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EVALUATION OF STEREOTYPED MOVEMENTS USING HIGH TECHNOLOGY DEVICES FOR EARLY DIAGNOSIS AND TREATMENT OF AUTISM

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Abstract

***Purpose**:* Delays and motor deficiencies in Autism Spectrum Disorder (ASD) are extremely common and often announce the appearance of widespread atypical development. However, they are not properly emphasized in the diagnostic or assessment criteria for ASD. Thus, our paper provides a literature review on the motor evaluation of stereotyped movements of ASD individuals in relation to early diagnosis, treatment and possible interventions.

***Methodology**:* Computerized searches (Pubmed) and manual searches were performed to identify the most relevant studies. We used the following keywords and search terms: autism spectrum disorder, autism, ASD, motor skills, motor disorders, stereotyped movement, assessment, evaluation, measurement, diagnosis, detection. Identified studies were screened by abstracts and conclusions for relevance. The criteria for the inclusion in the review were as follows: peer-reviewed studies; published after 2010; English-language. The following exclusion criteria were applied: published before 2010; participants diagnosed with other developmental disorders than ASD; studies focusing on participants with ASD that did not evaluate motor skills and development.

Findings: Early diagnosis of ASD is essential to develop effective interventions and mitigate the ASD main symptoms. Our results show that objective and quantitative measures of motor function should be considered as a priority for future research on the subject.

Unique contribution to theory, practice and policy: Specific motor and movement deviations such as stereotyped movements must be evaluated using high technology devices to promote the early diagnosis of children with ASD. Thus, motor deficits should be considered to effectively diagnose ASD. We highly recommend evaluating movement using quantitative methods to assess significant gaps in motor function of ASD individuals.

Keywords: *Autism Spectrum Disorder; Stereotyped movements; Early diagnosis; Motor function measurement.*

1. INTRODUCTION

Autism Spectrum Disorder (ASD) requires that an early diagnosis for young children be made essential because the interventions that will be required to shape the skills of children will be adopted much earlier when the brain plasticity is much more developed and accentuated. Early research has shown that poor motor skills are much related to social changes in behavior. Early diagnosis of the condition requires that motor skills deficiency is identified (American Psychiatric Association, 2013).

Research shows that the developmental sensorimotor deficits in the early childhood stages are clear indicators of a potential diagnosis of ASD. Atypical development are exhibited by the deficiency in motor skills and therefore have an intrinsic association with the other domains in development. In order to have an articulate understanding of the spectrum, it is important to define what ASD is and the clinical diagnosis together with the movement of autistic individuals (Ribeiro et al., 2019).

ASD is a neurodevelopmental disease that is more often associated with verbal and non-verbal communication, complications in behavior and social interactions (Ribeiro; Derenji; Da Silva Filho, 2019). Diagnosing the condition is challenging since the existing clinical techniques available require that one undergoes a long-term observation with an in-depth evaluation that needs express permission by licensed healthcare professionals.

The ASD condition is mostly not examined until when child is 3 to 4 years of age. There have been reports of parents expressing concern when a child is barely 18 months. Therefore, this paper presents a literature review on the motor evaluation of stereotyped movements of ASD individuals in relation to early diagnosis, treatment and possible interventions.

1.1 Methodology

Computerized searches (Pubmed) and manual searches were performed to identify the most relevant studies. We used the following keywords and search terms: autism spectrum disorder, autism, ASD, motor skills, motor disorders, stereotyped movement, assessment, evaluation, measurement, diagnosis, detection. Identified studies were screened by abstracts and conclusions for relevance.

The criteria for the inclusion in the review were as follows: peer-reviewed studies; published after 2010; English-language. The following exclusion criteria were applied: published before 2010; participants diagnosed with other developmental disorders than ASD; studies focusing on participants with ASD that did not evaluate motor skills and development.

2. LITERATURE REVIEW

In trying to understand what the stereotyped movement of the autistic individuals is all about, studies suggest that the atypicalities in the body movements that involve the repetitive actions i.e. the movement of body, arms, hands or fingers can emerge during the potential early markers stage (Ribeiro et al., 2019). Whether the stereotyped movement is likely to emerge during the early or late times in life seem to change depending on the study design.

Studies on the children who have a late diagnosis of the ASD have shown a higher frequency and duration for the stereotype movement as compared to the developing children, simultaneously. More retrospective studies also support similar findings. In contrast to these findings, videos showing retrospective study of children with the condition show no differences from the atypical developing children in the frequencies of abnormalities in movement (Ribeiro; Zaferiou; Silva Filho, 2020).

Textual comprehension does not also seemingly get acquired easily despite the intense didactic efforts put forth. The textual comprehension by the autistic individualsis evaluated through use of a subjective criteria rather than from an objective point of view. Subjective criteria implies that the patient's personal views are taken into consideration rather than relying on measurable and observable characteristics (Ribeiro et al., 2019). The use of eye tracking technology is effective when it comes to the use of subjective criteria given the fact that it focuses on collecting data from individuals affected with ASD.

A growing concern that exists among many clinicians and researchers is whether the atypicalities in the motor patterns development can appear at early stages and probably predate the markers in social and communication life of an individual with ASD. Research shows that the high risk infants are at the risk of having general delays in motor skills and more fragilities are also observed in movement abnormalities. Consequently, it is reported that the children with atypical motor development be closely monitored and a closer follow up made so as to recognize other developmental disorder (Towle & Patrick, 2016).

The measurement of the atypical motor development that pertains to stereotyped movements can be made using advanced technologies. These technologies can go a long way in diagnosis and treatment of the condition. Accurate detection and diagnosis of the movement behavior can be done through the use of sensing technology that gives the clinicians and caregivers the accurate feature of the condition, thus enabling them to characterize their nature objectively, identify the triggers for the occurrences and come up with therapeutic interventions in the case that the behavior becomes more challenging.

The acitagraphy technology for instance has been used widely to monitor the common sleep disorders that exists in children with ASD. This technology is used for the study of

the sleep and waking patterns of people with conditions such as the ASD. The method is more cost efficient and more appropriate for estimating the sleep-wake patterns for long periods of time (Cabibihan et al., 2017).

This technology is non-intrusive in a way that it makes use of a device that is in the form of a wristwatch to monitor motor movement over long periods of time. The sleep-wake estimation is premised on the observation that less movement is observed during sleep than wake.

This method is mostly effective for the infants and young children that might not sleep well around the environment. In order to observe the brainwaves in autistic individuals, it is important to note the patterns in brain activity of children with ASD. Most notably autistic individuals face a slowed brain responses in terms of motor movement than normal individuals.

The ASD screening tools have also been designed so as to easily track the eye patterns at any times during social interaction. Touch based therapies have also been enhanced through use of technology thus improving communication and the emotional well-being of individuals.

Humanoid robots have also become a big revelation in the improvement of social relationships with other people through offering companionship when engaging individuals with ASD.

2.1 Screening technologies for ASD stereotype movements: Autism Screening Instrument for Educational Planning

The ASIEP-3 tool is a special took that consists of Autism Behavior Checklist (ABC).This tool is designed for children with high levels of autistic behavior. The tool also has programs needed for educating the children and also monitoring their development over time (Towle & Patrick, 2016). The tool measures the communication, movement and language problems that a child with ASD might be experiencing.

The interactive assessment of the tool helps in the monitoring of the child's progress as well as the learning speed. The only shortfall of this tool is that it is more time consuming than the other tools since it takes nearly 90-120 minutes to complete one single screening process.

The childhood ASD rating scale was developed in order to identify the symptoms of ASD in young children. The technology measures and distinguishes the severity of the condition through the observation of motor skills, intellectual response consistency, social behavior and verbal and non-verbal communication. This tool is more observational in nature as it involves the input of parents and physicians through observation (Towle & Patrick, 2016).

The stated parties are involved because they are more familiar with a child's behavior. The tools work in a way that use a 4-point scale .The scale will then be recorded and the interpretation of the final score will be made by a trained professional. A cut-off score will determine the severity of the ASD.

The results will then be used to gauge the stereotype movement of the individuals and conducting of further evaluations that might be needed to identify the type of medication and treatment to give the person affected.

2.1.1 Pervasive Developmental Disorders Screening Test

The pervasive developmental disorders screening test is a tool that seeks to identify the symptoms of ASD and other developmental disorders termed as pervasive. The screening test consists of three stages that are based on different settings.

The first stage is the primary care screener, established to identify a primary care setting; the second stage which is a developmental clinic screener does consist of fourteen items and is tailored for children that are already in receipt of progressive services (Towle & Patrick, 2016); and the third stage involves the identification of toddlers aged between 18 and 48 months and their ASD conditions. The individuals are then discounted from the other pervasive development disorders.

All the stages have the designated cut off score on which the final results will be premised and evaluated. The time take in this approach varies from 15 to 20 minutes. It is imperative to also note that the sensitivity and the specificity varies in some way from one stage to another and is dependent on the cut-off scores.

3. CONCLUSIONS

Early diagnosis of ASD is essential to develop effective interventions and mitigate the ASD main symptoms. Objective and quantitative measures of motor function should be considered as a priority for future research on the subject. It is vital that specific motor and movement deviations such as stereotyped movements must be evaluated using high technology devices to promote the early diagnosis of children with ASD. Thus, motor deficits should be considered to effectively diagnose ASD. We highly recommend evaluating movement using quantitative methods to assess significant gaps in motor function of ASD individuals.

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