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THE EFFECT OF BALANCE AND STRENGTH TRAINING ON BALANCE IN AUTISM SPECTRUM DISORDER: A FEASIBILITY STUDY

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ABSTRACT

Objectives: *The objective of this pretest/posttest research study was to find the effect of balance and strength training on balance in autism spectrum disorder.*

Background: *Balance and stability are required to carry out activities of daily living. However, this stability is challenged in autism spectrum disorder, Autistic children lose their balance earlier and are more disturbed in their dynamic balance than normal children, which made them prone to falls. To help achieve balance and stability in autistic kids, certain balance exercises have been designed. This research study focuses on feasibility of these exercises along with strength training and how effective it is in improving balance in autistic kids by comparing the pre and post results of modified timed up and go test (mTUGT) and pediatric balance scale (PBS).*

Methods: *A feasibility study was conducted at The Autism Jewel Peshawar. A sample of 19 participants was selected based on the inclusion criteria that was both male and female participants, age 5-15 years, clinically diagnosed autism spectrum disorder, Paediatric balance scale score less than 45, Timed up and go score greater than 6.7 seconds, Able to walk/ high functional. The modified TUGT and PBS were checked pre and post exercises application for any improvement. Data of 18 participants after a period of 4 weeks was obtained as the remaining 1 was the kid who dropped out of the research study. The data was analysed using SPSS version 23.*

Results: *The mean age for this study was 6.97 years±2.17, of which 77.8% were boys and 22.2% were girls. The mean pre- modified TUGT was 11.05 seconds±1.86 seconds and mean post- modified TUGT was 8.33seconds±1.74 while the mean pre-PBS was 40.50±2.74 and post PBS was 50.50±4.50 at 95% confidence interval the results were statistically significant.*

Conclusion: *The results of this pre/post-test design study propose that balance and strength training can improve balance in ASD population. By comparison of the results to the proposed effectiveness in different research studies we conclude that our results were statistically significant.*

Keywords: *Autism Spectrum Disorder, Balance, Diagnostic and Statistical Manual of Mental Disorders, Dynamic Stability, Paediatric Balance Scale and Static Stability.*

Introduction

Eugen Bleuler (In 1911) coined the term "Autism" from a Greek word "autos" meaning Self. The original term refers to a fundamental interference with schizophrenia, which is to separate from the outer reality with a relative or absolute predominance of the inner life [1]. Autism was systematically introduced by Kanner in 1943, and Asperger in 1944, they find it a neurological origin disorder with abnormalities in brain regions coordination, due to frontal-posterior brain underconnectivity, with some genetic and non-genetic risk factors [1-4]. It is a "spectrum disorder," a persistent neurodevelopmental condition having varying degrees and combinations of symptoms like memory, attention, spatial processing, reasoning, language, and motor skill impairments across the individuals [3, 5-8]. There is about 1% prevalence of autism worldwide [21]. According to the World Health Organization (WHO), globally there is an average number of children having autism spectrum disorder that is 1 in every 150 [16]. According to Centers for Disease Control and Prevention (CDC), an average of about 1–2% of population is being diagnosed with autism [29]. Autism now a days is identified as the most common pediatric problem in United States affecting 1 in 68 children [9, 12, 30-32]. A review of 24 studies shows pooled prevalence of autism in Chinese children is 24.5 per 10,000 [33], while among European countries its prevalence is 1 in 87 for aged 7-9 years [34], and in ASIA according to a systematic review, the prevalence rate 1 out of 93 in South ASIA [35]. 1st time in 2018, a study in Karachi showed autism prevalence in Pakistan to be 1 out of 120 [36], with males being more likely to be diagnosed with autism than females (2, 7, 16, 36-39).

Methodology

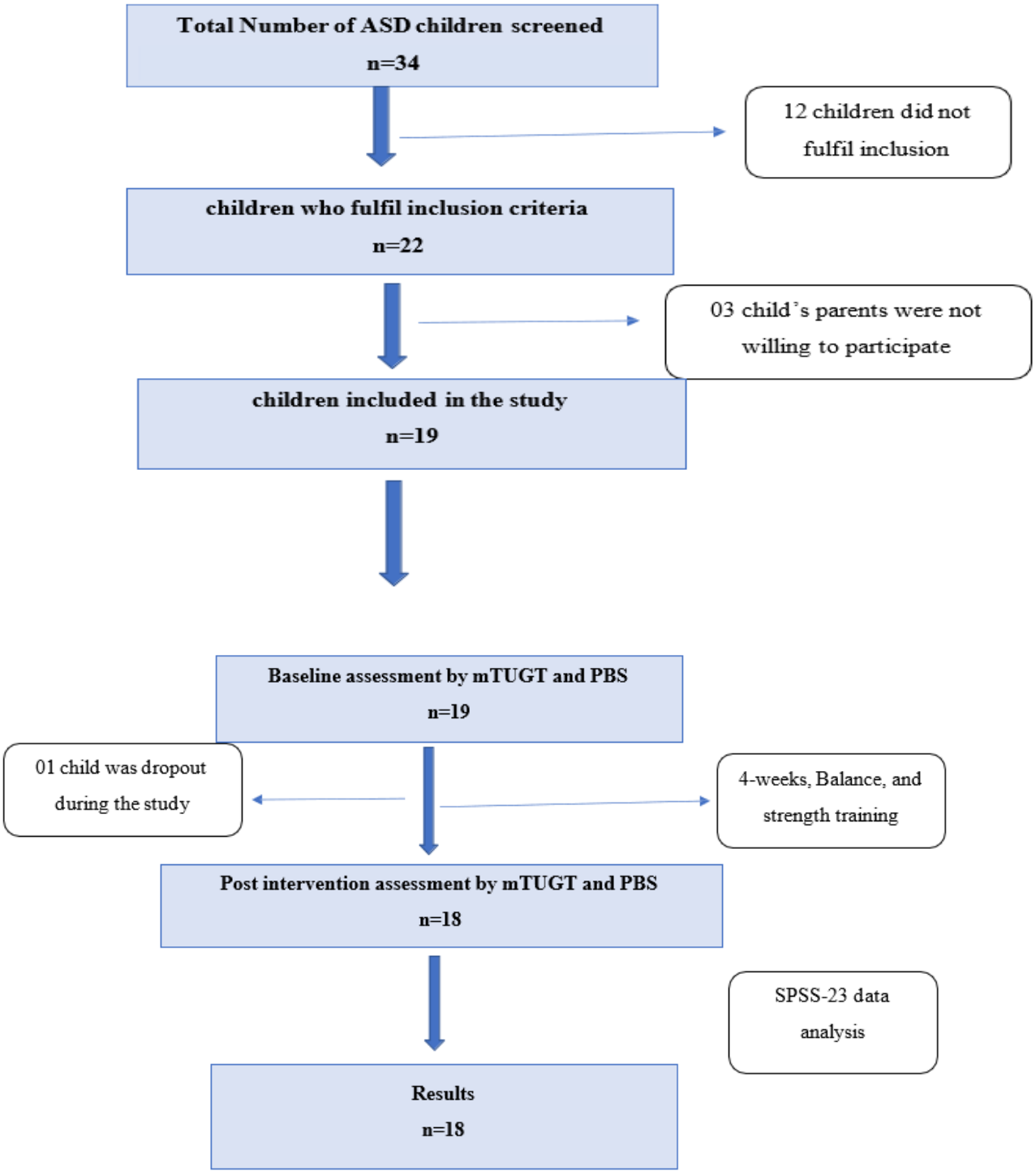
First ethical approval was obtained from the ethical committee of Khyber Medical University (KMU) Peshawar and permission from the center owner. Children with autism spectrum disorder in the center were screened based on diagnosis for eligibility. Eligible participants were assessed after parental consent. Their parents were explained about the study in detail after which the pre intervention results for PBS and modified TUG test outcomes were recorded. All the autistic children in the center were included.A pre/posttest study design was used

Inclusion Criteria

1. Clinically diagnosed autism spectrum disorder by pediatrician and psychologists.
2. Age 5-15 years
3. Both male and female
4. Pediatric balance scale score less than 45
5. Timed up and go score greater than 6.7 seconds.
6. Able to walk/ high functional

Exclusion Criteria

7. Pediatric balance scale score greater than 45
8. Conditions apart from autism spectrum disorder
9. Resent trauma or fracture
10. Having physical disability / significant physical impairments
11. Use of assistive/orthotic devices


Total Number of ASD children screened
n=34
12 children did not fulfil inclusion
children who fulfil inclusion criteria
n=22
03 child's parents were not willing to participate
children included in the study
n=19
Baseline assessment by mTUGT and PBS
n=19
01 child was dropout during the study
4-weeks, Balance, and strength training
Post intervention assessment by mTUGT and PBS
n=18
SPSS-23 data analysis
Results
n=18

Results

Table 4: Gender Wise Measurement of Variables (Means ±SD)

Variables	Male (Mean ±SD)	Female (Mean± SD)	: (Mean± SD)
Age (years)	7.08±2.39	6.60±1.25	6.97±2.17
Weight (kg)	28.64±10.60	31.75±36.71	29.33±10.11
Height (cm)	120.37±15.20	109.85±4.98	118.03±20.85
Pre-TUGT Score	11.50±1.69	9.50±1.73	11.05±1.86
Post TUGT Score	8.64±1.78	7.25±1.25	8.33±1.74.
Pre-PBS Score	40.28±2.99	41.25±1.70	40.50±2.74
Post PBS Score	49.78±4.79	53.00±2.16	50.50±4.50

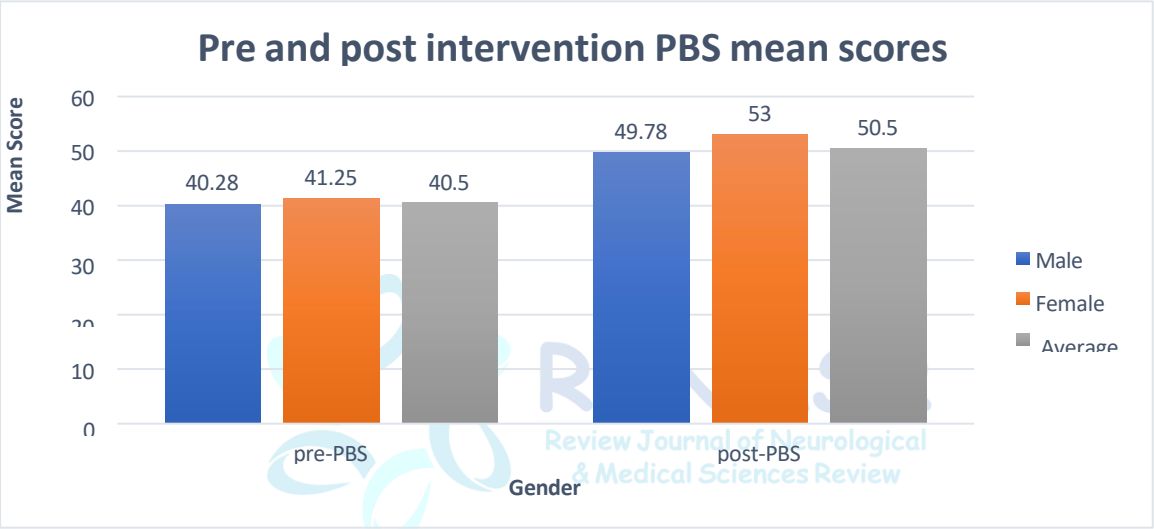


Figure 2: Showing post and pre intervention PBS scores for data

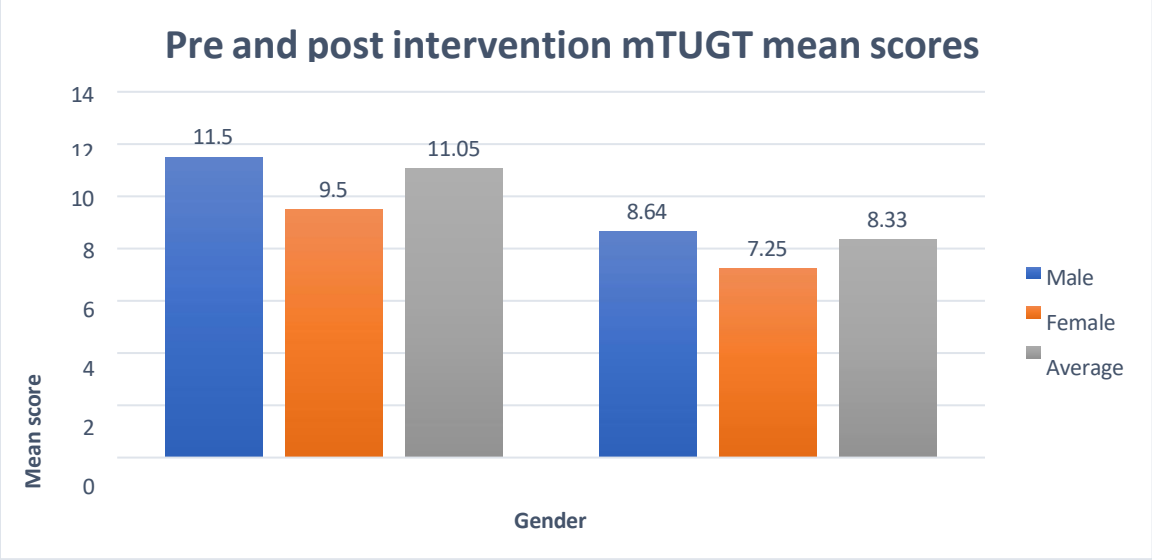
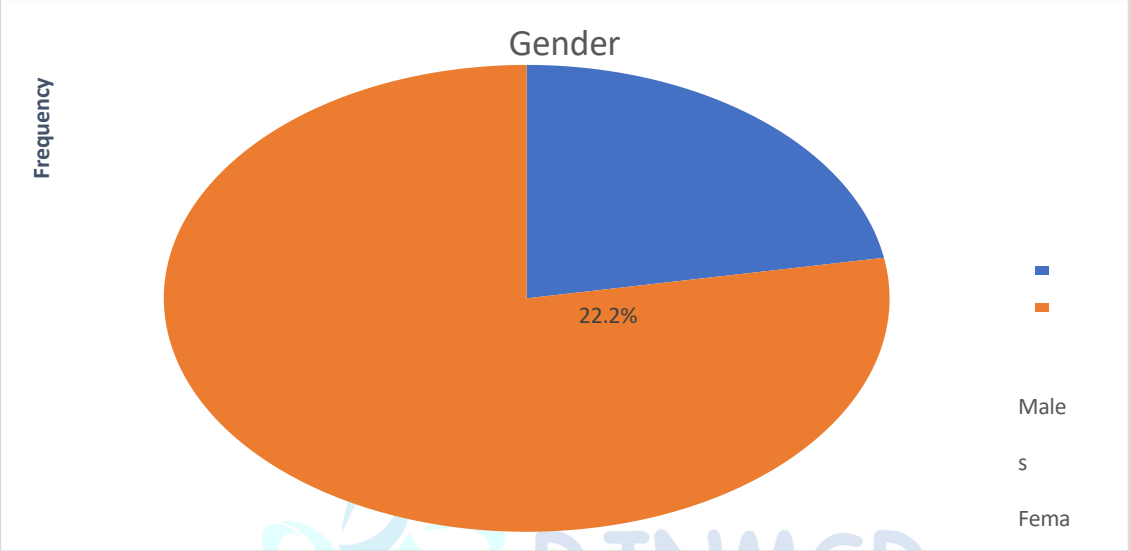


Figure 3: Showing post and pre intervention mTUGT scores for data

Table 6: Shows the Frequency and Percent of Gender in Total Sample.

Gender					
		Frequency (n)	Percent	Valid Percent	Cumulative Percent
Valid	Male	14	77.8	77.8	77.8
	Female	4	22.2	22.2	100.0
	Total	18	100.0	100.0	

Figure 4: Pie Chart showing the gender wise distribution of the data



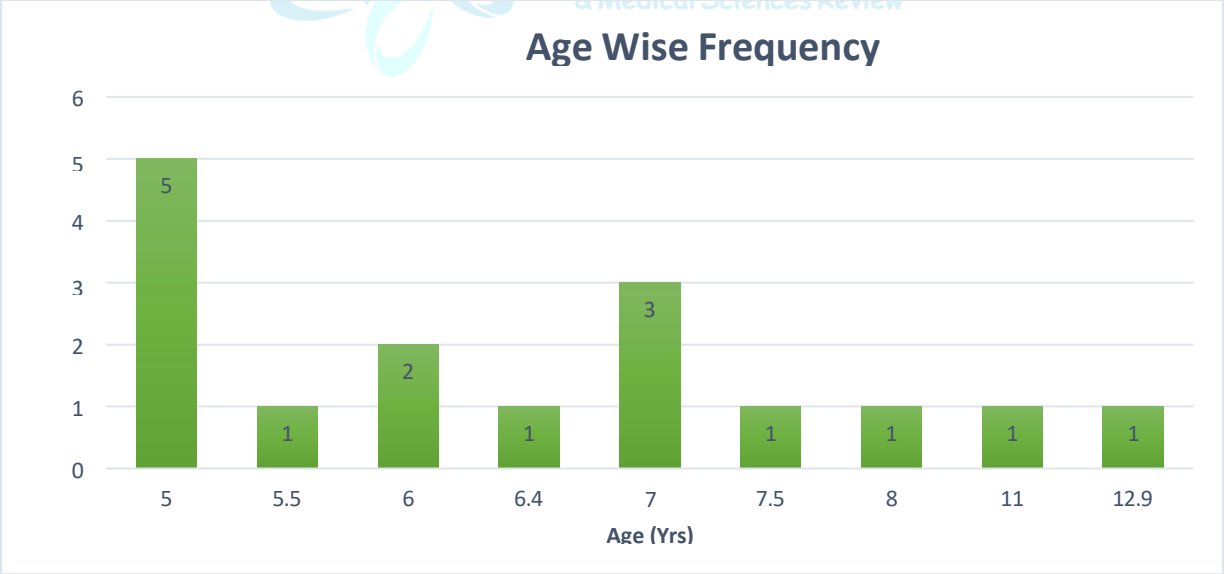


Figure 5: The Age Wise Frequency in ASD 18 Patients.

Table 7: Shows normality test for Pre and Post modified Timed up and go test (TUGT) and Pre and Post Paediatric Balance Scale (PBS).

SHAPIRO WILK TEST			
	STATISTICS	Df	SIGNIFICANCE
Pre mTUGT	.959	18	.582
Post mTUGT	.866	18	.015
Pre PBS	.834	18	.005
Post PBS	.769	18	.001

month time span.

Table 8: Wilcoxon's Rank Test Applied to Compare the Baseline Score of the Two Outcome Measures with the Follow Up Score.

Pre and post tests	N	Mean Rank	Sum of Rank
TUGT–Pre mTUGT Negative ranks			
Positive ranks			
Ties	18^a 0^b 0^c	9.50	171.00
Total	18	.00	.00
Post PBS – Pre PBS Negative ranks			
Positive Ranks			
Ties	0^d 18^e 0^f	.00	.00
Total	18	9.50	171.00

4.6- Spearman's Correlation Test:

Table 9: Spearman's correlation of age with mTUGT and PBS before and after exercise application.

	Pre mTUGT	Post mTUGT		Pre PBS	Post PBS
Age 6.97					
Correlation coefficient	-.197	-.343		.712**	.573*
Significance 2 tailed	.433	.164	.001		.013
N	18	18		18	18

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Discussion

This single group pretest/posttest study examined the effect of various balance exercises incorporated with strength training on balance control (both the static and dynamic) over a period of 4 weeks in autistic children. Comparing the result findings of this research study to those of other studies and find the similarities and differences respectively. As known that balance is a fundamental component of the physical function and is a lifelong skill to maintain centre of mass with reference to centre of gravity/base of support [38, 57]. As mentioned before a lot of research work has been done to find whether coordination, static and dynamic balance can be improved by balance and other exercise related training programmes [37]. This research has focused on the feasibility that how balance and strength training can help the static

postural control and dynamic balance in autistic kids when specific exercises are given. This study results interpreted that there was significant improvement in the post intervention balance in autistic children by these exercises and balance trainings, measured by PBS and the post intervention time was significantly reduced for mTUGT.To compare the correlation coefficient of age and the outcome measures in both pre-post mTUGT and pre-post PBS a research study was conducted in California where they assessed for relationship between the outcome measures with dynamic balance, gender, and age. For analysis applying the Spearman's correlation test between TUG test and PBS (dependent variable) and age, weight, and height (independent variable). They found age as a strong influencer for TUGT and PBS scores, and negative correlation between age and TUGT [(83)]. The results strongly support my study interpretations. In my study results age was negatively correlated with mTUGT and positively correlated with PBS scores. However, comparing it to our results there are many variations as the age range was 5-12 years, sample size was 160, participants were typically developing, and the study was an exploratory study.By Katerina Chomoriti (2021) in Greece a case control (pretest/posttest) study which aimed to investigate the effect of traditional dance training on balance in primary school ASD children. Nineteen students were randomly assigned into treatment group (ten students) and a control group (nine students). The 4-weeks training was their traditional dance, after training when they assessed static, dynamic, and functional balance. The training group showed improvement in dynamic and functional balance but not significant improvement in static balance, so dance (a creative process in which whole body move within time and space) can be a feasible and free of cost intervention for ASD children, enhancing their dynamic balance [(38)]. The result findings about the balance were also that balance increased by training, strongly supports my study findings. The reason could be that both studies have four weeks sessions of same time, sample size was equal at baseline assessment, number of boys are ¾ of sample size, more over one of balance tool was same that is TUGT.A pre-test/post-test quasi experimental study conducted on 13 autistic girls, the study has 1- week sports and exercises training, the effect was significant in improving motor skills and physical fitness and self-control [(93)]. This study supports my research work that physical fitness can help in improving balance. Sarvin Salar (2014) conducted research on ASD boys, to find the core strength and balance relationship. Thirty-two participants with age six-ten years were selected for the study by accessible method of sampling. After measuring both dynamic and static balance, hip external rotators and abductors strengths, results were analysed. The results showed that there was a significant relation of dynamic balance with core strength but there was no relationship between static balance and core strength [(4)]. This study comprehends my study results that core strength play a major role in balance, so by giving strength training along with balance can increase balance score as observed in my study. A very recent interventional study in Ireland was conducted to know the effect of physical exercises on anxiety in school going autism children, sixteen-week exercises including stretching, jumping, kicking, catching throwing activities in school. Age range of these 24 children was 5 to 18 years and frequency of exercises were three sessions per week. Analysis was the result of assessments at three stages pre intervention at end of 8th week and post intervention and anxiety rating scale responses by teachers and parents of these children. There was no significant change in anxiety by parents at end of intervention while the teachers' responses showed significant reduction in anxiety at school [(19)]. Comparing in terms of result this study supports our study results that physical exercises are helpful for autism children in their school or therapy settings and leading to overall fruitful results in these kinds of special children life. Both studies have frequency of exercises 3 sessions/week.A RCT conducted by Clare C. W. Yu to investigate the effects of supervised exercises on 112 autistic children. The exercises were based on games and given in 3 circuits per training session. Two groups containing fifty-six children each. Th experimental group were introduced with exercises for sixteen-weeks (32 sessions),

followed by thirty-two weeks follow up. After assessments and follow up data analysis showed evident increase in fitness and motor skills while reduction in ill behavior stereotypical symptoms [23]. This study supports my study regime as exercises do improve motor skills and balance and helps in improving behavior issues. A Meta analysis done by Ka-Lam Sam in China for finding evidence-based exercises and interventions in ASD population, to know the exercises regimes and post exercises benefits in autism spectrum disorder kids. This review included 5 studies consisting of 125 participants. 56 and 69 children in control and experimental groups respectively [24], This study had mean age 6.95 year, one study had 1 month intervention sessions while one of these studies showed number of training sessions equal to my study i.e., 12 session and their minimum age was also 5 years. This meta-analysis result interprets, that evidence-based exercises interventions do have positive effect on exercise mastery and early intervention of these exercises can lead to better motor coordination, which is in favour of my study that exercises can improve balance score as well as motor coordination.

Conclusion

The results of this pre/posttest design study propose that balance and strength training can improve balance in ASD population. All the participants in my study were with autism spectrum disorder diagnosis. The results interpreted in this study provide an explicit answer to the research queries mentioned in the introductory chapter of this appraisal/ thesis.

- Among the selected children meeting inclusion criteria there was significant improvement in balance scores on post pediatric balance scale assessment and decreased in time scores for post-test assessment of timed up and go test.
- Yes, balance and strength training are feasible and have very positive effect on their health both for hyperactive and hypoactive children the result was good. Exercises not only improve their coordination and core stability but also improve their excitement level, help them in better utilization of energy and they do perform well in other session like speech and behavior therapies.

We concluded after critical analysis and discussion of this study that different types of balance training in ASD children not only improve their balance but also help to improve their learning skills, motor coordination, agility, fitness and reduce stereotypical and other behavioral issues. Through task trainings based on class or group is highly effective for ASD children learning and socialization. So, with higher patient to therapist ratio the group-based training can be more efficient way of delivery of rehabilitation to many children and can be incorporated into the everyday practices at rehabilitation settings. This effective and feasible training program should be promoted as treatment strategy among autism spectrum disorder. The conclusion of this analysis can be worked over to inculcate the practice of physical therapy exercises in autism rehabilitation plane along with other therapies to increase the outcomes, these exercises can be applied as part of their fitness program, the balance should be targeted in autistic kids that requires rehabilitation services to reduce their chances of fall and improve the quality of life. These exercises program implementation by multidisciplinary healthcare team can facilitate the rehabilitation protocols to be used feasibly in the community. Moreover, further research has been suggested keeping in view the limitations of the current study. More focus should be done upon defining and planning physical therapy exercises for strength and balance trainings to be suggested by the health care therapist towards ASD patients. While working with autistic children we need to be familiar with them first, lights and noise in the clinical settings, number of people, materials and color choices should be known. Reinforcers, teaching methods, awareness about different behaviors and control strategies, and taking care of children routines are major things to be kept in mind while performing exercises/therapies for acquiring better results.

Strengths of Study

According to the author's apprehension and knowledge, this is the 1st ever study of its type that has been carried out to show the effect of balance and strength training on balance in autism spectrum disorder in the region of Peshawar.

Limitations

- This research study has been conducted on autistic children only thus results cannot be generalized to pediatric population and the small size of the sample may hinder the generalizability of the analysis and results in autistic population.
- This study was conducted in only one center, so it may not present a uniform distribution of overall autism patient distribution in the region.
- The exercise sessions were limited to 4 weeks that was not enough to achieve the effect that was prospected.
- The time duration for this study was short.
- The study did not recommend physicall therapy strength and balance training to any of the participants to reduce autism severity or symptoms.

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