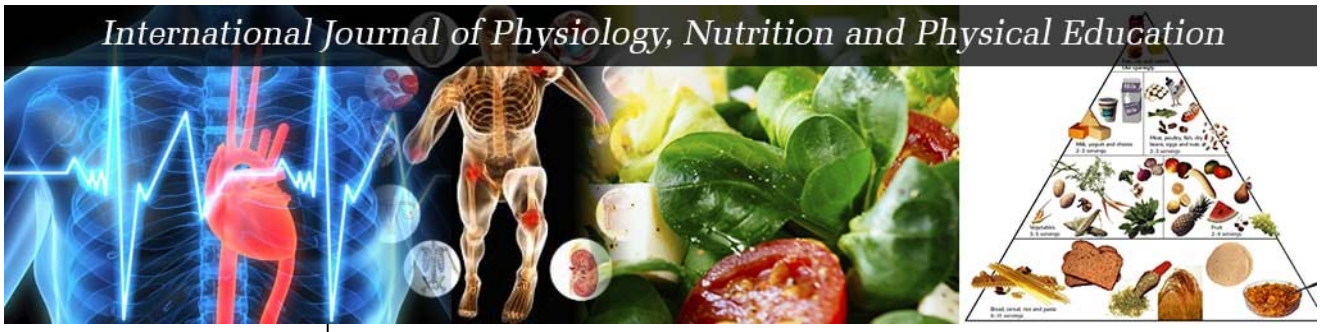

ISSN: 2456-0057
IJPNPE 2018; 3(1): 251-254

www.journalofsports.com
Received: 21-11-2017
Accepted: 22-12-2017

Michael Xavier
Ph.D. Research Scholar, Department of Physical Education, S.P. Pune University, Pune, Maharashtra, India

Dr. Deepak Shendkar
Director of Physical Education and Sports, Modern College of Arts and Commerce, Pune, Maharashtra, India

Correspondence
Michael Xavier
Ph.D. Research Scholar, Department of Physical Education, S.P. Pune University, Pune, Maharashtra, India

Effects of a systematic manipulative skills motor activity programme on the eye-hand coordination of children with autism spectrum disorder

Michael Xavier and Dr. Deepak Shendkar

Abstract
The purpose of this experimental study was to investigate the effects of a Systematic Manipulative Skills Motor Activity (SMSMA) Programme on the Eye-Hand coordination of children with Autism Spectrum Disorder (ASD). 10 children aged between 5 years to 7 years with moderate level of ASD were selected using the non-probability based convenience sampling technique. These children underwent a 6 week SMSMA Programme designed by the Researcher for 45mins, 5 days a week. The Eye-Hand coordination of these children was assessed using a Modified Minnesota Manual Dexterity (MMMD) assessment instrument. Descriptive statistics showed an increase in the mean performance from (523.25 sec, ±8.61) to (327.10 sec, ±5.46). Paired sample 't' test was used to compare the change in performance which showed that the calculated 't' value (70.275) was significant at 0.05 level of significance (p=0.000). Hence it was concluded that a 6 week SMSMA programme has a significant effect on the Eye-Hand coordination of children with ASD.

Keywords: Manipulative Skills Motor Activity, Autism Spectrum Disorder, Eye-Hand coordination.

Introduction
According to the American Psychiatric Association (2013) [2], presence of restricted or repetitive behaviours and impaired social-communication are the basic characteristics of Autism Spectrum Disorder (ASD). Recent studies also suggest deficits in gross and fine motor skills of children with ASD (Miyahara *et al*., 1997; Wing, 1981; Ming *et al*., 2007; Greenspan and Wieder, 1997; Provost *et al*., 2007; Fournier *et al*., 2010) [29, 47, 28, 16, 36, 10] which include underdeveloped fundamental motor control (Adrien *et al*., 1993; Jansiewicz *et al*., 2006; Teitelbaum *et al*., 1998) [1, 21, 42], inability to perform movements skilfully (Mostofky *et al*., 2006; Jones and Prior, 1985) [30, 22], improper motor learning patterns (Hughes, 1996; Haswell *et al*., 2009) [19, 17], and impaired Eye-Hand coordination and hand grasping movements (Noterdaeme *et al*., 2002; Mari *et al*., 2003) [32, 27]. Even now these underdeveloped motor skills are considered to be symptoms of ASD (Ming *et al*., 2007) [28] and are considered to hinder the development of adaptive skills (Baranek *et al*., 2005; Leary and Hill, 1996; Bauman, 1994; Mostofsky *et al*., 2006) [3, 24, 5, 30]. Underdeveloped motor skills may not only affect the development of basic daily motor activities (such as eating with a spoon), but also social behaviour, by hindering the child's participation in other activities that are age-appropriate (team games).

Well-developed fundamental motor skills form the base for the efficiency in later movements and physical skills in games and sports (Gallahue, 1982; Gabbard, 2000; Haywood and Getchell, 2002; Payne and Isaacs, 2002; Seefeldt, 1982) [13, 12, 18, 35, 40]. A mastery of fundamental motor skills is crucial in the optimum development of a child (Gallahue, 1982; Kogan, 1982; Seefeldt, 1980) [13, 23, 39], and these skills are observed and enhanced at the elementary school level (Ulrich, 2000) [43]. It is assumed that to be able to perform complex skills at a later stage, it is important that children develop fundamental gross motor skills to a certain proficiency at the elementary school level (Seefeldt, 1982) [40].

Eye-Hand coordination refers to the capacity of what the brain has to understand and interpret after what the eyes have seen (Gardner, 1986) [14]. Eye-Hand coordination is known as the ability to recognise, interpret and respond to visual stimulants based on previous experiences.

It is an output in the form of a physical skill after the individuals understanding and interpreting the visual stimulus (Frostig, 1964) [11]. The combination of basic visual functions and fundamental gross motor skills and Eye-Hand coordination allows us to perform many daily activities (Chaikin and Downing-Baum, 1997; Erhardt and Duckman, 2005; Van Waelvelde *et al*., 2004) [6, 9, 44].

Considering impaired motor abilities and perceptual abilities, literature states that both are related (Hulme *et al*., 1982; Lord and Hulme, 1987; Lord and Hulme, 1988; Sigmundsson *et al*., 2003; Wilson and McKenzie, 1998) [20, 26, 41, 46]. While many studies have been conducted to study the impaired motor skills of children (Hulme *et al*., 1982; Lord and Hulme, 1988; Parush *et al*., 1998; Schoemaker *et al*., 2001) [20, 26, 34, 38] Eye-Hand coordination is rarely an object of investigation considering the development of motor abilities of children with ASD. Wilson (2002) [45] suggests that cognitive functioning should be considered while working on adapted behaviour. This may be interpreted as complex adaptive behaviours like those of hands may be closely related to cognitive functioning than compared to simple ones like walking. Eye-Hand coordination is a complex aspect of fundamental motor activities that needs to be explored while studying the development of motor abilities of children with ASD (David *et al*., 2012) [7]. The ability to recognise the pattern of the visual stimulus and execute the action is an important aspect towards achieving a goal integrated in the environment (Schmitz *et al*., 2003) [37]. The effect of a systematic manipulative skills motor activity programme on the Eye-Hand coordination of children with ASD was investigated in this study. The researcher is of the opinion that Eye-Hand coordination may provide a base for further motor development of children with ASD. As such, enhancement in the Eye-Hand coordination may affect how children with ASD play, explore, use tools, and engage socially.

Materials and Method

Variables

After a thorough review of literature in the concerned area, various aspects of motor development of children were analysed based on priority. Considering these aspects, the researcher identified the variables and formulated the research problem. A Systematic Manipulative Skills Motor Activity Programme was identified as the Independent variable and the Eye-Hand coordination of Children with Autism Spectrum Disorder was identified as the Dependant variable.

Assessment Instrument

Considering the assessment of the Eye-Hand coordination of children with ASD, the "Minnesota Manual Dexterity Test" was modified by the researcher to measure the Eye-Hand coordination of the subjects. The validity of the modified assessment tool was established by experts in the related field. The modified assessment instrument was based on 2 subtests:- a. Dominant hand - placing test and, b. Non-dominant hand - placing test. Each subject was given 2 attempts for each subtest and the final score was measured to be the total of the average time taken to complete both attempts of both the subtests.

Research Design

The One group Pre-test Post-test research design was adopted by the researcher for this experimental study. The subjects were required to undergo the assessment of their Eye-Hand coordination both before and after the implementation of the programme.

Sample and Sampling

All the children with ASD, aged between 5 years to 7 years from the city of Pune were considered to be the population for the study, of which 10 were selected as sample for the study using the non-probability based convenience sampling technique.

Convenience sampling technique, for sample selection was adopted by the researcher as he had to consider the level of ASD of each child, and children with only moderate level of ASD were selected for the study.

Procedure

Phase 1

The "Minnesota Manual Dexterity Test" which is used to measure the Eye-Hand coordination and arm-hand dexterity was modified by the researcher. The test comprises of 5 subtests which include the Placing Test, Turning Test, Displacing Test, One-hand Turning and Placing Test and the Two-Hand Turning and Placing Test. 4 attempts are to be given and the time in seconds is recorded on the score sheet for each attempt. The final scoring is interpreted by the total seconds for all the attempts. For each test all disks must be fully inserted and inserted in the proper hole. The subject performs all tests from a standing position.

As the eye-hand coordination of children with ASD was to be measured, the instrument was modified to suit the main objective considering the physical and intellectual ability of the subjects. The modification now comprised of only 2 subtests that included Dominant hand Placing Test and Non-Dominant hand Placing Test. 2 attempts instead of 4 was to be given for each subtest, as less than 2 would be inadequate and more than 2 may cause the cognitive functioning to tire. The final scoring is to be interpreted as the total of the average time taken for completing both the attempts of both the subtests which was measured in seconds.

The validity of the modified instrument was established by three experts from the field of Physical Education and two experts from the field of Child Psychological Development.

Phase II

Before implementing the programme the Eye-Hand coordination of the subjects was measured. The Systematic Manipulative Skills Motor Activity programme designed by the researcher was then implemented for a period of 6 weeks, 5 days a week for 45min. The Eye-Hand coordination of the subjects was measured again after the implementation of the programme and the collected data was analysed to study the change in performance.

Results

The Eye-hand coordination of 10 children with moderate ASD was assessed before and after the implementation of a Systematic Manipulative Skills Motor Activity programme. The mean performance of the Pre-test was 523.25 sec. (± 8.61) whereas that of Post-test was 327.10 sec (± 5.46).

Comparative Analysis of Pre-Test and Post Test (N = 10)

Test	M	S.D.	M.D.	S.D.	S.E.	DF	't' ratio	Sig. (2-tailed)
Pre	523.25	8.61	196.15	8.83	2.79	9	70.257	0.000
Post	327.10	5.46						

*Significant at 0.05 level of significance

The effect of the programme was found to be significant as an

increase in the performance was seen, the mean difference of 196.15 sec (± 8.83) for degree of freedom 9 the calculated 't' value (70.257) is significant at 0.05 level of significance (p=0.000).

Discussion and Findings

The purpose of this study was to investigate the effect of a Systematic Manipulative Skills Motor Activity programme on the Eye-Hand coordination of children with Autism Spectrum Disorder. The programme was designed based on manipulative skills motor activities that involved tossing, catching, throwing, striking, dribbling with hands; activities that involved more use of hands and visual stimulus.

Strong evidences are available from motor development, motor planning, motor execution and motor correction that movement in children with ASD in impaired. As they grow, impaired motor planning, delays in initiating movement and inefficiency in performing complex motor tasks are seen in children with ASD (Papadopoulos *et al*., 2012; Dowd *et al*., 2012; Hughes, 1996; Glazebrook *et al*., 2008) [33, 8, 19, 15]. These children are not able to use on-going visual feedback, as well as information from a previous movement to plan subsequent movements more effectively (David *et al*., 2012; Schmitz *et al*., 2003) [7, 37].

In this study, a systematic manipulative skills motor activity programme was implemented with an aim to develop the Eye-Hand coordination at a low level, and the therapeutic effects were examined. The findings show that the programme had a positive influence on the Eye-Hand coordination.

It should be considered that a motor activity programme based on manipulative skills could be used as a clinical method for the functional development of Eye-Hand coordination which may form a base for further motor development in children with ASD. Rehabilitation programs for autistic children should be age appropriate and match their functional condition (Parush *et al*., 1998) [34]. A systematic study over a long term is required for establishing the results of this study.

Conclusion

From this experimental study it was concluded that a 6 week Systematic Manipulative Skills Motor Activity Programme has a significant effect on the Eye-Hand coordination of children with Autism Spectrum Disorder.

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