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Efficacy of exercise and early behavioral intervention in children with autism spectrum disorder

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Abstract

Impaired social communication and repetitive behavior have been described as manifested characteristics of autism spectrum disorder (ASD). In view of this, early interventions may be beneficial to improving these conditions in children with autism. It appears physical exercises in addition to targeted behavioral interventions could be effectively used in the treatment of ASD with a view to improving social communication deficit and stereotypic behavior. This paper therefore reviewed the efficacy of physical exercise and early behavioral interventions on characteristics of ASD. For the purpose of this study, pubmed and google scholar were searched for relevant studies on exercise and early interventions for autism. Ten papers were identified and reviewed in this study. The results of these studies confirmed that early interventions improve social communication and stereotypic behavior in young children with autism.

Keywords: Autism spectrum disorder, exercise, early intervention, social communication deficit, stereotypic behavior

Introduction

The global increase in the rate of autism spectrum disorder (ASD) is fast becoming alarming [1]. Investigations have shown that 1% to 2% of children populations are diagnosed with ASD [2, 3]. Children with ASD have exhibited more concurrent conditions thereby leading to relatively higher health care use compare with their peers without ASD [4]. This condition is apparently characterized with impairment in social communication and repetitive behavior [5]. More often, the impacts of this condition have constituted heavy global burden on health care use.

Impaired social interaction has been widely reported as one of the prominent characteristics of ASD [6 & 7]. As a result of social factor, preschool children with ASD who exhibit poor social interest in communication may be apparently disadvantaged in linguistic processing and learning engagement [8]. In view of unclear boundary between autism and language disorder, it is evident that children with social impairment and linguistic deficit, which may continue to later stage in life, are either diagnosed with autism or atypical autism [9]. Thus, language impairment has been recognized as a common co-existing disorder in preschool children with ASD [10]. Although linguistic impairment is greatly noted in preschool children with ASD, the degree of receptive ability impairment is comparatively higher than expressive ability [11]. Using Vineland adaptive behavior scale (VABS), socialization assessment at early age of children with ASD is a major predictor of language skill acquisition including expressive and receptive language [12]. This simply shows that poor socialization may negatively impact on children linguistic ability. Thus, early effective intervention towards improving social communication and stereotypic behavior should be given adequate priority in the treatment of ASD.

Early Behavioral Intervention in Young Children with Autism

There is potential evidence that early intervention program significantly improves social attention and learning process [13]. In addition to reduced severity diagnosis outcomes as a result of Early Start Denver Model (ESDM) intervention, this program also improves cognitive and adaptive behavior [14].

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With effective intervention at early age, children with ASD tend to exhibit less disruptive behaviors during learning process [15]. Combined social stories and verbal prompt intervention could be used to improve social behavior in this population [16]. Also, social training components which largely contain contingent imitation, natural reinforcement and environmental arrangement contribute to positive behavior outcome [17].

Long term behavioral intervention has been reported to be beneficial to improved social behavior and learning skill in young children with autism [18]. Finding has suggested that there is association between learning ability and improved adaptive functioning after applied behavior analysis (ABA) intervention [19]. In addition, video modeling intervention could also be used to improve behavioral skill at early stage of autism though other effective interventions may be combined, in some cases, with a view to achieving positive outcomes [20].

School-based and home-based Early Intervention for Children with Autism

Teaching of social skills to preschool children could be enhanced using integrated computer assisted instruction [21]. Given the effectiveness of early intervention program for preschool children with ASD, this may ensure smooth transition of the children to primary school class thereby creating conducive atmosphere and social preparedness for learning process. In school settings, increased use of teaching interactions that promote children response to difficult social and academic task may positively improve the prognosis of the disease [22]. However, there appears that inadequate number qualified personnel and lack of required training for few available preschool teachers on how to handle this condition may hinder provision of necessary intervention for these children in school settings [23]. To address this situation, government and non-governmental agency may have to work together towards enhancing human capacity and providing adequate training for school personnel required for optimizing inclusive education for people with disability.

Behavior problem in children with ASD is reported to be associated with high risk of stress and psychological distress often experienced by their mothers [24]. Although both father and mother of children with autism are always overwhelmed with increased stress as a result of high child dependence and management, limited family opportunities and life span care, the risk of this stress is relatively higher in mother than father [25]. The risk of stress is not limited to maternal parenting but also caregivers [26]. Taking into full cognizance of high demand of coping with the autistic associated stress by the parents of children with autism, their role in improving the condition of these children should be well articulated. In light of this, home-based developmental, individual-difference, relationship-based (DIR)/floor time intervention anchored by trained parents has been found to significantly improve

functional emotional status of the children [27]. With this evidence it is apparent that home-based intervention program can be successfully supervised by trained parents with a view to improving the disease condition of their children.

Impacts of Exercise in the Treatment of Autism

To understand the benefit of exercise on autism, jogging exercise has been proven to positively contribute to improved learning engagement and consequent academic achievement in children with ASD [28-30]. Despite the numerous benefits of physical activity, social and communication deficits have been identified by parents as obstacles to participation in physical exercises by people diagnosed with autism [31]. It is therefore noted that there is positive correlation between children social interaction with peers and physical activity participation [32]. In order to encourage full participation of children with ASD in sport and physical activity, it is suggested that such activity should be presented to the children in accordance with their preference and requirements in natural environment [33]. Nonetheless, organizing physical exercise in sensorimotor therapies for children with autism in an enriched environment appears to contribute significantly to reduced disease severity and symptoms including cognitive impairment [34].

Method

This review searched scientific journals on current studies related to exercise and early interventions in autism. For this purpose, google scholars and pubmed were basically searched for relevant literatures. In order to optimize search for current studies, the words use includes: exercise intervention, early intervention, autism spectrum disorder, social communication, language ability and stereotypic behavior.

Inclusion Criteria

In this review, studies included were mainly on physical exercises and behavioral interventions. Also, the interventions must be basically designed for young children with autism. The intervention studies must have been published not later than ten years. This explains that intervention studies published before 2007 were not included in this review. Age requirement for the study to be included is restricted to 10 years and below. Also, only papers that were published in English language were adjudged to meet the inclusion criteria.

Results

Among all the identified papers, 10 studies were found to meet the inclusion criteria and were examined in this paper. The characteristics and outcomes of the reviewed intervention studies are shown in table 1 below. The findings show that physical exercise and early behavioral intervention are very effective in the treatment of autistic symptoms in young children diagnosed with ASD.

Table 1: Summary of exercise and early interventions outcomes

Author	Design	Age	Sample	Intervention	Duration	Outcomes
Pajareya 2011 ^[27]	Randomized controlled trial	2-6yrs	32	Developmental, Individual-Difference, Relationship-Based (DIR)/Floor time	3 months	Improved functional emotional behavior
Lawton 2012 ^[35]	Randomized controlled trial	3-4yrs	52	Joint attention and symbolic play treatment	5-6 weeks	Increased shared positive affect during joint attention Increased shared positive affect with utterances during joint attention
Eapen 2013 ^[13]	Cross sectional	36-58 months	26	Early Start Denver Model (ESDM) intervention	10 months	Significant improvement in receptive language and communication skill
Crozier 2007 ^[16]	Case study	3-5yrs	3	Social story intervention	N/A	Increased positive behavior
Fernell 2011 ^[19]	Cross sectional	20-54 months	208	Intensive behavioral analysis (ABA) and non-intensive ABA targeted intervention	2 years	Improved adaptive functioning
Woo 2013 ^[34]	Randomized controlled trial	3-12 yrs	28	Sensorimotor enriched intervention	6 months	Enhanced cognitive performance Improved symptoms severity
Dawson 2010 ^[14]	Randomized controlled trial	18-30 months	48	Early Start Denver Model (ESDM) intervention	2 yrs	Improved cognitive ability Increased language ability Enhanced adaptive Function
Oriel 2011 ^[30]	Cohort	3-6yrs	24	Antecedent exercise (running/jogging) intervention	6 weeks	Increased academic engagement Reduced stereotypic behavior
Neely 2015 ^[36]	Cohort	7-8yrs	2	Antecedent exercise (Jumping)	10-12wks	Improved academic engagement Ameliorated stereotypic behavior
Bass 2009 ^[37]	Controlled trial	5-10 yrs	34	Horse-back riding	12 wks	Improved social function

Discussion

This study reviewed the efficacy of physical exercise and early intervention program on young children with ASD. The findings of reviewed papers clearly suggests that physical exercise such as jogging and running positively improve academic engagement and stereotypic behavior in preschool children with autism. This is evident in the study conducted by Oriel *et al.*^[30]. With a view to investigating the role of exercise intervention on academic engagement and stereotypic behavior, the study used antecedent exercise involving mainly jogging and running. At the end of six weeks antecedent exercise intervention, it was found that children improved in learning engagement and stereotypic behavior. This finding is further corroborated by Neely *et al* as their study found similar positive effect of antecedent exercise on academic engagement and stereotypic behavior^[36]. What appears to be another interesting finding is a study that confirms that horse-back riding intervention is capable of improving social functioning in children with autism^[37]. Bass *et al* further posited that specific factor that contributed to the recorded elevation in social functioning could not be ascertained, but stimulating nature of exposure to horse riding which is associated with physical presence and natural movement of the horse may be responsible.

Another widely used intervention in the treatment of early stage autism is ESDM. This intervention has been proven to be effective in improving language communication ability^[13, 14]. Eapen *et.al* in their study posited that ESDM intervention could be effectively used in community settings. Given this outcomes, it is important to note that community has a great role to play in the treatment of autism. To further support the efficacy of behavioral intervention on social communication, Lawton *et.al* found that shared positive affect during joint attention and shared positive affect with utterances during joint attention increased after joint attention and symbolic play treatment^[35].

Further, behavioral intervention model such ABA, is a very effective program for improving functioning outcomes in young children with autism^[19]. In a study that could be referred to as one of the largest studies in autism intervention

with the recruitment of 208 young children between the age of 20-54 months, Fernell *et al.* found that ABA intervention model improved adaptive functioning in this population. However, there was no recorded improvement found in adaptive functioning in autistic children with learning disability. They further posited that intensive ABA intervention did not record more outcome gain over non-intensive ABA intervention thereby suggesting that no superiority between the intensity of the intervention. It is important to note that the use DIR/floor time intervention could improve the functional emotional behavior in preschool children with autism^[27]. Of important note is that this intervention could possibly be organized by parents. Given the effectiveness of this intervention, parents may considerably experience reduced stress as a result of improved functioning of their children.

Conclusion

Both physical exercise and early behavioral interventions are highly effective in the treatment of young children with autism. It is important to note that combined use of these interventions may elicit more gains towards improving social communication and stereotypic behavior in this population.

Limitations

Inclusion of case study in this paper is considered as one of the limitations hence, there is tendency that studies with low population may influence true effects of the intervention. In addition, the use of non-randomized trial in this review is arguably another limitation of this paper.

Recommendations

Despite growing evidence of effectiveness of physical exercise and behavioral intervention in the treatment of autism, it is surprising to note that there is inadequate information on the role of combined use of these interventions on children with autism. There is need for researchers to extensively investigate the potentials of these combined interventions. Also, it appears that antecedent exercise is a promising intervention for ASD. However, there is little

information on the effects of this intervention in preschool children with autism. Therefore further investigation is required in this regards.

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