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Immediate Effects of Static Stretching Versus Dynamic Warm up Exercises on Vertical Jump Test in 12 to 16 Years School Students: A Comparative Study

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ABSTRACT: The static stretching has been found to enhance flexibility and reduce muscle tension, and dynamic warm up exercises raises core body and deep muscle temperatures, stimulates the nervous system, decreases the inhibition of antagonist muscles, and possibly reduces the risk of injury. Children are often encouraged to participate in some type of warm-up before vigorous physical activity, Warm-up is one of the most common practices at the beginning of Physical Education (PE) classes in schools. The aim of the study was to compare the immediate effects of static stretching versus dynamic warm-up exercises on vertical jump performance in 12 – 16 years school students. The 100 Participant (Boys and Girls) were taken, aged between 12 years to 16 years in 2 groups as Group A static stretching (n = 50) and Group B dynamic warm up exercises (n = 50). The pre assessment was taken before intervention and post assessment was taken after intervention. The study revealed an improvement in vertical jump performance in both intra groups (group A and group B). However, the results of the intergroup study revealed that dynamic warm-up exercises (group B) are more effective than static stretching (group A) in improving vertical jump performance in school students.

KEYWORDS: Dynamic warm up, Physical education, Static stretching, Vertical jump

INTRODUCTION

Warm-up prior to physical activity is a common practice believed to reduce the risk of injury and enhance performance [1]. This is thought to be achieved by various mechanisms such as increased muscle temperature and associated effects increased neural activation and joint range of motion (ROM), as well as reduced musculotendinous stiffness. Most warm-ups typically contain a relatively low intensity aerobic component that is general in nature such as jogging[1].

Children are often encouraged to participate in some type of warm-up before vigorous physical activity, Warm-up is one of the most common practices at the beginning of Physical Education (PE) classes in schools, training sessions or competitions for children[3] . It is important for all students to warm-up before participating in the main activities of a PE class. In order to prevent injuries and optimize performance[3].

Active static stretching eliminates outside force and it's adverse effects from stretching procedures[4]. It involves actively using your own muscles to achieve range of motion; as the antagonist (opposite) muscle contracts, the agonist (target) muscle groups lengthen and relax. This is a safe, effective, and recommended method of stretching[4]. Static stretching usually involves moving limb to the end of its range of motion (ROM) and holding the stretched position for 15–60 sec[3,6]. While static stretching has been found to enhance flexibility (increasing range of motion in the joints) and reduce muscle tension , it is widely conjectured that pre-event protocols that include static stretching will also reduce the risk of injury and enhance performance [3,4,6].

Dynamic stretching or dynamic warm up exercises raises core body and deep muscle temperatures, stimulates the nervous system, decreases the inhibition of antagonist muscles, increases post activation potentiation, and possibly reduces the risk of injury [2,5]. As a result of these effects, dynamic stretching may enhance force development, power development [2].

Vertical jumping is one of the exercises that can improve agility[7]. The instantaneous force refers to the force that occurs when the muscle contracts explosively due to the concentration of nerve impulses. . In other words, it is the ability to apply force with strong muscle strength and agility [6,7]. The main muscles used in vertical jumping are hamstring and gluteus maximus, which extend the hip joint, quadriceps femoris, which extends the knee joint, and gastrocnemius and soleus, which cause plantar flexion of the foot.

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It is reported that it is necessary to enhance the coordination of the nervous system as well as these muscles in order to improve the ability to jump vertically[7].

Vertical jump tests are common in physical education, fitness, and sports programs, as a means to assess lower limb "power". Jump demand different motor programs by the central nervous system, in order to execute the neuromuscular coordination necessary for the specific jump. The vertical jump can be used as the most basic functional expression of explosive muscle strength, as it requires only concentric activation[9].

The essential time for growth, development and for body bulit is between the ages of 12 to16 years. Children develop, and adopt good lifestyle habits through physical education[8] .

METHODOLOGY

A comparative study was conducted in Jalgaon city. 100 participants both male and female was randomly included. Vertical jump test was used as the outcome measure. The study's inclusion & exclusion criteria was school students, aged 12 to 16 years & athlete students, any lower extremity injury, musculoskeletal pain, recent surgeries and fractures, and upper extremity injury respectively.

PROCEDURE

An Ethical approval was taken from institutional ethical committee. The permission was taken from the school for carrying out study. Subject was selected on the basis of inclusion and exclusion criteria. A written informed consent form was taken from students who are willing to participate. The aim and objectives was explained to the participants. The participant evaluation sheet was distributed and explained to the participants.

To start from – first the participant was asked to do vertical jump. They Performed 3 vertical jump out of 3 trials the best vertical jump was then measured. The vertical height of the jump was measured from standing reach height (M1) to highest jump height (M2). Then the participant was divided into 2 groups with the help of paper chits method each of the subject was asked to randomly pick any chit containing the name of the group (A or B**).** In this Group A was given static stretching and Group B was given dynamic-warm up exercises. Then before intervention all participant was given 5 min of light jogging. After performed the stretching exercises, they was given 1 min rest interval and then again the participants was asked to perform vertical jump 3 times, the best vertical jump out of 3 was measured and recorded. Those subjects who was selected in the particular group was performed respective exercises which is mentioned below. Selected subjects was divided into two groups:-

Group A Static stretching

Group B Dynamic warm-up stretching exercises

The pre assessment was taken before intervention and post assessment was taken after intervention.

OUTCOME MEASURE:- VERTICAL JUMP TEST

The subjects have to apply chalk to the end of his/her fingertips. The subject stands sideways to a wall and reaches up with the hand closes to the wall. Keeping the feet flat on the ground, the point of the fingertips is marked or recorded. This is called the standing reach height **(M1).**

The subjects then stands away from the wall and from a static position jump vertically as high as possible with the attempt to touch the wall at the highest point **(M2)** of the jump. The distance between M1 and M2 is measured and recorded.

Group A static stretching exercises:-

1] Calf stretch:-

The subject stands straight on both feet at a distance of 2- steps distance from a wall. One leg is stretched in its place while taking a step forward with the other leg, using both hands on the wall for balance. Care must be taken not to lift the heels of the stretched foot off the ground. The same process is then repeated for the other leg. (fig.1)

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Fig. 1

2] Quadriceps stretch:-

The subject stands and touches a wall or stationery object for balance. The top ankle or forefoot is grasped from behind, and then pulled towards the buttocks. The hip is then straightened by moving the knee backward and held in this position. The same is repeated for the opposite side. (fig.2)

Fig. 2

3] Adductor Stretch:-

While seated on the ground the subject bends both legs putting both feet together. The knees are then lowered sideways as far as possible.(fig.3)

Fig. 3

4] Hamstring stretch:-

The subject sits on the ground with both legs straight out in front, and bends forward to touch the toes.(fig.4)

Fig. 4

5] Hip rotator stretch:-

The subject sits on the ground with both legs straight out in front, then cross one leg over the other. Then twist the upper body towards the bended leg and put one hand behind for support. Then place the opposite arm on bended leg for rotation.(fig.5)

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Fig. 5

Group B Dynamic warm-up exercises:-

1] Light skip:-

While jogging with a slight skip, the knees are raised slowly, with arms swinging in rhythm. (fig.1)

Fig. 1

2] High knee pull:-

While jogging each knee is pulled towards the chest with the help of both hands. (fig.2)

Fig. 2

3] Light butt kicks:-

While running, the heels are raised to touch the buttocks, with arms swinging in rhythm.(fig.3)

Fig. 3

4] Walking lunge:-

While walking with every step forward the body is lowered by flexing the knee and hip until the knee of the other leg is in contact with floor. The same is repeated with the opposite leg.(fig.4)

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Fig. 4

5] Straight leg kick:-

With both arms outstretched forward, each leg is raised up straight until toes touch palms.(fig.5)

Fig. 5

6] Rapid high knees:-

The subject raises knees towards the direction of chest as fast as possible while running.(fig.6)

Fig. 6

STATISTICAL ANALYSIS

The statistical significance of difference of pre-treatment and post-treatment quantitative characteristics in study group (intra-group comparisons) was tested using paired 't' test and for (inter-group comparisons) unpaired 't' test was used , after confirming the underlying normality assumption of pre and post treatment difference of parameters.

RESULT

The present study included 100 participants who met the inclusion criteria. There were equal age wise distribution in both group A and Group B. In group A there was 23 male and 27 female (n = 50) participants included. And in group B there was 30 male and 20 female (n = 50) participants included in the study. In group A and B it was noticed that male participants had higher vertical jump than female participants.

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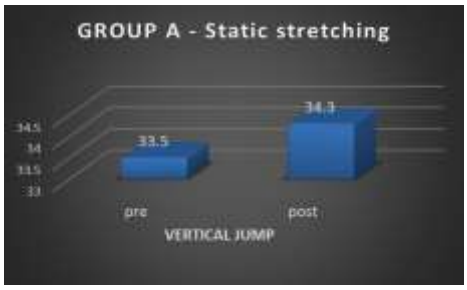
Table 1. Comparison of mean between pre – treatment & post treatment for vertical jump test in Group A

Vertical jump test	intervention	Vertical jump test mean (cm)	t value	p value	significance
Vertical jump test	Pre treatment	33.5±6.47	7.955	<0.0001	Extremely significant
	Post treatment	34.3±6.38			

Values are Mean ± Standard deviation. P-values are obtained using paired t- test, after confirming the underlying normality assumption. P-value <0.0001 is considered to be statistically extremely significant.



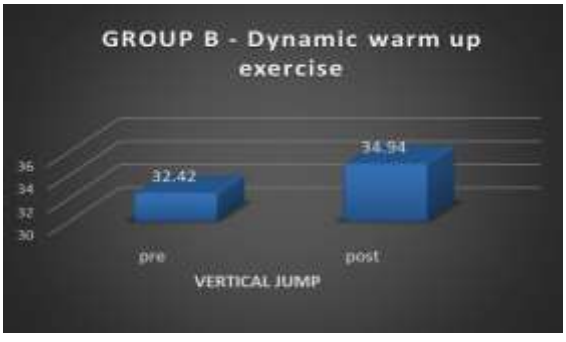
Comments (Intra -Group comparison):-

1. The average post-treatment vertical jump test was significantly improved in study subjects.
2. P value is <0.0001. This implies that vertical jump test has improved and was extremely significant in static stretching.

Table 2. Comparison of mean between pre- treatment & post treatment for vertical jump test in Group B

Vertical jump test	intervention	Vertical jump test mean (cm)	t value	p value	significance
Vertical jump test	Pre treatment	32.42±5.78	12.411	<0.0001	Extremely significant
	Post treatment	34.94±5.72			

Values are Mean ± Standard deviation. P- values are obtained using paired t- test, after confirming the underlying normality assumption. P-value <0.0001 is considered to be statistically extremely significant.



Comments (Intra -Group comparison):-

1. The average post-treatment vertical jump test was significantly improved in study subjects.
2. P value is <0.0001. This implies that vertical jump test has improved and was extremely significant in dynamic warm up exercises.

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Table 3. Comparison of mean between Group A & Group B for vertical jump test

Vertical jump test	PRE -POST MEAN	Vertical jump test mean± SD	t value	p value	significance
Vertical jump test	Group A	0.80±0.56	7.808	<0.0001	Extremely significant
	Group B	2.50±1.43			

Comments (Inter – Group comparison):-
On intergroup comparison using unpaired t test, there is extremely significant difference between two groups (p value <0.0001) which implies that group B is more effective than group A on vertical jump test.

DISCUSSION

This study was designed to compare the immediate effects of static stretching and dynamic warm up exercises on vertical jump test in school students. This study proved the efficacy of static stretching and dynamic warm up exercises in improving vertical jump performances. In this study in each group there was a significant increase in jump performance. In comparison, of both these techniques for their immediate effectiveness, it was found that dynamic warm up exercises has more effect on jump performance than static stretching.

In a study by Ye-ri Ji, et al (2021) on The Immediate Effects of Dynamic Stretching and Static Stretching Using a Wedge Board on the Balance Ability and Jump Function of Healthy Adult found that In Y-balance test, there was a significant increase in both groups except for the anterior direction, and there was a significant increase only in the SS (static stretching) group in the anterior direction ($p < 0.05$) , and There was a also significant increase in SJH (Sargent jump) in both groups ($p < 0.05$) but comparing the both group the dynamic stretching (36.47±8.75)has more effect on vertical jump than static stretching (34.73±10)which is also supports the present study, that is dynamic warm up exercises or dynamic stretching has more effectiveness on vertical jump performance than static stretching[7].

In a study by Dae-Jung Yang , et al (2013) on The Acute Effects of Dynamic and Static Stretching on Jump Height and Muscle Activity found that dynamic stretching was more effective than static stretching with respect to both jump height ($p<0.05$) which is very similar to the present study[9] .

Rationale for the immediate effects dynamic warm up exercises or dynamic stretching is that pre-event moderate- to high-intensity dynamic exercise may create an optimal environment for explosive force production by enhancing neuromuscular function. This phenomenon has been referred to as 'postactivation potentiation'' (PAP) and is believed to improve speed and power performance by increasing the rate of force development. Since PAP appears to have its greatest effect on fast-twitch fibers, it is mostly likely to affect activities such as jumping and throwing[3]. One could speculate that some of the pre-event moderate-intensity (e.g., high knee pull) and high-intensity (e.g., rapid high knee) dynamic exercises used in our study enhanced the excitability of the fast twitch units and therefore ''primed'' these units to play a more significant role during jumping and sprinting activities. While this suggestion is consistent with the work of others who reported that dynamic-type loading facilitated the function of the neuromuscular system without undue fatigue, no tests on neuromuscular activation were performed in our investigation[3].

In contrast to the present study, a study by Sabriye ERCAN et al. (2017) on The Acute Effect of Static and Dynamic Stretching on Horizontal and Vertical Jump concluded that According to the data obtained in the study, different stretching types did not affect

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horizontal jump distance, whereas a statistically significant difference was found in terms of vertical jump distance it is that static stretching is more effective than dynamic stretching. While in the present study dynamic warm up exercises or dynamic stretching is more effective than static stretching[11].

As this study proved the efficacy of both the intervention techniques separately on short term basis. But the dynamic warm up is more effective than static stretching.

CONCLUSION

The study revealed an improvement in vertical jump performance in both intra groups (group A and group B). However, the results of the intergroup study revealed that dynamic warm-up exercises (group B) are more effective than static stretching (group A) in improving vertical jump performance in school students.

LIMITATION

1. This was the study evaluating immediate effect of static stretching and dynamic warm up exercises, carry over or long-term follow-up effect was not monitored.
2. The outcomes of this study were assessed immediately which outlines the short-term effect.

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