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# Differences in the Exertion of Force Produced on a Surface of the Dominant and Non-Dominant Leg in Basketball Players of Different Competition Levels

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***Abstract:*** *Basketball as a sports activity has evolved over its long history from an alternative game to a highly selective sport in which success is reserved exclusively for the most talented and capable individuals. The aim of the research was to examine the differences in the exertion of force produced on a surface for the dominant and non-dominant leg in basketball players of different levels of competition. The research was conducted on a sample of 33 subjects of senior age from three levels of basketball competition in the Federation of Bosnia and Herzegovina (FBiH). Exertion of the force exercised during the jump on a surface was obtained using the Gyko System and Opto Jump. The "Single leg jump" test procedure was used. It is concluded that 30-50% of the variables have a statistically significant difference, which partially indicates the existence of statistically significant differences in the exertion of force in the dominant and non-dominant leg. The biggest difference in the dominant and non-dominant leg was detected in subjects of the A1 League (3 out of 6 variables). The smallest difference was detected in the subjects of the A2 League (no statistically significant difference was detected in any variable). Subjects in the Premier League showed a difference in 2 of 6 variables (flight time and jump height). The results obtained indicate that regular practice with both legs, both in the game and in training, will help players become balanced and efficient in all aspects of the game. Based on these results, it is possible to construct test batteries that will provide quality information necessary for planning and programming in basketball.*
***Keywords:*** *Basketball players, Single leg jump.*

## Introduction

The intensity of muscle activity in sports games depends on the duration and intensity of the game, the number of players, the dimensions of the playing field, and so on. The exertion, both physical and psychological, during the game affects the magnitude of the load on vegetative functions, which can be moderate or within the limits of submaximal or maximal load. (Skender, 2004, Skender, 2008).

CNS impact, muscle characteristics, flexibility,movement technique, and motivation are just some of the possible ways to increase speed, agility, and explosiveness. Connecting these abilities with the technical and tactical requirements of the soccer gameis what is the goal of development and the final requirement for training these abilities. (Jazvin at all 2021,). According to the structure of movement, it is the most energetically demanding, and according to the frequency, it is the most common physical ability in sports games. (Karalic, Skender & Jelcic, 2022).

The strong expansion of the basketball game is present around the world. In our country, conditions have been created that encourage the development and improvement of the scientific methodical basis of the training process, as well as other factors that will influence the achievement of top sports results. Successful basketball players are characterized by a polyvalent technique, expressed in morphological characteristics, functional capacities, motor abilities and psycho-social personality traits (Sekeljic & Stamatovic, 2008). Speaking about the fitness training of basketball players Semenick (1985) says that basketball is "basically an anaerobic running sport in which speed, strength, and agility are of primary importance." Any training stimulus observed in the long run must be managed according to biological and pedagogical principles, and based on this, motor skills can be developed gradually by increasing the load with the application of certain methods (Bjelica & Fratric, 2011). In order for a basketball player to effectively perform a starting acceleration of his body, he must have a good initial position and shift his body weight in the desired direction of movement. Stopping quickly from motion is just as important as acceleration. As basketball becomes faster and faster, thanks to increasingly advanced fitness preparations that enable players to achieve maximum results and goals, players have less time for the timely execution of the technical-tactical element in order to score in the attack phase. Thus, the problem arises of how to stop the movement as effectively as possible after receiving the ball from a teammate and perform a jump shot as quickly as possible, in order to maintain an advantage over the opponent, i.e., the defender and prevent him from successfully defending the shot. So far, extensive researche has been done on jump shots in basketball from the aspect of biomechanics. Rojas, Cepero, Ona, and Gutierrez (2000) investigated the adaptation in the jump shot technique of an offensive player against a defensive player. Okazaki and Rodacki (2000) analyzed the impact of increased distance on the basketball jump shot on the outcome and performance. Good biomechanics of a jump shot in basketball implies proper movement of the upper extremities, as well as a well-balanced and strong jump (Krause, seMeyer, D., & Meyer, J., 2008). Li-I Wang et. al. compared kinematics and kinetics during landing after a one- or double-contact jump and their potential impact on ACL injuries (Wang, Gu, Chen & Chang, 2010). Therefore, basketball belongs to sports that require great precision in performing movements (Erculj & Supej, 2006).

The aim of this paper is to present the differences in the exertion of force produced on the surface of the dominant and non-dominant leg in basketball players of different levels of competition.

## Method

This research was conducted on a sample of 33 senior league respondents. The ability of basketball players from three basketball competition levels in FBiH was tested and assessed. Namely, K.K. "J&A" Sports Academy which participates in the A2 league (N - 12), K.K. "Konjic" which participates in the A1 league (N - 11), and H.K.K. "Zrinjski", which participates in the Premier League.

A sample of measuring instruments

- DurationConc(s) - Duration of concentric contraction expressed in seconds
- DurationEks(s) - Duration of eccentric contraction expressed in seconds
- FMax(N/kg) - Expressed force on the surface with respect to body weight
- Vmax (m/s) - Body speed expressed in meters per second
- Flighttime (s) - Flight time
- Hight (cm) - Jump height
- Pmax (wat/kg) – Maximum power with respect to body weight

The parameters of the force exerted during the jump on the surface were obtained using the Gyko System and Opto Jump during the execution of the "Single leg jump" test procedure.

In the paper, basic descriptive statistical indicators were calculated for all respondents (arithmetic mean, minimum, maximum, and standard deviation). After that, a T-test was performed for the samples within each group in order to determine the statistical significance of the difference in the height of the jump and the exertion of force on the surface during the jump. The obtained results are considered statistically significant at $p<0.05$.

## Results

In order to show the differences in the exertion of force on the ground in the jump in the dominant and non-dominant leg of all subjects, Table 1 shows arithmetic means (SV) and standard deviations (SD). Table 2 shows T-test values (t), degrees of freedom (DF), and statistical significance (P).

The results of the T-test (Table 2) showed that at the univariate level there is a statistically significant difference in some of the jump parameters with which we measured the force exerted on the surface. In the case of Premier League players, there were differences in two out of six variables, in both cases in favor of the dominant leg. The variables are flight time (s) ($t = -2.28$) and (sig. = 0.048), and the variables jump height (cm) ($t = 2.26$) and (sig. = 0.050). Furthermore, the table presents an analysis of the differences between the arithmetic means of the A1 League respondents, and we can conclude that statistically significant differences were obtained in three out of six variables. Differences are evident in the variables flight time (s), jump height (cm), and eccentric contraction duration (s) at a high level of ≥98%. In two of the three variables in which there was a difference, there is an evident difference in favor of the dominant leg. For the variable flight time (s), the value is ($t = -2.89$) and (sig. = 0.016), the variable jump height (cm) has values (t = -2.90) and (sig. = 0.016), while the variable eccentric contraction duration (s) has values (t = 2.88) and (sig. = 0.016), speaking in favor of the non-dominant leg. This result, showing the duration of the eccentric contraction in the non-dominant leg, is also in favor of the dominant leg. The third part of the table tells us about the analysis of the differences in the arithmetic means of the A2 League respondents, where we can conclude that none of the six variables used contributed to a statistically significant difference.

Based on the obtained results of the central and dispersion parameters, and the results of the T-test, where we determined statistically significant differences between the dominant and non-dominant legs when exerting force on the ground in basketball players of three different levels of competition, we come to the conclusion, as was expected, that there are statistically significant differences in some cases in favor of dominant legs.

***Table 1.*** *Descriptive indicators of force exerted by the non-dominant and dominant leg on the surface with all subjects*

| | | Dominant leg | | Non-dominant leg | |
|---|---|---|---|---|---|
| | N | A.S. | Std. Dev. | A.S. | Std. Dev. |
| Flight time (s) | 33 | .4740 | .11368 | .4229 | .06517 |
| Jump height (cm) | 33 | 29.0758 | 13.44584 | 22.4515 | 6.35148 |
| Duration of concentric contraction (s) | 33 | .2912 | .09756 | .3435 | .27713 |
| Duration of eccentric contraction duration (s) | 33 | .4110 | .21257 | .5252 | .31172 |
| Maximum force (N/kg) | 33 | 32.4921 | 7.79913 | 32.4064 | 8.71306 |
| Maximum speed in m/s | 33 | 2.3639 | .50961 | 2.1261 | .27037 |
| Maximum power in wat/kg | 33 | 57.6082 | 21.86937 | 51.3888 | 13.29748 |
| Valid N (listwise) | 33 | | | | |

***Table 2.*** *Analysis of the differences of A.S. when exerting force on the surface of the dominant and less dominant leg in the subjects*

| | Premier League | | | A1 League | | | A2 League | | |
|---|---|---|---|---|---|---|---|---|---|
| | t | df | Sig. | t | df | Sig. | t | df | Sig. |
| Flight time (s) | -2.289 | 9 | .048 | -2.896 | 10 | .016 | -.948 | 11 | .363 |
| Jump hight (cm) | -2.268 | 9 | .050 | -2.904 | 10 | .016 | -.985 | 11 | .346 |
| Duration of concentric contraction (s) | -2.145 | 9 | .061 | -.305 | 10 | .766 | 1.665 | 11 | .124 |
| Duration of eccentric contraction duration (s) | .912 | 9 | .386 | 2.888 | 10 | .016 | -.426 | 11 | .679 |
| Maximum force (N/kg) | 1.168 | 9 | .273 | -.183 | 10 | .859 | -.640 | 11 | .535 |
| Maximum power in wat/kg | 1.543 | 9 | .157 | -2.051 | 10 | .067 | -.925 | 11 | .375 |

## DISCUSSION

It is assumed that the results achieved by the A2 League basketball players – that is, without any statistically significant differences – can be attributed to the lower level of competition and reduced systematic monitoring and programming of training. In other words, more attention is paid to satisfaction in the game, where there are no exercises for the development of explosive exercises, which is not the case with basketball players of a higher level of competition.

It is important to mention that the results shown above are largely expected in the basketball game. Due to the large number of jumps represented in the game, the dominant leg is considered to be the leg from which the jump is performed, i.e., the leg opposite to the dominant side of the body. The results indicate that statistically significant differences are in favor of the dominant leg. These results favor the left leg in right-handed players and vice versa. The most evident difference was obtained in the subjects of the A1 League, while the smallest differences were observed in the subjects of the A2 League.

Abrams GD, Harris JD et al. (2014) tried to determine in their research the differences between plyometric training that is done in the frontal and sagittal plane, which can largely be the reason for the results of our research. In the mentioned research, it was concluded that plyometric training in the sagittal plane improves the performance of the vertical jump in the opposite direction more than plyometric training in the frontal plane, while plyometric training in the frontal plane improved the performance of the lateral jump (left) and the lateral shuffle test (left) more from plyometric training in the sagittal plane. The standing long jump, lateral jump (right) and lateral shuffling (right) tests did not show a significant interaction effect. These results suggest that basketball players should include plyometric training in all planes to improve strength and speed of change of direction. Takashi Sugiyama, Masahiro Kageyama et al. (2014) aimed to show their research the asymmetry between the dominant and non-dominant legs in the jump in terms of the behavior of the lower extremities during running and single jumps. They came to the result, as we did in our research, that the height of the jump was significantly higher with the dominant leg. During the take-off phase, ankle and knee joint angles were significantly greater in the dominant leg. In addition, the contact time for the dominant leg was significantly shorter. Such results indicate that jump height asymmetry can be attributed to ankle joint kinematics during the take-off phase, which may be related to the ability to efficiently transfer take-off speed for the high jump. Work that deserves attention in this topic is Wang L.I. (2011) whose aim was to examine the kinematics in the ankle and knee joints and their risk for anterior cruciate ligament injuries that occur during jumping and landing. Higher maximum posterior and vertical ground reaction forces, and maximum anterior and lateral forces of the proximal tibia were observed during the landing phase of the one-legged jump. These results indicate that single-leg landings may have a higher risk of ACL injury than double-leg landings in jumping tasks that may be influenced by lower limb kinematics during the landing phase.

Basketball is eye-catching because of the speed of the game, acrobatic moves, tactical elements, and the possibility to score spectacular points. Basketball is a dynamic sport that involves different movements to achieve success on the court such as: running, dribbling, shooting, blocking, jumping, passing, defensive moves, and blocks. These movements make basketball a dynamic and exciting game that requires good coordination, agility, speed, strength, and tactical thinking. Wen, Dalbo et al. (2018) state in their research that many of the basic movements performed during basketball are based on basic strength-related attributes, including speed, change of direction, and jump. It was also pointed out that possible tests of basketball players should be based more on the specificity of movement appropriate for basketball players, which gives importance to the tests that were used for the purpose of this research. It is important to note that basketball training is adapted to different age groups, experience levels, and goals of the player or team. Professional players and teams often conduct an intensive and comprehensive training program, while amateur players and recreational teams may have less intensive training focused on improving basic skills and enjoying the game.

The non-dominant leg is the one that the player uses less often to make accurate shots or dribbles. In basketball, it is also important to develop and use the non-dominant leg to improve balance, agility, and flexibility, which can help the player in different situations on the court.

Here are some reasons why it is important to develop and use the non-dominant leg in basketball:

Better balance: Developing a non-dominant leg improves a player's balance and allows him to be more stable when dribbling, shooting or changing direction.

Less predictability: If a player is too dependent on one leg, he becomes predictable for the opposing player's defense. Using both legs makes it difficult for the defense to predict which leg the player will use to drop off or finish the action.

Flexibility: The development of a non-dominant leg allows the player more opportunities to pass and perform various moves.

Reduction of injuries: Equal use of both legs helps to reduce the asymmetry of the body and the risk of injuries caused by excessive load on one leg.

## Conclusion

The research was conducted with the aim of determining the differences in force exertion on the surface between the dominant and non-dominant legs of basketball players at different levels of competition.

A slightly disrupted distribution was observed in the variable of the duration of concentric contraction of the right leg among all participants. Based on the results of central dispersion parameters and T-test results, which indicated a difference in the force load on the dominant and non-dominant leg surfaces, it can be concluded that 30-50% of the variable has a statistically significant difference, partially suggesting the existence of statistically significant differences in force manifestation in the dominant and non-dominant leg.

The largest difference between the dominant and non-dominant leg was found in the participants of the A1 league (3 out of 6 used variables). Differences were observed in the variables of flight time, jump height, and eccentric contraction duration. In Premier league subjects, a difference was found in 2 out of 6 used variables (flight time and jump height).

Coaches often work with players to develop and improve skills on both legs to make players more complete and versatile. Regular practice with both legs, both in-game and in training, will help players become balanced and efficient in all aspects of the game. From the obtained results, it will be possible to construct batteries of tests that will provide quality information necessary for planning and programming basketball training.

## References:

Abrams, G. D., Harris, J. D., Gupta, A. K., McCormick, F. M., Bush-Joseph, C. A., Verma, N. N., ... & Bach Jr, B. R. (2014). Functional performance testing after anterior cruciate ligament reconstruction: a systematic review. *Orthopaedic journal of sports medicine*, *2*(1), 2325967113518305.

Bjelica, D., & Fratrić, F. (2011). Sportski trening: teorija, metodika i dijagnostika. Nikšić: *Faculty for Sports and Physical Education.* [in Serbian]

Erčulj, F., & Supej, M. (2006). The impact of fatigue on jump shot height and accuracy over a longer shooting distance in basketball. *Baltic Journal of Sport and Health Sciences*, *4*(63).

Jazvin, A., Palić, A., Ademović, A., & Skender, N. (2021). Correlation between sprint, agility, and vertical jump of elite soccer players. *Ovidius University Annals, Series Physical Education and Sport/Science, Movement and Health*, *21*(2 SI), 229-234.

Karalić, T., Skender, N., & Jelćić, M. (2022). Influence of body parameters on the performance of specific motor tests in volleyball. *Homosporticus, 24*(1), 25-30.

Krause, J., Meyer, D., & Meyer, J. (2008). *Basketball Skills and Drills*. Human Kinetics.

Okazaki, V. H. A., & Rodacki, A. L. F. (2000). Increased distance of shooting on basketball jump shot. *Journal of Sports Science and Medicine*, 11, 231-237.

Rojas, F., Cepero, M., Ona, A., & Gutierrez, M. (2000). Kinematic adjustments in the basketball jump shot against an opponent. *Ergonomics, 43*(10), 1651-1660.

Semenick, D. (1985). Bioenergetics. *NSCA Journal,* 45, 72-73.

Skender, N. (2004). Transformacioni procesi motoričkih sposobnosti i morfoloških karakteristika pod uticajem sedmomjesečnog programa kod učenika III i IV razreda osnovne škole. *Nepublikovana doktorska disertacija, Fakultet sporta i tjelesnog odgoja Univerzitet u Sarajevu,* Sarajevo. [in Serbian]

Skender, N. (2008). Transformacioni procesi antropoloških obilježja. *Bihać: Pedagoški fakultet Univerziteta u Bihaću.* [in Serbian]

Šekeljić, G., & Stamatović, M. (2008). Hipotetski petodimenzionalni prostor bazičnih faktora ekstrahovan faktorskom analizom iz skupa morfoloških karakteristika, motoričkih sposobnosti i manifestnih košarkaških varijabli. *Sport Mont, 6*(15-16-17), 690-697. [in Serbian]

Sugiyama, T., Kageyama, M., et al. (2014). Asymmetry between the Dominant and Non-Dominant Legs in the Kinematics of the Lower Extremities during a Running Single Leg Jump in Collegiate Basketball Players. *Journal of Sports Science and Medicine, 13*(4), 951-957.

Wang, L., Gu, C., Chen, W., & Chang, M. (2010). Potential for non-contact ACL injury between step-close-jump and hop-jump tasks. *Journal of Sports Science and Medicine, 9*, 134-139.

Wen, Dalbo et al. (2018). Acute caffeine supplementation promotes small to moderate improvements in performance tests indicative of in-game success in professional female basketball players. *Applied Physiology, Nutrition and Metabolism*, 44(11). DOI: 10.1139/apnm-2018-0671.

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