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Effect of Agility Training Exercise on Motor Proficiency and Anthropometry in 6 To 10-Year-Old Overweight Children - A Randomized Controlled Trial

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ABSTRACT

Background and Objectives: Overweight and Obesity is the current global and threatening nutritional non-communicable health disorders faced by children and adolescents leading to morbidity and mortality in early adult life. FMS represent the foundational skills required to participate in many physical activities, and include locomotor skills (e.g., running, jumping, and hopping) and object-control or manipulative skills (e.g., catching, throwing, and kicking). Early intervention is necessary to promote healthy life style & improve fitness. Therefore, this study was undertaken to determine the effects of agility training on anthropometry and motor proficiency in 6 to 10 years old obese and overweight children.
Methodology: Sixteen subjects were selected based on inclusion and exclusion criteria, then divided into two groups. Group A (Experimental group n= 8) received Warm up exercises, star agility run and cool down exercises. Group B (Control group n=8) received both warm up and cool down exercises with jogging and skipping. Exercise program was held for three days a week for 40 minutes for 4 weeks. Motor proficiency and anthropometry were measured at the beginning and at the end of intervention sessions using Bruininks-Oseretsky test of motor proficiency, Skin fold thickness (calliper), and BMI.
Results: From pre to post four week intervention, a statistically significant changes were observed in most of the outcome measures in paired t test of experimental group when compared to control group, most probably in skin fold (triceps $p=0.001$, abdomen $p=0.01$, thigh $p<0.01$) and BOT ($p<0.01$). Between groups from pre to post four week intervention only BOT ($p=0.01$) shows a significant improvement. In case of skin fold measurements, the results showed statistically less significant from pre test to post test. In the case of BMI, between group and within group showed no change.
Conclusion: According to the present study, four weeks of agility training showed significant changes in the BOT scores in experimental group when compared to the control group. Hence the study concluded that a planned and structured four weeks of agility training program is effective in improving motor proficiency in 6 to 10-year-old overweight & obese children.

Key words: Motor proficiency, Anthropometry, star agility run, physical activity

INTRODUCTION

Overweight and Obesity is the current global and threatening nutritional non-communicable health disorders faced by children and adolescents leading to morbidity and mortality in early adult life[1]. Global trends over the past two decades show the prevalence of overweight/obesity among children and adolescents to be increasing at an alarming rate[2].

Overweight is defined by the CDC as a BMI for age at or about the 95th percentile on the CDC growth charts. Fundamentally, the aetiology of overweight in children and adolescents, as in adults, is attributable to energy (caloric) intake in excess of energy expenditure. Genetic, environmental, socio-cultural, and family characteristics have been identified as key influences on energy expenditure and dietary intake, and subsequent overweight prevalence[2].

Some evidence suggests a relationship between childhood and adult obesity. Individuals who are overweight and obese in childhood are more likely to stay overweight and obese through adolescence in to adulthood[3]. Children are also psycho socially affected by being overweight or obese and experience depression, lower self-esteem, and bullying. Children who are overweight and obese do not typically exhibit medical symptoms or conditions, but the underlying physiological changes that may lead to conditions such as cardiovascular diseases, hypertension and type 2 DM, begins in this early stage of development. They will experience social and emotional consequences and difficulty in establishing peer relationships[3].

Childhood obesity has also been related to decreased motor proficiency, which is a crucial competence throughout this developmental stage. Lower motor proficiency was related to sedentary activity. As motor proficiency tracks throughout childhood, children with poorer motor skills may become less active adolescents with associated poorer fitness levels[4]. Physical fitness is in part genetically determined (e.g., sex, distribution of muscle fibres types), but it can also be immensely influenced by lifestyle factors[5.]

In the early childhood years, children begin to learn a group of motor skills known as fundamental motor skills (FMS)[6]. Pre-school and school years are critical to a child's dsevelopment and mastery of fundamental movement skills (FMS)[7]. FMS are broken down into two categories: locomotor skills that involve moving the body through space (i.e. run, jump, hop, leap, slide, gallop) and object control skills, that entail using the hands and feet to manipulate and/or project objects (i.e. throw, catch, kick, dribble, roll, strike and catch). Locomotor and object control skills enable individuals to move and actively engage in their environment. Fundamental motor skills are considered the building blocks for more advanced movement and sports-specific skills[8]. The acquisition of FMS is developmentally sequenced and are contingent upon multiple internal and external factors (biological, psychosocial, social, motivational, cognitive etc) and the process of acquisition occurring through a range of active play experiences and structured programs[7].

Motor proficiency involves two separate and distinct components: motor abilities and motor skills. Motor abilities are typically defined as underlying capabilities which are relatively stable and not easily improved upon through practice. Although abilities can be shaped during growth and development. motor skills are epically likely to changed and develop during preadolescence and may define a critical learning phase for such skills[9].

Agility is the ability of the body to quickly react to change in speed or direction of movement. Agility depends on visual scanning, knowledge of situation, recognition of pattern and anticipation which means Cognition and Change of direction of movement (COD)[1].

Developing agility in children continues over a long period of time. The basic methodology of agility training implies the learning of a basic walking technique, running technique, change of direction, jumps, and landings. The authors found the faster that children completed the running speed and agility task and the farther they jumped, the more physically active and less sedentary they were[15].

Currently recommended interventions include modifications of eating habits, increase in physical activity and addressing psychosocial issues. Several longitudinal analyses of gross motor coordination among overweight and obese children have reported that the weight status of a child negatively influenced the gross motor coordination. Hence, I intended to evaluate the effect of agility training exercise in improving motor proficiency in 6 to 10 year overweight and obese children

METHODOLOGY

Study Design: Randomized Controlled Trial
Study Setting: Community
Study Duration: 3 Months
Sampling

- Sampling method
  Simple Random Sampling
- Sample size
  n=16
  8 students in each group (Group A and Group B)

Inclusion Criteria

- BMI greater than or equal 23 as per Asian category
- Both boys and girls
- Age 6 to 10 years
- Stable haemodynamically

Exclusion Criteria

- Children with known physical disabilities
- Any diagnosed cardiac condition
- Any musculoskeletal injury less than 6 months duration
- Musculoskeletal problems
- Genetic or Hereditary problems
- Metabolic problems
- Psychological problems
- Developmental delay

Outcome Measurement

- Bruininks-Oseretsky Test of Motor Proficiency-Short Form
- Body Mass Index (BMI)
- Skinfold Thickness

Materials Used

- Skinfold calliper
- Agility cone
- Stadiometer
- Weighing machine
- Stop watch
- Measuring tape
- Balance beam

Fig 1: agility cones

Fig 2: skinfold calliper

Fig 3: stadiometer

Fig 4: stop watch

Fig 5: measuring tape

fig 6: balance beam

Fig 7: weighing machine

Procedure

Ethical approval was obtained from the Ethical committee of Medical Trust Hospital, Ernakulam for conducting study. Subjects were screened using BMI and those who fulfilled the inclusion criteria were shortlisted. Informed consent was taken from the parents and description of the study were given to the parents and their children. After signing the consent, a total of 16 students were taken and divided into 2 groups.

Pre intervention measurements were taken for both groups using BMI, skinfold thickness and Bruininks-Oseretsky Test of Motor Proficiency-Short Form. The intervention period last for 4 weeks.

Experimental Group

The training sessions were carried out under the supervision with necessary safety precaution. Children were instructed to run in different running techniques (e.g., forward, backward, side steps) from the centre to the edge and back of a 9 x 9-m star-shaped field with four spikes. The spikes and the centre of the field were each marked with pylons. Starting at the centre of the field, the participants had to run forward to spike 1 (line 1) and backward to the centre (line 2). From the centre, they turned to the right side and side-stepped to spike 2 (line3), turned to the left side and side-stepped back to the centre (line 4). Upon reaching the centre, students turned backward and ran to spike 3 (line 5) and forward to the centre (line 6). Finally, they turned to the left side and side-stepped to spike 4 (line 7), turned to the right side and side-stepped back to the centre (line 8).

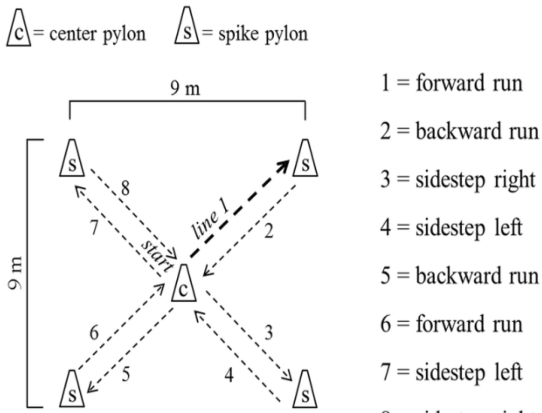


Figure 8: star agility run

Control group

They were taught about conventional exercises. Treatment session includes warm up exercises (muscle stretch, joint rotation, squatting) conventional exercises includes skipping and jogging and cool down phase (stretch and deep breathing).

A total of 12 sessions were conducted over a 4-week period with three sessions per week on non-consecutive days were given to both experimental and control group. Each session lasted for 40 min with 20 min exercise and 10 min each of warm up and cool down phase in both groups.

Bruininks-Oseretsky Test of Motor Proficiency-Short Form

The Bruininks-Oseretsky Test of Motor Proficiency was designed to evaluate gross and fine motor skills in children between the ages of 4.5 and 14.5 years of age. Four assessment options are available for the BOT-2, namely a complete form, short form, selected components and selected sub-components. For the purpose of this study, the Short Form (BOT-2 SF) sub-components (strength, running speed and agility, and balance) were used. The short form took approximately 20 to 30 min to complete. Point allocation was done per sub-component, after which raw scores were converted to point scores. The short form took approximately 20 to 30 min to complete. Point allocation was done per sub-component, after which raw scores were converted to point scores. Point scores were totalled and converted to standard scores.

Body Mass Index (BMI)

BMI, a reliable indicator of body fat for most children and teens, is a number calculated from a child's weight and height [BMI=Weight (kg)÷(Height m)2] (Centers for Disease Control and Prevention [CDCP], 2014). Height (cm) and weight (kg) were measured according to standard procedures that height was measured with the child in a standard erect posture, without shoes and weight were measured with the child attired in ordinary, indoor clothing without shoes.

Skinfold Thickness

Skinfold thickness measurements at the following areas were taken:

- Triceps: a fold along the vertical axis of the humerus on the midline of the posterior aspect of the upper arm, halfway between the acromion process of the scapula, and the olecranon process of the ulna were taken
- Abdomen: a longitudinal fold, 2 cm to the right of the umbilicus was measured
- Thigh: a longitudinal fold on the anterior midline of the thigh, halfway between the superior border of the patella, and the inguinal crease were measure

Fig 9: measuring weight

fig 10: single leg standing on balance beam

Fig 11: walking forward on balancebeam

fig 12(a): jumping up and clappinghands

Figure 12(b): jumping up and clapping hands

DEMOGRAPHIC INFORMATION

	Mean age	Standard deviation	Minimum	Maximum
Experimental group	2	0.81	6	10
Control group	2	0.81	6	10

The age group taken for the study was between 6 to 10 years and the mean age of the experimental group was 2 with a standard deviation of 0.81 and the mean age of control group was 2with a standard deviation of 0.81

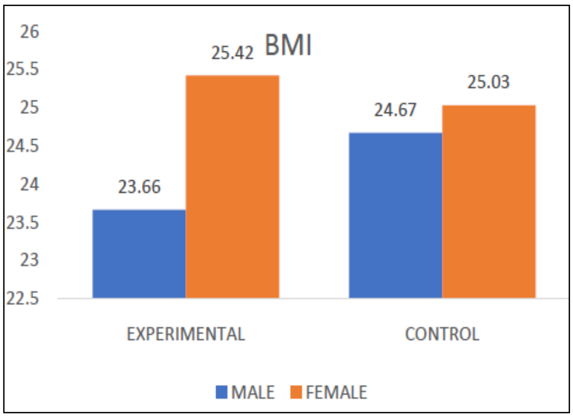
Age	Experimental group		Control group	
	Frequency	Percentage	Frequency	Percentage
6 years	2	25%	1	12.5%
7years	1	12.5%	2	25%
9 years	2	25%	3	37.5%
10years	3	37.5%	2	25%

GENDER

Gender	Experimental Group		Control Group	
	Frequency	Percentage	Frequency	Percentage
Male	3	37.5%	4	50%
Female	5	62.5%	4	50%
Total	**8**	**100.0%**	**8**	**100.0%**

BODY MAS INDEX

Group	Gender	Height	Weight	BMI
Experimental	Male	139±2.64	45.6±2.08	23.6±0.19
	Female	133.8±2.64	45.2±4.76	25.4±1.58
Control	Male	135±5.09	45.5±5.19	24.67±1.26
	Female	133.7±2.5	44.25±1.7	25±1.23



Graph 3 - Graphical representation of BMI in experimental & control group

Statistical analysis and interpretation

The statistical analysis of the results was performed by using the SPSS Software (SPSS.20) and Microsoft Excel. Students t -test was used for the calculation of the results. Paired t test was used for the intra group comparison of pre and post test results. Independent t test was used for the inter group comparison. Significant level kept as $p<0.05$. Equations were used in;

$$\text{Sample } n \geq \frac{2\sigma 2(z\beta+z\alpha/2)\ 2}{difference\ 2}$$

- n- Sample size in each group (assumes equal sized groups)
- $\boldsymbol{\sigma}$- Standard deviation of the outcome variable
- $Z\alpha$ - Represents the desired level of statistical significance (typically 1.96)
- $Z\beta$ -Represents the desired power (typically 0.84 for 80% power)
- differences- Effect size (the difference in mean)

Independent Variables: star agility run, skipping and jogging

Dependent Variables: anthropometric measurements, motor proficiency.

COMPARISON WITHIN GROUP (paired t test)

Comparison of Pre- Test and Post- Test Values of BMI in Group A (Experimental Group)

Test	Mean	SD	Mean improvement	n	t	Df	p value
Pre- test	24.87	1.45	0.225	16	2.08	7	0.0760
Post- test	24.65	1.59					

Mean change 0.22 is the difference between pre-test and post-test mean BMI (24.87 and 24.65). Since the t-value 2.08 shows $p>0.05$, there is no significant difference existing between the pre-test and post-test BMI of children in the experimental group. This proves that agility training exercise has no effect on BMI of overweight children in improving motor proficiency and anthropometry among overweight children.

Comparison of Pre-Test and Post- Test Values BMI in Group B (Control Group)

Test	Mean	SD	Mean improvement	n	T	Df	p value
Pre- test	24.47	1.15	0.06	16	1.25	7	0.24
Post- test	24.41	1.05					

Mean change 0.06 is the difference between pre-test and post-test mean of BMI (24.47 and 24.41). Since the t-value 1.25 shows $p>0.05$, there is no significant difference existing between the pre-test and post-test BMI of children in the control group. This proves that agility training exercise has no effect on BMI of overweight children in improving motor proficiency and anthropometry among overweight children.

Comparison of Pre-Test and Post-Test Value of Skinfold Thickness of Triceps in Group A (Experimental Group)

Test	Mean	SD	Mean improvement	N	T	Df	p value
Pre- test	28.87	3.399	1	16	5.29	7	0.001
Post- test	27.87	3.440					

Mean change 1 is the difference between pre-test and post-test mean skinfold thickness of triceps (28.87 and 27.87). Since the t-value 5.29 shows p =0.001, there is significant difference existing between the pre-test and post-test skinfold thickness of triceps of children in the experimental group. This proves that effect of agility training exercise on skinfold thickness of triceps in improving motor proficiency and anthropometry among overweight children.

Comparison of Pre-Test and Post-Test Value of Skinfold Thickness of Triceps in Group B (Control Group)

Test	Mean	SD	Mean improvement	N	t	df	p value
Pre- test	27.62	2.55	0.87	16	3.86	7	0.006
Post- test	26.75	2.76					

Mean change 0.87 is the difference between pre-test and post-test mean skinfold thickness of triceps (27.62 and 26.75). Since the t-value 3.86 shows p <0.01, there is significant difference existing between the pre-test and post-test skinfold thickness of triceps of children in the control group. This proves that effect of agility training exercise on skinfold thickness of triceps in improving motor proficiency and anthropometry among overweight children.

Comparison of Pre- Test and Post-Test Values of Skinfold Thickness of Abdomen in Group A (Experimental Group)

Test	Mean	SD	Mean improvement	N	t	df	p value
Pre- test	34.5	2.13	0.62	16	3.41	7	0.01
Post- test	33.87	2.41					

Mean change 0.62 is the difference between pre-test and post-test mean skinfold thickness of abdomen (34.5 and 33.87). Since the t-value 3.41 shows p=0.01, there is significant difference existing between the pre-test and post-test skinfold thickness of abdomen of children in the experimental group. This proves the effect of agility training exercise on skinfold thickness of abdomen in improving motor proficiency and anthropometry among overweight children.

Comparison of Pre-Test and Post-Test Values of Skinfold Thickness of Abdomen in Group B (Control Group)

Test	Mean	SD	Mean improvement	n	T	df	p value
Pre- test	33.12	2.29	0.5	16	2.64	7	0.03
Post- test	32.62	2.13					

Mean change 0.5 is the difference between pre-test and post-test mean skinfold thickness of abdomen (33.12 and 32.62). Since the t-value 2.64 shows p<0.05, there is significant difference existing between the pre-test and post-test skinfold thickness of abdomen of children in the control group. This proves the effect of agility training exercise on skinfold thickness of abdomen in improving motor proficiency and anthropometry among overweight children.

Comparison of Pre- Test and Post-Test Values of Skinfold Thickness of Thigh in Group A (Experimental Group)

Test	Mean	SD	Mean improvement	n	t	df	p value
Pre- test	36.75	4.83	0.87	16	3.86	7	0.006
Post- test	35.87	5.11					

Mean change 0.87 is the difference between pre-test and post-test mean skinfold thickness of thigh (36.7and 35.8). Since the t-value 3.86 shows p <0.01, there is significant difference existing between the pre-test and post-test skinfold thickness of thigh of children in the experimental group. This proves the effect of agility training exercise on skinfold thickness of thigh in improving motor proficiency and anthropometry among overweight children.

Comparison of Pre-Test and Post-Test Values of Skinfold Thickness of Thigh in Group B (Control Group)

Test	Mean	SD	Mean improvement	n	t	df	p value
Pre- test	35.12	3.56	0.5	16	2.6	7	0.03
Post- test	34.62	3.92					

Mean change 0.5 is the difference between pre-test and post-test mean skinfold thickness of thigh (35.12 and 34.62). Since the t-value 2.6 shows p <0.05, there is significant difference existing between the pre-test and post-test skinfold thickness of thigh of children in the control group. This proves the effect of agility training exercise on skinfold thickness of thigh in improving motor proficiency and anthropometry among overweight children.

Comparison of Pre- Test and Post -Test Values of BOT Group A (Experimental Group)

Test	Mean	SD	Mean improvement	n	t	df	p value
Pre- test	27.87	2.90	5.5	16	4.54	7	0.002
Post- test	33.37	2.55					

Mean change 5.5 is the difference between pre-test and post-test mean BOT scores (27.87 and 33.37). Since the t-value 4.54 shows p<0.01, there is significant difference existing between the pre-test and post-test BOT scores of children in the experimental group. This proves the effect of agility training exercise on BOT scores in improving motor proficiency and anthropometry among overweight children.

Comparison of Pre- Test and Post-Test Values of BOT Group B (Control Group)

Test	Mean	SD	Mean improvement	n	t	df	p value
Pre- test	27.5	6.45	0.87	16	0.93	7	0.38
Post- test	28.37	4.68					

Mean change 0.87 is the difference between pre-test and post-test mean BOT scores (27.5 and 28.37). Since the t-value 0.93 shows p> 0.05, there is no significant difference existing between the pre-test and post-test BOT scores among overweight children in the control group. This proves there is no effect of agility training exercise on BOT scores in improving motor proficiency and anthropometry among overweight children.

COMPARISON BETWEEN GROUPS (Independent T Test)

Comparison of Pre-Test BMI between Group A and Group B (Experimental and Control Groups)

Group	Mean	SD	Mean improvement	n	t	df	p value
Experimental	24.8	1.45	0.4	16	0.60	14	0.55
Control	24.4	1.15					

The difference (0.4) shows the difference between mean in two groups (24.8 and 24.4). Since the t-value 0.60, shows p-value >0.05, there is no significant difference in pre-test BMI values between the experimental and the control groups. So, we can consider the groups as homogenous in the baseline level.

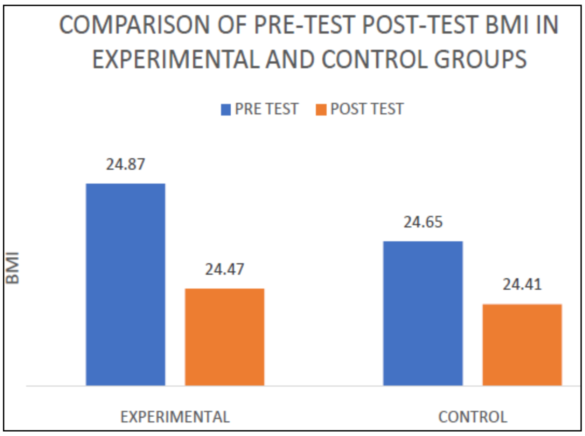
Comparison of Post Test BMI Values between Experimental and Control Groups

Group	Mean	SD	Mean improvement	n	t	df	P value
Experimental	24.65	1.59	0.11	16	0.73	14	0.73
Control	24.41	1.05					

The difference (0.11) shows the difference between mean in two groups (24.65 and 24.53). Since the t-value, 0.73 shows p-value >0.05, there is no significant difference in post-test BMI values between the experimental and the control groups. The scores in the experimental group are significantly higher than that in the control group. This proves that there is no significant effect of agility training exercise on BMI among overweight children.

Comparison of Pre-Test Post-Test BMI in Experimental and Control Groups

Group	Pre test mean	SD	Post test mean	SD
Experimental	24.87	1.45	24.47	1.15
Control	24.65	1.59	24.41	1.05



Graph 4: comparison of pre testpost test BMI score in group A (experimental) & group B(control)

Comparison of Pre-Test Skinfold Thickness of Triceps between Group A and Group B (Experimental And Control Groups

Group	Mean	SD	Mean improvement	n	t	df	p value
Experimental	28.87	3.39	1.25	16	0.83	14	0.41
Control	27.62	2.55					

The difference (1.25) shows the difference between mean in two groups (28.87 and 27.62). Since the t-value 0.83, shows p-value>0.05, there is no significant difference in pre-test skinfold thickness of triceps between the experimental and the control groups. So, we can consider the groups as homogenous in the baseline level.

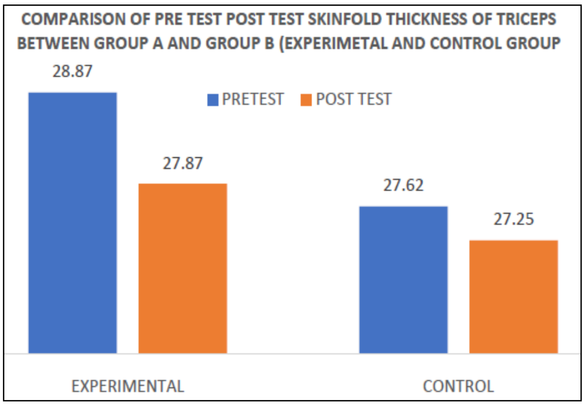
Comparison of Post-Test Skinfold Thickness of Triceps Group A and Group B (Experimental and Control Group)

Group	Mean	SD	Mean improvement	N	t	df	p value
Experimental	27.87	3.44	0.62	16	0.40	14	0.69
Control	27.25	2.71					

The difference (0.62) shows the difference between mean in two groups (27.87 and 27.25). Since the t-value, 0.40 shows p-value >0.05, there is no significant difference in skinfold thickness in post-test between the experimental and the control groups. The scores in the experimental group are significantly higher than that in the control group. This proves that there is no significant effect of agility training exercise on skinfold thickness of triceps among overweight children.

Comparison of Pre-Test Post-Test Skinfold Thickness of Triceps between Experimental and Control Groups

Group	Pre-test mean	SD	Post-test mean	SD
Experimental	28.87	3.39	27.87	3.44
Control	27.62	2.55	27.25	2.76



Graph 5: comparison of pre testpost test skinfold thickness of triceps in group A (experimental) & group B(control)

Comparison of Pre-Test Skinfold Thickness of Abdomen between Group A and Group B (Experimental and Control Groups)

Group	Mean	SD	Mean improvement	N	t	Df	p value
Experimental	34.5	2.13	1.37	16	1.23	14	0.23
Control	33.12	2.29					

The difference (1.37) shows the difference between mean in two groups (34.5and 33.12). Since the t-value 1.23, shows p-value >0.05. Hence there is no significant difference in pre-test skinfold thickness of abdomen between the experimental and the control groups. So, we can consider the groups as homogenous in the baseline level.

Comparison of Post Test Skinfold Thickness of Abdomen Experimental and Control Groups

Group	Mean	SD	Mean improvement	N	t	Df	p value
Experimental	33.87	2.41	1.25	16	1.09	14	0.29
Control	32.62	2.13					

The difference (1.25) shows the difference between mean in two groups (33.87 and32.62). Since the t-value, 1.09 shows p-value>0.05, there is no significant difference in post-test skinfold thickness of abdomen between the experimental and the control groups. This proves that there is no significant effect of agility training exercise on skinfold thickness of abdomen among overweight children.

Comparison of Pre-Test Post-Test Skinfold Thickness of Abdomen between Experimental and Control Groups

Group	Pre-test mean	SD	Post-test mean	SD
Experimental	34.5	2.13	33.87	2.41
Control	33.1	2.29	32.62	2.13

Comparison of Pre-Test Skinfold Thickness of Thigh between Group A and Group B (Experimental and Control Groups)

Group	Mean	SD	Mean improvement	n	t	Df	p value
Experimental	36.75	4.83	1.62	16	0.76	14	0.45
Control	35.12	3.56					

The difference (1.62) shows the difference between mean in two groups (36.75 and 35.12). Since the t-value 0.76, shows p-value>0.05, there is no significant difference in pre-test skinfold thickness of thigh between the experimental and the control groups. So, we can consider the groups as homogenous in the baseline level.

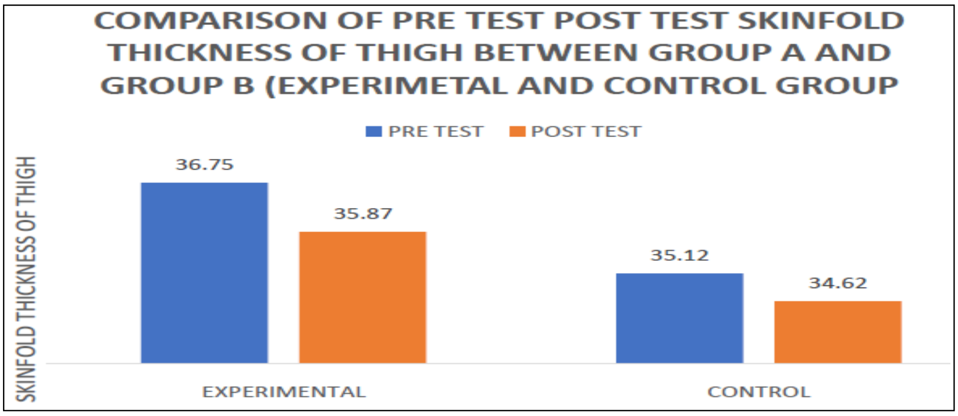
Comparison of Post Test Skinfold Thickness of Thigh Score Experimental and Control Groups

Group	Mean	SD	Mean improvement	n	t	Df	p value
Experimental	35.87	5.11	1.25	16	0.54	14	0.59
Control	34.62	3.92					

The difference (1.25) shows the difference between mean in two groups (35.87and 34.62). Since the t-value, 0.59 shows p-value >0.05, there is no significant difference in post-test skinfold thickness of thigh between the experimental and the control groups. This proves that there is no significant effect of agility training exercise on skinfold thickness of thigh among overweight children.

Comparison of Pre-Test Post Test Skinfold Thickness of Thigh between Experimental and Control Groups

Group	Pre-test mean	SD	Post-test mean	SD
Experimental	36.75	4.83	35.87	5.11
Control	35.12	3.56	34.62	3.92



Graph 7: comparison of pre testpost test skinfold thickness of thigh in group A(experimental) & group B(control)

Comparison of Pre-Test BOT between Group A and Group B (Experimental and Control Groups)

Group	Mean	SD	Mean improvement	n	T	df	p value
Experimental	27.87	2.90	0.37	16	0.14	14	0.88
Control	27.5	6.45					

The difference (0.37) shows the difference between mean in two groups (27.87and 27.5). Since the t-value 0.14, shows p-value >0.05, there is no significant difference in pre-test BOT values between the experimental and the control groups. So, we can consider the groups as homogenous in the baseline level

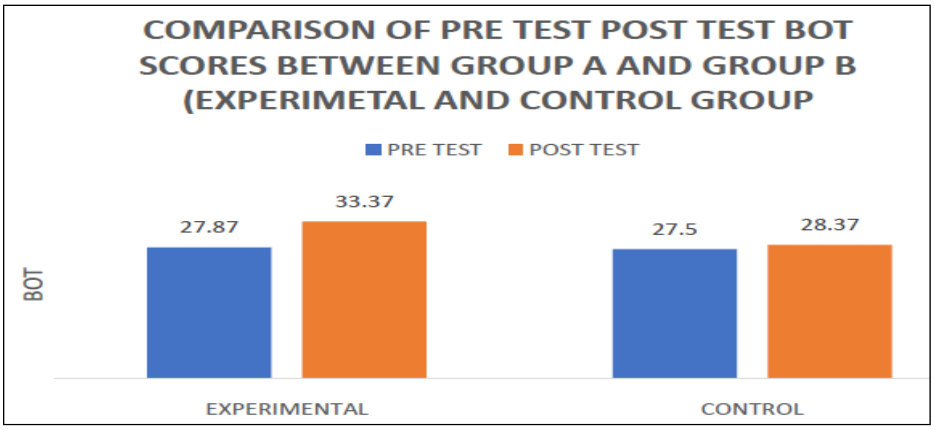
Comparison of Post Test BOT Score between Experimental and Control Groups

Group	Mean	SD	Mean improvement	n	t	df	p value
Experimental	33.37	2.55	5	16	2.64	14	0.01
Control	28.37	4.68					

The difference (5) shows the difference between mean in two groups (33.37and 28.37). Since the t-value, 2.64 shows p-value= 0.01, there is significant difference in post-test BOT scores between the experimental and the control groups. This proves that there is significant effect of agility training exercise on BOT among overweight children.

Comparison of Pre Test Post Test BOT Scores between Group A and Group B (Experimental and Control Group)

Group	Pre test mean	SD	Post test mean	SD
Experimental	27.87	2.90	33.37	2.55
Control	27.5	6.45	28.37	4.68



Graph 8: comparison of pre testpost test BOT score in group A(experimental) & group B(control)

DISCUSSION

Childhood obesity is a major health problem in many developing countries, including India. As a result, overweight and obese children achieve fewer opportunities to develop proficient motor skills. To the best of our knowledge, this study has done to investigate the evolution in motor proficiency according to children's weight status across developmental time. In recent years, it has become increasingly apparent that overweight/obesity among children is associated with a lower competence in motor skill and coordination.

José Marmeleira et.al (2017) conducted a study on Relationship between motor proficiency and body composition in 6-to10-year-old children and they concluded that children's motor proficiency is negatively associated with body fat, and normal weight children show better motor competence than those who are overweight or obese. Motor fitness consists of speed, balance, coordination, reaction time, power and agility.

The effect of agility training exercise on motor proficiency and anthropometry in overweight children was studied in this pre-post experimental study. As hypothesized, findings showed that overweight participants reported poorer performance on FMS than their leaner peers. Furthermore, increased BMI was correlated with poorer results in FMS.

Sixteen children were taken from the community who satisfy BMI were included in this study. Students were divided in to 2 groups (Group A and Group B) according to randomisation. Group A received star agility run along with warm up and cool down exercises. Group B received warm up and cool down exercises along with jogging and skipping. Pre and post measurements were done before and after interventions. The outcome measures used are Body Mass Index (BMI), Skinfold thickness of triceps, abdomen and thigh and Bruininks-Oseretsky Test of Motor Proficiency- Short Form (BOT SF). The results were analysed using t-test. Paired t-test was used to compare the results within the group and independent t-test to compare results between the groups. Significant level kept as p value <0.05.

In case of the BMI, in paired t- test, since the t- value 2.08 shows p > 0.05, there is no significant difference existing between the pre-test and post-test BMI among the experimental group. The t-value 1.25 shows p>0.05, there is no significant difference existing between the pre-test and post-test BMI among the control group also. The results showed there is no significant difference in BMI in both groups. In the independent t test, since the t- value 0.60, shows p-value>0.05, (p=0.55) there is no significant difference in post-test BMI values between the experimental and the control groups. The mean difference, 0.4 shows the difference between mean in two groups 24.8 and 24.4 respectively.

In this study there is no significant improvement in BMI. This could be due to; the duration of the study was 4 weeks which was probably not sufficient to provide a significant change in BMI.

In case of the skinfold thickness of triceps, in paired t-test, the t-value, 5.29 shows p=0.001, there is significant difference existing between the pre-test and post-test skinfold thickness of triceps among experimental group. The t-value, 3.86 shows p<0.01, there is significant difference existing between the pre-test and post-test skinfold thickness of triceps in the control group also. Both groups have shown improvement.

In the independent t test, since the t-value 0.40 shows p- value >0.05 (p=0.69) there is no significant difference in post -test skinfold thickness of triceps between the experimental and the control groups. The difference, 0.62 shows the difference between mean in two groups 27.87 and 27.25 respectively.

A lack of precision in the identification of the standard mid-point from subject to subject could lead to a large random variation in these measurements. The size of bite, whether deep or superficial, has been found to produce a small systematic difference in skinfold thickness. Attention to accurate location of the triceps mid-point and standardization of depth of bite should reduce the variability of the measurement[17]. Also, the duration of the study was 4 weeks which was probably not sufficient to provide a significant improvement in skinfold thickness of triceps.

In case of the skinfold thickness of abdomen, in paired t-test, the t-value, 3.41 shows p=0.01, there is significant difference existing between the pre-test and post-test skinfold thickness of abdomen among experimental group. The t-value, 2.64 shows p<0.05, there is a significant difference existing between the pre-test and post-test skinfold thickness of abdomen in the control group also. Both groups have shown improvement.

In the independent t test, since the t-value 1.09 shows p-value>0.05 (p=0.29) there is no significant difference in post-test skinfold thickness of abdomen between the experimental and the control groups. The difference, 1.25 shows the difference between mean in two groups 33.87 and 32.13 respectively.

Numerous studies have demonstrated a link between lipolysis and fatty acid (FA) oxidation during exercise. The relative contribution of FA utilization during an exercise bout depends on its intensity. White adipose tissue lipolysis increases from low to moderate intensities and decreases at high intensity[16]. Indeed, when exercise is performed at high intensity, glucose is the major energy substrate to rapidly fuel the contracting muscle. Studies from different groups have shown that FA oxidation gradually increases during a prolonged exercise bout[17]. Current evidence suggests that 30-40 min of mild-to-moderate exercises/day is required to prevent weight gain, whereas 60-90 min of moderate exercise is required for sustained the long-term weight reduction[18]. Training in this study was done for 40 min in total with the exercises being done for 20 min only. This could possibly be the reason why major clinically significant changes were not noted even though a statistical change was seen.

In case of the skinfold thickness of thigh, in paired t-test, the t-value, 3.86 shows p<0.01, there is significant difference existing between the pre-test and post-test skinfold thickness of thigh among experimental group. The t-value, 2.6 shows p<0.05, there is a significant different existing between the pre-test and post-test skinfold thickness of thigh in the control group also. Both groups have shown improvement.

In the independent t test, since the t-value 0.54 shows p-value>0.05 (p=0.59) there is no significant difference in post -test skinfold thickness of thigh between the experimental and the control groups. The difference, 1.25 shows the difference between mean in two groups 35.87 and 34.62 respectively.

The ability to reduce body fat from a specific region of the body has been investigated in the past with some ambiguous results[19]. Ramirez-Campillo et.al reported that a localized muscle endurance unilateral lower body resistance training protocol in men and women decreased fat mass in the upper extremities and the trunk but did not decrease fat mass in the trained leg[20]. In another study investigating regional body composition changes in women after 6 months of resistance and aerobic training, Nindl et al reported a 31% and 12% reduction in fat in the arms and trunk, respectively, but regional fat loss in the legs did not occur. Part of this phenomenon could be explained by the variations in local adipose tissue metabolism[21]. Smith et al and Kral et al reported that fat was absorbed slower in the femoral region than the abdominal region[22]. Also, the duration of the study was 4 weeks which was probably not sufficient to provide a significant improvement in skinfold thickness of thigh.

In case of the BOT, in paired t-test, the t- value, 4.54 shows p<0.01, there is significant difference existing between the pre-test and post-test BOT among experimental group. The t-value, 0.93 shows p>0.05, there is no significant difference existing between the pre-test and post-test BOT in the control group.

In the independent t test, since the t-value 2.64 shows p- value =0.01 (p=0.01) there is a significant difference in post -test BOT between the experimental and the control groups. The difference, 5 shows the difference between mean in two groups 33.37 and 28.37 respectively. The scores in the experimental group were significantly higher than that in the control group.

The Obese and Overweight subjects were finding difficulty to move fast when compared to Normal weight children in case of agility, may be due to their excessive body weight that have caused extra demand on the working muscles to propulse forward and backward against gravity apart from poor cognition and balance[1]. Agility is the ability to maintain or control body position while quickly changing direction during a series of movements. Agility training is thought to be a re-enforcement of motor programming through neuromuscular conditioning and neural adaptation of muscle spindle, Golgi-tendon organs, and joint proprioceptors. A study reported that improvements were a result of enhanced motor unit recruitment patters and neural adaptation usually occurs when respond or react as a result of improved coordination between the central nervous system signal and proprioceptive feedback[25].

Strength of the Study

- Number of participants were equal in both groups.
- Only 16 subjects were taken, easy to conduct within proper time.
- Participants actively committed to the exercise sessions and were regularly present.
- Parents were very friendly they give immense support throughout the study.
- Cost effective programme.

Limitations of the Study

- As the measurements were taken manually, this may introduce human error, which could threat the reliability of the study.
- Both genders were included which may affect the outcome measures.
- Due to this current pandemic situation, I couldn't do in the schools and longer duration training could not be performed which could have produced better results.

Future Research

- The sample size of the study can be increased; hence it may lead to better results.
- The treatment duration of the study can be increased.
- It can be included in the physical education period in schools.
- A follow up study could ensure the long term effect of the treatment programme.

CONCLUSION

From the above study, it was obtained that a planned and structured 4 weeks agility training program is effective in improving motor proficiency in overweight children of 6-10 years old. In future, a structured agility training program incorporated into the regular physical education protocol in schools may prove beneficial in managing the increasing menace of overweight and obesity among children, especially in the lower age groups. Studies incorporating dietary modifications with active involvement of parents in training may add to better results and also help in improving the maintenance of weight changes and compliance to the program.

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