*Biological Forum – An International Journal* **15(5): 738-743(2023)**

**ISSN No. (Print): 0975-1130**
**ISSN No. (Online): 2249-3239**

# Effect of Various Strength Training modalities and Combination of Saq-Plyometric Training Packages on Lower Body Circumferences of Senior Soccer Players

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*(Received: 11 March 2023; Revised: 15 April 2023; Accepted: 22 April 2023; Published: 20 May 2023)*
*(Published by Research Trend)*

**ABSTRACT: The role of strength training modality is pivotal. However, it is not used extensively in sports. In addition, there are controversial views found as to which type of training is more effective. Some have stated these training cannot monitor intensity (American College of Sports Medicine, 1995). The aim of the study was to ascertain the impact of 12 weeks of various strength training modalities, combined with plyometric and SAQ training packages, on the chosen lower body circumferences of soccer players. 120 intercollegiate male soccer players (N=120) were selected for this study utilizing the non-probability sampling method known as purposive sampling. The subjects ranged in age from 18 to 25. Three equal groups of 40 each were formed out of the chosen subjects. Group I ($N_1$=40) served as the control group, Group II ($N_2$=40) received strength training, and Group III (N3=40) received training that combined SAQ and plyometrics. Lower body circumference was the chosen dependent variable for this study, and the training approach was chosen as the independent variable. The acquired data were statistically analysed using an ANCOVA to determine whether there were any significant differences between the groups. To examine the level of significant difference between groups, if any, the 0.05 level of confidence was fixed. The study revealed that the plyometric and SAQ training combined with 12 weeks of strength training improved thigh and calf circumference more than the control group.**

**Keywords:** SAQ, Plyometric Training, Strength Training, Calf, Thigh, Circumference and Soccer.

## INTRODUCTION

Soccer is played worldwide for enjoyment and competitions. It draws attention of amateurs across the globe. Thought it has no ancient history, soccer has gained the momentum since last two decades. England introduced soccer in modern style. England's Soccer Association created the rules in 1863. It was then practiced and played not only in England but across the globe slowly and steadily (McQuilliam *et al*., 2022). It is found that an appropriate assessment method is needed to assess their soccer talent and predict their performance.

The awareness of young athletes towards training specialization has raised to the great extent. Young athletes no longer kick balls on fields. Young soccer academies have a specific development plan that changes by year and club. Today's youngsters should be taught on when and how players gain new skills. "Timing matters," they say. A player's training should be focused on the traits distinguishing from ordinary one. The studies indicate that top players did 28% more high-intensity exercises and % more sprinting than average players (Mohr, 2003). Off-season strength training for soccer focuses on functional strength, early pre-season on maximisation, late pre-season on muscular power and endurance, and in-season on maintenance. Muscular strength and power training may improve a young soccer player's vertical jump, shooting power, and 30m sprint, as well as aerobic endurance (Wong *et al.*, 2010). Strength training impacts the first phase. 100 days of resistance training increases muscular cross-sectional area by 23% and peak strength by 91.7 %. Cross-sectional muscle area directly affects strength per unit (Ikai & Fukunaga 1970) Strength training is time-sensitive for athletes. Players should start strength training at 16 but must first learn proper techniques and motor control. Strength training helps athletes become world-class. Strength training with SAQ and/or plyometrics yields the best results. Soccer fitness training should include SAQ (speed, agility, and quickness) training. Baechle (1994) defined speed as "the velocity of movement". Agility is quick physical movement in reaction to a stimulus (Baechle, 1994). Soccer demands strength, power, speed, agility, balance, stability, flexibility, and endurance (Moreno, 1995).

**Anthropometrics and body composition in soccer.** It's possible to tell, even at a young age, where a person is going to play on the field based on the size of their body. According to research carried out by Reilly et al. in the year 2000, it has been observed that in the sport

of soccer, goalkeepers and defenders are often larger than midfielders. Hencken and White (2006) have examined that incongruent with those of prior research that concentrated on the anthropometric features of top soccer teams, and these findings have been published in the journal Science. Regarding the anthropometrics of soccer players, Reilly *et al.* (2000) served as the primary source of reference for several different study projects. In addition, they discovered that professional soccer teams had a rather wide range of body sizes among its players; hence, anthropometric disparities across playing positions were to be anticipated due to this finding. Reilly *et al.* (2000) has shown substantial disparities in a range of anthropometric traits, the most notable of which are height and body mass. These discrepancies may be suggestive of a morphological optimization within the sport of soccer, as suggested by the variables in question.

Apart from the most recent study, all of the others have concluded that the ideal body mass for a midfielder is one that is lower than average so that they have more mobility. It has been hypothesized that defenders are often larger in height and weight, but have a smaller overall body mass. However, the one research that revealed contradicting results was conducted by Hencken and White (2006). They discovered that the positions did not vary substantially from one another in terms of total mass, fat mass, muscle mass, residual mass, and lean body mass.

An excessive amount of body fat is shown to be a barrier to effective football performance (Zalai & Csaki 2015). The aim of the study was to determine the effect of 12 weeks selected training methodology i.e., various strength training modalities, combination of plyometric and SAQ training packages on soccer players selected lower body circumferences (Dong *et al.,* 2023).

## MATERIAL AND METHODS

For the purpose of this study, 120 intercollegiate male soccer players (N = 120) were chosen using a non-probability sampling technique called purposive sampling. Age ranges of subjects was 18 to 25 years. The selected subjects were divided into three equal groups consisting of 40 each. Group I ($N_1$=40) acted as control group as not given any sort of specific training but underwent traditional soccer training. Group II ($N_2$=40) underwent Strength Training and Group III ($N_3$=40) underwent combination of SAQ and Plyo metric training. For this study pre-post design (ref 1) was employed for selected dependent variables i.e., lower body circumference and independent variables was selected training methodology.

**Collection of Data.** Calf Circumference-The circumference of calf muscle was obtained in standing position. The steel tape was wrapped horizontally around the naked lower leg of the subject at the maximal budge of the calf muscle. With slight up and down movements of the steel tape keeping it in a horizontal direction, the maximal circumference entail measurement gave the value of calf muscle circumference and was measured to the nearest 0.1 cm. Thigh Circumference-The circumference of thigh muscle was obtained in standing position. The steel tape was wrapped horizontally around the naked upper leg of the subject at the maximal budge of the thigh muscle. With slight up and down movements of the steel tape keeping it in a horizontal direction, the maximal circumference entail measurement gave the value of thigh muscle circumference and was measured to the nearest 0.1 cm.

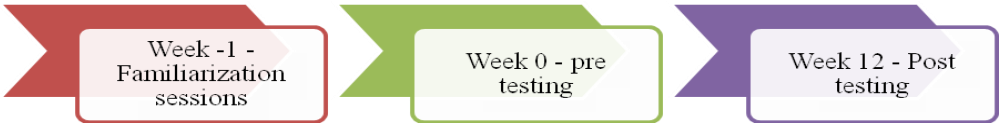


**Fig. 1.** Intervention of training and collection of data.

## RESULTS AND DISCUSSION

ANCOVA is widely used statistical analysis technique for experimental studies (AlAita & Aslam 2023). The collected data were analyzed statistically through analysis of covariance (ANCOVA) to find out the significance difference, if any between the groups. The 0.05 level of confidence was fixed to test the level of significance difference, if any between groups (Verma, 2013).

**Table 1: Levene's Test of Equality of Error Variances for selected lower body circumferences.**

| Variables | F | df1 | df2 | Sig. |
|---|---|---|---|---|
| Calf Circumference | 1.382 | 2 | 117 | .115 |
| Thigh Circumference | 0.375 | 2 | 117 | .688 |
| Tests the null hypothesis that the error variance of the dependent variable is equal across groups | | | | |

Table 1 represents the value of Levens test. The Levens is an assumption for ANCOVA test for determining homogeneity of group. The obtained value for Levens test was 0.115 and 0.688 respectively for selected lower body circumferences which is more than 0.05 and hence the assumption of equality of variance is not violated. Thus, the null hypothesis of equality of population means of three groups is rejected and it may be concluded that the selected lower body

circumferences of control and experimental groups are different.

*A. Thigh Circumference*

Table and Fig. 2 represents the descriptive stats i.e., mean and standard deviation of thigh circumference before and after selected training intervention. The experimental studies are more comprehensive and transparent (Deng *et al.*, 2022). The mean and standard deviation of thigh circumference for control group before and after intervention was 56.30±3.52 cm and 57.54±3.06 cm respectively. The mean and standard deviation of thigh circumference for strength training group before and after intervention was 50.76±4.38 cm and 58.54±3.54 cm respectively. The mean and standard deviation of thigh circumference for Combination of Plyometric and SAQ group before and after intervention was 57.61±3.01 cm and 57.42±2.90 cm respectively.

**Table 2: Descriptive Stats of Anthropometrical Parameters i.e., Thigh Circumference in cm.**

| Parameters | Groups | Mean | Std. Deviation |
|---|---|---|---|
| TC_PRE | Control | 56.8350 | 3.52722 |
| | Strength Training Group | 50.7650 | 4.38965 |
| | Combination of Plyometric and SAQ | 57.6150 | 3.01012 |
| TC_POST | Control | 57.5400 | 3.06275 |
| | Strength Training Group | 58.5425 | 3.54971 |
| | Combination of Plyometric and SAQ | 57.4250 | 2.90046 |

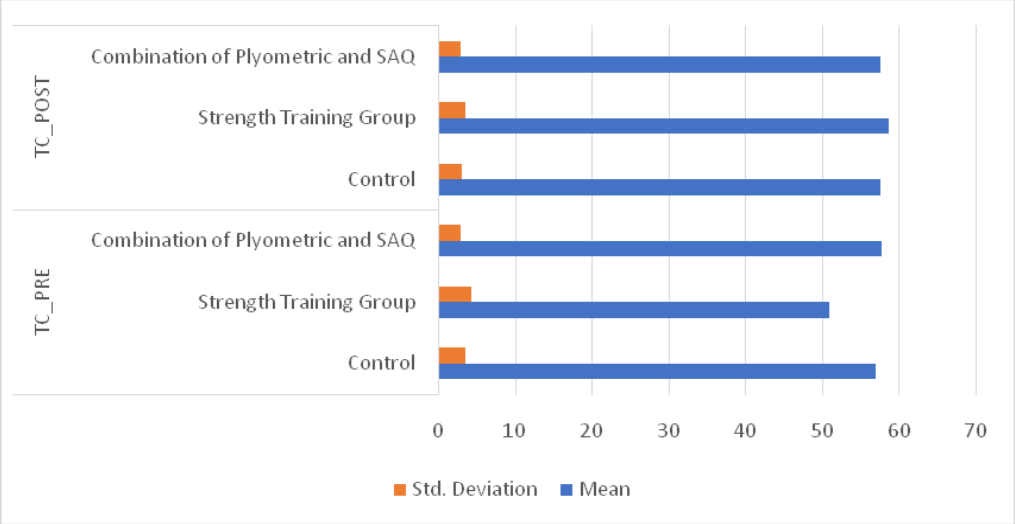


**Fig. 2.** Bar chart for descriptive stats of Motor Parameters i.e., Thigh Circumference in cm.

**Table 3: Tests of Between-Subjects Effects for Thigh circumference.**

| Source | Type III Sum of Squ. | Df | Mean Squ. | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 68.754[a] | 3 | 22.918 | 2.318 | .079 |
| Intercept | 1266.826 | 1 | 1266.826 | 128.138 | .000 |
| TC_PRE | 38.527 | 1 | 38.527 | 3.897 | .051 |
| Groups | 67.287 | 2 | 33.643 | 3.403 | .037 |
| Error | 1146.822 | 116 | 9.886 | | |
| Total | 402613.610 | 120 | | | |
| Corrected Total | 1215.576 | 119 | | | |
| a. R Squ.d = .057 (Adjusted R Squ.d = .032) | | | | | |

Table 3 shows the F-value for comparing the adjusted means of the criterion variable in three groups (Control Group, Strength Training Group, and Combination of Plyometric and SAQ Training Group). The F-statistic computed for selected groups is sig. because p-value associated with it is 0.00 which is less than 05. Thus, the null hypothesis of no difference among the adjusted means for the data on criterion variable (Thigh circumference) in three treatment groups may be rejected at 5% level.

Since F-statistic is sig., post hoc comparison has been made for the adjusted means of the three treatment groups, which is shown in Table 4. It may be noted here that p-value for the mean difference between Control group and Strength Training Group as well between Control group and Combination of Plyometric and SAQ training group is .000. Since p value is less than .05, both these mean differences are sig. at 5% level.

Table 4 represents post hoc analysis, for selected groups. There was sig. ($p<0.05$) value obtained for all the pair wise comparison. There was sig. difference between means of selected groups. Strength Training group mean (58.54 cm) was highest when compared to control and Combination of Plyometric and SAQ Group which was 57.54 cm and 57.42 respectively.

*B. Calf Circumference*

Table 5 and Fig. 3 represents the descriptive stats i.e., mean and standard deviation of calf circumference before and after selected training intervention (Hurley *et al.*, 2018). The mean and standard deviation of calf circumference for control group before and after intervention was 36.85±7.47 cm and 34.61±6.85 cm respectively. The mean and standard deviation of calf circumference for strength training group before and after intervention was 38.82±7.47 cm and 38.50±7.94 cm respectively. The mean and standard deviation of calf circumference for Combination of Plyometric and SAQ group before and after intervention was 38.38±7.77 cm and 36.85±7.47 cm respectively.

**Table 4: Pair wise Comparisons for Thigh circumference.**

| (I) Groups | (J) Groups | Mean Difference (I-J) | Std. Error | Sig.[b] |
|---|---|---|---|---|
| Control | Strength Training Group | -1.947 | .851 | .072 |
| | Combination of Plyometric and SAQ | .236 | .706 | 1.000 |
| Strength Training Group | Control | 1.947 | .851 | .072 |
| | Combination of Plyometric and SAQ | 2.184* | .887 | .046 |
| Combination of Plyometric and SAQ | Control | -.236 | .706 | 1.000 |
| | Strength Training Group | -2.184* | .887 | .046 |
| Based on estimated marginal means | | | | |
| *. The mean difference is sig. at the .05 level. | | | | |
| b. Adjustment for multiple comparisons: Bonferroni. | | | | |

**Table 5: Descriptive Stats of Anthropometrical Parameters i.e., Calf Circumference in cm.**

| Parameters | Groups | Mean | Std. Deviation |
|---|---|---|---|
| CALF-CIRCUMFERENCE-PRE | Control | 36.8550 | 7.47550 |
| | Strength Training Group | 38.8200 | 7.47821 |
| | Combination of Plyometric and SAQ | 38.3800 | 7.77093 |
| CALF-CIRCUMFERENCE-POST | Control | 34.6100 | 6.85617 |
| | Strength Training Group | 38.5050 | 7.94481 |
| | Combination of Plyometric and SAQ | 36.8550 | 7.47550 |

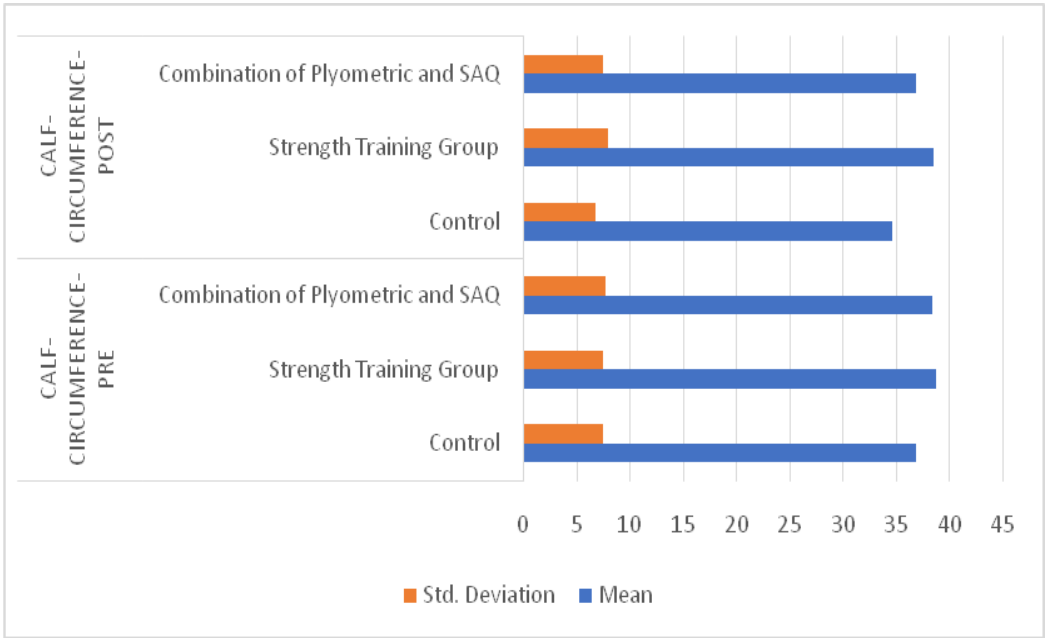


**Fig. 3.** Bar chart for descriptive stats of Motor Parameters i.e., Calf Circumference in cm.

Table 6 shows the F-value for comparing the adjusted means of the criterion variable in three groups (Control Group, Strength Training Group, and Combination of Plyometric and SAQ Training Group). The F-statistic computed for selected groups is sig. because p-value associated with it is 0.00 which is less than 05. Thus, the null hypothesis of no difference among the adjusted means for the data on criterion variable (Calf circumference) in three treatment groups may be rejected at 5% level.

Since F-statistic is sig., post hoc comparison has been made for the adjusted means of the three treatment groups, which is shown in Table 7 It may be noted here that p-value for the mean difference between Control group and Strength Training Group is .037. Since p value is less than .05, both these mean differences are sig. at 5% level.

Table 7 represents post hoc analysis, for selected groups. There was sig. ($p<0.05$) value obtained for Control group and Strength Training Group the pair wise comparison. There was sig. difference between means of selected groups (Hughes *et al.,* 2023). Strength Training group mean 38.50 cm was highest when compared to control which was 34.61 cm respectively.

**Table 6: Tests of Between-Subjects Effects for Calf circumference.**

| Source | Type III Sum of Squ. | Df | Mean Squ. | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 479.538[a] | 3 | 159.846 | 2.943 | .036 |
| Intercept | 8183.119 | 1 | 8183.119 | 150.658 | .000 |
| CALF_CIRCUMFERENCE_PRE | 173.757 | 1 | 173.757 | 3.199 | .076 |
| Groups | 354.308 | 2 | 177.154 | 3.262 | .042 |
| Error | 6300.637 | 116 | 54.316 | | |
| Total | 168025.520 | 120 | | | |
| Corrected Total | 6780.175 | 119 | | | |
| a. R Squ.d = .071 (Adjusted R Squ.d = .047) | | | | | |

**Table 7: Pair wise Comparisons for Calf circumference.**

| (I) Groups | (J) Groups | Mean Difference (I-J) | Std. Error | Sig.[b] |
|---|---|---|---|---|
| Control | Strength Training Group | -4.211* | 1.657 | .037 |
| | Combination of Plyometric and SAQ | -2.490 | 1.654 | .404 |
| Strength Training Group | Control | 4.211* | 1.657 | .037 |
| | Combination of Plyometric and SAQ | 1.721 | 1.648 | .896 |
| Combination of Plyometric and SAQ | Control | 2.490 | 1.654 | .404 |
| | Strength Training Group | -1.721 | 1.648 | .896 |
| Based on estimated marginal means | | | | |
| *. The mean difference is sig. at the .05 level. | | | | |
| b. Adjustment for multiple comparisons: Bonferroni. | | | | |

As per the results obtained from Table 4 and 7, 12 weeks of strength training when compared to control and combination of plyometric and SAQ training showed greater improvement for thigh and calf circumference. This result might be obtained because strength training forces your glands to produce the muscle developing hormones called the growth hormone (GH) and testosterone. These hormones play vital roles in human cell growth and multiplication, strengthening muscle tissue and bone tissue (Kamarauskas *et al.,* 2023). The improved circumference of lower body was also supported by various authors such as (Clark *et al.,* 2018; Costil and David, 2012; Pipes, 1994; Singh Hardyal 1991).

## CONCLUSIONS

The aim of the study was to determine the effect of 12 weeks selected training methodology i.e., various strength training modalities, combination of plyometric and SAQ training packages on soccer players selected lower body circumferences. For this purpose, 120 intercollegiate male soccer players (N = 120) were chosen using a non-probability sampling technique called purposive sampling. Age ranges of subjects was 18 to 25 years. The selected subjects were divided into three equal groups consisting of 40 each. Group I ($N_1$=40) acted as control group as not given any sort of specific training but underwent traditional soccer training. Group II ($N_2$=40) underwent Strength Training and Group III ($N_3$=40) underwent combination of SAQ and Plyo metric training. For this study pre-post design was employed for selected dependent variables i.e., lower body circumference and independent variables was selected training methodology. The collected data were analysed statistically through analysis of covariance (ANCOVA) to find out the significance difference, if any between the groups. The 0.05 level of confidence was fixed to test the level of significance difference, if any between groups. The results of this study suggest that 12 weeks of strength training when compared to control and combination of plyometric and

SAQ training showed greater improvement for thigh and calf circumference.

## FUTURE SCOPE

The promising results of this study can help soccer coaches to focus on 12 weeks or more strength training for improves lower body thigh and calf muscles.

**Acknowledgement.** The researcher acknowledges the support of Vice-chancellor and HOD, Physical Education for constant motivation and providing best research environment.
**Conflict of Interest.** None.

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**How to cite this article:** Konark Roy and Dulal Debnath (2023). Effect of Various Strength Training modalities and Combination of Saq-Plyometric Training Packages on Lower Body Circumferences of Senior Soccer Players. *Biological Forum – An International Journal*, *15*(5): 738-743.