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The effect of virtual reality on child development in individuals with autism spectrum disorder (ASD): an integrative review of the literature

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Abstract: Autism Spectrum Disorder (ASD) is a deficit in neuropsychomotor behavior, approximately 80% of children with ASD have deficits in child development, which can lead to dyskinesia, sleep disorders, speech delay, epilepsy and repetitive behaviors. Virtual Reality (VR), through its dynamics, is a proposal that acts on the development of neuropsychomotor capacities in individuals with ASD. The present study aimed to highlight the effect of virtual reality on the development of individuals with ASD. This is an integrative review of the literature, in which a survey was carried out in the databases: PUBMED, LILACS, SCIELO, published between the years 2019 and 2023, in English and Portuguese. A total of 22 articles were found. Of this total, 15 were excluded because they were not original articles and 07 were considered eligible and chosen to read the abstract, and 03 were excluded because they did not fit the theme worked. In the end, 04 articles were selected to be read in full, which really presented relevance to the theme. The use of VR brings several benefits to the neuropsychomotor development of individuals with ASD, presenting a significant improvement in functions.

Keywords: Virtual Reality; Autism Spectrum Disorder; Fatil Development.

1. Introduction

Mechanical ventilation is a procedure essentially used in Autism spectrum disorder (ASD) consists of deficits in repetitive sensorimotor behaviors as well as early social communication (Lord et al., 2018). Leo Kanner (1943) reported for the first time the term "autism" as a means of diagnosing a specific syndrome in children with early manifestations, specific symptomatology, and difficulties in social and emotional interaction (Kanner, 1943).

In 2000, the Autismand Deveopmental Dissabilites Minitoring (ADDM) reported the incidence of ASD at an

estimated 1:150 children. Then, in 2006 the incidence was 1:100 in children, and in 2008 there was an increase in the incidence from 1:88 children (Sharma; Gonda; Tarazi, 2018).

For the past 50 years, autism has been considered a strictly defined disorder in childhood and extremely rare associated with genetic components. However, ASD is currently seen as a spectrum according to the Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM-5) of the American Psychiatric Association and the International Classification of Diseases, 10th Revision (ICD-10) with classifications from mild to severe and individuals with individual characteristics (Genovese; Butler, 2020; Lord et al., 2018).

Given the current scenario, it is notable that there are marked differences in the prevalence of ASD worldwide, being equivalent to more than 70 million individuals between 1.5% and 2% of the general population (Roman et al., 2021). In addition, these variations in prevalence depend on several factors, such as increased awareness of autism and changes in diagnostic criteria (Jiang et al., 2022).

According to the American Academy of Pediatrics, it is necessary to screen infants and children during 18 months and again at 28 months of age in order to identify the early signs of autism (Hyman; Levy; Myers, 2020). Due to the great variability in the symptomatology of individuals with ASD, symptoms such as dyskinesia (bradykinesia/hypotonia), sleep disturbances, speech delay, epilepsy, and repetitive stereotyped behaviors that appear in the early stages of child development can often be observed (Lai et al., 2019).

Approximately 80% of children with ASD have deficits in motor development (Bhat, 2020). According to Vatando and Hasanzadeh (2018), they report an association between the development of motor skills and the identification of emotions in children with ASD. Psychomotor skills are behaviors directed and controlled towards a goal, such as fine motor coordination (Kilroy et al., 2022).

Individuals with ASD, because they have motor disorders, are constantly directed to rehabilitation programs, and in this way will be acting in the search for new means and innovative techniques to intensify the treatment method. Therefore, virtual reality (VR) is a treatment method where it will act on the development of motor skills in the individual with ASD, in order to improve the reaction and displacement time. Thus, it will be relevant to verify that VR has emerged as an abrasive and efficient tool to improve motor coordination and cognitive actions (Moraes et al., 2020)

In recent years, the number of published studies covering VR-based evaluations and treatment in the population with ASD has increased significantly. Much of the research related to autism in VR has focused on social and emotional capacities. However, these computer technology systems present themselves as a very encouraging alternative for people with autism (Dechsling et al., 2022). In view of the above, this study intends to evidence, through the literature, the effect of virtual reality on the development of dementia with autism spectrum disorder (ASD).

2. Methodology

The present study is an integrative literature review, in which we sought to identify recent bibliographic publications that evidenced the effect of virtual reality on the development of individuals with autism spectrum disorder (ASD). For the search strategies, the following descriptors were used in health sciences (Decs\ MeSH: "Virtual Reality", "Autism Spectrum Disorder", "Child Development" and "Virtual Reality", "Autism Spectrum Disorder", "Child Development" using the Boolean operator AND and OR. In the following databases: via the US National Library of Medicine National Institute of Health (PUBMED), Scientific Electronic Library Online (SCIELO), in addition to the databases indexed in the Virtual Health Library (VHL), such as the Latin American and Caribbean Health Sciences Literature (LILACS).

Among the eligibility criteria, the following inclusion criteria were used: (1) Sample of individuals with autism spectrum disorder (ASD) who used virtual reality as an instrument to evaluate the effect on the development of these children; (2) Studies published in English and Portuguese; (3) Studies published in the last five years 2019\2023 to ensure current and meaningful information; (4) Availability (full text). The exclusion criteria were: (1) articles that did not use virtual reality in children with ASD; (2) Studies that did not describe the effect of virtual reality on these individuals; (3) Studies that did not objectively detail their research results; (4) Thesis, Literature reviews.

After using the descriptors in the databases, the titles were analyzed for inclusion of articles that met the eligibility criteria.

3. Results

The present study searched for articles in the main databases to obtain relevant and reliable results. A total of 22 articles were found, of which 15 were excluded because they were not original articles. 07 were considered eligible and chosen to read the abstract, and 03 were excluded because they did not fit the theme worked. In the end, 04 articles were selected to be read in full, which were really relevant to the theme. The identification and selection of articles are described in the flowchart below (figure 1).

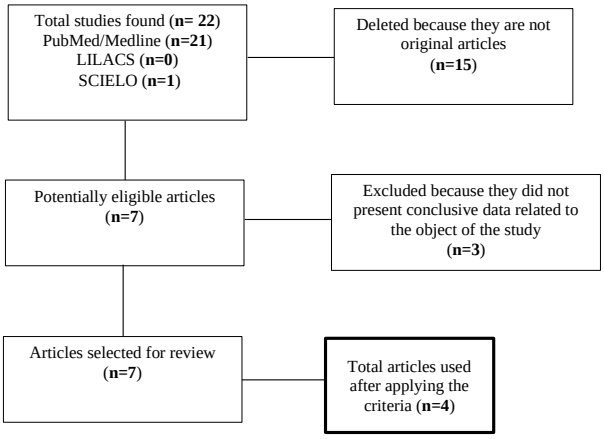

Figure 1. Flowchart of the literature selection process found on motor performance and virtual reality in individuals with autism spectrum disorder (ASD).

Table 1. Characteristics and data from studies on the effect of virtual reality on infant performance in individuals with ASD

Author/year	Objective	Population	Intervention	Finding
ZHAO, Junqiang et al. (2022)	To explore the impact of using virtual reality technology to intervene and encourage the areas of behavior, development, cognition, imitation, and social interaction in children with autism spectrum disorder.	Forty-four children with autism spectrum disorder were randomly divided into an intervention group and a control group, with each group consisting of 22 participants.	Control group: was submitted to traditional rehabilitation training, being training in a group class by; social interaction training; fine motor training. Intervention group: virtual technology (VR) was added to the rehabilitation training offered to the control group.	After the intervention, the developmental abilities of both groups of children in the areas of cognition, imitation, and social interaction improved compared to before the intervention score (P <0.05). Comparing the two groups, there was a difference in scores, and it was demonstrated that the levels of the intervention group were better than the levels of the control group only in the areas of cognition and social interaction (P <0.05).
ANTÃO, Jennifer Yohanna Ferreira de Lima et al. (2020)	To explore the use of letters and numbers of the alphabet in an Augmented Reality (AR) task and its influence on reaction time in an Augmented Reality (AR) task.	96 participants, 48 in an ASD group and 48 in a typical development (DT) group. The groups were divided into experimental group (ASD) and control group (DT participants).	A computer program (MoviLetrando) was used, for face-to-face learning, which involves interaction with a virtual symbol projected on the screen; letters of the alphabet (vowels and/or consonants) and numbers (1-10).	In the analysis of the reaction time results, only the ASD group showed improvement in the performance of the simple TRT obtained after the task by augmented reality (AR) application (p<0.01), which demonstrates that practice with an Augmented Reality (AR) game can improve reaction time in participants with ASD and that reaction time (RT) is related to cognitive and motor performance.
KUMAZAKI, Hirokazu et al. 2020	To evaluate the feasibility of APSV (Simple Virtual Hearings) as an educational method for individuals with ASD.	Fifteen male subjects with ASD were randomly assigned to two groups: one group received SVPA (n = 8) and the other group (n = 7) received an independent study (IS).	From day 2 to day 6, participants in the APSV (Virtual Hearing) and IS (independent study) groups were encouraged to read and answer questions frequently asked at real public speaking events. Participants in the APSV study group performed this	After the training sessions, the participants' self-confidence improved the self-confidence scores of the APSV group, showing a greater improvement than that of the SI group (F = 11.095; P = 0.005). In addition, compared to Day 1, self-

			activity in front of the APSV system, while those in the SI group performed it in an empty room.	confidence scores increased significantly on Day 7 (P = 0.001) in the APSV group.
and salivary cortisol levels decreased significantly in the APSV group.				
MORAES, Ibis A Petal. (2022)	To evaluate whether the longitudinal practice of an activity in virtual and real environments improves motor performance and whether this improvement is transferred to a later practice by changing the environment.	50 young people with ASD and 50 with TD (Typical Development), matched for age and sex, were divided into subgroups of 25 people.	Coincident timing tasks were performed based on Kinect (non-physical contact) and keyboard environments (with physical contact). The subgroups performed the first two phases of the study (acquisition and retention) on the same device – real or virtual – and then switched to the other device to repeat the acquisition phases and turned on a touch screen (transfer phase).	Practice in the virtual task led to better performance in subsequent practice in the real task, with more pronounced improvement in the ASD group (P >0.06) compared to the DT group.

4. Discussion

According to (Eggmann, 2018), Early training in critically ill patients refers to the implementation of rehabilitation and exercise interventions during hospitalization in intensive care units (ICU). Traditionally, patients admitted to ICUs are kept at rest to minimize physiological stress and allow for recovery. However, recent evidence suggests that early training can have significant benefits.

Therefore, exercise in mechanically ventilated critically ill patients, including resistance training (strengthening exercises) and resistance training (aerobic exercises), can help combat ICU-acquired muscle weakness, improve functional capacity, reduce mechanical ventilation time, shorten the length of hospital stay, and improve quality of life after hospital discharge (Eggmann, 2018).

In turn, training can be tailored to patients' individual needs, taking into account factors such as disease severity, hemodynamic stability, and functional capacity (Schujmann, 2020).

However, it is important to point out that each patient is unique, and not all critically ill patients will be able to participate in an early exercise program. The decision to implement early training should be based on a careful assessment of the patient's clinical status and ability to tolerate exercise (Schujmann, 2020).

In view of this, atelectasis is characterized by the partial or complete collapse of a portion of the lung due to airway obstruction. Pleural effusion occurs when there is abnormal accumulation of fluid in the pleural cavity, which surrounds the lungs. Both complications can lead to respiratory problems and prolonged hospitalization (Moradian, 2017).

The randomized clinical trial you mentioned investigated whether early mobilization can reduce the incidence of atelectasis and pleural effusion in patients undergoing coronary artery bypass grafting (Moradian, 2017).

Early and improved rehabilitation can help prevent muscle and respiratory complications, reduce ICU-acquired muscle weakness, improve functional capacity, accelerate physical recovery, reduce mechanical ventilation time, and shorten the length of hospital stay. In addition, these interventions can have a positive impact on patients' quality of life after hospital discharge (Mcwilliams, 2018).

It is important to highlight that early and enhanced rehabilitation should be tailored to the individual needs of each patient and carried out under the supervision of qualified healthcare professionals such as physiotherapists or rehabilitation specialists. The therapeutic approach should consider factors such as the patient's hemodynamic stability, the severity of the underlying disease, and functional capacity (Mcwilliams, 2018).

ICU-acquired muscle weakness is a common complication in critically ill patients who have spent prolonged time in the ICU and receive mechanical ventilation. Early mobilization, which involves performing exercises and physical activities tailored to the patient's capabilities, and early nutrition, which involves the proper administration of nutrients to prevent muscle loss, are therapeutic approaches that have been studied to combat ICU-acquired muscle weakness (Zhou, 2022).

The combination of early mobilization with early nutrition seeks to maximize the benefits and synergies between these two interventions, with the goal of improving muscle strength, physical function, and clinical outcomes for patients (ZHOU, 2022).

4. Conclusion

In conclusion, the effects of early mobilization in critically ill patients hospitalized in Intensive Care Units

(ICUs) are significant and beneficial. Early mobilization refers to the initiative to start rehabilitation and physical activity as early as possible during the ICU stay, even when the patient is in critical condition.

Studies and scientific evidence have shown that early mobilization brings several advantages to critically ill patients. It helps prevent complications resulting from prolonged immobility, such as muscle weakness, atrophy, pressure ulcers, deep vein thrombosis and ventilator-associated pneumonia. In addition, early mobilization contributes to the reduction of the length of stay in the ICU and the period of mechanical ventilation, which results in shorter recovery time and, consequently, lower financial cost for the health system.

The benefits of early mobilization are not restricted to physical aspects alone. The practice also has a positive impact on the mental health of critically ill patients, promoting a sense of control, improved mood, and reduced anxiety and depression. In addition, the interaction with the health team during early mobilization strengthens the bond between patient and professional, resulting in a more humanized and empathetic relationship.

However, it is important to emphasize that early mobilization must be performed safely and appropriately, taking into account the patient's clinical conditions and stability. A multidisciplinary and coordinated approach, involving physicians, nurses, physiotherapists and other health professionals, is essential to ensure the safety and efficacy of this type of intervention.

Therefore, early mechanical mobilization is a very important therapeutic technique in the ICU, and can bring significant benefits to critically ill hospitalized patients.

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