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Application of physical therapy exercise to special school adolescent students with increased BMI, to improve balance and jumping performance

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Abstract

Introduction: Balance difficulties result from reduced mobility, and reduced activity, leading also to obesity occurrence in children and adolescents with Neurodevelopmental Disabilities.

Purpose: This study's is to investigate Physiotherapy Exercise's effects on the components of balance and jumping agility in adolescent students of Special Schools.

Methods: 24 special education students, age 13-20, were divided into two groups, a Control Group with Body Mass Index (BMI) mean 23.99 ± 8.56 kg/m^2 with and Physiotherapy (PT) Exercise group with BMI mean: 35.03 ± 10.89 kg/m^2. The rehabilitation program included balance exercises, coordination task exercises, core strength and ball exercises. Intervention lasted 2 sessions per week for 3 months, 45 minutes each. Participants were evaluated with balance, agility and coordination tasks before and after the experiment process.

Results: The results were analyzed in by using SPSS program. Groups differed significantly from each other in terms of Body Mass Index. Control group performed better on all tests in the first evaluation phase. There was significant improvement in both groups. PTE Group increased percent change (Mean >15%) in post-intervention tasks performance.

Conclusion: Balance and agility improvement is affected by weight gaining factors. Physiotherapy exercise benefits balance and jumping ability improvement, when it comes to special school adolescent students with increased (BMI). More research needs to be conducted for a comprehensive perspective.

Keywords: Adolescents; Special Education Schools; Balance; Agility; Jumping Skills Increased Body Mass Index; Physiotherapy; Therapeutic Exercise

1. Introduction

Modern daily living, with sedentary work and recreational activities, unhealthy foods, imbalances between nutrition and exercise and reduced activity lead to weight gain, increasing the obesity occurrence (Kumari et al., 2022). Childhood obesity has grown rapidly in recent years, risen to over 30% in the children and youth population, while it is estimated that by 2030 there will be over 300 million obese children and adolescents worldwide (Buro et al., 2022; Lobstein & Brinsden , 2019; Abarca-Gómez et al., 2017). Reinehr et al. (2010) described that obesity risk is doubled in adolescents with neuromuscular and neurological disorders, coexisting with feeding disorders, reduced exercise activity, pain

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developed due to motor or posture impairment, and self-estrangement from community due to reduced self-esteem related to disability (Haegele & Maher, 2021).

Balance difficulties result from reduced mobility, low processing ability of environmental sensory stimuli, reduced executive functioning and also low ability of visuomotor and low limb coordination (Kaupuzs & Larins, 2017; Westendorp et al., 2011). Insufficient balance may reflect in Core Sway, described as increased trunk deviations due to change in the position of Body's Center of Gravity (Lipowicz et al., 2019; Peterka & Loughlin, 2004). Immature motor and balance reactions, combined with an uncoordinated swaying trunk increase the risk of fall in the young population with physical and/or mental disabilities. This phenomenon persists into adulthood, further discouraging involvement in physical activity (Enkelaar et al., 2012).

Recent physical exercise instructions by the World Health Organization for disabled children and adolescents, aged 5-17 years, recommend moderate-to-vigorous aerobic training 60 minutes of daily activity per week, combined with limiting sedentary screen time on electronic devices (WHO, 2020). Physical Therapy (PT) exercise planning aims in creating a personalized approach, based on the developmental level, benefiting also the cognitive and emotional maturation of the child/adolescent. Functionality and mobility may also improve, benefiting in some cases the disabled young to maintain independence in daily or in social activities (Pratt & Peterson, 2015; Houtrow & Murphy, 2019; Gallahue & Donnelly, 2007; Winnick & Porreta, 2017, Papadopoulou et al., 2024).). Taking the aforementioned data into account, we designed and implemented a physical therapy exercise program addressed to adolescent students with neurodevelopmental disorders and increased Body Mass Index, in order to investigate the effect of PT exercise on balance and agility.

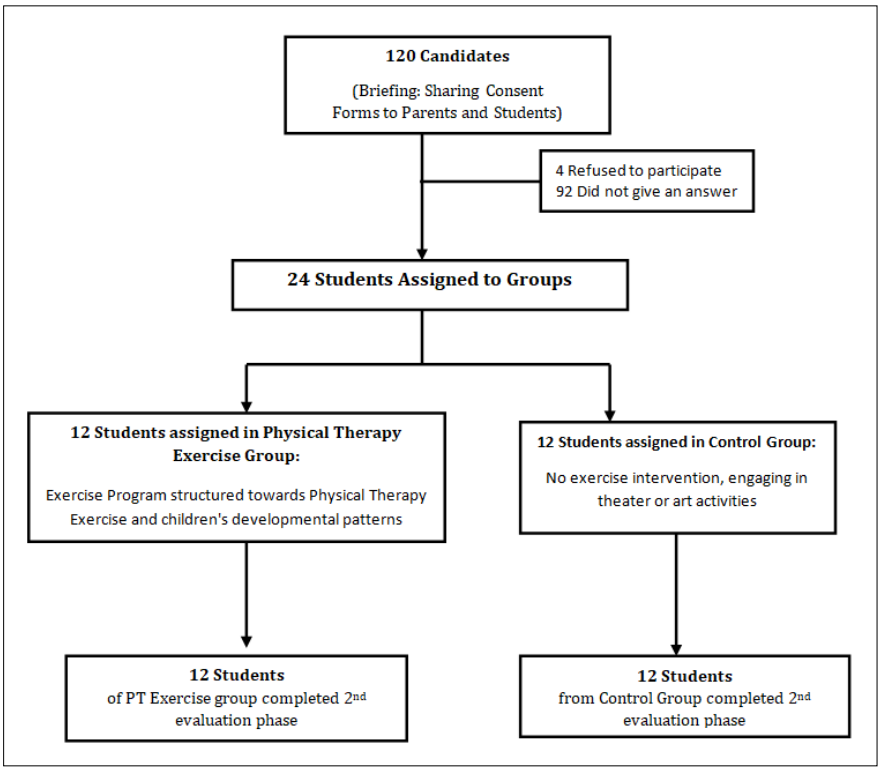

Figure 1 Selection process of the participants and allocation to groups.

2. Methods

2.1. Participants

Twenty-four teenage students of a Special Vocational High School in Eastern Thessaloniki joined the research program "Pediatric Physiotherapy" conducted by the International University of Greece's Physiotherapy Department. The aim was to investigate Physical Therapy (PT) Exercise's effect in balance and jumping capability of Teenage Special School Students. 120 information and consent forms were distributed to students including the details of the research. Inclusion criteria were (i) written consent of at least one parent/guardian, (ii) student's willingness to participate, (iii)

the ability to cooperate and follow instructions. The students were divided based on their educational activities into an intervention group with members who organized school holidays and into a Physical Therapy (PTE) exercise group. Selection process of the participants and group allocation to group is described in Diagram 1. Somatometric Characteristics for each group is described in Table 1. Disability or pathological conditions is summarized in Table 2.

For data collection, performance was recorded in various tests regarding the control of balance and jumping skills, by an unblended assessor, who did not involved in intervention process. Tasks focused on balance, walking, jumping and strength exercises were measured, for recording student performance. The purpose was to measure skills required at daily functionality or at training regimens. Materials used for those tasks were, tape measure, wide tape (5cm), hoop (diameter 55cm) for the one leg jump test, a chair, cones for distance marking and a stopwatch application.

Table 1 Somatometric Characteristics for PT Exercise and Control Group

Somatometric Characteristics	**PT Exercise Group**		**Control Group**		**Between Group Comparison**
	Mean ± SD	**Homogeneity (p)**	**Mean ± SD**	**Homogeneity (p)**	**p value**
Gender (boys/girls)	9/3	< 0.001	7/5	0.478	0,375 (t)
Middle/High School	6/6	< 0.001	8/5	<0.001	< 0,001 (t,MW)
Age	15.89 ± 1.81	< 0.001	16.15 ± 1.76	<0.001	0,142 (MW)
Heigh (cm)	162.04 ± 10.25	< 0.001	164,44 ± 11.44	<0.001	0,012 (MW)
Weight (kg)	91.90 ± 29,20	0.412	64.89 ± 21.78	0.496	< 0,001 (t,MW)
BMI	35.03 ± 10.89	0.319	23.99 ± 8.56	0.033	< 0,001 (t,MW)

*T-test of independent variables and Mann-Whitney (MW) test were used for data comparison. One-side ANOVA was used to measure homogeneity.

Table 2 Condition of the Participants

Conditions of Participants	**PT Exercise Group**	**Control Group**
Down Syndrome	1	0
Central Nervous System Dysfunction	2	0
Autism Spectrum Disorder	5	5
Attention Deficit Hyperactivity Disorder	5	9
Speech - Language Impairment	5	6
Vision Impairments	1	1
Mild Mental Retardation (IQ 56-80)	5	3
Moderate Mental Retardation (IQ 35-55)	6	1
Depression - Anxiety	0	2
Obesity	10	2

2.2. Evaluative tasks

2.2.1. Walking and speed performance Evaluation

Timed Up & Go Test (TU&G): A chair and a cone were placed, in 3m (10 feet) distance. Each participant started the test sitting on the chair. Given the signal, they walked towards the cone, turned clockwise, then returned and sat on the chair. Three attempts were recorded of which; the attempt with fewer seconds was used in analysis. **25 meter sprint:**

Two cones were placed in 25m distance. The timekeeper stood at one point of the route and the student at the opposite point. With the corresponding sigh (vertical lowering of the hand) the student started sprinting. Two attempts were recorded of which the fastest attempt was used in analysis. **Passing through lines at the floor:**. Each examinee had to walk on a tape strip (6m long, 5cm wide) placed on the ground, without deviating from the line. Steps outside of straight lines were recorded. Afterwards, a tape similar in length and width was placed on the ground in parallel with the first, at 15cm distance. Each examinee had to pass between the two lines without stepping at top or out of the parallels. Steps outside the limits were recorded and counted.

2.2.2. Power performance evaluation

Power is defined as Force x Velocity (P = F × V) (Tsaklis, 2010). Therefore, increase in repetitions of an activity (increase in velocity of application), will result in power increase. We measured repetitions performed within 30 seconds for (i) abdominal crunches, (ii) sit-ups, and (iii) knee push-ups. For abdominal crunches, students laid on a yoga mat, from a supine position, lifting the trunk off the floor repeatedly. Knee push-ups were applied from a prone position on the mattress, while bending the knees. For Sit-Ups students were starting from standing position, with arms stretched forward and lowering trunk weight towards the floor, also forming ≥120^{o} knee-angle

2.2.3. Jumping Performance and Balance evaluation

Long jump: Each examinee had to stand with their heels on a line taped on the ground, to perform a long jump farther from the mark. Distance was measured in centimeters for three attempts; and only the longest jump attempt out of three was used in data analysis.

Single-legged jump, timed: Each examinee performed consecutive single-leg jumps, within 15 seconds of time. Insufficient separation of the heels from the ground when jumping, were not counted. The attempt with the highest jump repetitions out of two for each leg, were used in analysis. Single-legged jump in designated space was a modification to measure the quality of jumping. Each participant had to perform 10 consecutive jumps on each leg, in a wreath (55cm diameter) placed on the ground. Jumping on top or outside the limits of wreath and also insufficient separation of the heels from the ground when jumping was not counted in the final score for data analysis.

For static balance evaluation, single-leg stance time was recorded (in seconds) for eyes opened or closed. Time recording stopped when the examinee managed to maintain the position for ten seconds, or when failing to maintain single-leg position (returned to double leg stance). Two attempts were recorded for each leg of which; the maximum timing holding into position was used in analysis.

2.3. Intervention

Intervention lasted for 12 weeks, with 45-minute sessions, twice a week, during the gym class. A Physical Therapist was giving advice and exercise plans to two Physical Education instructors. Exercise consisted of 5-10 minutes warming up, main physical therapy exercise program lasting 30-35 minutes and 5 minutes of recovery. Exercise was carried out in open space or inside the gym lobby, according to weather conditions. Adolescents of PT Exercise Group followed a physiotherapy exercise program adapted to their motor and functional needs. Control Group Adolescents dealt with artistic activities, such as painting, music, theater and the organization of festive events. Intervention elements are described on Table 3.

Table 3 Elements used in Physiotherapy Approached Exercise planning.

Warm-Up Phase	**Jogging / Fast Walking**	**3-5 minutes, 40% HRmax**
	Stretching: 3 stretch tries x 10'' seconds	Muscle Groups: Pectoralis Major Stretch, Hamstring Stretch, Gastrointestinal Stretch, Adductor stretching, Dorsal Stretch
Main Exercise Program	Ball games	(i) Kicking a soccer ball from various positions, (ii) Dribbling a basketball while standing or moving (iii) Exercise in pairs: Passing the ball to the opposite teammate: a) by kicking a soccer ball, b) passing a volleyball with both hands, c) Hemsball type ball-shooting, after bouncing on a hoop

	Circuit Training Elements:	(i) Passing a low-height obstacle route; (ii) Walking on raised platforms; (iii) Jumps in hoops; Obstacle jumping (iv) Crossing in a path "of eights " between cones: Walking a path while walking, running, kicking a soccer ball or dribbling a basketball (v) Walking in a Lined path, or between parallel Lines: Zigzag paths, maze-type, or meander-type paths, depending on the requirement of the requested exercise.
	Core strengthening exercises	1 set per circular pass x 5-7 times: Push-Ups; Sit-Ups; Dorsal and Abdominal Crunches on mattress
Recovering Phase	Breathing Exercises Hristara-Papadopoulou et al, 2014, a,b)	(a) Raise the upper limbs with inhalation, bend the core while exhalation: Inhale for 3 seconds, Hold breath for 5 seconds, Exhale for 7 seconds. 3 repetitions per exercise; (b) Circular movement: Lifting upper limbs with inhalation, horizontal abduction position with elbows at 90o angle. Breath hold, connecting hands with clapping; (c) Horizontal abduction of the upper limbs by inhaling, exhaling by hugging the chest (horizontal adduction) and simultaneously bending the neck forward.
	Stretching: 3 stretches x 10 seconds	Pectoralis major; Side abdominals (on each side); Dorsal stretch

2.4. Result Analysis

After collecting the results, the data were analyzed using the statistical program SPSS, version 16 (Statistical Package for Social Sciences). Results were expressed as Mean ± Standard Deviation (SD). Unpaired and paired t-testing data analysis applied accordingly for between group comparisons, and also for pre- and post- intervention performance. P value of ≤0.05 was considered significant for this study, while p value of ≤ 0.001 was considered highly significant.

3. Results

Between groups comparison was implemented with t-test of Independent Sample and also Mann-Whitney Test (MW) was used additionally, in order to trace differentiation in somatometric characteristics. One-way ANOVA testing, detected homogeneity in each participant's group for weight and BMI ($p>0.05$) factors, while PTE and CG differed significantly to height, weight and BMI factors ($p<0.05$). There was no significant difference in age and gender distribution between groups ($p>0.1$) (Table 1).

Performance comparison between the pre- and post Intervention Evaluative phase, was calculated with paired sample t-test. Additionally Wilcoxon (Wx) testing was used to measure significance in groups with unequal distribution. Between-Group performances differed in both assessment phases ($p<0.001$: t, Wx- test) except from the initial measurement of sit-ups repetitions within 30 second time duration ($p=0.843$, t-test, Table 5). Somatometric characteristics and between group comparison is listed in Table 1. Tables 4 and 5 describe respectively the performance before and after Exercise intervention, for Control Group (CG) and the Physical Therapy Exercise (PTE) Group.

Speed Performance: Significant improvement in timed performance of the TU&G test and for the 25m sprint ($p<0.05$) were observed for both groups. Sprinting time was reduced by 11.10% in PT Exercise Group more than in CG (Table 4, 5).

Table 4 Control Group Performance Before (Pre-) and after (Post-) Intervention.

Control Group -Evaluation Tasks: -	**Pre-Intervention Mean ± SD**	**Post- Intervention Mean ± SD**	**Mean Change (%)**	**P (Wx, t-test)**
Walking & speed performance				
Time Up & Go (sec)	8.64 ± 1.27 sec	8.64 ± 1.85 sec	5.85% (n)	0.042[Wx]
25 meter sprint (seconds)	6.69 ± 1.63 sec	5.97 ± 1.48 sec	[10.76%](n)	VS
Steps at top/ out of a straight lining	0.82 ± 1.27	0.29 ± 0.46	[64.63%](n)	VS
Steps at top/ out of parallel lines	0.99 ± 1.33	0.07± 0.26	[92.92%](+)	VS
Power performance (Repetition per 30 sec.)				
Abdominal Crunches	18.42±6.55 rep	19.72±6.64 rep	7.05% (n)	0.029[Wx]
Push-Ups	20.06±6.62	19.95±6.06 rep	-0.54% (-)	0.573[t]
Sit-Ups	22.13±6.08 rep	23.07±6.11 rep	4.24% (-)	VS
Single-leg balance (max. time: 10 second)				
Balancing on RIGHT foot, eyes open	9.44 ± 1.12 /10 sec	9.39 ± 1.42 sec	-0.52% (n)	0.029[Wx]
Balancing on LEFT foot, eyes open	8.88 ± 1.88 /10 sec	8.80 ± 1.84 sec	-0.9% (n)	0.188[t]
Balancing on RIGHT foot, eyes closed	5.78 ± 2.25 /10 sec	6.99 ± 2.33 sec	20.93% (+)	VS
Balancing on LEFT foot, eyes closed	4.61 ± 1.81 /10 sec	5.10 ± 2.09 sec	10.62% (n)	VS
Jumping Performance				
Long Jump (per centimeters)	133.57 ± 29.72 cm	140.06 ± 25.80 cm	4.86% (n)	0.002[Wx]
Jump repetitions per 15 sec; RIGHT leg	22.40 ± 10.02 rep	24.17 ± 12.18 rep	7.90% (n)	0.035[Wx]
Jump repetitions per 15 sec; LEFT leg	21.55 ± 8.60 rep	22.38 ± 10.72 rep	3.85% (n)	0.065[t]
Limited Space jump reps /10; RIGHT leg	7.38 ± 2.68 /10 rep	8.55 ± 2.05 /10 rep	15.85% (+)	VS
Limited Space jump reps/10; LEFT leg	7.50 ± 2.74 /10 rep	7.93 ± 2.62 /10 rep	5.73% (n)	0.011[t]

Test abbreviations: (Wx): Wilcoxon test, (t): t-test, (MW): Mann-Whitney Test | VS: Very Significant results, $p<0.001$, both tests; GDiff: Groups did differ, $p<0.001$, both tests, […] Percentage change in negative value but positive effect, used in timed evaluative tasks | Subjective Assessment: Positive sign (+): Percentage change increased over 15%, means visible results in motor conditions; Neutral Sign(n): Percentage change increased <15%; Negative Sign (-):Percentage change did not increased

Table 5 PTE Group Pre – and Post- Intervention Performance. Comparison with Control Group.

Physical Therapy Exercise Group **Evaluation Tasks: -**	**Pre-Intervention** **Mean ± SD**	**Post- Intervention Mean ± SD**	**Mean Change (%)**	**Comparison with Control (t,MW)**	
				Pre- (p)	Pre- (p)
Walking & speed performance					
Time Up & Go (sec)	12.82 ± 2.77 sec	10,06 ± 3,51 sec	[21.52%](+)	GDiff	GDiff
25 meter sprint (seconds)	8.14 ± 1.49sec	6.36 ± 1,36 sec	[21.86%](+)	GDiff	GDiff
Steps at top/ out of a straight lining	4.73 ± 5.53	3.87 ± 6,51	[18.18%](+)	GDiff	GDiff
Steps at top/ out of parallel lines	3.30 ± 4.53	2.06 ± 2,98	[37.57% (+)	GDiff	GDiff
Power performance (Repetition per 30 sec.)					
Abdominal Crunches	13.16±4.14 rep	17.30±5.61 rep	31.45% (+)	GDiff	GDiff
Push-Ups	13.22±6.83 rep	11.40±6.26 rep	-13.76% (-)	GDiff	GDiff
Sit-Ups	19.78±7.79 rep	22.81±5.10 rep	15.31% (+)	0.843^{t}	0.843^{t}
Single-leg balance (max. time: 10 second)					
Balancing on RIGHT foot, eyes open	6.30±2.67 sec	8.58 ± 1.85 sec	36.19% (+)	GDiff	GDiff
Balancing on LEFT foot, eyes open	5.13±2,80 sec	7.40 ± 2.31 sec	44.24% (+)	GDiff	GDiff
Balancing on RIGHT foot, eyes closed	3.02±2.07 sec	5.14 ± 1.85 sec	70.19% (+)	GDiff	GDiff
Balancing on LEFT foot, eyes closed	1.64±1,94 sec	4,28 ± 2,86 sec	160.97% (+)	GDiff	GDiff
Jumping Performance					
Long Jump (per centimeters)	83.67 ± 19.18 cm	97.45 ± 26.38 cm	16.46% (+)	GDiff	GDiff
Jump repetitions per 15 sec; RIGHT leg	16.51 ± 11.42 rep	20.81 ± 12.50 rep	26.04% (+)	GDiff	GDiff
Jump repetitions per 15 sec; LEFT leg	11.68 ± 12,53 rep	15.72 ± 9.40 rep	34.59% (+)	GDiff	GDiff
Limited Space jump reps /10; RIGHT leg	6.97 ± 2.34 /10 rep	8.91 ± 1.69 /10 rep	27.83% (+)	0.004^{MW}	0.004^{MW}
Limited Space jump reps/10; LEFT leg	6.05 ± 3.17 /10 rep	7.65 ± 2.48 /10 rep	26.45% (+)	GDiff	GDiff

Test abbreviations: (Wx): Wilcoxon test, (t): t-test, (MW): Mann-Whitney Test | VS: Very Significant results, p<0.001, both tests; GDiff: Groups did differ, p<0.001, both tests, […] Percentage change in negative value but positive effect, used in timed evaluative tasks | Subjective Assessment: Positive sign (+): Percentage change increased over 15%, means visible results in motor conditions; Neutral Sign(n): Percentage change increased <15%; Negative Sign (-):Percentage change did not increased

Balance Performance: The PTE group significantly improved in single-legged balance standing, with open and closed eyes (p<0.001). Percentage Change was greater in PTE Group compared with CG, for right leg standing, with eyes open and eyes closed (36.19%; 70.19%) and for left leg standing, with open and closed eyes (44.24%; 160.97%)(Table 5). Reduction of steps at top or outside of a straight/ parallel lining may be considered as an improvement indicator for balance in walking on a fixed path; and was very significantly evident in the PTE Group, for walking on a straight line

(p=0.001) and between two parallel lines (p=0.003) (Table 5). Highly significant reduction in gait deviations was also traced in CG (p<0.001) (Table 4), however average performance for the pre- and post-intervention measurements was numerically lower than in the PTE group, so improvement may not be considered as drastic (Table 5).

Power performance, measured through repetitions for 30 seconds time duration: Repetitions for sit-ups and abdominal crunches tasks, increased significantly for both groups (p<0.05)(Table 4,5). Push-ups repetitions for 30 second duration, increased in PTE Group (p=0.053 t-test), while no significant change was observed in the performance of the CG group (p=0.537) (Table 4,5).

Jumping Performance: Long jump (p<0.001) and repetitive right and left single-leg jumping within a limited space, (p<0.05) increased significantly for both groups (Table 4,5). PTE Group improved significantly in right and left leg repetitive jumping with 15 seconds duration, while improvement did not occur in CG, for 15-second right leg jump task evaluation (p>0.05) (Table 4,5).

4. Discussion

Previous studies investigated the connection between balance and exercise, in adolescents with neurodevelopmental disorders, recording increase in muscle strength, or improvement in trunk control ability (Eid et al., 2017; Jankowicz-Szymańska et al., 2012; Olama, 2011). Adolescents, also due to changes occurring in development (weight and height gain, hormonal changes, perceptual and psychosocial changes, self-discovery), strongly express the need for self-management and actively intervene in matters concerning their participation (Cavicchiolo et al., 2022; Natsuaki et al., 2014; Brown & Larson, 2009). This particularity had to be taken into account, to formulate a Physical Therapy Exercise (PTE) program with the purpose: (a) to provide motor and function benefit, focusing on balance factors, to adolescents with Neurodevelopmental Disorders, and also for this program (b) to be interesting to ensure exercise consistency.

A small student sample (N<30) participated in this research program, while group allocation adjusted to students intra-school activities, leading to the formation of two groups that differed significantly in terms of Body Mass Index (BMI), with the PT Exercise Group having also increased obesity indicators (BMI Mean: 35.03 ± 10.89 kg/m^2, homogeneity p=0.319), compared to the Control Group with near healthy weight distribution (BMI Mean: 23.99 ± 8.56 kg/m^2, homogeneity p=0.033) (Table 1). A point of interest is that the PTE Group (BMI >30 kg/m^2) had lower performance in pre-intervention measurements (Table 5), in balance and jumping evaluative tasks, compared to Control Group (near healthy weight) (Table 4). Therefore it is concluded that balance and agility improvement is affected by weight gaining factors.

Another point of interest, considering the difference in performance between the two groups for the initial and final measurements, PT Exercise Group drastic improvement in percentage change, compared to Control Group. We conclude that effectiveness of the intervention is related to engaging in physical activity, even if the increase in BMI is maintained. A similar observation was also recorded by Sasidharan et al. (2014), where the increased BMI over 22 kg/m^2, had a significant impact on balance disorders, in preschool children. Exercise affected balance ability but did not lead to a reduction in obesity. Pbert et al. (2016), also reported inability to eliminate obesity related behaviors, following a counseling intervention, in typical public high school adolescents. The relatively greater percentage improvement in evaluative tasks for PTE Group may be attributed to the fact that there was "space for improvement" of functional abilities, compared Control Group that had qualitatively better baseline measurements.

Issues that must be considered to therapeutic approach include environmental setting enabling behavioral imitation of individuals with motor delays or dysfunctions, and without association with typical developed individuals (eg disability centers, special schools) may lead to mimicking, creating and increasing dysfunctional adaptations for disabled individuals, leading also to fall risk or habitual balance deficits to increase. (Hayes & Bulat, 2017; APCP: Burslem et al., 2016; IDEA, 2014; Fernani et al., 2013; Enkelaar et al., 2012). Our research is the first to utilize performance-based measurements in balance and agility tasks, to assess change in performance of special school adolescent students, also comparing performance changes between groups which differ in Body Mass Index. Physiotherapy based exercise application may positively affect balance and pacing ability of disabled students, reducing the risk of falling when standing, walking, or performing complicated movements.

4.1. Suggestions for physiotherapeutic exercise application

Reviewing literature and taking into account the exercise planning applied in this research, we quote suggestions to improve Physiotherapy Practice, starting by familiarization with PT Specialists.

- Design and goals of PT exercise program should take into account weight, in order to maximize athletic performance and to reduce difference between expected and real outcomes of exercise.
- Consideration of age, maturity, developmental milestones and interests of children/adolescents, in order to maximize participation in therapy. It is described as best to align therapeutic goals with games, recreational or challenging activities.
- Disability condition must not be sidelined. Emphasis must be given to functional needs and movement abilities, around realistic goals, as manifested in daily living.
- Collaboration with a multidisciplinary team of professionals specialized to disabled population management (physicians, developmental psychologists, welfare workers, occupational therapists, special education trainers, parents/guardians) can maximize the results of Physiotherapeutic approach, taking into consideration different perspectives for the benefit of the disabled child/adolescent. .

5. Conclusion

Exercise has a positive impact performance in disabled adolescents with increased BMI by improving speed, balance, pacing and agility jumping. Correlation of obesity affecting functional balance and jumping skills is added to health-scientific related literature with rare findings about adolescent special school students. However, due to the small sample of the population, the factor of bias is not removed from the results. Further research needs to be conducted for a comprehensive perspective.

5.1. Declarations

This study was developed as part of the Master's Program “Pediatric Physiotherapy”, conducted by the Physiotherapy Department of the International Hellenic University of Greece. Thanks are offered to Mrs. Hristara-Papadopoulou Alexandra, for the promotion of this research. The Authors declare that no financial interest led to the preparation of this research report.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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