

THE EFFECTIVENESS OF PLYOMETRIC-VERTICAL JUMP AND ISOMETRIC-STRENGTH TRAINING ON PERFORMANCE OF KICKING SKILL IN SOCCER

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ABSTRACT

This study examined the effectiveness of plyometric vertical jump, isometric strength training and the combination of the two in optimising performance of kicking skill by the female soccer players. Plyometric- vertical jump was chosen to train the leg power while the toe raise was used to train for leg strength. The quasi-experimental research design was adopted for the study. The data for the study was generated from a population of seventy-eight female students in four secondary schools in Awka Educational zone, Anambra State. Thirty-two female students aged 14-18years volunteered to participate in the study. The volunteered female students were apparently healthy, physically active and free of any lower and upper extremity bone injuries for past one year and they had no medical or orthopedic injuries that may affect their participation in the study. The statistical analysis utilised were mean, t-test and ANCOVA. The result revealed that plyometric- vertical jump and isometric-strength training respectively and the combination of the two, significantly had positive effects on kicking skill among female soccer players. These positive effects on kicking ability no doubt help in optimising performances of the female soccer players among others. Based on the findings, it was recommended that coaches and athletes should include plyometric- vertical jump and isometric strength training in their training schedule for better sports performance since they improve kicking skill in soccer.

Keywords: Plyometric, Vertical, Jump, Isometric, Strength and Training

Introduction

Soccer is no doubt one of the most popular sports played all over the world. It is the greatest spectator sport in Africa. In Nigeria, soccer has become a great entertainment industry enjoyed by both the young and the old. Nigeria has attained widespread recognition in the world, and this awareness is still growing in light of the outstanding results of her national teams and club teams at several continental and international competitions. The quest to maintain this recognition and still afford the masses the opportunity to enjoy their loving game has placed great responsibilities on the shoulders of the players and the coaches in building a formidable skillful team that is capable of winning gold medal at all times. For anybody to excel in soccer there is need to master such basic skills as kicking, trapping, heading, passing, goal-keeping, dribbling, shooting to mention but few. It is the combination of these basic skills that produces the attractive display in the field and also helps the players to win laurels in the game. Kicking ability

represents the most important soccer-specific skill (Bacvarevic, Pazin, Bozic, Mirkov, Kukol & Javic 2012), since it is used not only in passes, crosses and clearances, but also to score goals, thus increasing the chances of winning games. In fact an analysis of the 2010 Soccer World Cup revealed that 80.69% of the goals were achieved by kicking (Njorarai, 2013). Kicking has different styles such as instep kick, heel kick, inside of the foot, and outside of the foot, to mention but a few. Soccer therefore is a physiologically demanding sport that requires a high degree of skill and physical fitness efficiency.

According to Lorenzo, Fernandez-del-Olmo and Rafael (2016), kicking is one of the most frequently used skills in soccer and the most fundamental for soccer performance. Kicking is one the essential skills that must be sufficiently mastered if the player is to excel in the game of soccer. Different styles of kicking include instep kick, heel kick, inside of the foot and outside of the foot kick. Inside of the foot kick which is the main focus of this study, is among the wide easily used skills in the game of soccer. Most soccer players acquire it through training. Kiddo (2019) expressed that some common kicking errors include kicking with the toes, non-kicking leg behind the ball or close to the ball and opposite arm not used for balancing. Since optimal performance in soccer require among other things, leg muscular strength, leg speed and adequate scientific training, this study tried to investigate certain training modules whose physical fitness components football players can perform from their training sessions to enhance good mastery of kicking skill among young soccer players.

Plyometrics are the exercises that involve stretching the muscles immediately before rapid contractions. This combined action is called a stretch-shortening cycle (SSC) (Uzor, 2021) such as squats, jumping, skipping, hopping, running, bounding to mention but few depending on using passively elastic energy in the muscle and the active role of stretch reflex. Therefore, plyometric has been widely used for increasing dynamic athletic performance such as vertical jump ability (Glendinning, 2014; Uzor, 2016; Markovic, Dizdar & Javic, 2016; King, 2012; Ramirez-Campillo, Morgan, Oliver, Pedley&Lloyd, 2022) Speed (Uzor, 2016), agility and muscle activation of lower extremities. Vertical jumping is a fundamental component of many sports including soccer.

Isometric- strength training is a form of exercise involving the static contraction of a muscle without any visible movement in the angle of the joint. According to Powers and Howley (2001), the term 'isometric' combines the Greek words isos (equal) and -metria (measuring), meaning that in these exercises the length of the muscle and the angle of the joint do not change, though strength may varied (Markovic, et al (2016). The three main types of isometric exercise are presses, pulls and holds. They may be included in a strength training regime in order to improve the body's ability to apply power from a static position or in the case of isometric holds, improve the body's ability to maintain a position for a period of time.

Observation has shown that soccer budding talents abound in our schools and colleges. Emergence of formidable national team-The Super FALCONS and the likes at the club

sides has given impetus to the growth of female soccer at all levels in Nigeria. However, it is observed that the kicking abilities of female soccer players especially at secondary school level have not become what it ought to be. The poor kicking skills, lack control, coordination and without enough application of force in attempting goals are among the lapses observed among this group.

The study tried to examine how Plyometric- vertical jump and isometric -strength training can be used to improve kicking efficiency of young soccer players with the aim of overcoming their kicking lapses and thereby enhance their performance. In this regard, Plyometric- Vertical jump (Squat) was used for leg power of the players while isometric-strength training (toe raise) was used to train for leg muscular development.

The following research questions were formulated to guide the study:

1. How effective is plyometric- vertical jump training in improving the performance on kicking skill by the female students in the game of soccer?
2. How effective is isometric strength training in improving performance on kicking skill by the female students in the game of soccer?
3. How effective is the combined effect of plyometric- vertical jump and isometric-strength training in improving performance on kicking skill by the female students in the game of soccer?

The following null hypotheses were stated and tested at 0.05 level of significance.

1. There will be no significant difference in the pre testpost test mean scores of female students on performance of kicking skill in the game of soccer using plyometric- vertical jump training.
2. There will be no significant difference in the pre testpost test mean scores of female students on performance of kicking skill in game of soccer using isometric-strength training.
3. There will be no significant difference in the pre testpost test mean scores of female students in kicking skill in the game of soccer using the combination of vertical jump and isometric-strength training.
4. The post test mean scores on kicking skill of female students who were trained using plyometric- vertical jump and isometric- strength training will not differ significantly.
5. The post test mean scores on kicking skill of the female students who were trained using plyometric -vertical jump only and those trained in both plyometric-vertical jump and isometric- strength training will not differ significantly.
6. There will be no significant difference in the post test mean scores on kicking skill of the female students who were trained only in isometric -strength and those who were trained in both vertical jump and isometric- strength training.

7. There will be no significant difference in the effectiveness of the treatment models when compared with the control group on performance of kicking skill in the game of soccer.

Methods and Material

The Quasi-experimental research design was utilised for the study. It was pre testpost test non-randomised control group design. It is a design where the observations are made in the study groups before and after interventions and subjects are assigned to groups but without proper randomisation. This design was also considered appropriate because it was not possible to place subjects in groups by random assignment without disrupting the athletes in their team groups and the training venues. Also the subjects in both the treatment and control groups differ by number and they were not equal at baseline.

Participants:

All the 284 female football players aged 14-18years in four secondary schools in Awka Educational zone who have participated in one or two extramural soccer competitions formed the population of the study. A total of 32 female students who volunteered to participate for the 10 weeks training in their various schools were selected and used for the study. The subjects were selected purposively.

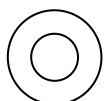
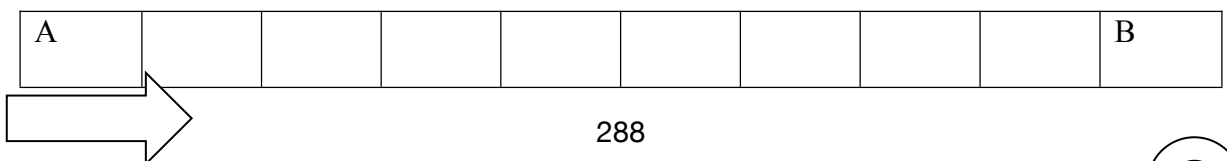
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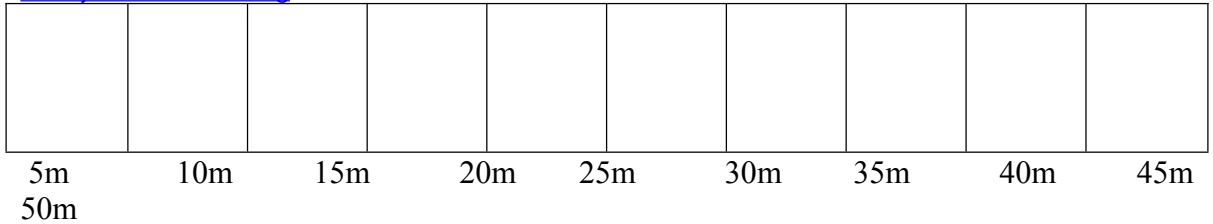
A modified performance soccer skill test -kicking for distance and control developed by Stanley, Waglow and Alexander (1975), was adopted and used as test instrument for data collection for the study. An alley measuring 50m by 20m apart marked out in 5m intervals was used to measure participant's ability to execute efficient performance of kicking skill using inside of the foot and ball control.

Aim: To measure the kicking for distance and control the ball.

Equipment & Facilities: Soccer balls, an alley 50m long and 20m wide with 5m marked out at intervals and soccer boots

Procedure: The subjects place the ball on area marked **Arrow** on the line marked out **A** and **B** and kick the ball using inside kick. The researcher records the scores the first place on the marked alley where the ball lands. Any kick outside the alley is not recorded while kicks above 50m are encouraged.





Modified Soccer Kicking for Distance and Control

Experimental Procedure

All the 32 participants who volunteered to participate for the study were gathered for grouping at the soccer pitch. The subjects were purposively assigned into one of the four groups: three experimental groups and Control group.

They were assigned into three experimental groups namely Group A (8) Plyometric-Vertical Jump (PVJ), Group B (8) Isometric-Strength Training (IST), and Group C (8) Combination of Plyometric- Vertical Jump and Isometric- Strength Training (PVJ/IST) and (8) Control Group (C).

An alley measuring 50m by 20m apart marked out in 5m intervals was used to measure participant's ability to execute efficient performance of kicking skill using inside of the foot and ball control. The researcher demonstrated the accurate training tests: plyometric-vertical jump and isometric-strength training for each group after which she appointed a group leader from those who performed best. The training lasted for (8) weeks. The days used for the training session in a week were Mondays, Wednesdays, and Fridays. The training lasted for 45 minutes with 15 minutes warm up exercises, 20 minutes plyometric-vertical jump, isometric- strength training and combination of the two and then 10 minutes of cooling down. The researcher appointed a group leader of each from the subject that performs best. During treatment sessions, the researchers exposed the subjects to accurate training sessions on plyometric- vertical jump using Sergeant Jumps and isometric-strength training using toe raise and those in the control group were placed on practices for the period. The consent of the participants, their parents and that of the school authority were sought and obtained.

A pretest was administered on all the experimental and control groups to establish baseline kicking ability of all the participants. At the end of 8 weeks treatment period, post tests were administered on all the groups using the same instrument as in pre test. Three trials were given to each subject from each group and best scores were taken as the subjects score. The score was estimated to the nearest meter and any kick outside the boundaries of the alley was discarded.

Data collected were analysed using statistical mean to answer the research questions while t-test was used in testing hypotheses 1-6 and ANOVA was used to test the null hypothesis.

Table 1: Training programme for Plyometric Vertical Jump, Isometric-Strength Training and Combined

Mode 1 X sets X reps Squats	Mode 2 X sets X reps Toe Raises	Mode 3 X sets X reps Combined
Wk 1 Jumps X 3 X 8	Toe Raises 3 X 3 X 8	Combined 3 X 3 X 8
Wk 2 Jumps 3 X 5 X 8	Toe Raises 3 X 5 X 8	Combined 3 X 5 X 8
Wk3 Jumps 3 X 5 X 10	Toes Raises 3 X 5 X 10	Combined 3 X 7 X 10
Wk4 Jumps 3 X 8 X 10	Toe Raises 3 X 8 X 10	Combined 3 X 8 X 10
Wk5 Jumps 3 X 8 X 10	Toe Raises 3 X 8 X 10	Combined 3 X 8 X 10
Wk 6 Jumps 3 X 8 X 10	Toe Raises 3 X 8 X 10	Combined 3 X 8 X 10
Wk7 Jumps 3 X 10 X 10	Toe Raises 3 X 10 X 10	Combined 3 X 10 X 10

Results

Summaries of the analysis were presented in tables to highlight the findings.

Table 1: Pre Test Post Test mean scores of Female Students on performance of kicking skill in the game of soccer using Plyometric- Vertical Jump and Control group.

Source of Variation	Pre Test Mean	Post Test Mean	Mean Gain	Remarks
Plyometric Vertical Jump	37.50	57.00	19.50	Highly Effective
Control group	30.13	42.50	12.37	Effective

Table 1. shows that with mean gain of 19.50, the female students who were trained using plyometric -vertical jump performed better than those in the control group who had the mean gain of 12.37 due to training. Plyometric -vertical jump therefore highly improved performances on kicking skill in the game of soccer.

Table 2: Pre Test Post Test mean scores of Female Students on performance of kicking skill in the game of soccer using Isometric- Strength Training and Control group.

Source of variation	Pre Test Mean	Post Test Mean	Mean Gain	Remarks
Isometric- Strength Training	26.25	50.63	24.38	Highly Effective
Control group	30.13	42.50	12.37	Effective

Table 2 shows that with mean gain of 24.38, the female students who were trained using isometric -strength training performed better than those in the control group who had the mean gain of 12.37 due to training. Isometric- strength training therefore highly improved performances on kicking skill in the game of soccer.

Table 3: Pre Test Post Test mean scores of Female Students in kicking skill in the game of soccer using the combination of Plyometric- Vertical Jump (PVJ) and Isometric- Strength Training (IST) and Control group.

Source of variation	Pre Test Mean	Post Test Mean	Mean Gain	Remarks
PVJ & IST	32.75	63.75	31.00	Highly Effective
Control group	30.13	42.50	12.37	Effective

Table 3 shows that with mean gain of 31.00, the female students who were trained using both plyometric- vertical jump and isometric- strength training improved highly in kicking skill against the gained mean of 12.37 for the control due to training.

Table 4: T-test on the Post Test mean scores on kicking skill of Female Students who were trained using Plyometric- Vertical Jump (PVJ) only and those trained in both Plyometric - Vertical Jump and Isometric- Strength Training

Source of Variation	N	Mean	SD	df	Cal.t	Crit.t	p>0.05
PVJ & IST	8	57.00	5.07	14	7.60	2.15	0.05
Control group	8	42.59	1.85				

Table 4 reveals that at 0.05 level of significance and 14 degree of freedom, the calculated 7.60 is greater than the critical-t of 2.15. The first null hypothesis is therefore rejected. The researchers conclude that the post test mean scores of those who were trained using plyometric- vertical jump differ significantly with that of those in the control group.

Table 5: T-test on the Post Test mean scores on kicking skill of Female Students who were trained using plyometric- vertical jump only and those trained in both plyometric -vertical jump and Isometric Strength Training (IST).

Source of Variation	N	Mean	SD	df	Cal.t	Crit.t	p>0.05
PVJ	8	50.63	4.27	14	4.93	2.15	0.05
PVJ & IST	8	57.00	5.07				

Table 5 reveals that at 0.05 level of significance and 14 degree of freedom, the calculated 4.93 is greater than the critical-t of 2.15. The first null hypothesis is therefore rejected. The researchers conclude that the post test mean scores of those who were trained using isometric- strength training differ significantly with that of those in the control group.

Table 6: T-test on the Post Test mean scores on kicking skill of Female Students who were trained only in isometric- strength training and those who were trained in both Plyometric- Vertical Jump (PVJ) and Isometric- Strength Training (IST).

Source of Variation	N	Mean	SD	df	Cal.t	Crit.t	p>0.05
IST	8	63.75	3.33	14	15.78	2.15	0.05
PVJ & IST	8	57.00	5.07				

Table 6 reveals that at 0.05 level of significance and 14 degree of freedom, the calculated 15.78 is greater than the critical-t of 2.15. Therefore, the third null hypothesis is therefore rejected. The researchers conclude that the post test mean scores of those who were trained in plyometric- vertical jump differ significantly with that of those in the control group.

Table 7: T-test on the mean scores of Female Students who were trained using both Plyometric- Vertical Jump (PVJ) and Isometric- Strength Training (IST) and those in the Control group.

Source of Variation	N	Mean	SD	df	Cal.t	Crit.t	p>0.05
PVJ	8	57.00	5.07	14	7.60	2.15	0.05
IST	8	50.63	4.27				
Control group	8	42.59	1.85				

In Table 7, it was discovered that at 0.05 level of significance and 14 degree of freedom, the calculated 2.72 is greater than the critical-t of 2.15. Therefore, the fourth null hypothesis is therefore rejected. Therefore, there is significant difference in the post test mean scores of the female students who were trained using plyometric- vertical jump and those trained using isometric- strength training.

Table 8: T-test on the Post test mean scores of Female Students who were trained using Plyometric- Vertical Jump (PVJ) and those in both Plyometric -Vertical Jump and Isometric -Strength Training (IST).

Source of Variation	N	Mean	SD	df	Cal.t	Crit.t	p>0.05
PVJ	8	57.00	5.07				

14 3.15 2.15 0.05

PVJ & IST 8 63.75 3.33

Table 8 reveals that at 0.05 level of significance and 14 degree of freedom, the calculated 3.15 is greater than the critical-t of 2.15. Therefore the fifth null hypothesis is therefore rejected. There is then significant difference in the mean performances of the female students who were trained using group 1 and 3.

Table 9: T-test on the Post Test mean scores of Female Students who were trained using Isometric- Strength Training (IST) and those in both Plyometric- Vertical Jump and Isometric- Strength Training (IST).

Source of Variation	N	Mean	SD	df	Cal.t	Crit.t	p>0.05
IST	8	50.63	4.27				
				14	6.85	2.15	0.05
PVJ & IST	8	63.75	3.33				

Table 9 indicates that at 0.05 level of significance and 14 degree of freedom, the calculated 6.85 is greater than the critical-t of 2.15. Therefore, the sixth null hypothesis is therefore rejected. There is then significant difference in the mean performances kicking skill in the game of soccer by the female students who were trained using group 2 and 3.

Table 10: Summary of ANCOVA on the female student's performances in kicking skill in soccer using pre test and post test scores with treatment groups.

Source of Variation	SS	df	MS	Cal.F	Crit. F	P>0.05
Corrected Model	1982.66	4	495.66	33.52		
Intercept	434.35	1	434.35	29.37		
Covariate	10.6	1	10.06	0.68		
Treat Methods	1626.82	3	542.27	36.67	2.91	0.05
Residual	399.31	27	14.79			
Total	93867.00	31				

Table 12 shows that at 0.05 level of significant, 3 df numerator and 31 df denominator, the calculated F 36.67 is greater than the critical F 2.91. Therefore, the seventh null hypothesis is rejected. The researchers conclude that all the three treatments models have significant effect in optimising performances in kicking skill in soccer.

Discussion

Analysis of data in tables 1-3 showed that with the mean gain of 19.50 (PVJ), 24.38 (IS) and 31.00 (PVJ & IS) against consistent 12.37 for the control group, plyometric- vertical jump, isometric- strength training and in their combined group highly improved

performance in kicking skill by the treatment group. Also when these treatment modules were subjected to t-test analysis to determine their significant effects, tables 4-6 showed marked significant effects in the post test mean scores of plyometric -vertical jump, isometric- strength training and their combination over that of the control group. These findings therefore agreed with the finding of Liviu&Oravitan (2021) and Luhtanen (2004), that vertical jump performance is determined by a complex interaction among several factors including the maximal force-power that the involved muscles can develop. Similarly, for efficient performance in kicking skill, studies by Powers and Howley (2001) recommended that for that maximum performance, strength training must be included in the training programme for athletes including soccer.

The analysed data using Analysis of Co-variance (ANCOVA) on female students' performance of kicking skill in soccer using pre testpost test mean scores along with the treatment groups revealed that all three treatment groups have significant effect on performance of kicking skill. It agreed with Ramirez-Campillo, et al, (2022), who reviewed the programming plyometric- vertical jump training in soccer under frequency. This recent study explained that prepubertal male soccer players completed either one or two jump training sessions per week for 8 weeks with the total volume equated at 680 jumps. The groups experienced similar improvements in physical fitness (e.g., linear sprint; jumping) under both training frequencies. Similar results were found in amateur female soccer players who completed either one or two jump training sessions per week for 8 weeks (i.e., total volume equated at 810-foot contacts per leg. In line with the aforementioned studies, two meta-analyses (Liviu&Oravitan 2021; Ramirez-Campillo, Alvarez, Sanchez, Slimani, Gentil, Chelly & Shephard, 2019) revealed no effect of jump training frequency on female and young male soccer players' physical fitness (e.g., linear sprint; vertical jump).

The hypothesis was rejected at 0.05 level of significance since the calculated F value of 36.67 was greater than the F critical value of 2.91. Hence the hypothesis of no significant was rejected. This complimented the assertion of Markovic, Dizdar, & Javic (2016), who explained that for a skillful soccer performance, force, power, velocity, strength, accuracy and purposefulness must exist at the same time in exactly the right combination.

The finding on t-test revealed that isometric-strength training had a positive marked effect on performance of instep kick. Since the null hypothesis was accepted at 0.05 level of significance, Kiddo (2019) supported that the analysis of the dynamic movement of kicking has shown that side foot kick is the fastest type of kick in soccer. Therefore, to increase goal-scoring odds, players should reach the highest ball speed possible (Lorenzo, Fernandez-DelOlmo, Sandez-Molina & Martin-Acero, 2018), added that it depends on several variables, such as the speed of the foot upon impact as well as the quality of the ball kick-foot impact.

Hypothesis 3 focuses on the extent to which both vertical jump and isometric-strength training combined could affect the performance of instep kick in soccer by female students.

The hypothesis was rejected 0.05 level of significance since t-calculated was greater than f-critical ($25.18 > 2.42$). This complemented the earlier reports of Luhtanen (2004); Markovic, et al (2016); Powers and Howley (2001) that soccer is a complex sport activity, whose success depends on various variables and factors, including physiological abilities and technical skill and among them, one of the most important is the kicking. It should be noted that most kicks are usually done using feet (instep kick or side foot kick).

Conclusion/ Recommendations

The result of this study has provided added information and emphasis on the need for soccer players especially those coaching female amateur soccer at the grass-root levels to include, pertinent physical fitness enhancing training programmes such as plyometric-vertical jump and traditional strength training such as toe raise into their training schedules. This will go a long way to improve physical efficiency of the player's especially female teams. Invariably, this will correspondingly enhance the expected optimal performance of female soccer players especially their kicking abilities. The ministry of Education should organise seminars, workshops, refreshers course for the coaches, game-mistresses and games-maters from primary to secondary school levels in collaboration with physical education experts from higher institutions to update their coaching knowledge and competence with special emphasis on the importance and the need to include enhancing training programme while coaching amateur female soccer players.

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