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ORIGINAL RESEARCH ARTICLE

The Effect of 12 Weeks Plyometric Training on Some Selected Physical Fitness Components of U-17 Female Volleyball Project Trainees In the Amhara Region

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ABSTRACT

This study aimed to investigate the effect of 12 weeks of plyometric training on some selected physical fitness components; in the case of u-17 female volleyball project trainees in Debark town. For the current study, the true experimental design was employed, Trainees were comprehensibly selected and divided into two groups as experimental (n = 15) and control group (n = 15) blindly. For both experimental and control groups technical and tactical volleyball training for three days, a week for forty minutes per training session was given. Additionally, only for experimental group participants plyometric training was provided for two days a week for forty minutes per training session during the entire training period (12 weeks). The plyometric training protocol was prepared by considering the FITT principle and adapted from Gjinovci et al.(2017)(see the protocol next to reference lists). Before and after the intervention of plyometric training, for both groups, vertical jump test, T-test, 30-second jump test, and modified star excursion test were conducted to measure power, agility, muscular endurance, and dynamic balance respectively. To determine the effect of the training descriptive statistics, mean and standard deviation were made. Paired was carried out to compare the pretest and post-test mean difference of selected variables within the group. The results showed that a statistically significant difference was observed in vertical jump, agility, muscular endurance, and balance before and after intervention and between groups. On the contrary, there was no statistically significant difference in the control group in all variables (p>0.05). We conclude that after 12 weeks of interventions of plyometric training statistically significant differences were observed in power, agility, muscular endurance, and balance of the experimental group. For instance, the means result of power were found MD = 5.25333, t = 15.761, and p =0. 000, for agility it was MD = -2.43, t = -13.93 and p = 0. 000 for muscular endurance, MD = 5.93, t = 11.04 and p = 0. 000 and on balance the results were LA and RA was MD = 5.10000, t = 5.979 and p = 0. 000 and MD = 6.01333, t = 7.667 p = 0.000 respectively.

***Keywords: -** agility, balance, muscular endurance, plyometric training, power, volleyball*

INTRODUCTION

Volleyball is a team sport in which two teams of six players are separated by a net. Each team tries to score points by grounding a ball on the other team's court under organized rules (Vassil and Bazanovk, 2012). Today, with a history of more than a century, volleyball is a complicated team game that demands multi-faceted athletic activities and constantly changing positions(Gül *et al.,*2019).

In volleyball, all of the basic motoric qualities such as general strength, endurance, speed, agility, power, balance and coordination are required due to the importance of playing time, proper, and rapid play (Matavulj *et al.,*2001). During competitive volleyball, players engage in numerous sprints, jumps (defensive and offensive) activities and court motions of high intensity that happen repeatedly during the competition where power, strength, agility, balance, muscular endurance and speed are important and unless they affect volleyball performance (Bazyler *et al.,*2018; Devrim & Erdem, 2019; González-Ravé *et al.,*2011; Milić *et al.,*2017; Taye and Wondirad, 2017). A vertical jump (power) is a difficult movement that needs the coordination of multiple muscles in the torso, arms, and legs (Charoenpanicha *et al.,*2013). Knowing that each player performs more than 250 jumps in a volleyball match of five sets (Martinez, 2017; Vlantes & Readdy, 2017), the jumping ability has been identified as one of the key determining factors of high performance in volleyball (Stanganelli *et al.,*2008).

Agility is the ability to control the body and change its direction as rapidly, effortlessly, efficiently and as easily as possible when moving between two points (Devrim and Erdem, 2019; Turner, 2011){Turner, 2011 #110;Devrim, 2019 #128}. Plyometrics also requires body stability to perform the exercises properly and without injury. When an individual hops, jumps and performs depth jumps the body must stabilize itself to keep it upright. Balance (postural control) can be defined statically as the ability to maintain a base of support with minimal movement, and dynamically as the ability to perform a task while maintaining a stable position (Winter *et al.,*1990). And it is responsible for the correct execution of complex sports movements, as well as for protection against injuries. The static and dynamic balance adequacy of muscle groups in the core region that connect the body, legs, and arms also affects agility (Makhlouf *et al.,*2018). Likewise, muscular endurance is the ability of a muscle or muscle group to perform repeated contractions against submaximal resistance. Conditioning for the volleyball program must physically prepare players for many repetitive jumps, starts and stops, dives, rolls, and overhead motions that occur during matches. However, in female players, an average of 45 jumping acts were performed by every player in two games of NCAA Division I teams. The maximum number of jumping acts per player over two games was 73 (Tillman *et al.,*2004).

To have an effective performance during the game, it is necessary to make proper training programming by the development of these traits which are the requirements of volleyball (Devrim and Erdem, 2019). Therefore, these traits need to be run and developed with each other in training (Thakur *et al*., 2016). One of the commonly used training methods used to improve physical fitness components is plyometric training (Mine *et al*., 2020). Volleyball is known as a very fast-paced and explosive sport in which plyometric training is frequently used (Silva *et al*., 2019). Plyometric training refers to exercises involving jumping, hopping, and skipping that are characterized by eccentric contractions of the muscle-tendon unit immediately followed by concentric contractions, this response has also been referred to as the stretch-shortening cycle or myotatic reflex (Meylan and Malatesta, 2009). The SSC process significantly enhances the ability of the muscle-tendon unit to produce maximal force in the shortest amount of time (Rassier and Herzog, 2005).

There are studies in the literature that suggest plyometric training can help with vertical jump performance, agility, muscular endurance, static and dynamic balance, leg strength, joint awareness, sprint ability, and overall proprioception (Arazi and Asadi, 2011; Asadi, 2013; Mine *et al*., 2020). Miller *et al*. (2006) reported that 6-week plyometric training can be an effective training technique to improve athletes' agility. Likewise, the vertical jumps of under-14 female players improved by 3.9 cm after a four-week aquatic plyometric training intervention (Martel *et al.*, 2005). After six weeks of rigorous plyometric training on a gymnasium floor, the jumping ability of under-15 players improved by 9.2 % (Hewett et al., 1996). Similarly, Improvements of 16.9% in counter-movement jump were observed after a 12-week plyometric training protocol that was implemented on under-17 female players (Lehnert *et al*., 2009). In the same test, 12 weeks of plyometric training resulted in a 27.6 % improvement in under-22 female players (Gjinovci *et al*., 2017).

In addition, previous studies have investigated the positive effects of plyometric training on the following physical fitness components in volleyball players. Plyometric exercise is an efficient way to boost strength (Asadi, 2012) and sprint ability (Arazi and Asadi, 2011). Harput (2016), found that the effect of plyometric training on female volleyball players on balance, jump distance and, hamstring quadriceps rate, at the end of 6 weeks of plyometric training, significant difference was found. Thakur*et al., (2016)* concluded that the 12-week low-intensity plyometric exercises that they apply to 11.1 years age volleyball players are effective on balance performance ($p < 0.05$). Plyometric training appears to be most effective in increasing vertical jump (VJ) performance and lowering injury risk in young developing female athletes (ages 12–18 years) with no plyometric training experience (Rubley *et al.,*., 2011).

In recent years there has been an increase in the number of participants in volleyball sport under clubs, projects, and recreational programs in Ethiopia (Desalegn, 2017; Desalegn *et al.,* 2016).

There is a paucity of research conducted on the effect of plyometric training in Ethiopia at large and in North Gondar in particular.

From this point of view; this study aimed to determine the effects of 12-week plyometric training program on some selected physical fitness components: in the case of under-17 female volleyball project trainees in Debark town; north Gondar zone, Amhara region, Ethiopia.

Materials and Methods

For the current study, the true experimental design was employed, Trainees were comprehensibly selected and divided into two groups as experimental (n = 15) and control group (n = 15) blindly. For both experimental and control groups technical and tactical volleyball training for three days, a week for forty minutes per training session was given. Additionally, only for experimental group participants plyometric training was provided for two days a week for forty minutes per training session during the entire training period (12 weeks). The plyometric training protocol was prepared by considering the FITT principle and adapted from Gjinovci et al.(2017) (*see the training plan next to reference lists*). The intensity of the protocol is designed based on practical guidelines for plyometric intensity Ebben (2007). The frequency, volume (foot contact), and progression is designed based on Donald and Meyer (2013). The warming-up activities are designed based on Potach (2004).

Data Collection Procedure

To investigate the effects of 12 weeks of plyometric training on selected physical fitness components, the baseline information like participants' health conditions, previous injury, demographic characteristics, and pretests were recorded by the researcher. Next, technical-tactical training was given for both experimental and control groups and additional plyometric training for two days was given for the experimental group. Moreover, Functional tests like the vertical jump test for explosive power, T-test for agility, 30-second jump test for muscular endurance, and star excursion test for balance were applied to both groups before and after the intervention and the data were recorded by the coach and the researcher.

Methods of Data Analysis

To analyze, quantitative data Statistical analyses were performed using the SPSS (statistical package for social science) version 20 (Chicago, IL, USA). The outcome measure was presented as mean ± SD. Paired sample t-test was employed to measure the pretest and post-test of each variable of both groups. The level of significance was measured at $p < 0.05$.

Results and Discussion

In the current study, as shown in Table 1 the overall mean and SD age of the players was 15.53 ± .51 years for the experimental group and 15.46 ± .51 years for the control group. In terms of height, the mean and SD were 158.26 ±3.9 cm for experimental and 157.8 ± 2.85 cm for control groups. The mean weight of the players was 47.53 ± 4.51 kg for the experimental and 46 ± 2.2 kg for the control group correspondingly. Concerning BMI 19.02 ± 1.06 was for the experimental group and 18.47 ± .92 for the control group. Regarding the playing experience of the participants, 3.55 ± .34 years was for the experimental and 3.66 ± .22 years for the control group.

Table 1. Demographic Characteristics of Participants

Group	N	Sex	Age	Height(cm)	Weight(kg)	BMI	EXP
			Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
EG	15	Female	15.53 ± .51	158.26 ±3.9	47.53 ± 4.51	19.02 ± 1.06	3.55 ± .34
CG	15	Female	15.46 ± .51	157.8 ±2.85	46 ± 2.2	18.47 ± .92	3.66 ± .22

SD = Standard Deviation; N = Number of Participants; EXP = playing experience;
EG = Experimental Group; CG = Control Group

SD = Standard Deviation; N = Number of Participants; EXP = playing experience;
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Table 2: Paired (Dependent) Sample T-Test Results of Power Pre And Post-Test Result

Group	Variable	Paired Comparison	Paired Differences				t	df	Sig. (2-ailed)
			Mean ± SD	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
EG	Power	Pre – Post test	-4.83±0.94	0.24	-5.35	-4.31	-19.94	14	.000*
CG		Pre –Post test	0.12±0.42	0.11	-0.11	0.35	1.12	14	0.283

EG = Experimental group; CG = Control group; *= Significance Difference;
df = Degree of freedom

As presented in Table 2 a paired sample t-test was made to compare the mean difference between pretest and post-test of power (vertical jump test). The experimental group showed statistical significance mean differences between pretest and posttest MD= -4.83±0.94. This indicated that the post-test means the score was greater than the pretest means the result of power. p-value has been observed (P = .000; P≤ 0.05). As can be seen, the intervention of 12 weeks of plyometric training has statistically significant effects on power. On the contrary, based on a paired sample t-test presented in the above table, a statistically significant difference was not observed in the control group MD = 0.12±0.42 (P = 0.283; P >0.05). Here, we can conclude that 12 weeks of plyometric training had a statistically significant effect on power in the case of U-17 female volleyball project trainees in Debark Town.

Table 3. Paired (Dependent) Sample T-Test Results of Agility Pre and Post-Test Result

			Paired differ-ences	**Std. Error Mean**	**95% Confidence Interval of the Difference**				
Group	**Variable**	**Test**	Mean± SD		Lower	Upper	**t**	**df**	**Sig. (2-tailed)**
EG	Muscular Endurance	Pre-post test	2.37±0.52	0.13	2.08	2.65	17.75	14	0.000*
CG		Pre-post test	0.04±0.29	0.07	-0.12	0.2	0.54	14	0.6

EG = Experimental group; CG = Control group; *= Significance Difference;
Df = Degree of freedom

As illustrated in Table 3, a paired sample t-test was made to compare the mean difference between the pretest and post-test agility test (T-test). The experimental group showed that statistical significance mean difference between pretest and posttest MD = 2.37±0.52. This indicated that the posttest mean ±SD (10.43 sec ±0.32) was less than the pretest mean (12.8 sec ±0.45). This decrement in time showed that 12 weeks of plyometric training had a statistically significant difference in agility (P = .000; P≤ 0.05). On the divergent, in the control group, there was no statistically significant mean difference between the pretest (12.9 ±0.60) and post-test (12.86 ±0.59) agility. MD=0.04±0.29 was observed (P=0.6; P>0.05). Here, we can conclude that 12 weeks of plyometric training intervention had a statistically significant effect on the Agility of U-17 female volleyball project trainees in Debark town.

Table 4. Paired (Dependent) Sample T-Test Results of Muscular Endurance Pre- and Post-Test Result

			Paired differ-ences	**Std. Error Mean**	**95% Confidence Interval of the Difference**				
Group	**Variable**	**Test**	Mean± SD		Lower	Upper	**t**	**df**	**Sig. (2-tailed)**
EG	Muscular Endurance	Pre-post test	-5.8±0.77	0.2	-6.23	-5.37	-29	14	0.000*
CG		Pre-post test	-0.13±0.64	0.16	-0.49	0.2	-0.8	14	0.43

EG = Experimental group; CG = Control group; *= Significance Difference;
Df = Degree of freedom

As it has been displayed in the above Table 4, a paired sample t-test was made to compare the mean difference between the pretest and post-test of muscular endurance (30-second jump test). In the experimental group statistically, a significant mean difference MD = -5.8±0.77 has been observed between pretest mean ± SD (17.27±1.09) and posttest mean ± SD (23.07 ±1.49). Hence, P = .000; P≤ 0.05. As can be seen, the post-test mean result was greater than the pretest score. This revealed that 12 weeks of plyometric training had statistically significant effects on muscular endurance. On the contrary, based on a paired sample t-test presented in the table, a statistically significant difference was not seen (P=0.6; P>0.05) in the control group. Here, we can conclude that 12 weeks of plyometric training intervention had a statistically significant effect on the muscular endurance of U-17 female volleyball project trainees in Debark town.

Table 5: Paired (Dependent) Sample T-Test Results of Left and Right Anterior Directions of Balance Pre And Post-Test Result

			Paired Differences						
					95% Confidence Interval of the Difference				
Group	**Variable**	**Paired compari-son**	Mean ± SD	Std. Error Mean	Lower	Upper	**t**	**df**	**Sig. (2-tailed)**
EG	LLA	Pre-post test	-5.6±1.05	0.27	-6.18	-5.01	-20.5		.000*
	RLA	Pre-post test	-6±1.46	0.38	-6.81	-5.19	-15.9	14	.000*
CG	LLA	Pre-post test	-0.23±0.70	0.18	-0.62	0.15	-1.28		0.22
	RLA	Pre-post test	-0.18±0.52	0.13	-0.47	0.1	-1.39	14	0.18

EG = Experimental group; CG = Control group; *= Significance Difference; df = Degree of freedom; LLA = left leg anterior RLA= right leg anterior

During the period of the study (12 weeks) on the total sample (n=30) 15 as experimental and 15 as control groups. The experimental group reported the overall mean result of pre -posttest -5.6±1.05 for LLA with a marginal error of P=0.000 and -6±1.46 for RLA with a significant rate of P=0.000 from a balance test (star excursion). In this regard, in the experimental group, a significant difference was observed in the balance of the subjects.

However, the mean result of a balance test (star excursion) of a control group, -0.23±0.70 was reported from LLA and -0.18±0.52 from RLA, in terms of P-value 0.22 and 0.18 have been observed. Due to this, in both (LLA and RLA) of the control group significant difference was not seen. P => 0.05.

Therefore, we can conclude that 12 weeks of plyometric intervention had a statistically significant effect on the balance of U-17 female volleyball project trainees in Debark town.

As presented in Table 6, a paired sample t-test was made to compare the mean difference of pretest and post-test results left leg posterolateral (LLPL) balance test (star excursion) was measured in each group. And in the LLPL direction, in the experimental groups, pretest and post-test mean differences were found to be in (MD = -1.93, SD =1.22, t = -6.123, df = 14, and p = 0.000). This indicated that there was a statistically significant difference between pre and post-test results of LLPL balance in the experimental group. As can be seen, the intervention of 12 weeks of plyometric training has statistically significant effects on the LLPL balance performance of U-17 female volleyball project trainees in Debark town. p < 0.05 was measured. On the other hand based on the above table 4.15 of a paired sample t-test of pre and post-test LLPL balance test (star excursion) results in control group found to be in (MD = -0.20, SD = 0.174, t = -1.146, df = 14 and p = 0.271). This showed that there was no statistically significant difference between pretest and posttest results of LLPL balance. Here, p >0.05. For this reason, we can say that there was no statistically significant difference between pre and post-test results of LLPL balance found in the control group.

In the same way, a paired sample t-test was made to compare the mean difference of pretest and post-test results right leg posterolateral (RLPL) balance test (star excursion) was measured in each group. And in RLPL direction experimental group mean difference between pretest and posttest result found to be in (MD = -3.00, SD =.756, t = -15.37, df = 14 and p = 0.000*). This indicates that there was a statistically significant difference between pre and post-test results of RLPL balance in the experimental group. As can be seen, the intervention of 12 weeks of plyometric training has statistically significant effects on the RLPL balance performance of EG. p <0.05 was measured. On the other hand, in control group, pre and posttest RLPL balance test (star excursion) results found to be in (MD = -0.10, SD = 0.712, t = -0.544, df = 14 and p = 0.595). This showed that there was no statistically significant difference between pretest and posttest results of RLPL balance. Here, p > 0.05. For this reason, we can say that there was no statistically significant difference between pre and post-test results of RLPL balance found in the control group. In the final analysis, we can conclude that 12 weeks of plyometric training intervention had a statistically significant effect on LLPL and RLPL balance in the case of U-17 female volleyball project trainees in Debark town P < 0.05 was measured.

Table 6: Paired (Dependent) Sample T-Test Results of LLPL and RLPL Pre and Post-Test Result of Experimental and Control Group

			Paired Differences							
						95% Confidence Interval of the Difference				
Group			Mean	Std. Deviation	Std. Error Mean	Lower	Upper	**t**	**df**	**Sig. (2-tailed)**
EG	LLPL	Pre-post test	-1.93	1.22	0.315	-2.61	1.256	-6	14	0.000*
	RLPL	Pre-post test	-3	0.755	0.195	-3.418	2.581	15	14	0.000*
CG	LLPL	Pre-post test	-0.2	0.676	174	-0.574	0.174	-1	14	0.271
	RLPL	Pre-post test	-0.1	0.712	0.183	-0.494	0.294	-1	14	0.595

balance test (star excursion) results in control group found to be in (MD = -0.20, SD = 0.174, t = -1.146, df = 14 and p = 0.271). This showed that there was no statistically significant difference between pretest and posttest results of LLPL balance. Here, p >0.05. For this reason, we can say that there was no statistically significant difference between pre and post-test results of LLPL balance found in the control group.

In the same way, a paired sample t-test was made to compare the mean difference of pretest and post-test results right leg posterolateral (RLPL) balance test (star excursion) was measured in each group. And in RLPL direction experimental group mean difference between pretest and posttest result found to be in MD = -3.00, SD =.756, t = -15.37, df = 14 and p = 0.000*. This indicates that there was a statistically significant difference between pre and post-test results of RLPL balance in the experimental group. As can be seen, the intervention of 12 weeks of plyometric training has statistically significant effects on the RLPL balance performance of EG. p <0.05 was measured. On the other hand, in control group, pre and posttest RLPL balance test (star excursion) results found to be in (MD = -0.10, SD = 0.712, t = -0.544, df = 14 and p = 0.595). This showed that there was no statistically significant difference between pretest and posttest results of RLPL balance. Here, p > 0.05. For this reason, we can say that there was no statistically significant difference between pre and post-test results of RLPL balance found in the control group. In the final analysis, we can conclude that 12 weeks of plyometric training intervention had a statistically significant effect on LLPL and RLPL balance in the case of U-17 female volleyball project trainees in Debark town P < 0.05 was measured.

Table 7: Paired (Dependent) Sample T-Test Results of LLPM and RLPM Pre and Post-Test Result of Experimental and Control Group

Group	Variable	Paired Comparison	Mean ± SD	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
EG	LLPM	Pre – Post-test	-4.4±1.29	0.33	-5.12	-3.68	-13	14	0.000*
	RLPM	Pre - Posttest	-2.8±0.77	0.2	-3.23	-2.37	-14		0.000*
CG	LLPM	Pre – Post-test	-0.27± 0.88	0.23	-0.76	0.22	-1.2	14	0.26
	RLPM	Pre - Posttest	-0.17± 1.19	0.31	-0.83	0.49	-0.5		0.59

EG = Experimental group; CG = Control group; *= Significance Difference; df = Degree of freedom; LLML = left leg posteromedial RLPM = right leg posteromedial

As presented in Table 7, at the time of the study (12 weeks) the total sample (n = 30) was 15 as experimental and 15 as control groups. The pre-posttest means and SD of the LLPM of the experimental group were -4.4±1.29 with a marginal error of 0.000 and a mean of -2. 8±0.77 with a p = 0.000 significance level was registered on RPM. Incidentally, in the experimental group, a significant difference was observed in the balance of the subjects.

However, the mean result of a balance test (star excursion) of the control group, -0.27± 0.88 was reported from LLPM and -0.17± 1.19 from RLPM, in terms of P-value 0.26 and 0.59 have been observed respectively. Due to this, in both (LLPM and RLPM) of the control group significant difference was not seen.

Therefore, we can conclude that 12 weeks of plyometric intervention had a statistically significant effect on the balance of U-17 female volleyball project trainees in Debark town.

Discussion

Plyometric training uses the inherent elastic components of muscles and tendons, as well as the stretch reflex, to enhance the power of subsequent movements (Trajković et al., 2016). Considering that jump performance ability is highly influenced by the individual's ability to take advantage of the elastic and neural benefits of the SSC, well-developed strength, and the rate of excursion of the activated musculature during the contraction, it is expected that plyometric training may benefit athletes' jumping performance(Silva et al., 2019).

According to the result of descriptive statistics (mean ± SD), the experimental group posttest results of power were increased after the intervention from 28.5333±1.07681 to 33.36cm±.611. Similarly paired t-test showed that the pre-posttest mean score difference of power was found mean difference of MD = -4.83, STDV = 0.94), t = -19.944, and p = < 0.05. On the other hand, the mean and STDV of power in the control group pretest and post-test results were 28.23±1.03 and 28.11±1.14 respectively. The paired t-test showed that the pre-posttest mean score difference of power was found a mean difference (MD = 0.12), St. Deviation of (SD = 0.42), t = 1.12, and p = 0.283. Here p = < 0.05.

The finding of the present study is similar to different scholars' findings. For instance, Aykora and donmez (2017) reported that there was a statistically significant difference in the mean values of vertical and initial test measurements (1.66 ± 0.88 cm) in plyometric exercise according to Tabata protocol in volleyball players aged 16-17 (p < 0.05). Similarly, Improvements of 16.9% in counter -movement jump were observed after a 12-week plyometric training protocol that was implemented on under-17 female players (Lehnert *et al.*, 2009). In the same test, 12 weeks of plyometric training resulted in a 27.6 % improvement in under-22 female players (Gjinovci *et al.*, 2017). Similarly, Mine *et al.*(2020) on their six-week plyometric intervention on 16-22 age group female volleyball players, vertical jump values are higher than the initial values cognizant of this, plyometric exercises may have a positive effect on the jump performance. Bayraktar and Cilli (2017), stated that volleyball players at the end of a 14-week plyometric study experimental group pre-test and post-test values taking 3 steps vertical jump (6.92 ± 6.25 cm) and active jump (6.17 ± 4.72 cm) showed a statistically significant difference (p < 0.05). Likewise, Pancar et al. (2018) reported that the 8-week plyometric training program applied in addition to handball training was significant in favor of the posttest (29.71 ± 3.58 cm) in the vertical jump performance of female handball players in the 12-14 age group (p < 0.05). Gul et al. (2017), also by plyometric training, which they applied to basketball players for 8 weeks, was seen as effective on the vertical and horizontal jump, handgrip, sit & stretch flexibility test performance. Moreover, according to Stojanović et al.(2017) Plyometric training is an effective training to improve VJ performance (e.g., CMJ, SJ, and DJ) in female athletes.

Regarding agility, the result of the present study is similar to other findings. For instance, Michailidis (2015) stated that there is a significant increase in agility performance of pre-adolescent soccer players only in EG, whereas, the CG did not change. Thomas et al. (2009) also observed that there is a significant increase in agility performance in EG after the effect of two PT techniques in youth soccer players. Similarly, Ozmen and Aydogmus (2017), in their research that investigated the effect of plyometric training applied to badminton players in the adolescent period on agility and squat jump performance, found that the plyometric group showed more improvement (6%) than the control group and plyometric training improved agility and jump performance in adolescent badminton players (p<0.05). Similarly, (M. G. Miller et al., 2006) reported that 6-week plyometric training can be an effective training technique to improve athletes' agility, and improvements in agility may be beneficial for athletes during the final pre-season preparation stage.

The finding of the current study in terms of muscular endurance was similar to Tesfaye (2020), She conclude that 8 weeks of plyometric training had significant effects on muscular endurance performance of U-17 female volleyball project trainees in Burie Town. Likewise, Kumar (2020), also found a significant improvement in the muscular endurance of volleyball players after Plyometric training.

The findings of this study showed additional plyometric training to skill training for volleyball players can be suggested to have potential advantages for gaining balance. This finding is supported by Turgut et al. (2017).They revealed that, right leg, there was a statistically significant training-by-group interaction for SEBT anterior score ($p = 0.001$), posteromedial score ($p = 0.03$), and posterolateral score ($p = 0.01$). In Comparisons with the baseline and 12-week, follow-up indicated that the dynamic balance was more improved in the intervention group for SEBT anterior ($p < 0.001$; mean difference (MD), 10.4%), posteromedial ($P < 0.001$; MD, 8.2%), and posterolateral score ($P < 0.001$; MD, 10.2%), whereas there were no differences found in the control group. Likewise, on left leg, there was a statistically significant training-by-group interaction for SEBT anterior score ($P = 0.001$), posteromedial score ($P = 0.009$), and posterolateral score ($p = 0.01$). Similarly, in the comparison between the baseline score and after the intervention the dynamic balance was improved in the experimental group for SEBT anterior ($p < 0.001$; mean difference (MD), 11.7%), posteromedial ($p < 0.001$; MD, 11.1%), and posterolateral score ($p < 0.001$; MD, 10.1%), whereas there were no differences found in the control group between pretest and post-test scores.

Conclusion

Based on the findings of this study, the researcher has investigated the following conclusions. The plyometric training group had shown significant improvement in all selected physical fitness component variables (power, agility, muscular endurance, and balance) among u-17 female volleyball project trainees in Debark town. The control group had not shown any significant changes in selected physical fitness components variables

Finally, we conclude that 12 weeks of intervention of plyometric training had a statistically significant difference in power, agility, muscular endurance and balance of U - 17 female volleyball project trainees in debark town north Gondar zone Amhara region Ethiopia.

Limitation of the study

In the present study, the researchers tried to control the extraneous variables. Since it has been conducted in an inconsistent environment; this may affect the internal validity.

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