THE EFFECT OF PLYOMETRIC TRAINING FOR LOWER EXTREMITIES STRENGTH AND POWER IN HIGH-SCHOOL FEMALE BASKETBALL PLAYERS

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Plyometric training is one of very prevailing training methods. It has its unique effect compared to other training methods. Having targeted 16 girl basketball players in senior high school, a set of box horse curriculum was designed with polymetric training for the study. The players were randomly divided into experimental groups (respectively with 30, 40, and 50 cm of box horse) and control group, four players for each group. Except for the control group, the other three groups had to receive 12 weeks of box horse training in addition to general basketball course training. The results of the study showed: Based on the plyometric training designed and applied to senior high school girl basketball players, this study shows that either CMJ or CJ has its effect.

KEY WORDS: plyometric training, squat jump, counter movement jump, continua jump, basketball players

INTRODUCTION: As mentioned in the literatures, with the diving platform at 40 cm, the possible highest jumping height may be achieved with plyometric training (Lin Chun-Chung, 1991). With 40 cm height of diving platforms, mover muscles'function for grounding force and jumping height would be increased, so the effectiveness of plyometric jumping training could be enhanced (Chen Yu-Yin, 1991). As pointed in the study of Balkey (1987), too high of diving platform would possibly hurt heel tendons. The results of the study of Bobbert (1987) for relationship between the knee joint angle of 20 cm, 40 cm and 60 cm diving platforms and the motive force, found that the grounding from 60 cm diving platforms is more disadvantageous than that from 20 cm and 40 cm diving platforms. If the diving platform's height is too low, the muscle stimulus would not be enough because 20 cm diving platforms bear lighter degree of weight, the effectiveness becomes not so significant. However, for 60cm diving platform, knee joints and heel tendons are easy to get injured, so it is not suggested for use. The influence made from 30 and 50 cm height of diving platform has less been mentioned, so this study has focused on 30 cm, 40 cm and 50cm of diving platform as the research items, in the hope to find out better effectiveness. This study will use plyometric training designing 12 weeks of box horse training, in attempt to have an in-dept understanding about the influence that plyometric training can make on leg's muscular strength and explosive power. It is anticipated that following 12 weeks of training, trainees' SJ, CMJ and CJ's ability will improve significantly.

METHODS: This study has targeted 16 high school girl basketball players who did not receive any plyometric training course before, with an average age at 16.526 ± 0.772 and average weight at 60.315 ± 6.912 kilos while average height was 167 ± 5.405 cm. They were randomly divided as experimental groups and control group. The control group received only general basketball training, but for experimental groups, in addition to the general training, they were randomly divided into three groups respectively for 30, 40 and 50 cm of box horse for 12 weeks of box horsing training. Three trainings for each week and, each time the four groups were circulated with 10 jumps for each circulation. Prior to the training, the trainees were acquired by testing 10 times of their SJ, CMJ and CJ through the Kistler force plate. The sampling frequency of SJ and CMJ was 1000 Hz for three seconds while it was also 1000 Hz for CJ, but the time lasted 10 seconds. The personal profiles and testing results of the tested players for the study were all showed with average value or standard deviation, and SAS packaged software was used to compile the data for statistic analysis. Two-way ANOVA and trend analysis were adopted in the study to compare the variance between pre and post tests. The level of significance for statistic test was set at $\alpha = .05$.

Table 1 Trying basic document.

	N	Years	High(cm)	Weight(kg)
Mean	16	16.526	167	60.315
SD		±.772	±5.405	±6.912

Table 2 Plyometric Training curriculum.

	control	30 cm	40 cm	50 cm
N	4	4	4	4
Normal	basketball	basketball	basketball	basketball
Plyometric	×	3/week	3/week	3/week
Sets	×	4	4	4
Rep/set	×	10/set	10/set	10/set

RESULTS AND DISCUSSION: The results suggest that plyometric training indeed boost leg's muscular strength and explosive power. On the part of SJ, there was no significant variance between the groups of 30, 40 and 50 cm and control group following 12 weeks of training. However, the test conducted in the sixth week after the training showed a level of significance at $p < 0.05$ between the groups of 30, 40 and 50 cm and control group. A level of significance was shown at the test held for the experimental groups and control group in the 18th week. The test of the 50 cm group did not reach the level of significance either within its group members or with other groups. It might be resulted from the training method, because the players were afraid of being injured, they jumped up to boxes before they jumped down the boxes which might lead to more gentle movements causing no significant variance. Or perhaps the players did not do their best in their training. All the factors shall be further investigated. On the part of CMJ, there was a level of significance $p < 0.05$ for both experimental and control groups. It testified that plyometric training could effectively promote CMJ's bounce-ability. Some interesting phenomena also showed in comparisons within group members. The 30 cm and 50 cm groups mentioned above showed the level of significance compared with the control group for either within the group members or between the groups. It was only the 40 cm group for which the comparison within group members showed the same results as pre-training period although its level of significance was reached compared with the control group. It was a very interesting part in this study. As mentioned in many bibliographies that the 40 cm diving platform is the most optimal height for training, but the results shown in this study nevertheless indicated that the progress of 40 cm group was less significant than that of 30 cm and 50 cm groups. During the training process, this group never reached the level of significance although eventually it showed the significant level in the 18th week compared with the control group. It requires further verification to see if it was caused by the different training method and design from that of other studies. With regards to CJ, both experimental groups and control group all reached the level of significance at $p<0.05$. According to the trend variance test analysis for the experimental groups (30cm, 40cm and 50 cm) and the control group, it showed the linear （$F = 359.93$ $p < 0.05$), second （$F = 626.95$ $p < 0.05$) and third （$F = 266.01$ $p < 0.05$) trends of continuous jumping tests all reached the level of significance. At the same time, the interaction （$F = 4.24$ $p < 0.05$) also arrived at the level of significance. This study indicated that the continuous jumping ability in the 50 cm group was apparently better than the other three groups, and 30 cm and 40 cm groups were better than the control group although the difference was not much. The control group was only trained with general basketball practice, although there was a difference compared to the pre-training period, the difference level was comparatively smaller compared with other groups receiving plyometric training. The study also suggests that the max, average value of the 50 cm group was obviously greater than that of other groups. It should be attributed to the higher box horse leading to more weight in training, so the progress was more significant. The results of this study have echoed this assumption. All the training groups in this study showed the level of significance during both pre and post training periods. Although the control group only received basketball training course, the level of significance was still existent, even, on some parts, this group showed better results than other groups, but the decline of muscular strength for this group might be faster than that of other groups receiving plyometric training. However, it is a way of normal training for muscular strength. There was no much function showed in the aspect of SJ, it was probably that SJ is not often used in basketball sports, so it is understood that SJ is less applicable for basketball sport items because it is less combined with the jumping in basketball games. On the other hand, the jumping movements in CMJ are frequently applied on the basketball courts in training, compounding the intensified training for the study, its effect was significantly greater than that to SJ. CJ is the motion frequently used the basketball courts. The progress was significant through the training. The 50 cm group performed better than other groups. It illustrates the change in height would increase the training weight which would lead to greater progress.

CONCLUSION: The results of this study showed that both CMJ and CJ all achieved the level of significance. As to SJ, probably due to its motion being less applicable for basketball sport items, no significant progress was found. Through this study, it is verified that plyometric training could be functioned effectively on CMJ and CJ, so it could be applied to the jumping motion of basketball sports. Suggested the following research may use the different high combination training way, compares whether compared to sole highly trains has effectiveness.

Table 3 SJ Afterwards comparison.

	N	Mean	Control	30cm	40cm	50cm
Control	4	0.51088	*	*	*	
30cm	4	0.45465	*			
40cm	4	0.45010	*			
50cm	4	0.58149				

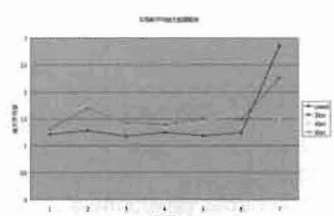

Figure 1 SJ of curve.

Table 4 CMJ Afterwards comparison.

	N	Mean	Control	30cm	40cm	50cm
Control	4	0.69660	*	*	*	*
30cm	4	0.52503	*	*		
40cm	4	0.54780	*			
50cm	4	0.61827	*			*

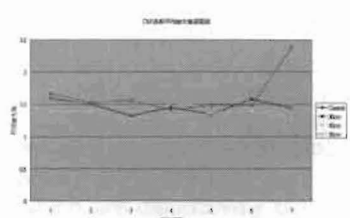

Figure 2 CMJ of curve.

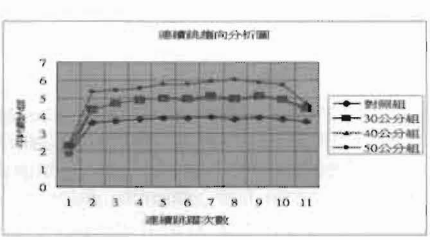

Figure 3 CJ of trend curve.

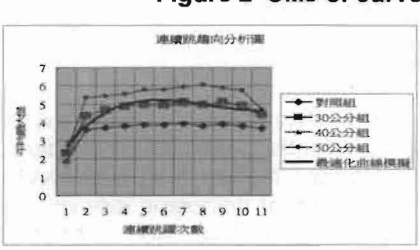

Figure 4 CJ of optimization curve.

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