular endurance, but may be beneficial in slowing deconditioning and maintaining strength in those muscles. The exercise frequency and duration should be assessed carefully. Children who are critically ill may exercise more frequently with less intensity and durations. Actual intensity depends on medical diagnosis, associated disorders, functional status, and current fitness level. Activities and games that bring children to their physical limits should be avoided. The training should consider activities and games with intermediate intensities that do not evoke symptoms. Frequent rest periods should be included for activities and games that included high intensity. Heart rate and blood pressure may be used to monitor exercise intensity. Progression of activity should be slower and should be monitored carefully. One potential advantage of virtual reality-based training is the availability of different games and difficulty levels. This enables the clinicians to select activities according the individuals needs. The training program should be monitored, and any sign of injury should be evaluated before continuation of the training program. A limited number of case reports have raised concerns about injuries from repetitive use of a gaming system. Such injuries can be prevented by providing appropriate supervision and avoiding improper body mechanics during exercises.

2. Summary

Children who are critically ill have been reported to avoid physical activity. As a result, these children are often at risk for deterioration in functional abilities and quality of life. Physical activity has been reported to prevent the detrimental effects of lack of activity and improve functional outcomes in patients who are critically ill. The integration of virtual reality gaming systems into pediatric rehabilitation is appealing and motivating for children. In addition, children who are critically ill typically experience limited opportunity to engage in play. The use of the virtual reality gaming systems provides these children with the opportunity to participate in an exercise program that is fun, enjoyable, playful, and, at the same time, beneficial. The lack of training studies involving children who are critically ill makes it difficult to set guidelines on the recommended “type” and “dose” of physical activities and virtual reality gaming systems that is needed to confer health benefits. Further research exploring the use of virtual reality systems in rehabilitation of children who are critically ill will be useful. Until we fill the gap in this area, several considerations should be taken into account before recommending virtual reality gaming systems as a training program for children who are critically ill. Clinicians must employ sound clinical rationale and evidence-based principles when designing intervention using virtual reality gaming systems.

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