Journal of Physical Education & Health, 2019, vol. 8 (14), 41-48

https://doi.org/10.5281/zenodo.3746167

THE EFFECT OF DYNAMIC BALANCE EXERCISES ON CERTAIN KINEMATIC VARIABLES AND JUMP SHOOT ACCURACY AMONG FEMALE BASKETBALL PLAYERS

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Abstract

The aim of the research is to identify the impact of dynamic balance exercises on certain Kinematic Variables and Jump Shoot Accuracy among Female Basketball Players. Researchers used the experimental method for one group with pre - post Tests. The research sample was intentionally selected for Female Basketball Players under the age of 16 at the Beni Suef club registered in the Egyptian Basketball Federation for the 2019 sports season and totalling ten (10) players who were filmed during the Jump Shoot after dribbling to recognize certain Kinematic Variables that affect shooting accuracy. Researchers conducted tests of front and lateral balance using a (MFT) device, Hexagon Test, Vertical jump from motion and skill tests to measure the accuracy and speed of the shoot. The implementation of the training program was conducted for eight weeks - five units per week; the time of each unit was 120 minutes, including 40 min. devoted to balance exercises. The main findings showed improvement in the results of balance tests using the (MFT)device, Hexagon, vertical jump from motion, and improvement in the motion path of the centre of gravity for the horizontal and vertical paths. It also showed benefits for the horizontal displacement transfer of Momentum to vertical motion energy which enabled the player to reach the highest point, and improvement of shooting angles which is considered the main factor in giving the ball the right trajectory in order to enter the ring to improve the ratio of the jump shoot. Researchers recommended the necessity of using dynamic balance exercises within Female training programs.

Key words: *dynamic balance, motion analysis, jump shoot, accuracy, basketball*

Introduction

Dynamic balance is one of the important capabilities in Female basketball. Offensive and defensive manoeuvres for Female basketball Players require a great ability of physical control, because of the dynamics and speed performance as well as the court area and the time taken to attack (24 seconds), which affects the performance of basic game skills. Shooting, especially jump shooting is considered critical for offensive and defensive manoeuvres, because it is the final moment following attack manoeuvres carried out by the team. This is an opportunity for the female player to demonstrate her ability in physical balance and control after performing successive attack manoeuvres which enable her to exploit the gaps in the defence of competitors shooting' lines. To accomplish this skill well, high physical and mechanical ability is required in order to jump vertically, thereby reaching the highest point of transferring the horizontal displacement of the centre of the body's gravity to the vertical displacement. This enables direction of the path of the ball accurately towards the target so as to get a better angle for the ideal shooting arc. This leads to an increase in shooting accuracy and a higher ratio of success. Through examining previous studies and scientific references such as Balakrishnan et al. [1], Struzik et al. [2] (2014), Prem Kumar" [3], Lucett [4], Oudejans et al. [5], Meng et al. [6], Houssain [7], Shallaby [8], Gualtieri et al. [9], Beigel [10], Hobbs [11] the researchers noticed that there is a great interest in balance exercises; especially motion balance. These studies used group of exercises (coordination ladder,

balance board, dot exercises, plyometric cones) to develop dynamic balance.

The most important results showed that balance exercises contributed to the development of physical and technical performance. Through following-up female players' matches, researchers noticed the existence of motion confusion when performing jump shooting due to physical growth associated with adolescence, and the existence of some difficulties in the flight path of the ball and the angle of shooting, which is the primary factor in giving the ball the correct flight arc and creating an entry angle of the ball in the ring which affects the ratios of jump shooting.

The two researchers noticed the negligence among trainers for training dynamic balance in spite of its effect on the level of physical and skill performance, in addition to the lack of Arabic research dealing with this subject. The current research therefore aims to design a program for motion balance and identifying some of its effect on Kinematic Variables and Jump Shoot Accuracy for Junior Basketball Players. All the efforts exerted by the two researchers add innovation to this research.

The Aim of the research

The present research aims to design a set of dynamic balance exercises and recognize their effects on certain Kinematic Variables and Jump Shoot Accuracy for Junior Basketball.

The hypotheses of the research:

- There are significant differences between the averages of Pre - Post Tests in physical variables under consideration in favour of the Post test.
- There are significant differences between the averages of Pre - Post Tests in skill variables under consideration in favour of the Post test.
- There are significant differences between the averages of Pre - Post Tests in Kinematic Variables under consideration in favour of the Post Test.

Materials and Methods

The two researchers used the experimental method for one group using Pre - Post Tests. The sample of the research was selected intentionally from Female Basketball Players under 16 years of age in Talaa Elgesh club and the sample size was ten (10) players.

Table 1. Mean and standard deviation of Age, Height, Weight, and Training age of the subjects (N=10)

Variables	Median	Mean	SD	Skewness
Age (yr.)	14,56	14,55	0.52	- 0.003
Height (m)	172	172.5	3.14	0.34
Weight (kg)	75.50	76.20	4.57	0.28
Training age (yr.)	5.53	0.70	- 0.634	- 0.576

Table 1 showed that the skewness for variables (age, height, weight, training age) Ranged between (0.28, 0.003) of any confined between ± 3, which demonstrates that the sample represents a homogeneous society equinoctial in these variables.

The researcher conducted the first and the second pilot studies from 13/06/2019 till 18/06/2019 to recognize the suitability of the proposed program of dynamic balance exercises for the research sample, the validity and safety of the tools and equipment used, and the extent of understanding the research sample for tests: especially the device (the MFT) test of front and lateral dynamic balance (Attachment 2).

The researcher filmed the skill of jump shoot after dribbling to face the target board for the research sample, and analyzed test results dynamically to recognize Kinematic variables that affect the jump shoot skill.

Time Plan and Basis of Balance Exercises

Pre measurements were conducted in physical variables (front and lateral balance, hexagon form and vertical jump of movement), skill variables (remote, close shooting, shooting accuracy and the speed of shooting) and Kinematic Variables (horizontal and vertical displacement to the centre of gravity, angle changing for legs joints and shooting arm, the flight path of the shooting angle) in the period from 20/06/2019 to 25/06/2019 in the variables

under consideration. The researchers took into account the application of these measurements in the same manner.

A training program was implemented (conducted) during the preparation period for a period of eight weeks of five units per week making a total of forty training modules with a time of 120 minutes for each unit, then 40 minutes were allocated for dynamic balance exercises which were carried out directly after the warm-up. The amount of training size for dynamic balance exercises for the was program 1600 min (40 s × 40 units). The training time ranged from 15 to 30 seconds with interval rests between exercises of 10 to 15 seconds, group frequency from 2 to 3 times and interval rests between groups from 30 to 50 seconds. The intensity and size for physical and skill exercises were determined through (time and frequency), the exercises were performed by using tools (coordination ladder, cones) and without tools.

After finishing the research training program, the researchers filmed the sample again to follow–up the development of kinematic variables and applied post measurements to the research sample in the variables of the research in the period from 22/08/2019 till 27/08/2019.

In light of the objectives and hypotheses of the research, the researcher used appropriate statistical methods (Arithmetic mean - median - standard deviation- skewness coefficient - percentage of improvement T - Test and Spearman correlation) using the (SPSS V. 20) program and the Excel program to achieve dynamic analysis for jump shooting.

Results and discussion

Table (2) showed that there were significant differences between the averages of pre and post measurements in the physical tests under discussion, and testing of the jump shooting accuracy in favour of the post measurement as the value of (t) calculated is greater than the value of (T) Indexed at 0.05.

Table 2. Significant differences between the averages of (Pre- Post) tests for the group in the variables of physical and skills performances of the study (N = 10)

Variables		Measuring unit	Mean before	Mean after	SD	Mean Diff.	(t) Value	%
Dynamics Balance Tests	Frontal dynamic (MFT)	degree	3.07	2.52	0.60	0.55	2.91*	17.92
	Lateral dynamic (MFT)	degree	3.44	2.94	0.53	0.50	3.00*	14.54
	Hexagon Test	Sec.	14.18	12.59	0.38	1.59	13.29*	11.21
	Vertical Jump	Cm	36.50	46.50	2.06	10.00	15.39*	27.40
Shooting Tests	Shooting near & far	Point	8.60	13.70	1.37	5.10	11.77*	59.30
	Shooting Speed	Point	7.50	14.04	1.06	6.70	20.00*	89.33
	Shooting accuracy	Sec.	48.30	43.60	0.59	4.70	15.67*	9.73

Value (T) Driven at the level of significance (0.05) and 9 degrees of freedom = 1.833

Table (2) showed that there was improvement in all the tests used, and the existence of statistical significance in favour of post measurements, where test scores for front and lateral dynamic balance improved according to (the MFT) device by (18%) of the front balance, and (15.5%) of the lateral balance. The researchers believe that this percentage is good because it changes female players' estimation from passing to good, according to the standard device following balance exercises using balance plates. The nature of the test requires a sufficient amount of muscle power to dominate and control all the joints of the body in general and feet in particular, from the ankle joint which bears the greatest burden in maintaining the status of the body balanced on the base of the device.

This is in line with Balakrishnan et al. [1], Basnett [12], Schreiner [13] and Jungwirth [14] who pointed out that balance exercises using (MFT) balance plates contribute to strengthening of the muscles working at the joints of the lower limb, helping to improve the ability to control the ankle joint on the device, which affected the improvement in tests of front and lateral balance.

The rate of improvement in the hexagons form test was 11.2%. This test requires a great deal of dynamic balance, agility and muscle ability in the legs and trunk to enable the female player to jump (36 leaps) and change her directions during fast jumping. The researchers attributed this improvement to training points, Plyometrics and the compatible ladder which led to the development of dynamic balance. This contributed to the development of speed, agility and muscle ability which female players need to improve the time of jumping under consideration.

This is in line with Balakrishnan et al. [1], Ambegaonkar [15], Anthony [16], Alemdarolu [17], Ricotti [18] who pointed out that training points, Plyometrics and the compatible ladder contribute to the improvement of dynamic balance, speed and agility, as well as muscle ability in both legs, trunk and arms which improve the ability of jumping, dynamic direction, control of the body and maintaining poise when performing rapid movements without dynamic defect or disorder during performance.

There was a rate of improvement in the vertical jumping test of 27.40% movement. This test requires a great deal of muscle capacity, compatibility and dynamic connection, which are available in the exercises of the program (Coordination ladder, Dot, Plyometrics, Hexagon form) to develop a dynamic balance which was the cause of the development of these physical qualities required by the test. This is in line with the results of other authors [2, 4, 8, 19-21] who pointed out that there is a direct correlation between dynamic balance and some physical qualities (strength, muscle power, accuracy, endurance). By increasing the individual's ability to balance dynamically, there was an increase in the level of muscle power, endurance and accuracy, and an inverse relationship between dynamic balance and some physical qualities (speed & agility). The ability of the player to control the body, which resulted from the use of dynamic balance exercises, helped the performance of agility and speed movements in the least time possible.

Through the results of motion analysis for shooting, the researchers showed that the rise in the weight of the center of gravity results from the player grasping the technical directions given to them. This explained the Technique of mechanical transference to parts of the body and the effect of movement in the arms and feet in the full range of motion to take the body to the proper position to achieve the highest point of elevation, and improve the players' ability to stop the dribbling for jump shooting in order to increase the ability to brake horizontal dynamic energy of the body and turn it into vertical displacements in shooting.

Table 3. Time distribution and Average horizontal, vertical displacements of C G Pre - Post (m) (n=10)

Phases	Time of centre of gravity		Horizontal		Vertical	
	pre	post	pre	post	pre	post
start	0.2	0.16	1.02	1.07	1.02	1.07
take-off	0.52	0.60	1.217	1.148	1.114	1.21
height	0.12	0.12	1.382	1.15	1.54	1.69
landing	0.84	0.88	1.42	1.17	1.31	1.36

The Table (3) shows that the time of the preliminary stage in the post measurement was less than the pre measurement by (0.04 s), which reveals the speed of transition from the stage of running and stopping for jumping. As for the jumping stage (take-off) there is an increase in the time of jumping in the post measurement by (0.08 s). The two researchers attribute this to the increase in vertical displacement and the ideal full use of smooth dynamic transference from the feet to the trunk.

Table (3) also shows the amount of front horizontal displacement towards the ring which reflects the player's ability to convert the acquired dynamic energy of running while dribbling and momentary stopping in order to

be ready to jumping into the vertical direction, where the mechanical objective to the skill of jump shoot is to reach the highest point without clashing with the defender, and to distance oneself from the defender while shooting accurately [22]. The lower the horizontal displacements after landing, the lower the risk of bumping into the defender and committing personal faults. In the pre measurement this was (40 cm) versus (10 cm) in the post measurement, revealing an increase in the ability to command and control the joints of the body that work to keep the weight of the centre of gravity above the base [23]. As for the average vertical displacement for pre measurement, this was measured as the amount of the maximum height of the center of gravity of the body at 52 cm, and the average of vertical displacement in the post measurement was 62 cm with a 10 cm difference from the pre measurement. The researchers attributed this difference to dynamic balance exercises that contributed to the technical performance improvement of the skills in the research.

Table (4) shows that there was a similarity in the angular changing of the joints of the lower limbs in the preliminary and finally stages in pre and post measurements, and there was a difference in the main stage in favour of post measurements. Thus, the lower end was appropriately extended in post measurements to achieve dynamic quality called a stretched arc, which enables the player to shoot smothly and achieve a high point while making the upper limbs of the body move away from competitive defenders in a good way.

Table 4. Average horizontal, vertical displacements and resultant Velocity of ball (m) N=10

Phases	Shoulder		Elbow		Wrist		Ankle		Knee		Hip	
	pre	post	pre	post	pre	post	pre	post	pre	post	pre	post
start	88.2	85.9	49.6	76.9	135	130.3	72	74.7	119.2	121.3	125.8	140.4
take-off	102.8	108.5	48.1	64.2	145.9	120.7	64.7	60.4	128.1	130.3	153.3	151.5
height	141.4	143.1	165.9	175.4	179.4	180.4	114.4	144.5	164.9	177.7	176.1	179.9
landing	135.1	100.4	129.4	110.	209.5	218.5	116.8	99.4	165.0	162.0	166.1	167.1

Table (4) showed that there was a similarity in the angular changing of some joints of the shooting arm (particularly the shoulder joint) while performing the skill of shooting from jumping. The average of angular change during the landing stage in the pre measurement was 135.1° while in the post measurements this was 100.4°. Mechanically a good balance during landing cannot be achieved because if the shoulder angle is great it will force the arm up, thus the centre of body weight will be high and consequently balance will be lower [24].

As for the elbow joint there was clear difference in the maximum height of the centre of gravity of the body where it achieved an angle of 165.9° in the pre measurement and an angle of 173.4° in the post measurement, indicating the lack of full extension of the arm.

As for the wrist joint, which ends with it, all powerful outcomes and movements at the moment of leaving the ball which record in the pre measurement angle of 209.5° and in the post measurement 218.5°. It demonstrates a good follow-up hand in the post measurement.

Table (5) shows that the average total time for the ball path for the pre measurement was recorded at 1.4 seconds and in the post measurement it was recorded at 1.36 second. In the main stage, the flight time in the post measurement was less than the flight time in the pre measurement with 0.04 s, where the time was 0.60 seconds versus 0.56 seconds for post measurement. The researcher attributed this to the rising arc of the ball [2].

Table (5) shows that the average horizontal indentation in the sample of the study in the pre and post measurements was relatively stable. The researcher attributed this to the stability of the distance where the last cone of dribbling was placed on the three point's line. The shooting player must jump to shoot directly after the cone. The average of horizontal distance between the centre of the ring and place of jumping ranged between 4.5 to 4.7 meters [25].

Table 5. Average horizontal, vertical displacements and resultant Velocity of ball (m)

Phases	Time		vertical		Horizontal		R Velocity	
	pre	post	pre	start	pre	post	pre	post
start	0.01	0.01	1.4	1.4	0.02	0.039	0.01	0.01
take-off	0.16	0.2	2.3	3.9	0.142	2.42	0.315	1.13
height	0.6	0.52	4.87	3.88	2.17	2.6	4.616	4.89
landing	1.4	1.36	3.12	3.05	4.56	4.72	2.94	3.8

The vertical displacement as shown from Chart (6 b) revealed that the ball's trajectory in the pre-measurement recorded a maximum height of 4.87 meters with an average angle of the starting ball of 65°: 59° while the maximum height in the post measurement was 3.88 meters and the angle of the starting ball was 45 °: 50 °. Most Arab and foreign references agree that that the perfect angle of starting ranges from 42°: 49° [2, 26-28].

Table (5) illustrates that the average of resultant velocity was extremely close. The difference was in the preliminary stage where the speed outcome recorded a maximum point in favor of the post measurement. The pre measurement was 0.315 m / sec2 versus 1.13 m / sec2 in the post measurement.

Conclusions

- There were statistically significant differences between pre and post measurements in the physical, skill and Kinematic variables under consideration and in favour of the post test.
- Exercises of suggested dynamic balance have a clear impact (on agility -speed) as shown from results of post test.
- There were various degrees of improvement in the rate of front and lateral balance on the (MFT) device and Hexagon test: its impact was shown on controlling parts of the body in order to change directions and improve technical performance.
- Raising the path of the body weight's center in the vertical jump which was shown from vertical motion analysis is considered an important significance in the jump shoot.
- There was great improvement in velocity and shooting accuracy due to improvement in neuromuscular compatibility which is characterized by confusion and disorder experienced by players at the age of the research sample.
- There was movement of joints of the lower limb and shooting hand in accordance with the technique and skills of jump shooting.
- There was improvement in the dynamic of the ball trajectory, starting angle and ball entrance angle to the ring.

Recommendations

- Using exercises (compatible ladder, balance plates, the MFT device, points exercises, Plyometrics, cones) to improve dynamic balance and apply them in other skills for junior and older players in addition to female players.
- Using dynamic analysis to check technical errors and comparing performance among players.
- Showing results to players to have Feedback for actual performance and preferred performance.
- Use and innovation of similar exercises for actual game situations.
- Applying dynamic balance exercises from actual motion analysis to the basic skills of the game.

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Received: December 2019
Accepted: January 2020
Published: March 2020

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