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IMPACT OF PLYOMETRIC TRAINING AND STATIC STRETCHING IN FEMALE ADOLESCENT HANDBALL PLAYERS BY USING SARGENT JUMP TEST: AN EXPERIMENTAL STUDY

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ABSTRACT

Introduction: Handball is a high-intensity sport requiring explosive lower-limb power for jumping, sprinting, and rapid directional changes. Stretching and plyometric exercises are commonly incorporated into training programs; however, evidence comparing the effects of static stretching and plyometric training on vertical jump performance in female adolescent handball players is limited.

Aim: To compare the effects of plyometric training and static stretching on vertical jump performance in female adolescent handball players using the Sargent Jump Test.

Method: An experimental study was conducted on 40 female adolescent handball players aged 15–17 years, selected through convenient sampling. Participants were randomly divided into two groups: Group A (Static Stretching, n=20) and Group B (Plyometric Training, n=20). Both groups underwent their respective intervention protocols for 3 weeks (4 sessions per week) following a standardized warm-up. Vertical jump performance was assessed using the Sargent Jump Test before and after the intervention period. Statistical analysis was performed using SPSS version 20, with significance set at $p < 0.05$.

Result: Both groups demonstrated a statistically significant improvement in Sargent Jump Test performance following the intervention ($p < 0.05$). The plyometric training group showed a greater mean improvement compared to the static stretching group. However, between-group comparison revealed no statistically significant difference in post-intervention jump performance.

Conclusion: Both plyometric training and static stretching are effective in improving vertical jump performance in female adolescent handball players. Although plyometric training showed a higher mean improvement, it was not significantly superior to static stretching over the short intervention period. These findings suggest that both interventions can be effectively incorporated into training programs to enhance lower-limb explosive power.

Keywords: Plyometric training, Static stretching, Female adolescent handball players, Sargent jump test, Vertical jump performance

INTRODUCTION

Handball is an Olympic and professional sport that is played all over the world, particularly in Europe **[1]**. It is characterized by highly developed motor skills such as speed, explosive power, endurance and strength with a heavy emphasis on running, jumping, blocking, side-to-side cutting, sudden start and stops and throwing **[2]**. It is an explosive and fast paced ball games with a high technical, tactical and athletic demand **[3]**. Stretching is considered an essential component of an athlete's warm-up. However, most studies concerning the effect of static stretching on vertical jump performance have been inconclusive, and often shown a significant negative effect. By contrast, dynamic stretching has been demonstrated to have a significant positive effect or, at least, no advise effect on subsequent vertical jump performance. The question then arises if dynamic or static stretching produces similar increases in body temperature and vertical jump performance in the morning and the evening. Indeed, the increases in body and muscle temperature may increases nerve conduction velocity, enzymes activity and muscle compliance. In this context, Souissi *at al*. showed that 15 minutes rather than 5 minutes of warm-up may increases body temperature affecting diurnal variation of muscle power during the 30-second Wingate test. Study published by Hamdi Choureau *at al*. suggested that the lack of data on the effect of different type of stretching (dynamic and static stretching) on diurnal variations of vertical jump height is present. they hypothesized that dynamic stretching could affect the diurnal variation of short-term maximal performance by a greater increase in jump height in the morning than the evening through increasing core temperature at this time of day **[4]**. According to Million *at al*. (2003), the Vertical Jump test can be performed either in Laboratory, with the use of jump platforms (JP), or in the field using the Sargent Jump Test (SJT). In order to measures explosive strength of the lower limbs of athletes from a variety of sports (Socha *at al*.,2006). However, the validity of SJT in relations to the gold standard JP test in young soccer players, as well as the intra- and inter-evaluator reproducibility on the SJT has never been examined. There are Paulo Gil da Costa Mendes de Salles *at al*., studied that there was to evaluate the validity, intra- and inter-evaluators reproducibility of the SJT, as well as to assess explosive strength of the lower limbs in soccer players of the sub-15 class5. Jumping is a complex human movement that requires complex motor coordination between upper and lower body segments. In particular, the propulsive action of the lower limbs during a vertical jump has been considered particularly suited for evaluating explosive characteristics of sedentary individuals and elite athletes. Also, since performance in most individual and team sports depends on the athlete's ability to produce force quickly, the use of reliable and valid testing procedures is beneficial for monitoring the effects of training and foe talent selection purposes **[5-24]**.

METHODOLOGY:

- Study Design: An Experimental Study
- Study Design: Convenient Sampling
- Sample Size: 40 female (20 each group).
- Duration of the Study: 3weeks (4days/week both the group)

INCLUSION CRITERIA:

- AGE: 15 To 17 years
- GENDER: Female
- Willing to participate.

EXCLUSION CRITERIA:

- Any acute illness/trauma/surgery- any ligament injury and fracture of lower limb
- No previous injuries at least 3 months before the testing.
- or engage in any resistance training 48 hours before the testing sessions.

OUTCOME MEASURE

- Sargent Jump Test, NPRS

PROCEDURE:

The Subjects participated both Female (Group A- 20 with SS & 20 with PT) and Female (Group B-20 with PT & 20 with SS) in 3 vertical jump testing across a 4 days per week up to three weeks. Each test session had the subjects running around an indoor track for five minutes at a low effort. Two minutes following that, a jog was conducted using the Static Stretching Protocol and the Plyometric Training Protocol. SS Time lasted eight minutes in total, with six minutes of PT time. Throughout the stretching routine, each subject was watched to make sure the right technique was applied. The players were undertaking a sequence of three vertical jumps, with one minute of rest in between each jump, one minute after finishing the particular protocol. To give the subjects enough time to recover between sessions, the second testing session was scheduled one week later. The third testing session was conducted using the same methodology.

STATISTICAL ANALYSIS:

The statistical package of social sciences (SPSS) version was used to analyses the data that was gathered. the non-parametric analysis was employed in statistically analysis because the distribution data was not normal. Demographic values were compared within the group using T-test, as well as between groups using the T-test. The threshold for statistical significance was established at $P<0.05$.

RESULTS:

The baseline characteristics of the participants shown in **Table 1** that the mean age of the plyometric exercise group was 16.05 ± 0.94 years, while the static stretching group had a mean age of 15.60 ± 0.82 years. The mean height of participants in the plyometric group was 159.35 ± 4.27 cm, whereas in the static stretching group it was 157.35 ± 4.21 cm. The starting point score was 203.60 ± 7.42 for the plyometric group and 197.00 ± 13.77 for the static stretching group.

Table 1: Baseline characteristics

	Plyometric Ex		Statistic Stretching	
	Mean	Std. Deviation	Mean	Std. Deviation
AGE	16.05	0.94	15.60	0.82
HEIGHT	159.35	4.27	157.35	4.21
STARTING POINT	203.60	7.42	197.00	13.77
PRE SJT WEEK 1	232.20	5.32	230.75	7.14
POST SJT WEEK 3	233.00	4.88	231.05	6.90

The pre SJT score in week 1 was 232.20 ± 5.32 in the plyometric group and 230.75 ± 7.14 in the static stretching group. After the intervention, the post SJT score in week 3 increased to 233.00 ± 4.88 in the plyometric group and 231.05 ± 6.90 in the static stretching group. Statistical analysis showed that there was a significant difference within the groups, as the p-value was less than 0.05. The **Table 2** shows the comparison of pre and post SJT scores within the plyometric exercise group and the static stretching group using the t-test.

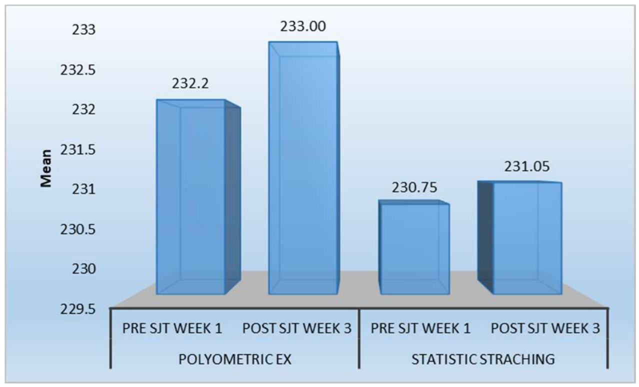
In the plyometric exercise group, the mean pre SJT score in week 1 was 232.20 ± 5.32, which increased to 233.00 ± 4.88 in post SJT week 3 after the intervention. The calculated t value was 3.38 with a p value of 0.003, indicating a statistically significant improvement in SJT scores following the plyometric exercise program.

In the static stretching group, the mean pre SJT score in week 1 was 230.75 ± 7.14, which increased to 231.05 ± 6.90 in post SJT week 3 after the intervention. The t value was 2.349 with a p value of 0.030, which also indicates a statistically significant improvement.

Overall, both the plyometric exercise group and the static stretching group showed significant improvement in SJT scores after the intervention, as the p value in both groups was less than 0.05. However, the plyometric exercise group showed a slightly greater statistical change compared to the static stretching group.

Table 2: Comparison of pre and post SJT scores

Group		Mean	Std. Deviation	t Test	P Value
Plyometric Ex	PRE SJT WEEK 1	232.20	5.32	3.38	0.003
	POST SJT WEEK 3	233.00	4.88		
Statistic Stretching	PRE SJT WEEK 1	230.75	7.14	2.349	0.030
	POST SJT WEEK 3	231.05	6.90		



Graph 1: Comparison of pre and post SJT scores

Between the group there is no significant difference.

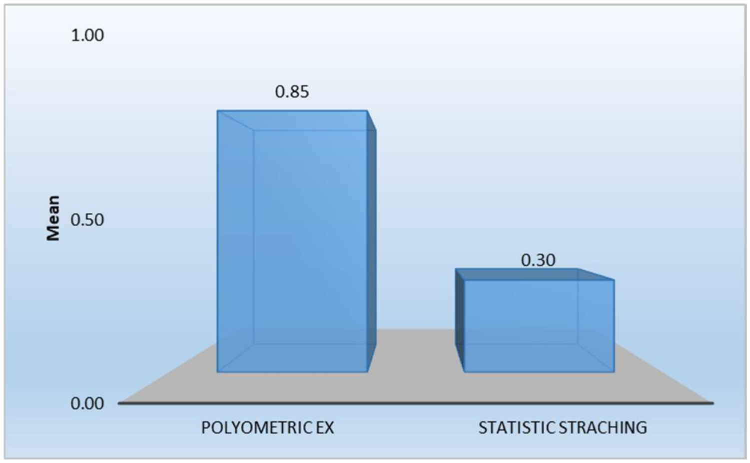
The **Table 3** shows the between-group comparison of the difference in SJT scores between the plyometric exercise group and the static stretching group.

The plyometric exercise group showed a mean difference in SJT score of 0.85 ± 1.03, whereas the static stretching group showed a mean difference of 0.30 ± 0.57. The t-test value was 2.073 with a p value of 0.045.

Although the plyometric exercise group demonstrated a slightly higher improvement in SJT scores compared to the static stretching group, the overall comparison between the two groups indicates that there was no statistically significant difference between the groups. This suggests that both plyometric exercises and static stretching produced similar effects on SJT performance.

Table 3: between the group difference

Group		Mean	Std. Deviation	t test	P Value
Difference SJT	Plyometric Ex	0.85	1.03	2.073	0.045
	Statistic Starching	0.30	0.57		



Graph 2: Between the group difference

DISCUSSION OF THE STUDY:

Interpretation of the Research Results

The research compares the effects of two interventions, "Plyometric Ex" (Plyometric Exercise) and "Statistic Stretching" (Static Stretching), on a performance measure, likely related to the "SJT" (possibly representing a jump test or similar performance indicator). The analysis involves both within-group and between-group comparisons using statistical tests (t-test) and p-values to determine significance.

Within-Group Analysis

Plyometric Ex Group: There is a significant difference within the Plyometric Ex group between the "PRE SJT WEEK 1" and "POST SJT WEEK 3" measurements (p-value = 0.003), which is less than 0.05. This indicates that the plyometric exercise program led to a statistically significant change in the SJT performance from week 1 to week 3. The mean SJT score increased from 232.20 to 233.00, suggesting an improvement after the intervention.

Statistic Stretching Group: Similarly, there is a significant difference within the Statistic Stretching group between "PRE SJT WEEK 1" and "POST SJT WEEK 3" measurements (p-value = 0.030), also less than 0.05. This indicates that the static stretching program also led to a statistically significant change in SJT performance, with the mean increasing from 230.75 to 231.05.

In summary, both interventions resulted in a significant improvement in the SJT scores within their respective groups over the three-week period.

Between-Group Analysis

The "Difference SJT" table compares the mean difference in SJT scores between the "Plyometric Ex" and "Statistic Starching" groups. The p-value for this comparison is 0.045, which is less than 0.05.

The statement "Between the group there is no significant difference" appears to contradict the p-value of 0.045, which typically suggests a significant difference if At 0.05, the alpha threshold is established. However, the interpretation "no significant difference" could imply that while a statistical difference exists, it might not be considered practically meaningful, or there might be an error in the concluding statement provided in the image given the p-value. Assuming the p-value of 0.045 is correct and the The mean change of SJT between the two groups differs statistically significantly (alpha level: 0.05). The mean difference for Plyometric Ex is 0.85, and for Static Stretching is 0.30, suggesting a larger improvement in the Plyometric Ex group.

Based on the provided data, both plyometric exercise and static stretching interventions led to significant improvements in SJT performance within their respective groups. Furthermore, the statistical analysis suggests a significant difference in the extent to which the two groups have improved, with plyometric exercise greater mean increase SJT scores compared to static stretching. The concluding statement in the image regarding "no significant difference" between groups should be re-evaluated in light of the calculated p-value.

CONCLUSION AND FUTURE SCOPE OF THE STUDY:

this study show while comparing within group pre and post value there are statistically significant in plyometric training, while in static stretching within group comparing the differences of pre and post data the result was statistically not significant , and between group comparison there are comparing the difference of pre and [post data and taking p-value .that is statistically significant which show plyometric is more effective or given significant different co paring with the passive stretching .so, there are plyometric is more effective then static in female handball players.

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