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Effect of Exercise Therapy on Endurance and Flexibility in Young School Children

Urooj Ahmed Khan

Visiting Faculty, Department of Health physical Education & Sports Science,
University of Karachi, Karachi, Pakistan

uroojkhan2490@gmail.com

Prof. Dr. Basit Ansari

Department of Health physical Education & Sports Science, University of Karachi,
Karachi, Pakistan

basitansari@hotmail.com

Hamayun Imran Azeemi

Department of Health physical Education & Sports Science, University of Karachi,
Karachi, Pakistan

humayun@uok.edu.pk

ABSTRACT

The major concern of this research was to investigate the effect of exercise therapy on endurance and flexibility in young school children. The current research was conducted to investigate, evaluate the impact of exercise therapies and to investigate the difference in endurance and flexibility between boys and girls. Positivist research paradigm, pre-test post-test quasi experimental research design. ABA single subject experimental research design was used to collect the data from the students before, during and after the intervention. PAQ-C, flexibility and endurance tests of participants, Mean, standard deviation percentage, graphs, correlation and regression tests were calculated to generate the results. Students are mostly engaged in jogging and other activities. They are only engaged in physical activities in PE classes. Results of this study demonstrated that PA have significant effect on student flexibility and endurance. Boys perform better than girls. The current study founded that PA affects the flexibility and endurance of school children. Students, weight, height, waist circumference not changed due to PA. Endurance and flexibility increased after three months of physical activity.

Keywords: Flexibility, Endurance, Physical Activity

INTRODUCTION

Academic achievement appears to be minimally impacted or moderately improved by PA in school-age children, with chronic physical activity (PA) showing a greater positive effect compared to acute physical activity. (Barbosa et al., 2020). People who are physically active have a healthier body composition and fewer health problems (Fatima et al., 2023). In the current times, individuals have become possessive of their healthcare needs, leading to a surge in the health industry and the proliferation of exercise-related businesses. As per 2009 survey, the worldwide count of health and fitness establishment was over 128,000, which has now increasing steadily to over 186,000 as of 2015 (Sonchan et al., 2017). There is a solid relation between sedentary life style and increasing cardiovascular risk factors among children call attention to the need of enhancing and evaluating physical fitness in this population (Jimenez-Pavon et al., 2013). Children with lower physical ability levels are less active than skilled classmates (Robinson et al., 2012). Experimental studies are conducted among human participants in order to understand and develop new knowledge by defining the effects of intervention collected in order to improve the diagnosis, treatments, preventions of human disabilities and interests (Zabor et al., 2020). According to research, if children are given the opportunity, atmosphere, and chance to develop their physical skills, and teachers signal that physical activity is a preference, they will get better. If everything is in alignment, kids should make progress in this area (Pica, 2018).

They may then work with each youngster individually. The President's Council on Physical Fitness and Sports (2000) stated that physical fitness as the capacity to execute everyday chores aggressively and vigilant while yet having the energy to enjoy leisure activities and meet emergency needs. Fitness consists of two elements: fitness associated with health and fitness associated with skills. The latter brings together stability, integration, strength, quickness, and quickness of response. It includes cardiovascular endurance, muscle strength, flexibility, and body composition (Pica, 2018). Children with low endurance often use excess energy and muscles, making it hard to maintain tasks. Improving physical endurance helps kids perform daily activities better. Exercises that build strength also enhance muscular endurance. (Pica, 2018; Quinn, 2022). Children are generally flexible, with girls being more flexible than boys. Inactive boys lose flexibility around age 10, while girls start at age 12.. Hanging on monkey bars or playing with a parachute also help improve flexibility. (Pica, 2018; McCoy, 2021).

Measuring degree of muscle endurance is the first step towards improvement (Miller, 2022). To examine muscular endurance the repetition of an activity is counted i.e. how many a person can complete in one minute. According to several studies, repetitions are an excellent muscular endurance exercise. (Schoenfeld et al., 2021).

According to reviews of global literature, boys tend to maintain a stable level of aerobic power relative to their body mass between the ages of 6 and 16. However, girls experience a decline of approximately 2% per year during the same age range. On average, boys are approximately 25% more physically fit and 15-25% more active

than girls. There is a consistent decline in PA observed throughout the school years, with boys experiencing a decrease of about 2.7% per year, and girls experiencing a more substantial decrease of about 7.4% per year. These findings suggest that older adolescents, especially girls, may be at an elevated risk of obesity due to a sedentary lifestyle (Sallies, 2009).

The primary aim of physical education is to develop and maintain health at the highest possible level. Childhood health is a prominent symbol of overall well-being (Smith et al. 2014). PA has a good impact on children, as opposed to sedentary lifestyles and increased screen time, which have negative health repercussions. Parents have a huge influence on the way their kids behave habits (Jago et al., 2010). Physical activity may influence the advancement of motor abilities in youngsters. Almost all young children do not meet the minimum need of one hour of physical exercise every day (Barnett et al., 2016). Prolonged engagement in sport education, as well as well as subsequent growth of excitement, proficiency, and education, can assist individuals in their entire journey to physical literacy (Farias et al., 2020). In Pakistan, Fatima et al. (2023) investigated physical strength and flexibility in school and university students. She discovered that school pupils do poorly in endurance and flexibility tests. The researcher chose to explore and corroborate the findings of this particular investigation. Over the past decade, there has been significant focus on concerns related to low PA levels, sedentary behaviors, and mental health problems (Andermo et al., 2020), but there has been limited research investigating the connection between PA and health in young children until recently (Pate et al., 2019). The reduction of PA levels during adolescence is a crucial public health concern, as It has been related to a variety of unfavorable health effects. In order to better understand this phenomenon, a comparative study was conducted to determine the associated with age drop-in physical activity within adolescents in elementary school additionally, the study sought to determine if the decline in PA is consistent throughout the age range or if there are specific age groups that experience more significant declines (Allison et al., 2007).

Research Objectives

1. Investigate and evaluate the relationship and impact of exercise therapies on flexibility and endurance of school children.
2. Investigate the difference in endurance and flexibility components between boys and girls students.

Research Hypotheses

1. H₀ 1: There is no relationship between exercise therapy, flexibility and endurance.
2. H₀ 2: There is no significant impact of exercise therapies on flexibility and endurance levels of school children.
3. H₀ 3: There is no significant difference between flexibility and endurance of students before and after intervention

Regular PA has positive impact on overall health and fitness of youngster in schools. Studies providing evidences that engaging in PA can have multiple positive

effects as like improved physical fitness, motor skills development, cognitive function, academic performance, and social and emotional development. Additionally, PA can help to decrease the risk of obesity, type2 diabetes, and other chronic diseases. This study is design to evaluate their current health status.

LITERATURE REVIEW

There are multiple evidences that higher levels of physical activity (PA), particularly at higher intensities, lead to a variety of health benefits (Pedretti et al., 2020). However, now a day's youngsters are putting effort to meet PA guidelines, as evidenced by low moderate-to-vigorous physical activity (MVPA) engagement (Reis et al., 2024), extended periods of sedentary behavior (Tapia-Serrano et al., 2022; Reis et al., 2024), Sedentary behavior is related with poorer health results, such as decreased physical health, a less favorable cardio-metabolic profile, diabetes and obesity, less developed motor abilities, and greater mental health issues (Chaput et al., 2020; Sun et al., 2022).

Physical education programs are globally acknowledged as one of the most successful and advantageous settings for encouraging PA (Reis et al., 2024). Similarly, recent guidelines suggest combining cardiovascular and muscular strengthening activities to improve general health (Chaput et al., 2020; Umpierre et al., 2022). Studies suggests that fitness instruction ought to concentrate on organized and planned sessions, which can be successful in increasing physical health (Reis et al., 2024).

Physical Activity

Daily PA and Greater amount of movement and lesser resting is extremely beneficial to every individual, irrespective of their age, sexual orientation, race, ethnic background, or present health status. Children from three to five years should be engaged through their entire day. Youngster and adult from six to seventeen years of age required sixty minutes exercise in daily bases to be fit and healthy (Piercy et al., 2018).

Flexibility

Flexibility is known as the fundamental characteristics of tissues throughout the body that determine maximum range of motion (ROM) with no damage (Nuzzo, 2020). Static flexibility is known as the joint ROM in comfortable tissue, while dynamic flexibility implies to rigidity of the muscle-tendon group within regular ROM (Knudson, 2000).

According to the Institute of Medicine (2012), their findings prompted the formation of the President's Council on Physical Youth Fitness and the implementation of school fitness investigation. In 1960, Leighton discussed the importance of flexibility for physical instructors. Flexibility, according to Nick and Fleishman (1962), is one element of five physical excellences. The next year, Fleishman incorporated assessments of existing flexibility aimed at developing reliable tests for all aspects of wellness (Fleishman 1963). In 1980, Corbin and Noble referred to flexibility as an essential part of bodily health and claimed that it had health benefits

(Corbin & Noble, 1980). The first American physical fitness instrument was created in 1980 (Institute of Medicine, 2012; Nuzzo, 2020), which included the sit-and-reach exercise.

Today, flexibility is thought of as a component of wellness. As per the American College of Sports Medicine, it is fair, determined by existing research, to propose that persons participating in a general health plan practice flexibility training after cardio-respiratory or strength-training sessions, or as an independent activity. The organization also suggests three days of stretches each week, with four sessions of different exercises per day (Garber et al., 2011). In America, more than one third of personal trainers recommend static stretching (Waryasz et al., 2016).

In 2002, Canada's first set of PA guidelines for children introduced (Janssen, 2010). Couple of guidelines was published for little children (six to nine) and another for teenagers (ten to fourteen) (Janssen, 2010). The primary guidelines are the following:

1. Increase existing PA duration by 30min/day, gradually increasing to 90m/day over a period of around five months.
2. Schedule physical activity in five to ten minute intervals throughout the day.
3. The ninety minute increase in PA should comprise sixty minutes of light exercise and thirty minutes of intense action.
4. Engage in a variety of activities to attain the most beneficial health advantages.
5. Reduce time spent on activities like watching TV, playing video games, and browsing the internet. Start with 30 minutes a day and gradually increase to 90 minutes over five months (Janssen, 2010).

Flexibility Training

According to Lieberman (2023), flexibility exercises can help improve and maintain ROM in a single or multiple joints. They should be done slowly and carefully, with gradually increasing ROM. Stretching techniques are classified into three types: static, dynamic, and PNF (Lieberman, 2023).

Static

Static stretching involves holding a stretch at mild discomfort for 15 to 30 seconds. It's a safe, effective, and time-efficient way to improve flexibility and posture. These stretches also help relieve pain and enhance alignment. Examples include hamstring, hip flexor, back, shoulder, core, quad, and chest stretches. The American College of Sports Medicine (2014) suggested that the sit-and-reach included in fitness testing due to the relevance of hamstring elasticity in daily tasks and playing sports. Several researches have looked into the efficacy as well as accuracy of the sit-and-reach method (Wells & Dillon, 1957; Bozic et al., 2010; Atamaz et al., 2011; Nuzzo, 2020).

Dynamic

Dynamic stretches involve continuous movements, like jumping, to improve muscle elasticity and circulation. They are commonly used as warm-ups before activities like weightlifting but may cause muscle pain or injury if not done correctly

PNF

PNF stands for Proprioceptive Neuromuscular Facilitation, which improves

range of motion (ROM) and muscular function (MF), enhancing flexibility. It involves a sequence of muscle contractions and relaxations. PNF is effective for increasing flexibility.

Endurance

Most of the time, endurance is a result of a confluence of emotional and biological factors that enable us to carry out our current tasks for as long as we choose. In contrast to stamina, endurance is more concerned with an individual's capacity to carry out certain tasks; it does not involve achieving maximal performance (Sinrich, 2022).

Cardiovascular Endurance

The endurance related to the heart is the measure of the strain our hearts can withstand when engaging in PA. Our bodies grow more adept at pumping blood during that particular exercise when we increase our cardiovascular endurance (Sinrich, 2022).

Muscular Endurance

The amount of period that muscles can contract sufficiently to enable your body to do a certain task is known as muscular endurance. Muscular endurance deficit makes a person more susceptible to cramping caused by an excess of lactic acid buildup (Sinrich, 2022).

Anaerobic Endurance

Anaerobic endurance refers to the duration of a muscle's ability to do a specific PA in the absence of oxygen. An excellent illustration of this is weightlifting. Anaerobic activity differs from aerobic exercise, such swimming or cycling, in that it usually lasts less time but is more intense (Sinrich, 2022).

Endurance Training Program

Muscular endurance deficit makes a person more susceptible to cramping caused by an excess of lactic acid buildup (Sinrich, 2022). Three (3) factors make up an endurance training program: frequency, intensity, and duration (Lieberman, 2023). Training for both skeletal muscular power and aerobic capacity within a program is a viable strategy to improve performance (Gabler, 2018). The following are suggestions made by the American College of Sports Medicine (ACSM) (Reibe et al., 2018):

1. Time interval three to five days a week of aerobic activity
2. Training intensity: half to one third of the highest possible intake of oxygen recovery or heart rate reserve, or more than half to one third of the highest possible heart rate.
3. Training duration: half to one hour of continuous or sporadic aerobic activity; minimum of ten minutes sessions collected throughout the day.

The duration of exercise depends on its intensity. According to Lieberman (2023), aerobics consists of walking, running, jogging, dancing, stair climbing, cycling, swimming, etc.

The comprehensive research came to the conclusion that the majority of kids and teens who engage in one hour or more of light to hard aerobic activity on a daily basis will benefit in terms of their physical well-being.

The US Department of Health and Human Services' PA Guidelines Advisory Committee published the guidelines for PA in 2018 (Piercy et al., 2018). The following are suggestions based on age:

1. Kids (3-5) To promote growth and development, children should be engaged in exercise all throughout the course of the day.
2. Kids (6-17) an hour every day or more of light to hard exercise.
3. Adolescents a minimum of 150-300min per week of light to hard exercise, or 75-150min per weekly of light to hard exercise, or a comparable mix of light to hard exercise. a minimum of two days weekly should be dedicated to activities that strengthen muscles.
4. For seniors: various physical that incorporates cardiovascular, strength, and muscular coordination training. Cardiovascular workout that cause their hearts to beat more quickly, such as running, walking, football, or other such sports, should make up the majority of their daily sixty minutes of PA. There should be hard exercises three days weekly at the very least Xao-feng (2011).The reader may learn more about the validity of the data supporting the suggestion by looking at the degree of support. The grade advises the reader on whether to execute a measure by weighing the advantages and disadvantages of doing so (Jassen, 2010).

Typically, kids don't require structured muscular strength regimens like lifting. As kids become bigger and mature into teenagers, they could begin formal weights regimens. In addition to their athletic training, they could participate in these kinds of activities (Xao-feng, 2011).In between sets, there are rest intervals, which are times for recovery. The rest duration is determined by the training objective, the individual's training state, and the proportion of the load lifted.

Medium difficulty exercise is a five or six on a scale of zero to ten, when sitting is a zero and the maximum amount of engagement is a ten. Kids who engage in Medium difficulty exercise inhale harder and their pulses beat more quickly than those who sit or remain still. A category seven or eight exercise is considered intense. Kid's hearts beat far quicker and their breathing is substantially harder during hard-exercise (Xao-feng, 2011).

Enhancing children's cardio-respiratory fitness is a typical advantage of sports strategies (Wu et al., 2023). Furthermore, it appears that intervention programs both improve children's physical fitness and their medium to hard PA during sports sessions (Silva et al., 2021) .The current study's premise was that, as physical fitness increased through exercise therapy, there would be gains in endurance and flexibility following the treatment. Thus, the aim of this research was to investigate the effects of physical activities experiment on elementary school kids overall daily PA status and fitness.

Reported Effect of Physical Activities

The data is supporting the physical strength, endurance, and flexibility, with PA considering in schools. School based PA sessions provide the best results regarding kids and teens health and fitness. As a result, multiple research

investigations based on PA treatment were created and carried out in educational institutions, with the main objective of health and physical performance betterment in teenagers who were obese. Research findings indicate that this strategy was successful in enhancing fitness related metrics in other contexts (Yu et al., 2022).

Old researches provide information that flexibility activities, such as stretching, may improve flexibility (Sun et al., 2022). According to Sun et al. (2022), stretching exercises performed during the warming up and cooling down phases may be primarily responsible for any possible improvements in flexibility (Mayorga-Vega et al., 2014). A comprehensive study investigated the impact of acute static stretching on maximum muscular capabilities before exercise activities. Cardio-respiratory fitness is regarded as a key predictor of cardio-metabolic health.

Literature reviews and meta-analyses providing studies that found substantial gains in heart and lungs well-being, with time frame, rate, and duration of the treatment ranging from thirty to ninety minutes for every time, single to multiple sessions per week, and multiple weeks to couple of years. Many studies has included cardiovascular plus strength training with medium to strong degree. He et al. (2011) conducted six minute walking tests, which were analyzed in the systematic review and revealed an average difference to the advantage of the treatment sample. The three trials conducted PA treatments at medium to high level, two to three times weekly, for fifty to sixty minutes each, during a ten to fifteen weeks. The results indicated that there is tremendous progress.

METHODOLOGY

Positivist research paradigm was selected to design the study. A paradigm is a unified collection of views, ideas, inquiry designs, and data collection and analysis methodologies. These will influence choice-making and allow the researcher to effectively complete the study process (Neuman, 2007). Pragmatism was initially proposed by Peirce (1839-1914), and further refined by W. James (1842-1910) and J. Dewey (1859-1952) (Given, 2008). Pragmatism originates from Pragma, which implies to act.

Research Design

The researcher conducted this study using pre-test post-test Quasi experimental research design. ABA single subject experimental research design was used to collect the data from the students before, during and after the intervention. A-B-A design usually comprises multiple measurements and subsequent treatment afterwards. In accordance with (Gay, 2012), the A-B-A design is employed for single-subject experimental groups to assess the effectiveness of therapy. Experimental design indicates that "O" stands for measure, and "X" represents an experience with an experimental parameter. The A-B-A design was utilized in the study asit gives further proof to judge the effectiveness of the treatment.

Nature of Research

The approach was quantitative in nature. Survey research accompanied with experimental research was employed to collect the data to examine the impacts of PA

on students' flexibility and endurance. Survey research is an essential part of measuring and quantitative social research. Survey is a wide category that includes a variety of methods involving the questioning of particular those who responded (Gaille, 2020). In current study self-reported questionnaire was used to collect data from the students.

A controlled, randomized trial (RCTs) was utilized to recruit participants from a private elementary school in Karachi.

Population and Sample

The population included 5th class students of private elementary schools of Karachi. According to the SINDH Education Management Information System (SEMIS Census, 2014-2015) there were 20,025 boy and 33,181 girl total 53,208 students were enrolled in these schools.

The total sample size for the 53,208 population is 63 students for intervention. Just one coeducation private school of Karachi was visited to locate the sample.

Sampling Technique

To access the study's participants, non-probability convenient sampling approach was adopted. Just one private school of Karachi was visited to locate the sample. The total 63 responders both boys and girls learning in 5th grade were selected to conducted the study.

After recruitment, individuals were randomly assigned to the treatment group. It is crucial to ensure that nobody recognizes the group that the participant will be allocated to during the recruitment process (Hariton & Locascio, 2018).. During intervention total 13 students withdraw the intervention within three months. Following were the detail of the sample.

Conceptual Framework of the Study

Figure given below is presenting the conceptual framework of the study.

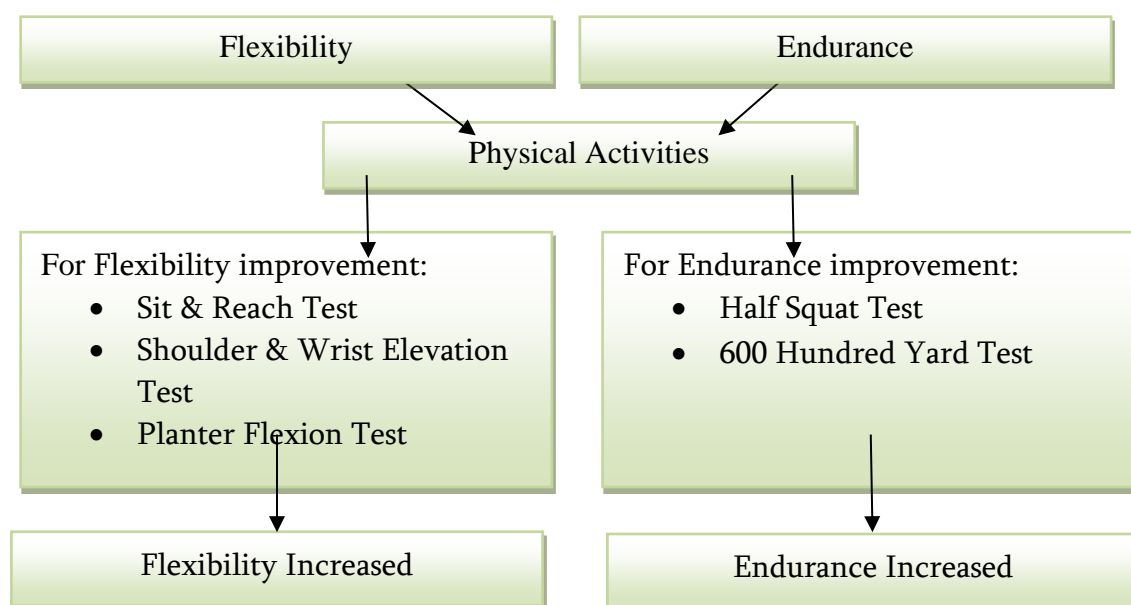


Figure 1: Conceptual Framework of the Study

Instrument of Study

A standardized instrument i.e. Physical Activity Questionnaire for Older Children PAQ-C was adopted to collect the data of PA (PA) effects on students' flexibility and endurance.

This instrument was developed by Kent, Peter and Rachel in 2004. PAQ-C is valid and reliable self-reported instrument, which covers moderate to high level of physical activities during a week (. This instrument was reported with high coefficient value for physical activities during school than other instruments (Baldwin, 2018). The instrument was consisted of nine (9) items. Students' responses over 9 items were collected on five point Likert Scale, where 1 indicated less engagement and 5 indicating highly engaged or maximum responses

Validity and Reliability of Instrument PAQ-C

Before using the PAQ-C, it was critical to assess the instrument's validity and reliability in a Pakistani environment. The validity of an analysis tool is established by how well it assesses what it is supposed to assess (Baldwin, 2018). The validity of a research instrument relates to how effectively it assesses what it is intended to assess (Thatcher, 2010; Robson, 2011). A measurement that delivers consistent findings with equal values is said to be reliable (Taherdoost, 2016). The most often used internal consistency measure is Cronbach's alpha (α). It typically falls between 0 and 1 (Vaske, Beaman, & Sponarski, 2017). Alpha values above 0.7 are considered as fair, value more than 0.8, excellent and sufficient and value more than 0.9 as demonstrating exceptional internal consistency (Cronbach, 1951). In the social fields of study, acceptable alpha values estimated range from 0.7 to 0.8 (Vaske, Beaman, & Sponarski, 2017).

Table 1: Reliability Analyses of items of PAQ-C

Sr.No	n=50			
	Constructs	mean	SD	Cronbach's Alpha (a)
1	PA in spare time			
	Skipping	1.84	1.283	2.14
	Rowing	1.20	.535	2.40
	Skating	1.54	1.164	2.74
	Tag	2.04	1.414	2.74
	Walking	2.80	1.457	3.00
	Bicycling	2.44	1.618	3.01
	Jogging	3.16	1.683	3.98
	Aerobic	1.44	1.091	2.04
	Swimming	1.76	1.188	2.16
	Base ball	1.68	1.220	2.18
	Dance	1.74	1.322	2.04
	Foot bal	2.04	1.414	3.04
	Badminton	1.82	1.335	2.08
	Skateboard	1.24	.771	2.24

	Soccer	1.48	.995	2.15
	Street Hockey	1.10	.586	2.02
	Volley Ball	1.84	1.299	2.16
	Floor Hockey	1.22	.815	2.03
	Basket ball	1.84	1.315	2.30
	Ice Skating	1.16	.618	2.17
	Cross Country Skiing	1.04	.283	2.17
	Ice Hockey	1.00	.000	1.98
	Other	3.80	1.229	4.39
2	Students' activeness during PE class, in previous 7 days	3.33	1.519	.794
3	Activities in Races in previous 7 days	3.02	1.664	.798
4	Activities during lunch time, in previous 7 days	3.22	1.558	.792
5	Activities right after school time, in previous 7 days	3.45	1.444	.790
6	Activities in evening time, in previous 7 days	3.63	1.349	.790
7	Games frequency at weekend	3.14	1.443	.795
8	Physical activities in free time	3.25	1.314	.787
9	PA for each day in last 7 days	3.45	1.102	.779
	Monday	2.98	1.346	.793
	Tuesday	2.76	1.422	.790
	Wednesday	2.73	1.440	.790
	Thursday	3.33	1.491	.792
	Friday	3.27	1.538	.791
	Saturday	3.71	1.472	.799
	Sunday	3.41	1.682	.795
9	Frequency of sickness or anything that prevent from PA	2.00	.000	7.83

Table demonstrated the item analysis of PAQ-C. It can be seen all the items of PAQ-C having Cronbach's Alpha(α) value is in between .700 to .900. These high Cronbach's Alpha values considered as exceptional internal consistency.

Tests for Flexibilities and Endurance

Physical testing batteries for evaluation of children flexibility included:

1. Modified sit and reach test for flexibility of lower extremity (hip and back flexion) specially hamstrings
2. Shoulder and wrist elevation test (Johnson 1977) to measure shoulder and wrist flexibility.
3. Planter flexion test for ankle flexion

Tests for endurance included:

1. Half-squat jump test to measure the endurance of muscles of the legs.
2. 600 yard run-walk test to assess overall cardiovascular endurance

Other measurements included

1. BMI
2. Height (in inches)
3. Weight (kg)
4. Waist circumference (in inches)

To measure the weight normal weight machine was used. For measuring the arm height, planter flexion, height and waist circumference etc measuring tape was used. Students' height was measured in inches. Additionally, waist circumference also measured in inches. On the other hand, sit and reach, shoulder and wrist elevation and plantar flexion were measured in centimeters. Stop watch was used to calculate run and walk test. Additionally, BMI was calculated with following formula.

$$\text{BMI} = \text{kg}/\text{m}^2$$

Where kg indicates the weight and m = means height multiple with 2. Adolphe, a Belgian mathematician, developed this BMI formula in the 1830s (Hazell, 2023).

The final obtained scores for flexibility were interpreted as per predetermined criteria (scores) by Mike Morgan, Corpus Christi State University, 1976. Following table showing the flexibility and endurance levels.

Intervention

The researcher began intervention once the ethical consideration and consents for the investigation were completed. The intervention lasted 12 (twelve) weeks the researcher employed the ABA single subject experimental research design to ensure that the intervention was carried out effectively. The pretest and posttest were employed to collect data twice, both prior to and following the treatment, since researchers believed that two measurements might be contrasted, and any variations attributed to therapy (Jackson, 2009). The participant students were treated with selected physical exercises.

Statistical Procedure

Data was collected through test and tabulated in Statistical Package named IBM 21. After preparation of data-sheet into IBM 21, some descriptive and inferential analyses were applied. These analysis included mean, standard deviation, percentage, skewness, kurtoses, graphs, and correlation, regression and *t*-test etc.

RESULTS

The purpose of the analysis of the collected data is to look at how exercise therapy affects young schoolchildren's flexibility and endurance.

Demographical Information of the Participants

Table 2: Gender Wise Information of Participant Students

Sr. No	n=50		
	Respondents	Frequency	Percentage
1	Boys	29	58.0

2	Girls	21	42.0
3	Total	50	100

Normality of the Data

To determine the normality of the data, two statistics were used: (1) Shapiro-Wilk and (2) skewness and kurtosis. According to Pallant (2011), skewness measures the symmetry of data distribution. Skewed data occurs when the distribution of answers for a variable shifts to the right or left side of the graph. Kurtosis is a measure of the peak or height of a data distribution. If most of the responses appear in the middle of a graph, the distribution has a high peak.

Table 3 : Normality of Data Items

n = 50						Shapiro-Wilk	
Sr. No	Variables	Mean	SD	Skewness	Kurtosis	df	Sig.
1	PAQ-C	47.84	12.35	.593	-.386	50	.718
2	Flexibility Test	335.50	36.71	-.166	-.079	50	.004
3	Endurance Test	72.59	20.00	-.859	.114	49	.055

Table 3 reveals that the p value for flexibility and endurance is less than $p=0.05$ thus is concluded that null hypothesis i.e., data is not normally distributed is rejected. Thus, it is concluded that the data for flexibility and endurance is normally distributed. Moreover, p value for PAQ-C is above $p= 0.05$, thus the null hypothesis that data is not normally distributed is not rejected. The data for PAQ-C is not normally distributed. On the other hand, the values produced for the skewness and kurtosis tests are within the specified range i.e. in between -1 to =1, therefore it can be concluded that the above-mentioned data is normal and appropriate for further investigation.

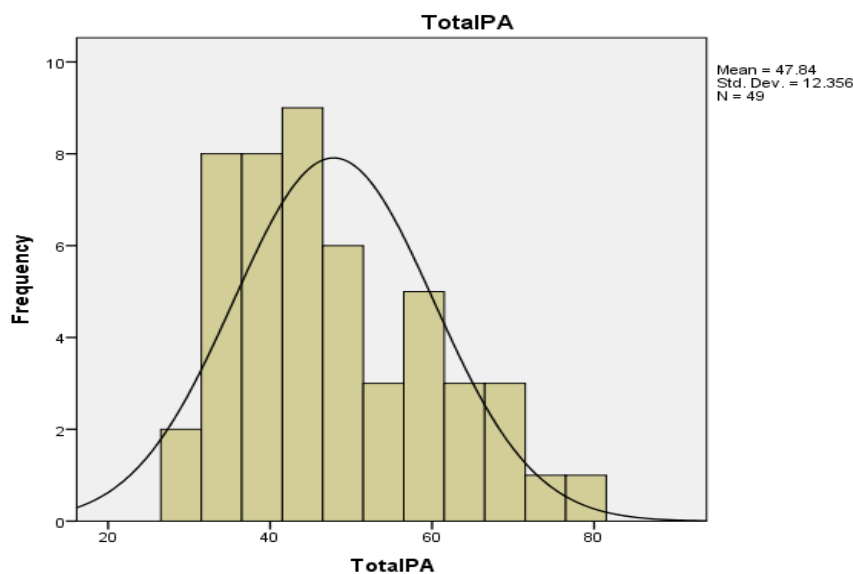


Figure 2: Normality of Data Items of PA Test

Note: In figure: normal curve showing normal skewness and kurtosis for PAQ-C.

Analysis of Questionnaire

Table 4: Descriptive Statistics of PA Questionnaire PAQ-C

Sr.No	n=50	Before Intervention		After Intervention	
		mean	SD	mean	SD
1	PA in spare time				
	• Skipping	1.84	1.283	2.14	.883
	• Rowing	1.20	.535	2.40	.735
	• Skating	1.54	1.164	2.74	1.101
	• Tag	2.04	1.414	2.74	.814
	• Walking	2.80	1.457	3.00	.757
	• Bicycling	2.44	1.618	3.01	1.581
	• Jogging	3.16	1.683	3.98	.762
	• Aerobic	1.44	1.091	2.04	.932
	• Swimming	1.76	1.188	2.16	.893
	• Base ball	1.68	1.220	2.18	.120
	• Dance	1.74	1.322	2.04	.702
	• Foot bal	2.04	1.414	3.04	.834
	• Badminton	1.82	1.335	2.08	.763
	• Skateboard	1.24	.771	2.24	.971
	• Soccer	1.48	.995	2.15	.750
	• Street Hockey	1.10	.586	2.02	.521
	• Volley Ball	1.84	1.299	2.16	.972
	• Floor Hockey	1.22	.815	2.03	.905
	• Basket ball	1.84	1.315	2.30	.745
	• Ice Skating	1.16	.618	2.17	.718
	• Cross Country Skiing	1.04	.283	2.17	.239
	• Ice Hockey	1.00	.000	1.98	.106
	• Other	3.80	1.229	4.39	.962
2	Students' activeness during PE class, in previous 7 days				
		3.34	1.507	4.09	.976
3	Activities in Races in previous 7 days				
		3.04	1.653	4.16	7.01
4	Activities during lunch time, in previous 7 days				
		3.20	1.552	4.08	.971
5	Activities right after school time, in previous 7 days				
		3.44	1.431	4.02	.932
6	Activities in evening time, in previous 7 days				
		3.62	1.338	4.17	.899

7	Games frequency at weekend				
		3.14	1.429	4.10	.991
8	Physical activities in free time				
		2.89	1.118	3.19	1.124
9	PA for each day in last 7 days				
	• Tuesday	2.76	1.408	3.62	1.003
	• Wednesday	2.70	1.446	3.51	1.326
	• Thursday	3.28	1.512	4.11	1.493
	• Friday	3.26	1.523	4.06	9.78
	• Saturday	3.74	1.468	4.32	.987
	• Sunday	3.44	1.680	4.31	1.437
10	Frequency of sickness or anything that prevent from PA				
		2.00	.000	2.32	.067

Table 4 is demonstrating the statistics for descriptive analysis of PA questionnaire. Mean score low mean score i.e., near to 1 indicates the students are not or rarely engaged in these kind of physical activities or in these time periods. The means score near to 2 indicates that students are less engaged in these physical activities than physical activities having mean value of 1. On the other hand, the high mean score i.e. 3 and 4 indicates that students are mostly engaged in these physical activities or in these time periods.

Standard deviation (SD) with high values indicates that students have different responses upon these statements. On the other hand, and low standard deviation (SD) (less than 1) indicate that students have similar responses upon these statements.

Relationship between exercise therapy, flexibility and endurance.

Table 5: Descriptive Statistics, Reliability Coefficients of Three points of Students at Three Phases of Single Subject A-B-A Design for Flexibility

Sr. No	n=50		
	Time Point	Mean	SD
1	Before Intervention		
	Sit & Reach	16.34	2.29
	Shoulder & Wrist Elevation	38.07	7.10
	Plantar Flexion (Height Chin to Toe)	38.18	7.11
2	First Baseline Phase A		
	Sit & Reach	16.90	1.94
	Shoulder & Wrist Elevation	38.32	7.14
	Plantar Flexion (Height Chin to Toe)	38.90	7.13

3	Treatment Phase B (intervention)		
	Sit & Reach	17.06	2.24
	Shoulder & wrist elevation	39.32	7.14
	Plantar Flexion (Height Chin to Toe)	39.11	7.24
4	Second Baseline Phase A		
	Sit & Reach	17.72	2.34
	Shoulder & wrist elevation	39.70	7.08
	Plantar Flexion (Height Chin to Toe)	45.88	7.65

Table 5 shows descriptive statistics for effects of physical therapy upon flexibility of students at three phases of single subject A-B-A design and also the pre intervention statistics to compare the scores.

Above mentioned statistics demonstrated that the means scores for sit and reach, shoulder and wrist elevation and plantar flexion tests are increased in mid treatment (Phase-B) and also following the treatment (Phase-A) when intervention was stopped.

So as per results, it is evident that flexibility of students is increased after intervention.

Table 6: Descriptive Statistics, Reliability Coefficients of Three points of Students at Three Phases of Single Subject A-B-A Design for Endurance

n=50			
Sr. No	Time Point	Mean	SD
1	Before Intervention		
	Half Squat jump (1 minute)	32.44	11.31
	600 Hundred Yard	3.01	.431
2	First Baseline Phase A		
	jump (1 minute)	32.74	11.51
	600 Hundred Yard	3.04	.435
3	Treatment Phase B (intervention)		
	Half Squat jump	32.88	12.14
	600 Hundred Yard	3.32	.479
4	Second Baseline Phase A		
	Half Squat jump	33.48	17.12
	600 Hundred Yard	4.12	.679

Table 4.6 shows descriptive statistics for effects of physical therapy upon endurance of students at three phases of single subject A-B-A design and also the statistics before intervention.

Above mentioned statistics demonstrated that the means scores for half squat jump and 600 hundred yard tests are increased in mid treatment (phase B) and also following the treatment (phase A) when intervention was stopped. So as per results, it is evident that endurance of students is increased after intervention.

Hypothesis Testing

Hypothesis 1

Sr. No	Factors	Mean	SD	df	Sig. <i>p</i>
1	PA effects on Flexibility	335.50	36.71	1	.041
2	PA effects on Endurance	72.59	20.00	1	.035

**p*=.05

Table 4.8 is demonstrating the detail of regression analysis for effects of exercise therapy upon flexibility and endurance of school students.

Above mentioned *p* value less than *p*=.05 of flexibility shows that PA has greater effect on students flexibility than endurance.

Hypothesis 2

Table 7: Difference between Pre-Test and Post-Test Scores of Flexibility and Endurance

Variables	Groups	Mean	SD	df	<i>p</i>	Cohen's d	
						Upper	Lower
Flexibility Scores	Pre-test	23.39	2.63	49	.000	94.58	82.83
	Post-test	42.10	6.98	49			
Endurance Scores	Pre-test	5.78	1.50	49	.434	6.98	.953
	Post-test	6.80	6.97	49			

p=0.05

The above mentioned table 7 represents the results of the paired sample *t*-test, which was conducted to compare the pre-test and post-test scores of flexibility and endurance of school students before and after the PA intervention.

On the basis of results $H_{0.2}$ is fail to accept. In other words, there is significant difference in pre-test and post test scores of flexibility. But the *p*= .734 for endurance is greater than the *p*= .05, thus $H_{0.2}$ is fail to accept. In other words, there is also significant difference in pre-test and post test scores of and endurance is seen. It implies that the intervention PA has an effect on the student's flexibility and endurance.

Hypothesis 03

Table 8. Difference between Boy's and Girl's Pre-Test Scores of PA, Flexibility and Endurance

n=50						
Sr.No	Variables	Gender	Mean	SD	df	<i>p</i>
1	Physical activity (PAQ-C)	Boys	48.43	12.18	48	.199

		Girls	47.05	12.83		
		Girls	24.76	2.54		
2	Sit & reach	Boys	60.12	3.22	48	.154
		Girls	58.90	2.44		
3	Shoulder wrist elevation	Boys	57.29	11.65	48	.140
		Girls	61.28	4.10		
4	Plantar flexion	Boys	45.88	7.65	48	.251
		Girls	38.18	7.11		
5	Total flexibility	Boys	126.78	11.08	48	.024
		Girls	118.71	13.39		
6	Half squat jump	Boys	33.48	17.12	48	.441
		Girls	30.22	16.96		
7	600 hundred yard	Boys	4.12	.679	48	.479
		Girls	3.87	.578		
8	Total endurance	Boys	32.30	9.80	48	.010
		Girls	40.59	8.15		

$p=.05$

Table 8 is representing the difference between boys and girls pre-test scores of flexibility and endurance. Independent sample *t*-test was conducted to compare the physical activities, flexibility, and endurance of boys and girls. It can be seen that there is no difference in physical activity .

Hypothesis 4

Table 9: Difference between Boy's and Girl's Post-Test Scores of Physical Activity, Flexibility and Endurance

n=50						
Sr. No	Variables	Gender	Mean	SD	<i>df</i>	<i>p</i>
1	Physical activity (PAQ-C)	Boys	52.31	17.80	48	.199
		Girls	49.54	12.99		
2	Sit & reach	Boys	62.50	3.36	48	.458
		Girls	62.04	3.61		
3	Shoulder wrist elevation	Boys	119.98	7.109	48	.102
		Girls	111.52	26.12		
4	Plantar flexion	Boys	49.58	8.25	48	.310
		Girls	43.81	8.13		
5	Total flexibility	Boys	214.43	27.62	48	.480
		Girls	208.90	26.40		
6	Half squat jump	Boys	34.28	16.04	48	.457
		Girls	31.78	15.13		
7	600 hundred yard	Boys	5.34	.709	48	.457
		Girls	4.40	.638		

8	Total endurance	Boys	39.91	16.01	48	.014
		Girls	32.50	17.70		

$p=.05$

Table 9 is representing the difference between boys and girls post-test scores of PA, flexibility and endurance. Paired sample t-test was conducted to compare the mean score of physical activities, flexibility, and endurance.

These results show the null hypothesis is not rejected. There is no significant difference in post test score of physical activity of boys and girls.

Total Flexibility

These results show the mean value of flexibility of boy ($m= 214.43$, $SD= 27.62$) is significantly greater than the mean scores of girls ($m= 208.90$, $SD= 26.40$); $p= .480$ on significance level of $p= .05$. Thus, the null hypothesis is not rejected. There is no significant in post test score of flexibility of boys and girls.

Total Endurance

These results show the mean value of endurance of boy ($m= 39.9$, $SD= 16.01$) is significantly greater than the mean scores of girls ($m= 32.50$, $SD= 17.70$); $p= .014$ on significance level of $p= .05$. Thus, the null hypothesis is rejected. There is significant difference in post test score of endurance of boys and girls. Boy's endurance increases more than girls.

Above mentioned results demonstrated that there is a mostly no significance difference in boys' and girls' physical activity after intervention. But boy performs better in endurance test than girls after intervention.

The pre-test and post-test mean score are not too much different or increase as intervention was a short duration activity i.e., three (3) months. Thus it is hard to change flexibility and endurance to large extent in a short time period, but the mean scores are demonstrating that flexibility, endurance are increased due to exercise therapy intervention.

DISCUSSION

This research study was conducted to investigate the effect of exercise therapy upon endurance and flexibility in young school children. The major objectives of this research study were as follows:

1. Investigate the relationship of exercise therapies adherence and improvements in flexibility and endurance of school children.
2. Evaluate the impact of exercise therapies on flexibility and endurance levels of school children.
3. Investigate the difference in endurance and flexibility components between boys and girls students.

The study was limited to only one private sector elementary school of Karachi. The fifty (50) were sample of the study. Both boys and girls were included in the study. A quantitative survey was conducted to investigate the effects of effect of exercise therapy upon endurance and flexibility. To investigate the effects experimental pre-

test, post-test; A-B-A single subject was research was also designed. Non-probability convenient sampling approach was adopted to select the sample. Valid and reliable PAQ-C was research instrument, which reliability value is of .867.

Different tests were conducted to measure change in flexibility and endurance. Some other measurements included BMI, height, weight, waist circumference etc. The intervention comprised of 12 (twelve) weeks. Data was collected before, during and after the intervention. Different descriptive and inferential statistics were applied to analyze the data. Educational and local programs can be beneficial in keeping young people healthy and active on a nationwide scale. Improved cardio-respiratory fitness is a typical benefit of exercise intervention courses for kids (Wu et al., 2023). The research has shown that higher levels of sport participation are connected with healthier kids. In contrast, poor levels of health appear to contribute to kids becoming sedentary (Faigenbaum, 2021). I Pakistan we need to do more researches like this to improve the over all health of our kids who are the future of our country. I found very little research on kids regarding their health parameters in Pakistan. Exercise is crucial for kids' physical and mental growth. Regular physical activity helps build strong bones and muscles. It improves cardiovascular health, boosting energy levels. Exercise enhances cognitive function, concentration, and academic performance. Physical activity reduces the risk of obesity and related health issues. It also promotes emotional well-being, self-esteem, and social skills. Encouraging kids to exercise from a young age sets them up for a lifetime of health and happiness.

CONCLUSION AND RECOMMENDATIONS

The current study examined the effects of PA on outcomes of physical fitness and athletic performance in youth. Study founded that physical activity affects the flexibility and endurance of school children aged between 8 to 14 years. Students, weight, height, waist circumference not changed due to physical activity. On the other hand, sit and reach performance, shoulder wrist elevation performance and planter flexion, half squat jump as well as six hundred yard running performance are increased after three months physical activity. Additionally, a potentiating effect of physical activity was most visible in boy than girls. Preliminary finding from this study also indicates that physical activity increases flexibility more than endurance. But this may be due to less endurance exercise and short time periods.

Physical trainer in school, may include both flexibility and endurance exercises in PA class to increase flexibility and endurance performance in young children to improve their physical fitness. As physical training affects differently different age groups, thus biological age should always be reported given their relevance to training adaptations. Findings may report separately for boys and girls so that effect on training adaptations can be determined. Physical training program's duration may increase (more than three months) to improve effectiveness of PA training class. These guidelines require confirmation, as it was based on data of current study with small sample and limited time frame. We need to work on different health related and skill related components of school going children's to know the health status, motivate

them for PA, and to give them better future with a long healthy life. It is the duty of the parents to encourage children to get more involve in physical activities rather they give more time to screen, scrolling, and video games. Along with PA, nutrition also plays an important part to enhance the health, avoid obesity and diseases and remain active. Encouraging kids to engage in regular physical activity is crucial for their overall health and well-being. By promoting exercise habits from a young age, parents and caregivers can help kids develop healthy habits that will benefit them throughout their lives. Exercise has been shown to reduce symptoms of anxiety and depression in kids, promoting emotional well-being and self-esteem. Physical activity improves concentration, memory, and academic performance in kids.

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