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The influence of Structured Physical Activity Intervention on Fundamental Motor Skills Development of Children with Mild and Moderate Autism Spectrum Disorder

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Abstract

The children with Autism Spectrum Disorder (ASD) have impairment of gross motor skills. However, the motor deficiency is not a part of diagnosis of ASD. Majority of the people with ASD have motor imbalanced that affected serious health issues, body posture and PA performance. The major purposes of the study were to examine the impact of a structured physical activity programme on gross motor skills development on mild and moderate ASD. In order to achieve this purposes, the researcher has firmed two objectives namely (1) influence of PA intervention on gross motor development (locomotors & object control skills) of children with ASD and (2) influential comparisons of treatment effect between mild and moderate children with ASD. Purposive sampling technique was implemented to recruiting participants and a total of 20 samples were fixed after screening with the chronological age range in between 6 to 10 years and they deployed in two groups based on the degree of autism (Mild and Moderate). The total duration of experimentation last to 14 weeks, three times per week and each session having 40-60 minutes. Outcome variables (DV) were measured in three-time period (initial, mid, & post-test) and repeated measures ANOVA was used to find out the significant differences. The present study, demonstrate the substantial benefits for children with ASD through the structured PA programme. The locomotors skills have shown the statically significant (mild group $f=52.66^*$, $P<0.05$/ Moderate ASD $f=54.92^*$, $P<0.05$). In terms of object control skills also found significant differences with the effect of PA intervention (Mild ASD $f=60.51^*$ $P<0.05$/ Moderate ASD $f=77.28^*$ $P<0.05$). However, the group-wise comparison showed not significant difference between mild and moderate ASD. The present study concluded that 14 weeks structured PA programme was showed the gross motor skills development of children with mild and moderate ASD.

Keywords: Autism Spectrum Disorder, Physical Activity, locomotor, Object control, fundamental skills.

Introduction

The Autism Spectrum Disorder is a condition of social and communication impairments, it may occur due to the abnormality of biological and cognitive development among the children. The children with ASD have shown symptoms that fluctuating individually that vary from mild to severe conditions. The difficulties of socialization, communication and mental imagination that are the sufficient capture of an autistic person are universal nature (American Psychiatric Association 2013). Prevalence of autism spectrum disorder has increased statically in all over the world today. Approximately, earlier it was 1: 10000 in 1980 but latest estimation revealed that 1:68, it is almost 120% of hiking in USA (Autism Society of America, 2014; V. C. N. Wong and S. L. H. Hui, 2008). Majority of the children with ASD have difficulty in participate the physical activity programme due to poor motor planning, lack of locomotors and objective skills of these children (Pan, 2011). Many of the studies proved that children with ASD have poor and delayed motor skills development (Hilton et al., 2012; Ming et al., 2007; Fournier et al., 2010). Moreover, abundant study revealed that children with ASD have a high degree of motor impairment (Allen et al., 2017). In terms of gross and fine motor skills of children with ASD had significantly poor motor quotient comparatively children with TD (Provost B. et al., 2007; Jasmin E et al., 2009). Many of the autistic children have been denied to the participation of physical activity programme and perhaps, these children have limited opportunity to engaging physical activity classes because of their impairment of communication and social difficulties (K. R. Fox & C. Riddoch, 2000; C. Y. Pan & G. C. Frey, 2006). There are numerous health problems have been significantly improved due to sedentary behaviour of these children and which leads an increased rate of overweight and obesity of Autistic children (Must et al., 2016; Hill et al., 2015; Broder-fingert et al., 2014; Curtin et al., 2010). More often the children with ASD have poor coordination, lack of body balance, low level of health fitness, muscular strength and declined body movement control (Pan et al., 2016; Schopler et al., 2011; Tyler et al., 2014; Kern et al., 2013; Borremans et al., 2010). Majority of the scholars are believed that there is a strong relationship between physical activity and ASD but In fact, the gross motor skills impairment is not the part of Autism diagnosed criteria (Berkeley S L et al., 2001). Strong evident based on the regular physical activity enhance motor skills, reduce tensions, and maintain a better healthy life for all the people (Houwen, S., Hartman, E., & Visscher, C, 2010). And physical activity provided to control anxiety, low motivation, depression, stress and positive social interaction (Pan .C & Frey G. C, 2005; Ozgun, et al., 2017). Indeed structured PA intervention have to provide not only the health benefit but also improve the socialization, developmental-behavioural skills and avoided isolation from their peer groups (J. Muller et al., 2009; D Garcia Villamisare & J Dattlo 2011; D. Saldana et al., 2009). The developing country like India the prevalence of ASD has increased significantly. There are numerous studies were conducted in the field of Autism, unfortunately, majority of the study which dealing in psychological aspects and in the field of physical activity intervention was very rare existed especially, assessment of daily activity level (Pan & Frey, 2006). Moreover, the limited study was conducted in the field of physical activity intervention of ASD in India because of the unavailability of the participants and parental support. In this study, the researcher has tried to be proved how often influenced by14 weeks structured physical activity intervention on fundamental motor skills development of children with Autism Spectrum Disorder.

Objectives of the study

The primary motive of the present study was to analyze the influence of physical activity intervention of gross motor skills outcome on children with ASD. The secondary objectives of the study were to clarify the group-wise comparison for gross motor skills due to 14 weeks of structured PA intervention programme.

Materials and Procedure

All the procedures of the present study have maintained the systematic standard and properly executed as well. The University Ethical board has been approved for the entire study protocol in 2018. The researcher has collected parental and teachers consent form in the begging of the study protocol.

Participants: all the participants were recruited from Satya Special School, Pondicherry, India. Their chronological age in between 6 -10 years old at the time of data collection. The inclusion criteria were fixed as a child with ASD diagnosed, a total of 20 samples was finalized after the screened. The recruitment process began with the parental consent form and a detailed explanation was presented to the teacher as well as parents. All the selected samples were being an assessment of medical checkups and exclusion of children if who have a disorder other than the ASD. Recruited samples were placed for an experimentation process and along with their daily school routine. Majority of the participants has difficulties in verbal communication, denied eye contact, and some of them have repetitive behaviour (hand flapping, head rotation, body rocking). The participants who skipped the consecutive three training session would be excluded from the study. The researcher has ensured that all the participants have to get equal opportunities while conducting the training session. All the participants were being assessed gross motor skills (DV) an three consecutive time period in terms of, initial test from the beginning, mid-test after 6 weeks of PA programme, and finally post-test after the experimentation got over. The total duration of the physical activity intervention programme lasts for 14 weeks three times per week, each session includes not more than 60 minutes.

Table -1, Participant's description

Groups	N	Age Mean / SD	ASD Degree Mean / SD	BMI
Mild ASD	10	9.50 / 1.354	84.30/ 8.908	17.4
Moderate ASD	10	9.600/ 1.578	129.80 / 13.78	19.3

Apparatuses: The following tools were used for the assessment of participants. Parental and teachers consent form were collected from the binging of the study, 1) Indian Scale for Assessment of Autism (ISAA) which was used for the assessment and Degree of autism among the participants. ISAA tool included 5 points of a rating scale from one to five, a total of 40 testing items, in fact, all the assessment has done by the clinical observation, and information taken from the parents or caretakers. 2) Test of Gross Motor Development (TGMD-3) for users to evaluate dependent

variables. The TGMD has included 13 individual skills items which included locomotors and object control skills as well. All the test have a scoring rate of pass (one) and field (zero), each participant has to get two chances in each skill. In terms of, standardized criteria for each tool included in the study measures always keeping high (D. A. Ulrich).

Behavioural description of the participants

The investigator himself sits in the regular class, along with the children for one week prior to the actual investigation starts and carefully observes for all the students' classroom behaviour and character. Generally, all the participants have some common characters like impairment of verbal communication, avoidance of eye contact, and many of them have repetitive stereotypical behaviour. Out of twenty participants, two were girls and the girls have shown severe symptoms when compared to their peers who were boys. The one girl who was calm and quiet inside the classroom but she makes sounds and her hits her head vigorously on the wall when she gets disturbed. She always screams with a high voice, she won't sit in the chair; she seems very disturbed when someone touches. Her parents revealed that she always preferred to roam around and she was attracted to the comic book. She will be calm when she gets the comic book; so all the time, the teacher used to do the same thing every day. The investigator also noticed one boy who always disturbed the entire class by hitting other classmates and he may flap his hands while seeing others cry. If the teacher shouts at him in the meantime, he may run to the corner of the classroom and his whole body shivers; he covers both the ears with his hands, also sometimes rotate and roll his eyes. Majority of the participants showed common ASD symptoms and interestingly, all the children are obedient to the class teacher. Unfortunately, they have a very week attention span. Therefore, the investigator had demanded all the parents to be present at the time of the PA programme.

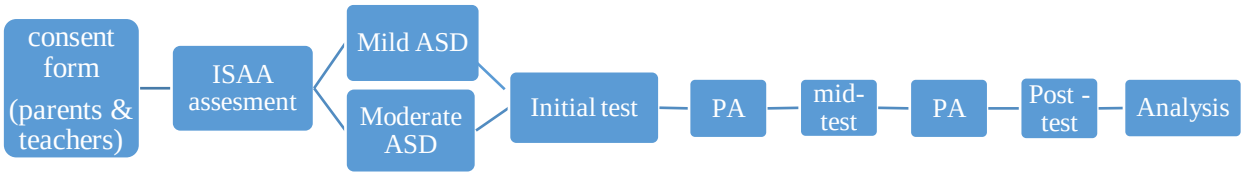


Figure 1 *framework of the study*

Experimental design of the study

A quasi- Experimental without control group research design was included in the study. There are two experimental groups were presented, such as group I (Mild ASD) and group II (Moderate ASD). Therefore, both group has been participated for interventional PA programme for 14 weeks (total of 46 sessions), three times in a week. The dependent variable such as locomotors skills and object control skills were being assessed by three-time period, initial test (beginning), mid-test,

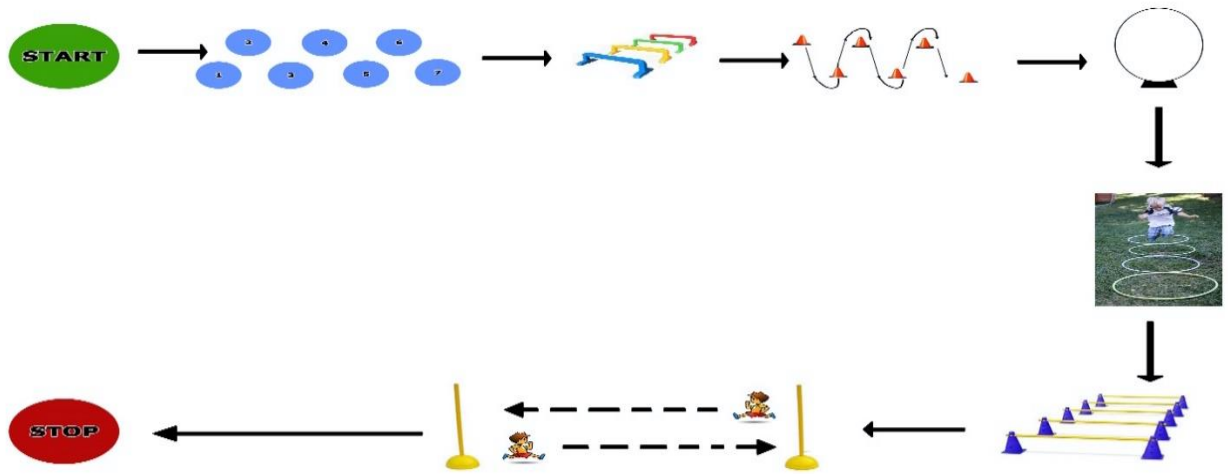
and post-test (after the experimentation). The researcher has focused on the quantitative aspect of the research study.

PA Intervention Programme

The physical activity programme was framed on the basis of PA guideline and national recommendation of PA for special children (DSM-V; treatments on autism; and the benefits of physical activity). The PA programme has been made in a well-organized structured form. All the activity were being conducted in the school activity arena (Hall, 15*10 meter squire)**.** The researcher had ensured that all the participants have medically and physically fit enough to engage in the activity with the help of a school nurse and Physiotherapist. The investigator has to assure that the presence of each parent and class teacher at the time of PA programme, detailed explanation and demonstration was made by the investigator to the teachers and parent at the beginning of the programme. Meanwhile, the investigator asked the parents to communicate with the children about the programme. Parents can assist the children if they needed and always be motivated during activity perform and engorged students after finished each session of programme. Indeed the ASD children have a high degree of motivation needed in fact, the people of ASD have problem with mood swings so that parents can only helping out the particular situation.

The PA programme has been classified in three specific phases 1, starting phase (warming up; 15 minutes) 2, major phase (main activity; 40 minutes) and 3, Limbering phase (cooling down; 5 minutes). Participants can start with green signal and end with red, and all the participants have completed all the station of exercise compulsory. In between the station of exercises, participants can either walk or jogging without breaking. Perhaps, all participants have to be completed in each station of exercise compulsory.

Figure II, *Diagram of PA programme*



1 to 3 weeks 3 repetition per individual; 4 to 6 weeks 4 repetition per individual;
7 to 9 weeks 5 repetition per individual; 10 to 14 weeks 6 repetition per individual.

The researcher, two-class teacher and each parent (mother) were companied in the entire PA programme. The total of 42 sessions of training lasts 14 weeks period, trice in a week Monday, Wednesday, and Friday.

Data collection methods

The quantitative aspect of the study protocol was applied in the present study. In terms of, data collection and methodology of the study have well established. All the data were collected by the researcher in the form of parametric. The assessment of the degree of Autism by used Indian Scale for Assessment of Autism (ISAA) at the beginning of the study. The primary data (DV) was collected in the three-phase such as Initial, mid-test, and post-experimental test. The repeated-measures ANOVA was used as statistical tools to find out the significant difference between IV and DV. The Bonferroni was used to assess the significant difference of the mean score among initial to mid, initial to post-test, and mid to post-test differences. All the statistical analysis was carried by the SPSS 20 and Microsoft Excel 2013.

Table II, *Descriptive analysis of gross motor skills among the participants*

Groups	**Locomotors skills**			**Object control skills**		
	Initial-test Mean / SD	Mid-test Mean / SD	Post-Test Mean / SD	Initial- test Mean / SD	Mid- test Mean /SD	Post- Test Mean / SD
Mild ASD	11.900 / 4.459	13.800/ 3.293	22.000/ 4.595	17.1000/ 3.635	22.400/ 3.748	31.666 / 4.301
Moderate ASD	10.300/ 4.112	12.100/ 4.201	18.300/ 5.397	17.500/ 5.681	20.700 / 5.271	28.900 / 3.872

Table III, Comparison of the different test results (initial test, mid-test and post-test) for each DV skill of children with mild autism

Skills	Test	Mean	Std. Deviation	F	df	Sig.	Pairwise comparison tests	ofSig.
Locomotors Skills	Initial	11.90	4.45845	52.66*	2	.000	Initial - Mid	.105^{ns}
	Mid	13.80	3.29309				Mid - Post	.000*
	Post	22.00	4.59468				Initial - Post	.000*
Object Control Skills	Initial	17.10	3.63471	60.51*	2	.000	Initial - Mid	.005*
	Mid	22.40	3.74759				Mid - Post	.000*
	Post	31.50	4.08928				Initial - Post	.000*

Note: *The Alpha level of 0.05, *Significant at 5% level, NS: Not significant*

The mean score, standard deviations, F-value, and P-value of locomotors skills and object control skills at different test categories are given in the Table1.

The F-value and P-value of the variable locomotors skills are 52.666 and 0.000 respectively. Since the P-value is less than 0.05, we conclude that there is a significant difference in the mean score of locomotors skills among the different test categories of children with mild autism. The post hoc test using Bonferroni correction shows that there is a significant difference in the mean scores of mid-test and post-test, and the mean scores of the initial test and post-test. Therefore, we can conclude that the exercise training programme improves the locomotors skills of children with mild autism.

Similarly, the F-value and P-value of the variable object control skills are 60.506 and 0.000 respectively. Since the P-value is less than 0.05, we conclude that there is a significant difference in the mean score of object control skills among the different test categories of children with mild autism. The post hoc test using Bonferroni correction shows that there is a significant difference in the mean scores of the initial test and mid-test, the mean scores of mid-test and post-test, and the mean scores of initial test and post-test. Therefore, we can conclude that the exercise training programme improves the object control skills of children with mild autism.

Table IV, Comparison of the different test results (initial test, mid-test and post-test) for each skill (DV) of children with moderate autism

Skills	Test	Mean	Std. Deviation	F	df	Sig.	Pairwise comparison tests	ofSig.
Locomotors Skills	Initial	10.30	4.11096	54.92*	2	.000	Initial - Mid	.015^{ns}
	Mid	12.10	4.20185				Mid - Post	.000*
	Post	18.30	5.39650				Initial - Post	.000*
Object Control Skills	Initial	17.50	5.68135	77.28*	2	.000	Initial - Mid	.014
	Mid	20.70	5.27152				Mid - Post	.000*
	Post	28.90	3.87155				Initial - Post	.000*

Note: *The Alpha level of 0.05, *Significant at 5% level, NS: Not significant*

The mean score, standard deviations, F-value, and P-value of locomotors skills and object control skills at different test categories are given in the Table2.

The F-value and P-value of the variable locomotors skills are 54.915 and 0.000 respectively. Since the P-value is less than 0.05, conclude that there is a significant difference in

the mean score of locomotors skills among the different test categories of children with moderate autism. The post hoc test using Bonferroni correction shows that there is a significant difference in the mean scores of the initial test and mid-test, the mean scores of mid-test and post-test, and the mean scores of initial-test and post-test. Therefore, we can conclude that the exercise training programme improves the locomotors skills of children with moderate autism.

Similarly, the F-value and P-value of the variable object control skills are 77.275 and 0.000 respectively. Since the P-value is less than 0.05, conclude that there is a significant difference in the mean score of object control skills among the different test categories of children with moderate autism. The post hoc test using Bonferroni correction shows that there is a significant difference in the mean scores of the initial test and mid-test, the mean scores of mid-test and post-test, and the mean scores of initial test and post-test. Therefore, we can conclude that the exercise training programme improves the object control skills of children with moderate autism.

Figure III, *Graphical representation of locomotors and object control skills of children with mild and moderate ASD.*

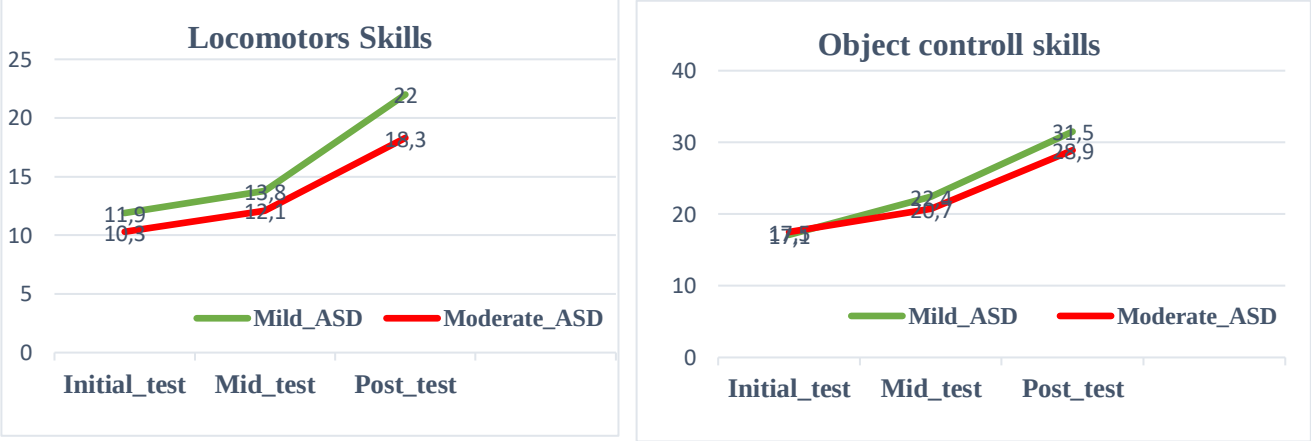


Table V, The group-wise comparison of gross motor skills (DV) among children with mild and moderate autism spectrum disorder.

Skills	Test	Autism type	Mean	Std. Deviation	t	df	Sig.
Locomotors Skills	Initial	Mild	11.90	4.458	0.834	18	.415[ns]
		Moderate	10.30	4.110			
	Mid	Mild	13.80	3.293	1.007	18	.327[ns]

			Moderate	12.10	4.202			
		Post	Mild	22.00	4.595	1.651	18	.116 ns
			Moderate	18.30	5.397			
Object Skills	Control	Initial	Mild	17.10	3.635	-0.188	18	.853 ns
			Moderate	17.50	5.681			
		Mid	Mild	22.40	3.748	0.831	18	.417 ns
			Moderate	20.70	5.271			
		Post	Mild	31.50	4.089	1.460	18	.162 ns
			Moderate	28.90	3.872			

Note: *The Alpha level of 0.05, *Significant at 5% level, NS: Not significant*

The group-wise comparison of locomotors skills of children with mild and moderate ASD. In terms of initial, mid and post-test the 't' value are 0.834, 1.007, and 1.651. The P-value is greater than the 0.05 (.415, .327, and 116) hens the t value shows that there is not a statically significant difference in group-wise comparison of locomotors skills. The object control skills t- value such as 0.188, 0.831, 1.460 respectively and all the t value are greater than the P-value (0.05) hence there is not a significant difference of group-wise comparison as well.

Discussion

The present study, the scholar had tried to investigate the benefits of well-designed physical activity intervention among children with ASD. The impairment of locomotors skills is very common among children with ASD (Berkeley et al., 2001; Memari and Ghaheri et al., 2013; Memari and Ghanouni et al., 2014; Memari and Ziaee et al., 2013). Perhaps, the investigator has fixed the structured physical activity intervention on gross motor skills development among children with ASD as a primary objective. Moreover, the investigator had tried to compare the group-wise improvements on DV due to impact on IV. Despite the majority of the scholars has revealed that PA programme is the key factor of all-round developmental process among the children specifically, children with ASD (Jansiewics et al., 2006; Minshew et al., 2004; Page & Boucher, 1998; Manjoiviona & Prior, 1995). Therefore, the researcher would be started with these statements and made a PA intervention on the baseline of the study objective.

The researcher has dealt with the quantitative aspect of the outcome rather than the qualitative outcome among the participants. For that, the study included specifically two groups of participants (Mild and Moderate ASD) on the basis of the degree of Autism (ratio of ISAA). The

specific target of the study dealt with the 14 weeks structured PA intervention on gross motor skills among Autistic children (ASD). In this study, demonstrate the substantial benefits for children with ASD through the PA intervention. In fact, ample studies were disclosed that improvement of health domains due to PA programme especially, children with ASD (Lang et al. 2010; Sowa & Muelenbroek 2012; Blair et al., 1989; Booth et al., 2000; Pate, Pratt, & Blair, 1995). Improvement of physical fitness and muscular strength (Andrew et al., 1979; Beasley, 1982; Bundschuh & Cureton, 1982; Fernhall, 1993; Frey et al., 1999; Nordgren, 1971; Pitetti & Tan, 1991; Pitetti et al., 1993; Rimmer, Heller, Wang, & Valerio, 2004; Schurrer, Weltman, & Brannel, 1985). The abundant literatures evident that pupil with ASD have numerous impairment in communication specifically, deficiency and delayed motor skills (Fournier et al. 2010; Hilton et al. 2012; Ming et al. 2007; Bhat et al. 2011; Leonard et al. 2014; Liu 2012; Lloyd et al. 2011; Shetreat-Klein et al. 2014; Teitelbaum et al.1998; Baranek, 1999; Ornitz, Guthrie, & Farley, 1977; Dewey, Cantell, & Crawford, 2007; Fournier et al.,2010; Hallett et al., 1993; Jansiewicz et al., 2006; Mostofsky et al., 2006; Noterdaeme et al., 2002; Srinivasan et al., 2013). Therefore, in this study investigator tried to get improvement on motor skills through structured PA intervention moreover, the investigator had achieved the study objectives as well. The study has been implemented positive outcome and the study result shows that the locomotor skills development of children with mild and moderate ASD due to the impact of structured PA intervention (Catama et al., 2017; Sallis et al., 1997; Sorensen & Zarrett, 2014; Houwen, Hartman, & Visscher, 2009; Bremer, Balogh, & Lloyd, 2015). The following 12 weeks physical activity intervention of children with ASD has proved significant improvement of gross motors skills and especially, the object control skills have been improved (Berkeley et al., 2001; Green et al., 2002; Mayes et al., 2007). According to Schalthesis et al., 2000 has revealed that improvement of socialization and increased motor skills through the regular participation of physical activity for children with ASD. Perhaps, reduced negative emotions and avoided isolation through regular activity play & PA intervention (Houwen, Hurtman & Visscher, 2009; J. Muller et al., 2009).

The secondary objectives of the study which deals with examining the group-wise comparison of gross motor skills. Although, there was a significant improvement in gross motor skills through the PA intervention. In terms of group-wise comparison (Mild GP & Moderate GP) tables revealed that there were no significant differences. Some of the scholars believed that severity of Autism and imitation of skills are highly correlated but later study proved that gross motor skills have did not correlated with Autism severity (Ditza A et al., 2010; Kaur, Srinivasan, & Bhat, 2018). Moreover, many of the other benefited were observed by the investigator due to structured PA programme. Eversol M et al., 2016 has identified self-enjoyments through PA participation. The structured PA programme has been delighted to improvement many other factors rather than the GM development. Benefited of healthy outcome (Blair et al., 1989; Booth et al., 2000; Pate, Pratt,& Blair, 1995) reduced stereotypical behavior of children with ASD (Bahrami et al. 2012; Sorensen, C., & Zarrett, N.2014; Elliot et al., 1994; Yilmaz et al., 2004; Levinson & Reid, 1993; Prupas & Reid, 2001). The PA programme could be provided to the participants can improve social and behavioural changes. Many of the social changes were noticed by the researcher through PA participation such as team cooperation, given high-five to the teammate and parents.The repetitive behavioural changes could not be counted in this study, in fact, the teachers, parents and

investigator had observed some of the tremendous changes like reduced hand-flapping, screaming, and self-injurious behaviour while participating. Indeed reduced stereotypical behaviour due to play or structured PA programme (Wolfberg P, 1999; Anderson-Hanley, Tureck, & Schneider man, 2011).

Conclusion

Structured regular physical activity as a key factor of children's all-round developmental process of today's society. Unfortunately, the participation of Physical Activity program for children with ASD has faced more challenging and difficulties. In the present study, deals with offered Structured PA programme for children with ASD and investigator had tried to provide equal opportunity for all the participants. The purpose of the study was to examine the influence of structured physical activity interventional programme on gross motor skills of children with mild and moderate Autism. In terms of locomotors skills of children with mild (52.666*/ P-value 0.05,) and moderate (54.92* /P-value 0.05) autism have significantly improved due to 14 weeks structured PA programme. The object control skills such as mild (60.506*/ P-value 0.05) and moderate ASD (77.28*/ P-value 0.05), it has shown the significant differences due to 14 weeks structured PA programme. Moreover, the overall gross motor skills development has been taken place due to the structured PA programme for children with mild and moderate ASD. The researcher had failed to find out the significant differences between the mild and moderate ASD in terms of locomotors and object control skills due to the 14 weeks structured PA programme. Although the result of the study has to be provided significant improvement in gross motor skills due to PA programme

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