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Effectiveness of Brisk Walking on VO_2 Max, Agility and Flexibility in Physically Inactive Children

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ABSTRACT

Background and Objectives: Physical inactivity is on the ascent in today's technology environment, and it is one of the main risk factors for noncommunicable diseases and death worldwide. It raises the risk of a broad range of lifestyle diseases. Physical inactivity is the world's fourth largest cause of death. The use of tech gadgets and transportation infrastructure may lead to a higher level of physical inactivity in children and adolescents, which has an impact on their physical fitness and academic performance. To encourage physical exercise and fitness, early intervention is required. Therefore, this study was undertaken to determine the effect of brisk walking on VO_2 Max, agility, and flexibility in physically inactive children

Methodology: Thirty subjects were selected based on inclusion and exclusion criteria, then divided in to two groups. Group A (Experimental group = 15) received warm up exercise, brisk walking and cool down exercises. Group B (control group = 15) does not receive any exercise. Exercise programme was held for 3 days per week for 40 minutes for 6 weeks. Pre and post measurements were taken using queen college step test for VO_2 Max, agility t test and modified sit and reach test for flexibility.

Results & Discussion: Paired t test is used to analyze the results within the group and independent t test were used to analyze the results between the group. The significant level kept at $p \leq 0.05$. From pre to post six week intervention, a statistically significant changes were observed in all outcome measures. In paired t test VO_2 Max, flexibility and agility expressed significant improvement in experimental group. In case of independent t test all the three parameters of the experimental group expressed significant improvement compared to control group.

Conclusion: The study concluded that brisk walking exercise is effective in improving VO_2 Max, agility and flexibility in physically inactive children. The experimental group shows significant improvement in all three parameters compared to control group.

KEY WORDS: Brisk walking, VO_2 Max, agility, Flexibility, Physical inactivity, Queen college step test, modified sit and reach test, Agility t test.

INTRODUCTION

All movement is referred to as physical activity. Walking, cycling, wheeling, sports, active recreation, and play are all popular methods to be active, and they may be done by anyone of any ability level. Despite this, current global estimates reveal that one in every four adults and 81 percent of teenagers do not get enough exercise. In addition, when countries develop economically, levels of inactivity rise, reaching as high as 70%, due to changes in transportation patterns, increased use of technology for work and relaxation, cultural values, and more sedentary behaviour. Physical inactivity has negative consequences for health care systems, the

environment, economic development, community well-being, and quality of life[1]. Physical activity has numerous health benefits, including greater aerobic capacity, muscular fitness, and body composition in the near term, as well as a reduced risk of diabetes, cardiovascular disease, obesity, and osteoporosis in the long run. Furthermore, there appears to be a link between physical activity levels and a sense of well-being among adolescents. In 2008, 80•3 percent of school-aged teenagers aged 13–15 years did not fulfill these recommendations globally. This was the first global estimate based on a global collection of adolescent physical activity data, which included data from 105 nations' school-based surveys. Physical activity declines with age from early childhood onwards, with a sharp dip in late adolescence. A number of research have shown that flexibility is beneficial[2].

Studies have also found a link between teenage physical activity and academic performance, suggesting that encouraging physical exercise in the classroom could improve students' educational outcomes[3]. Competitiveness and a sense of accomplishment inspire physically active teenagers, while sedentary adolescents identify avoiding boredom, well-being, and decreasing weight as causes for being physically active[4,5]. Physically active students have superior grades, attendance, cognitive ability (such as memory), and classroom behavior. Higher levels of physical activity and fitness are linked to better cognitive performance (e.g., focus and memory) among students[6].

Around 81 percent of kids aged 11–17 years were insufficiently physically active globally in 2016, according to a pooled study of 298 population-based surveys. In 2016, the high-income Asia Pacific region had the highest frequency of insufficient activity[7]. In 2008, physical inactivity was the fourth biggest cause of death worldwide[8].

The Physical Activity Questionnaire for Older Children and the Physical Activity Questionnaire for Adolescents were created and validated in response to the demand for a valid and practicable self-report measure for large-scale research with children and adolescents. The PAQ-C and PAQ-A are seven-day recall questionnaires that assess overall moderate to vigorous physical activity levels during the school year. In general, when compared to other physical activity measures, the PAQs have shown reasonably significant correlation coefficients. Both the PAQ-C and the PAQ-A may be useful in longitudinal studies. The PAQs are suitable for large-scale investigations because of their low cost, reliable and valid measurement of physical activity from childhood to adolescent, and convenience of administration[9]. A uniform scoring scheme is used in this questionnaire.

The VO2 Max rating, which is the maximal volume of O2 that a person can use per minute to oxidize food molecules to produce energy, is one of the greatest predictors for determining one's fitness. The respiratory, circulatory, and muscular systems are all involved in VO2 max. Exercise can increase VO2 max by improving the efficiency of the heart and respiratory system in delivering oxygen to the muscles, making the muscles more ready to receive it[10]. Aerobic workouts such as brisk walking, jogging, interval training, soccer, swimming, and cycling are some of the techniques to increase one's VO2 max[11]. People who live a sedentary lifestyle have a difficult time exercising since it exhausts them or takes a long time[12].

Furthermore, during the school day, the sitting position is the most common. According to one study, people who spend a lot of time sitting have less overall posterior chain flexibility. This is due to the fact that such a position tends to shorten the lower limbs' posterior muscles. As a result, it's possible that the people in this study who scored low on flexibility are spending too much time in this position[13].

The range of motion in a joint or group of joints, or the capacity to move joints effectively over their full range of motion, is

referred to as flexibility. Improving flexibility might make it easier to move around throughout the day. Flexibility minimizes the chance of injury, reduces the danger of falling, avoids and corrects muscular imbalances, improves posture, increases joint range of motion, improves sports performance, combats the consequences of long hours of sitting, and reduces joint discomfort and strain, to name a few[14]. Flexibility in pupils is determined by nutritional status, physical activity levels, and sex, according to several research[15].

Agility, often known as nimbleness, is the capacity to quickly shift one's bodily position. It is achieved by combining isolated movement qualities such as balance, coordination, speed, reflexes, strength, and endurance. Balance, static balance, dynamic balance, speed, strength, and coordination are all key attributes[16]. The authors discovered that the more physically active and less sedentary youngsters were, the faster they executed the running speed and agility challenge and the farther they leapt[17]. Children's agility is developed over a long period of time. The core concept of agility training entails learning basic walking, running, direction change, jumps, and landing techniques[18].

According to recent studies, children who are physically inactive have low levels of flexibility, agility, and VO2 max, and brisk walking is one of the easiest ways to increase physical activity. children can raise their activity levels or ease themselves into a more active lifestyle via brisk walking. Brisk walking, unlike other forms of exercise, has a low risk of injury and is a low-cost activity[19]. Hence I intended to evaluate the effect of brisk walking on VO2 Max, flexibility and agility in physically inactive children.

METHODOLOGY

Study Design: Quasi Experimental Study, Pre & Post design
Study Setting: Community
Study Duration: 6 Months
Sampling: Convenient Sampling
Sample Size: n=30
15 in each group (Experimental and Control)

Inclusion Criteria

- Age 11 to 14 (early adolescence, according to American academy of pediatrics)
- Children who are not participating in any sports or other recreational activities
- PAQ-C (physical activity questionnaire for children) scoring mild to moderate physical activity (according to Kowalski scores)

Exclusion criteria

- Students not willing to participate
- Any other musculoskeletal, neurological and psychological disorder
- Any other serious comorbidities or deformities
- Who undergone lower limb surgeries in the past one year
- Children who are not able to obey commands

Outcome Measurement

- Queen college step test
- Modified sit and reach test
- Agility t test

Materials Used

41.3 cm step, B‘Metronome android version 0.9.14., Stopwatch, 4 cones for agility test, Modified sit and reach test box, Inch tape

Figure 1: step

figure 2: modified sit and reach test box

Figure 3: stop watch

figure 4: inch tape

Figure 5: cones

Pre-Intervention Procedure

Ethical approval was obtained from the Ethical committee of Medical Trust Hospital, Ernakulam for conducting study. Subjects were screened using physical activity questionnaire and those who fulfilled the inclusion criteria were shortlisted. The contents and instructions of questionnaire were explained to each child in detail. Informed consent was taken from the parents and description of the study was given to the parents and their children. After signing the consent, a total of 30 students were taken and divided into 2 groups using convenient sampling. Pre and post intervention measurements were taken for both groups using queen college step test, modified sit and reach test and agility t test. The intervention period last for 6 weeks.

Guidelines

- walk each step from heel to toe
- wear running shoes and loose clothes for comfortable walking
- use arms opposition to feet, it helps to walk faster
- head should be straight and look forward
- avoid arching of back
- don‘t hold breath while walking
- don‘t lean forward and backward

Experimental Group

The training sessions were carried out under the supervision with necessary safety precaution. Treatment session includes warm up exercises (active upper limb and lower limb exercise) and cool down phase (stretch and deep breathing).

Children were taught about the importance of brisk walking for improving cardiorespiratory fitness, agility and flexibility. The procedure for the study was explained in detail and demonstration was given to the participants. A total of 18 sessions were conducted over a 6-week period with three sessions per week on nonconsecutive days were given to experimental group. Each session lasted for 40 min with 30 min exercise and 10 min each of warm up and cool down phase in group.

PROTOCOL

Experimental group participants undergone treatment protocol of brisk walking at a distance of

1.2 km in week I and II

1.6 km in week III and IV

2 km in week V and VI

3 times per week for a duration of six weeks.

Two cones were placed at a distance of 10 m and one round of brisk walking from one cone to another make 20m. Walking speed is covering 100 steps in a minute, which means covering 17 steps or more in 10 seconds. In first two weeks they covered 60 rounds that makes 1.2 km, in third and fourth week they covered 80 rounds and last two weeks they covered 100 rounds. They can take rest whenever necessary and walking should be completed within 30 minutes.

The walking speed is 3 to 3.5mph (100 or more steps per minute which is set by a metronome). Total duration of the protocol for each session is 30 minutes and 40 min including warm up and cool down.

Warm up: arm circles and shoulder shrugs, toe touches, leg swings forward and backward, side to side, hip circles. All these 5 exercises carried for 1 minute each.

Cool down: major lower limb muscles stretching including hamstring, calf, gluteus and quadriceps for a duration of 15 sec hold for each muscle with 4 repetition and diaphragmatic breathing exercise for one minute.

Group B control group does not receive any exercise.

PHOTOGRAPHS AND DESCRIPTIONS

Figure 6. modified sit and reach test

Figure 7. agility t test

Figure 8. queen college step test

DATA ANALYSIS AND INTERPRETATION

The present study was designed to explore the Effectiveness of brisk walking exercise on VO2 max, flexibility and agility in physically inactive children.

DEMOGRAPHIC INFORMATION

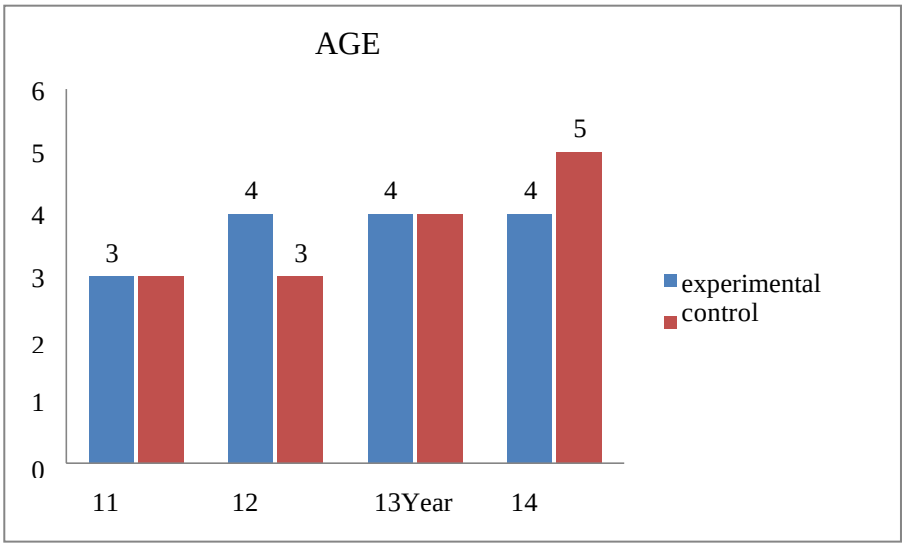
Group	Mean age	SD	minimum	maximum
Experimental group	12.6	1.12	11	14
Control group	12.73	1.16	11	14

Mean age in experimental and control group

The age group taken for the study was between 11 to 14 years and the mean age of the experimental group was 12.6 with a standard deviation of 1.12 and the mean age of control group was 12.73 with a standard deviation of 1.16.

Age	Experimental group		Control group	
	Frequency	Percentage	Frequency	Percentage
11 Years	3	20 %	3	20 %
12 Years	4	26.6 %	3	20 %
13Years	4	26.6 %	4	26.6 %
14 Years	4	26.6 %	5	33.3 %

frequency of age in experimental and control group

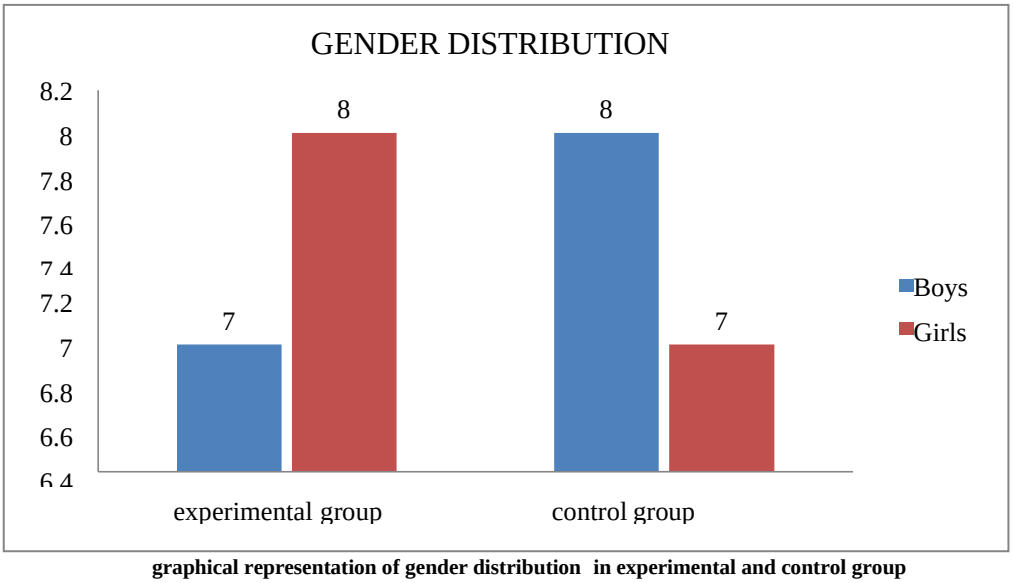


Graphical representation of mean age in experimental and control group.

GENDER

	Experimental group		Control group	
Gender	Frequency	Percentage	Frequency	Percentage
Boys	7	46.65 %	8	53.35 %
Girls	8	53.35 %	7	46.65 %
Total	15	100%	15	100%

frequency and percentage of gender in experimental and control group



graphical representation of gender distribution in experimental and control group

BODY MASS INDEX

	Gender	Height	Weight	BMI
Experimentalgroup	Boy	153.57±5.19	47.85±4.09	20.19±0.58
	Girl	149.75±4.85	44.87±4.35	19.81±1.04
Control group	Boy	143.25±5.62	40.87±4.85	19.92±1.01
	Girl	136±4.5	35.28±3.14	18.87±0.72

height, weight and BMI of subjects in experimental and control group

The statistical analysis of the results was performed by using the SPSS Software (SPSS.20). 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. Equations were used in;

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

- n- Sample size in each group (assumes equal sized groups)
- σ- 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: Brisk walking, physical inactivity Dependent Variables: VO2 Max, flexibility, agility.

COMPARISON WITHIN THE GROUP (paired t test)

COMPARISON OF PRE TEST AND POST TEST VALUES OF VO2 MAX IN GROUP A (EXPERIMENTAL GROUP)

Test	Mean	SD	Mean improvement	n	t	df	P value
Pre test	34.68	2.55					
Post test	41.44	4.94	6.75	15	7.86	14	0.000001

paired t test for VO2 Max in group A (experimental group

The mean column displays the mean pre-test and post-test of VO2 max of children in the Experimental group. SD is the standard deviations of VO2 max in two groups. Mean change 6.75 is the difference between pre-test and post-test mean VO2 max (34.68 and 41.44). Since the t-value 7.86 shows $p \leq 0.01$, there is significant difference existing between the pre-test and post-test VO2 max of children in the experimental group. This proves that brisk walking exercise has effect on VO2 max among physically inactive children.

COMPARISON OF PRE- TEST AND POST- TEST VALUES OF VO2 MAX IN GROUP B (CONTROL GROUP)

Test	Mean	SD	Mean improvement	n	t	df	p value
Pre test	34.79	2.55	0.37	15	0.47	14	0.64
Post test	35.17	2.70					

paired t test for VO2 Max in group B (control group)

The mean column displays the mean pre-test and post-test of VO2 max among physically inactive children in the control group. SD is the standard deviations of the VO2 max in two groups. Mean change 0.37 is the difference between pre-test and post-test mean of VO2 max (34.79 and 35.17). Since the t-value 0.47 shows $p > 0.05$, there is no significant difference existing between the pre-test and post-test VO2 max of physically inactive children in the control group.

COMPARISON OF PRETEST AND POSTTEST VALUES OF FLEXIBILITY IN GROUP A (EXPERIMENTAL GROUP)

Test	Mean	SD	Mean Improvement	n	t	df	P value
Pre test	16.97	1.12					
Posttest	20.40	1.27	3.43	15	14.2	14	0.000000001

paired t test for flexibility in group A (experimental group)

The mean column displays the mean pre-test and post-test of flexibility in children among in the experimental group. SD is the standard deviations of the flexibility in two groups. Mean change 3.43 is the difference between pre-test and post-test mean flexibility (16.97 and 20.40). Since the t-value 14.2 shows $p \leq 0.001$, there is significant difference existing between the pre-test and post-test flexibility of children in the experimental group. This proves the effect of brisk walking exercise in improving flexibility among physically inactive children

COMPARISON OF PRE- TEST AND POST-TEST VALUES OF FLEXIBILITY IN GROUP B (CONTROL GROUP)

Test	Mean	SD	Mean Improvement	n	t	df	P value
Pre test	16.56	1.15					
Posttest	16.54	1.07	0.02	15	0.25	14	0.79

paired t test for flexibility in group B (control group)

The mean column displays the mean pre-test and post-test of flexibility in children among in the control group. SD is the standard

deviations of the flexibility in two groups. Mean change 0.02 is the difference between pre-test and post-test mean flexibility (1.15 and 1.07). Since the t-value 0.25 shows $p \geq 0.05$, there is no significant difference existing between the pre-test and post-test flexibility of childrenin the control group.

COMPARISON OF PRE- TEST AND POST- TEST VALUES OF AGILITY IN GROUP A (EXPERIMENTAL GROUP)

Test	Mean	SD	Mean improvement	n	t	df	P value
Pre test	15.75	1.20					
Posttest	13.45	0.97	2.30	15	16.09	14	0.0000000002

paired t test for agility in group A (experimental group)

The mean column displays the mean pre-test and post-test of agility in children among in the experimental group. SD is the standard deviations of the agility in two groups. Mean change2.30 is the difference between pre-test and post-test mean agility(15.75 and 13.45). Since the t-value 16.09 shows $p \leq 0.001$, there is significant difference existing between the pre-test and post-test agility of children in the experimental group. This proves the effect of brisk walking exercise in improving agility among physically inactive children

COMPARISON OF PRE- TEST AND POST- TEST VALUES OF AGILITY IN GROUP B (CONTROL GROUP)

Test	Mean	SD	Mean improvement	n	t	df	P value
Pretest	15.84	1.297					
Post test	16.52	0.99	0.68	15	1.61	14	0.11

paired t test for agility in group B(control group)

The mean column displays the mean pre-test and post-test of agility in children among in the control group. SD is the standard deviations of the agility in two groups.Mean change 0.68 is the difference between pre-test and post-test mean agility (15.84 and 16.52). Since the t-value 1.61 shows $p \geq 0.05$, there is no significant difference existing between the pre-test and post-test agility of children in the control group.

COMPARISON BETWEEN GROUPS (Unpaired t test)

COMPARISON OF PRE-TEST VO2 MAX BETWEEN GROUP A AND GROUP B (EXPERIMENTAL AND CONTROL GROUPS)

Group	Mean	SD	Mean improvement	n	t	df	P value
Experimental group	34.68	2.55	0.11	30	0.11	28	0.80
Control group	34.79	2.55					

independent t test for pre test VO2 Max between group A (experimental) and group B(control)

The Mean column in the t test table displays the mean pre-test test VO2 max values in experimental and control group respectively. The standard deviation column displays the standard deviation of the scores in two groups. The difference (0.11) shows the difference between mean in two groups (34.68 and 34.79). Since the t-value 0.11, shows p-value >0.05, there is no significant difference in pre-test VO2 max values between the experimental and the control groups. So, we can consider the groups as homogenous in the baseline level.

COMPARISON OF POST TEST VO2 MAX VALUES BETWEEN EXPERIMENTAL AND CONTROL GROUPS

Group	Mean	SD	Mean improvement	n	t	Df	P value
Experimental group	41.44	4.94	6.27	30	4.30	28	0.0001
Control group	35.17	2.70					

independent t test for post test VO2 Max between group A(experimental) and groupB(control)

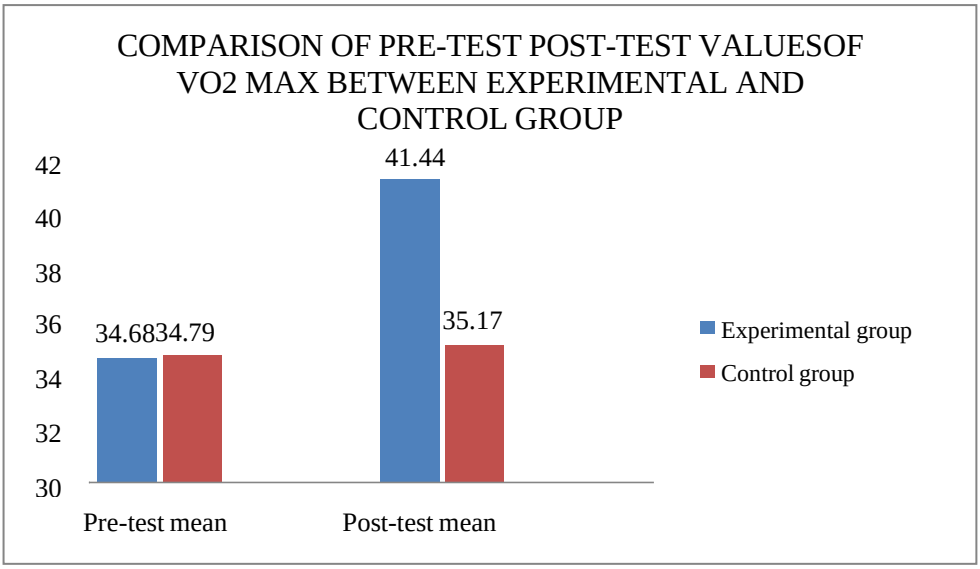
The Mean column in the t test table displays the mean post-test VO2 max values in experimental and control group respectively. The standard deviation column displays the standard deviation of the scores in two groups. The difference (6.27) shows the difference between mean in two groups (41.44 and 35.17). Since the t- value, 4.30 shows p-value < 0.001, there is significant difference in post-test VO2 max scores between the experimental and the control groups. The scores in the experimental

group is significantly higher than that in the control group. This proves that there is significant effect of brisk walking exercise on VO2 max among physically inactive children.

Group	Pre test mean	SD	Post test mean	SD
Experimental group	34.68	2.55	41.44	4.94
Control Group	34.79	2.55	35.17	2.70

comparison of pre test post test VO2 Max in group A (experimental)and group B (control)

COMPARISON OF PRE-TEST POST-TEST VO2 MAX IN EXPERIMENTAL AND CONTROL GROUPS



COMPARISON OF PRE-TEST FLEXIBILITY BETWEEN GROUP A AND GROUP B (EXPERIMENTAL AND CONTROL GROUPS)

Group	Mean	SD	Mean improvement	n	t	df	P value
Experimental group	16.97	1.12	0.40	30	0.97	28	0.33
Control group	16.56	1.15					

independent t test for pre test flexibility between group A (experimental) and group B (control)

The Mean column in the t test table displays the mean pre-test test flexibility values in experimental and control group respectively. The standard deviation column displays the standard deviation of the scores in two groups. The difference (0.40) shows the difference between mean in two groups (16.97and 16.56). Since the t-value 0.97, shows p-value >0.05, there is no significant difference in pre-test flexibility values between the experimental and the control groups. So, we can consider the groups as homogenous in the baseline level.

COMPARISON OF POST TEST FLEXIBILITY VALUES BETWEEN EXPERIMENTAL AND CONTROL GROUPS

Group	Mean	SD	Mean improvement	n	t	df	P value
Experimental group	20.40	1.07	3.86	30	8.9	28	0.0000000001
Control group	16.54	1.03					

independent t test for post test flexibility between group A (experimental) and group B(control)

The Mean column in the t test table displays the mean post-test flexibility values in experimental and control group respectively. The standard deviation column displays the standard deviation of the scores in two groups. The difference (3.86) shows the difference between mean in two groups (20.40 and 16.54). Since the t- value, 8.9 shows p-value < 0.001, there is significant difference in post-test flexibility scores between the experimental and the control groups. The scores in the experimental group is significantly higher than that in the

control group. This proves that there is significant effect of brisk walking exercise on flexibility among physically inactive children.

COMPARISON OF POST TEST FLEXIBILITY VALUES BETWEEN EXPERIMENTAL AND CONTROL GROUPS

Group	Mean	SD	Mean improvement	n	t	df	P value
Experimental group	20.40	1.07	3.86	30	8.9	28	0.0000000001
Control group	16.54	1.03					

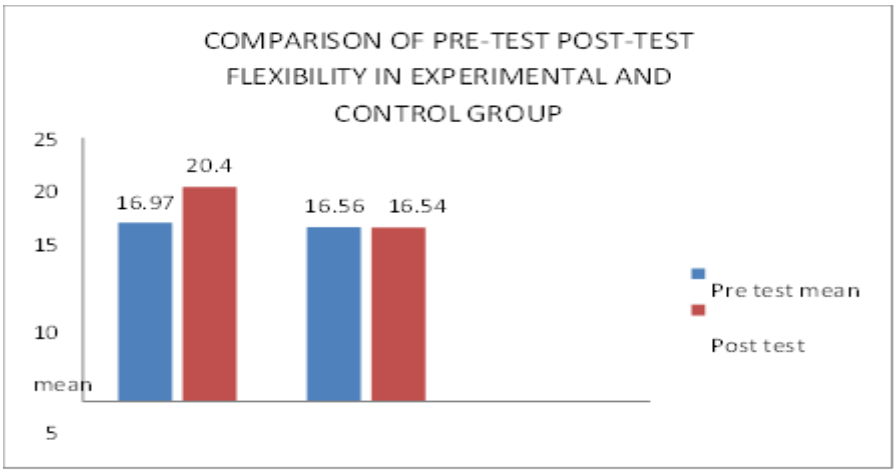
independent t test for post test flexibility between group A (experimental) and group B(control)

The Mean column in the t test table displays the mean post-test flexibility values in experimental and control group respectively. The standard deviation column displays the standard deviation of the scores in two groups. The difference (3.86) shows the difference between mean in two groups (20.40 and 16.54). Since the t- value, 8.9 shows p-value < 0.001, there is significant difference in post-test flexibility scores 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 significant effect of brisk walking exercise on flexibility among physically inactive children.

COMPARISON OF PRE TEST POST TEST FLEXIBILITY SCORES BETWEEN GROUP A AND GROUP B (EXPERIMENTAL GROUP AND CONTROL GROUP)

Group	Pre test mean	SD	Post test mean	SD
Experimental group	16.97	1.12	20.40	1.07
Control Group	16.56	1.15	16.54	1.03

comparison of pretest post test flexibility in group A(experimental) and group B(control)



COMPARISON OF PRE TEST AGILITY SCORES BETWEEN GROUP A AND GROUP B (EXPERIMENTAL AND CONTROL GROUP)

Group	Mean	SD	Mean improvement	n	t	df	p value
Experimental Group	15.75	1.20	0.08	30	0.19	28	0.84
Control Group	15.84	1.29					

independent t test for pre test agility between group A (experimental) and group B(control)

The Mean column in the t test table displays the mean pre-test agility scores in experimental and control group respectively. The standard deviation column displays the standard deviation of the scores in two groups. The difference (0.08) shows the difference between mean in two groups (15.75and 15.84). Since the t-value 0.19, shows p-value >0.05, there is no significant difference in pre-test agility values between the experimental and the control groups. So, we can consider the groups as homogenous in the baseline level.

COMPARISON OF POST TEST AGILITY SCORE BETWEEN EXPERIMENTAL AND CONTROL GROUPS

Group	Mean	SD	Mean improvement	n	t	df	p value
Experimental Group	13.45	0.97	3.07	30	8.58	28	0.000000002
Control Group	16.52	0.99					

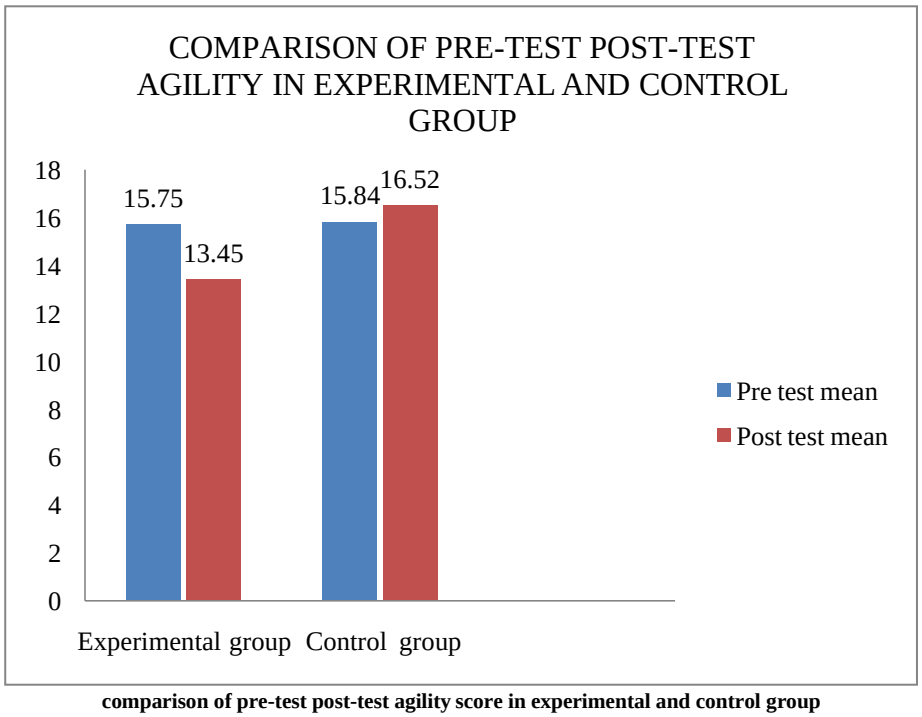
independent t test for post test agility between group A (experimental) and group B(control)

The Mean column in the t test table displays the mean post-test agility values in experimental and control group respectively. The standard deviation column displays the standard deviation of the scores in two groups. The difference (3.07) shows the difference between mean in two groups (13.45 and 16.52). Since the t- value, 8.58 shows p-value < 0.001, there is significant difference in post-test agility scores between the experimental and the control groups. The scores in the experimental group is significantly lower than that in the control group. This proves that there is significant effect of brisk walking exercise on agility among physically inactive children.

COMPARISON OF PRE TEST POST TEST AGILITY SCORES BETWEEN GROUP A AND GROUP B (EXPERIMENTAL AND CONTROL GROUP)

Group	Pre test mean	SD	Post test mean	SD
Experimentalgroup	15.75	1,20	13.45	0.97
Control Group	15.84	1.29	16.52	1.29

comparison of pre test post test agility in group A (experimental) and group B (control)



comparison of pre-test post-test agility score in experimental and control group

DISCUSSION

Over the last few decades, children's physical activity levels have dramatically changed. [20-22] Outdoor physical play is increasingly being replaced by less physical indoor games. [23-25] Children are increasingly being driven to school by car or bus instead of cycling or walking, and participation in organized sports is declining [26-27]. In recent years, the possible consequences of these changes for children's overall development and health have attracted much attention.

Physical fitness is determined by genetic factors and the level of regular exercise and physical activity. [28] The modern era has brought changes in ways of life and work that are associated with lower levels of physical activity.[29] From a traditionally

active lifestyle in which physical fitness was necessary to manage daily tasks, most people switched to the more sedentary lifestyles. Additionally, higher levels of physical fitness enable participation in a variety of physical activities and decrease the risk of health problems.[30-32] Physical fitness is considered to be an important health marker, because high levels of fitness during childhood and adolescence have a positive impact on adult health.[33,34] In recent years, it has become increasingly apparent that physical inactivity is related with physical fitness.

Bojan Masanovic et al in 2020 conducted a systematic study about Trends in Physical Fitness Among School-Aged Children and Adolescents. A total of 485 potential articles were identified, of which 19 articles were relevant for the qualitative synthesis; 17,46,023 children and adolescents from 14 countries were included. The study concluded that declining trend was found for one or all three topological areas of strength (9 of 10 studies for boys and in 8 in 11 for girls), endurance (9 in 14 studies for boys and in 8 in 15 for girls), flexibilities (4 in 9 studies), agilities (4 in 6 studies for boys and 4 in 7 for girls), and speed (2 in 6 studied). Easy and cost effective method to improve physical activity is brisk walking and thereby help in reducing risk factor for many diseases.

The effect of brisk walking on VO 2 Max, flexibility and agility in physically inactive children was studied in this pre post experimental study. As hypothesized findings showed that brisk walking has effect on physical fitness in physically inactive children. Thirty physically inactive children were selected from the community according to their PAQ c scores. Children were divided in to 2 groups, according to randomization. Group A is experimental group include 15 children and underwent brisk walking for 6 weeks and group B is control group include 15 children does not receive any exercise.

Pre and post measurements were done before and after interventions. The outcome measures used are queen college step test, modified sit and reach test and agility t test. 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 VO2 Max, it was found that in paired t test, since the t value 7.86 shows $p\leq 0.001(0.000001)$, there is significant difference existing between the pre- test and post-test VO2 Max among the experimental group. This shows that brisk walking is effective in improving VO2 max. The t value 0.47 shows $p \geq 0.05(0.64)$, there is no significant difference existing between pre-test and post-test VO2 Max among control group. The results showed there is significant difference in VO2 Max in experimental group. In the independent t test, since t value 4.30, shows p value $\leq$ 0.001(0.0001), there is significant difference in post-test VO2 Max between the experimental and control groups. The mean difference shows the difference between mean in two groups 0.11 and 6.27 respectively. The statistical analysis of VO2 Max shows experimental group has more significant improvement compared to control group.

In this study there is significant improvement in VO2 Max. It might be due to brisk walking increase cardiorespiratory endurance due to the increased aerobic metabolism. Aerobic training generally increases the heart mass and volume with greater left-ventricular end-diastolic volumes during rest and exercise. It affects the cardiac size and structure. A short term aerobic training improves submaximal heart rate and thereby increasing VO2 Max. Aerobic exercise improves plasma volume with expansion of extracellular fluid volume due to increased synthesis and retention of plasma albumin and it enhances circulatory reserve volume and increases VO2 Max[35].

In case of the flexibility, it was found that in paired t test, since the t value 14.2 shows $p\leq 0.001$(**0.**000000001), there is significant difference existing between the pre-test and

post-test flexibility among the experimental group. The t value 0.25 shows p ≥0.05(0.79), there is no significant difference existing between pre-test and post-test flexibility among control group. The results showed there is significant difference in flexibility in experimental group. In the independent t test, since t value 8.9, shows p value≤ 0.001(0.0000000002), there is significant difference in post- test flexibility between the experimental and control groups. The mean difference shows the difference between mean in two groups 3.43 and 0.02 respectively. The statistical analysis of flexibility shows experimental group has more significant improvement compared to control group.

In case of flexibility, aerobic exercise may increase the blood flow and nutrients to the soft tissues in the back and helped in reducing the stiffness of back muscles. Walking exercise is a good choice for strengthening the Para spinal muscles and back muscles and helps in reducing rigidity of back muscles and thereby improving flexibility. Walking can help in increasing flexibility. Even with or without stretching before and after walking, the interaction of your legs, arms, core and head while walking help to increase your flexibility. Lower limb Stretching exercise in cool down session after brisk walking might be contributed to improving flexibility.

In case of agility, it was found that in paired t test, since the t value 16.09 shows p≤ 0.001(0**.**0000000002), there is significant difference existing between the pre-test and post-test agility among the experimental group. The t value 1.61 shows p ≥ 0.05(0.11), there is no significant difference existing between pre-test and post-test agility among control group. The results showed there is significant difference in agility in experimental group and significant difference in control group. In the independent t test, since t value 8.58, shows p value≤ 0.001(0.000000002), there is significant difference in post-test agility between the experimental and control groups. The mean difference shows the difference between mean in two groups 2.30and 0.68 respectively. The statistical analysis of agility shows experimental group has more significant improvement compared to control group.

The improvement in agility is due to increase in VO2 Max. A study conducted by Kylie Jones et al about relationship between agility and endurance capacity, breathing parameters and gravity concluding that agility performance is improved due to increased oxidative capacity[36]. Brisk walking improves VO2 Max and there by increases agility performance.

A study conducted by Cindy et al on brisk walking and its effects on physical fitness variables on college women and there was significant improvement on flexibility and agility by brisk walking. A study conducted by Durai et al also concluded that brisk walking has effect on VO2 Max[37].

STRENGTH OF THE STUDY

- Number of participants were equal in both groups.
- Easy to conduct within proper time since subjects taken from nearby places.
- Participants actively committed to exercise sessions and were regularly present.
- Parents were very friendly they give immense support throughout the study.
- Cost effective exercise.
- Brisk walking exercise is easy to perform.

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.

FUTURE RESEARCH

- Sample size can be increased and may get better results.
- Treatment duration can be increased.

- Can be included as daily basis.
- A follow up study could ensure the long term effect of treatment programme.
- VO2 Max can be found using laboratory equipment's which may improvevalid outcome values
- Can include other physical fitness variables
- Can be given according to duration other than distance

CONCLUSION

Based on the values of the above study, it was obtained that there is a significant difference among experimental and control group and experimental group shows higher improvement compared to control group. Hence a planned and structured protocol of 6 week brisk walking exercise is effective in improving VO2 Max, agility and flexibility in physically inactive children within the group and between the group. Brisk walking is easy and low cost exercise and can be done anywhere and it helps to improve physical activity in children.

This study concluded that brisk walking improves VO2 Max, flexibility and agility in physically inactive children.

Declaration by Authors

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