

# Comparison the Effect of Water Plyometrics and Land Plyometrics On Body Mass Index and Biomotorical Variables of Adolescent Basketball Players

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## Abstract

The aim of this study was to compare the effects of water plyometrics and land plyometrics on Body Mass Index (BMI) and biomotorical variables of adolescent basketball players.

Ninety-one adolescent basketball players (48 male, 43 female) at the age of 16±1 year were enrolled in the study. Athletes were randomly divided in to three groups; water plyometric group (n:31), land plyometric group (n:30) and control group n:30). Study period was 12 weeks. All groups had standardized basketball training. water and land groups also had plyometrics three times a week. BMI and biomotorical variables including; body mass index, one repetition maximum leg strength, 30 meter sprint, vertical jump, flexibility were measured.

SPSS 11,5 version was used for the data analysis. "One Way ANOVA" was used to compare pretest and post test findings of study groups. Differences between pretest and posttest findings of genders and groups were analyzed by "Two Way ANOVA For Independent Samples". Significance was set at p<.05.

Significant differences were detected on BMI and biomotorical variables between pretest and posttest results in both water and land plyometric exercise groups. But there were no statistically significant differences between groups. After the study period there were also statistically significant differences between control and plyometric exercise groups.

**Keywords:** Plyometric exercise, Water plyometrics, Adolescent, Basketball

## Introduction

Plyometrics are a natural part of most movements, as evidenced knee injuries, and running economy [1-5].

Beside various benefits of plyometric training researcher also pointed that high intensity land based plyometrics have possible acute muscle soreness, muscle damage, or even musculoskeletal injuries [6-8]. Because of these risks of land plyometrics, water plyometrics became alternative training model to improve athletic performance. Water plyometrics are the type of plyometric exercises which can perform in water. There were limited research investigated the effectiveness of water plyometrics on physical performance of adolescent population. On the other hand there wasn't any research which was investigated the conjunction plyometrics with the basketball training. Therefore, the first aim of this study was to investigate the effects of water plyometrics and land plyometrics on structural and biomotorical features of adolescent basketball players and the second aim was the investigation the applicability of the performing the plyometrics with basketball training.

## Methods

### Study design:

This study was conducted using a pretest/posttest design. There were three groups: land, water and control groups. Study planned 12 weeks plyometric training program conjoined with basketball training by 3 training sessions per week. Plyometric exercises performed after low intensity technical basketball drills. The subjects were instructed to perform each exercise to their maximal ability. Each group was pretested and posttested on structural and biomotorical features.

### Subjects:

Physically healthy ninety-one (48 male, 43 female) adolescent basketball players-minimum two years licensed- at the average age of 16±1 year were participated in to study as volunteer. Study period was 12 weeks. All groups did standardized basketball training. Water and land exercise groups also did same plyometric exercises three times a week after the technical basketball training. They agreed not to modify their current exercise regimens throughout the course of the study. The study procedures and guidelines were orally presented to the subjects before they signed an institutionally approved consent form.

### Procedure :

Subjects were randomly assigned to following groups: water group (W) (n:31), land group (L) (n:30) and control group (C) (n:30). All groups performed standardized basketball training.

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Land and water groups performed same plyometric exercises after basketball training. While land group performed plyometrics in sport saloon, water plyometric group did in swimming pool in knee water level. Control group did basketball training only. Plyometric exercises were: side to side jump, tuck jump, double leg jump, split squat jump and squat jump. Training volume designed 2 sets and 10 repetitions for each exercises with 2 minutes rest for the first 4 weeks, while the intensity of the exercises increased throughout the course of the training program as described by Miller et al [9]. Basketball trainings were: basic warm up and cooling down for 30 minutes total, dribblings, passing, shooting and lay up for 40 minutes total. Each group was pretested and posttested on structural and biomotorical features including: body mass index, one repetition maximum (1RM) leg strength, 30 meter sprint, vertical jump and flexibility.

#### Measuring structural features;

Body weight was measured to the nearest 0.2 kg (Weight Tronix, New York, New York) and body height was measured to the nearest 0.5 cm using a stadiometer (Holtain, Crynych, Wales). From these two measurements, BMI was calculated (weight in kilograms divided by height in meters squared) ( $\text{kg/m}^2$ ).

Table 1. Demographic variables of groups

	Land Group (n: 30)	Water Group (n: 31)	Control Group (n: 30)	Total (n: 91)
Age (year)	16,3± 1,2	15,8± 0,7	16± 1	16± 1
Sport age (year)	2,7±0,8	2,7±1,2	2,3±1	2,6±1
Height (cm)	176,2 ± 12,4	172,9±9,8	171,7±10,1	173,5±10,9
Weight (kg)	69,3 ± 15,1	65,8±14,8	66,5±18,2	67,2±16

No significant differences between groups. All are mean (X) ± standart deviation (SD)

Table 2. Pretest- Posttest Comparison of groups.

Variables	Land Group		Water Group		Control Group	
	Pretest x±ss	Posttest x±ss	Pretest x±ss	Posttest x±ss	Pretest x±ss	Posttest x±ss
1RM (kg)	134,5±41	197,5±51,3*	135,7±44,9	200,7±45,7*	126,5±56,3	159,1±73**
Vertical Jump (cm)	48±9,3	52,6±8,8*	47,2±5,2	51,7±5,2*	43,7±8,2	45,3±8,8**
Flexibility (cm)	20,7±5,5	24,5±4,7*	21,2±7,5	25±7,5*	20,3±5,7	22±5,2**
30 m Speed (sn)	4,9±0,6	4,8±0,5*	5±0,5	4,9±0,5*	5±0,7	5±0,7**
BMI ( $\text{kg/m}^2$ )	22,2±3,5	21,3±3,1*	21,8±3,6	21,1±3,5*	22,2±4,2	22,5±4,1**

\*: Significant difference between pretest-posttest ( $p < 0.05$ )

\*\* : Significant difference with the Control group and others according to pretest-posttest ( $p < 0.05$ )

Demographic features of groups were shown on Table 1. Table 1 show us that; totally 91 athletes who had 16± 1 year average age, 2,6±1 year average sport age, 173,5±10,9 cm body height and 67,2±16 kg body weight, participated in to the study. Athletes divided in to the three groups (L,W,C) and ANOVA showed that there wasn't significant differences between groups according to demographic features.

Findings about pretest- posttest comparison of structural and biomotorical features of groups were shown on Table 2. According table ANOVA analysis proved that; pretest- posttest

#### Measuring biomotorical features;

30 meter sprint was performed in a saloon and measured by stopwatch (Protech 8376R-USA) three times with two minutes rest. Best performance was recorded.

Vertical jump was measured by jumpmeter (Takei-TAK004-JAPAN) three times with 1 minutes rest and best performance was recorded.

Flexibility was measured by sit and reach test by using sit and reach box (Sit and reach box-Acuflex-USA) two times with 2 minutes rest and best performance was recorded.

1 Repetition Maximum (1RM) leg strength was measured in the gym by using leg press machine (Profitness - USA). After 15 minutes warming and 5 minutes stretching, players tried to push the weight with starting 40kg for females, 60kg for male. If player succeeded pushing the weight more than 10 times, 2,5 kg added on weight till players couldn't push the weight more than 10 repetition. Given four minutes to players for rest when weight adding. Maximum 10 repetition performance of players put in to the 1RM formula ( $1 \text{ RM} = \text{weight}/(1,0278 - (0,0278 \times \text{repetition}))$ ) to find 1RM. [10]

## Results

performance of groups were statistically difference. After 12 weeks plyometrics L and W groups' biomotorical and structural features were significantly changed. But C group wasn't. This changing wasn't statistically difference between L and W groups but L and W groups' pretest-posttest performance was statistically difference with C group. L and W groups' biomotorical performance was statistically more improved than C group, also L and W groups' structural features statistically more decreased than the C group.

## Discussion

The aim of this study was to compare the effects of 12 weeks of water and land plyometrics on BMI and biomotorical variables of adolescent basketball players. 30 meter sprint speed, vertical jump, 1 RM maximum leg strength and flexibility performance were tested to analyse biomotor variables and BMI calculated. BMI can easily calculate and help to evaluate the persons structural view. The WHO [11] regard a BMI of less than 18.5 as underweight and may indicate malnutrition, an eating disorder, or other health problems, while a BMI greater than 25 is considered overweight and above 30 is considered obese. Athletes who participated in to this study were physically normal according to BMI classification (Table 2). On the other hand 12 weeks plyometric training statistically decreased L and W groups' BMI according to pretest-posttest analysis. This changing wasn't statistically differ between L and W but statistically differ with C. BMI of L and W were statistically more changed than the C group. It is possible say that 12 weeks plyometric training both on land and in water have similar effect but it is more effective than the basketball training alone on BMI. Because of the plyometrics were type of endurance and strength training models, same as the this research, past studies indicated that plyometrics decreasing BMI [12-14].

On the other hand, many studies proved that plyometrics had positive effect to improve the biomotorical performance which were speed [15,16], vertical jump [1,17-21], leg strength [3,4,22-24] and flexibility [23]. In this study biomotorical performance of athletes were statistically improved as noticed by the past studies. But there were limited studies compare with water and land plyometrics on biomotorical performance. Many of those studies proved that water plyometrics as effective as the land plyometrics on biomotorical performance and some of those were opposite. Robinson [25] and Starley [26] pointed that there wasn't significant differences between land and water plyometrics on speed performance. Recent study found similar result too but Shiran [27] noticed that land plyometrics more effective method than the water plyometrics on speed performance. That finding may because of plyometrics performed 5 weeks. Miller [28], Stemm [29], Robinson [25] showed that there wasn't any significant differences between water and land plyometric groups according to vertical jump performance. Recent study reached same result and there wasn't any opposite findings in past studies. Robinson [25], Miller [28], Shiran [27] found that water and land plyometrics has similar effect on maximal leg strength performance same as the findings of recent study. But Starley [26] found that water plyometrics statistically more effective method than the land plyometrics to improve maximal leg strength. Recent study found that there wasn't any significant difference between land and water plyometrics on flexibility performance. There wasn't any study in literature which was investigate the effects of land and water plyometrics on flexibility performance.

## Conclusion

In terms of performing the plyometrics after the basketball training, this study will be the first. Also no injury observed during the study and all participants finished the study. This study showed that 12 weeks land and water plyometrics statistically improved biomotorical variables of adolescent basketball players. Beside there wasn't any significant differences between land and water plyometrics groups' biomotorical performance according to pretest and posttest findings. But there was statistically difference found between control group with water and land groups. Based on these findings it is possible to say that 12 weeks water or land plyometrics with basketball training more effective method to improve biomotorical performance of adolescent basketball players than the basketball training alone. Also it is possible to say that plyometrics can perform after the low intensity basketball training without injury occur.

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