

ORIGINAL SCIENTIFIC PAPER

Asymmetry in Ball Kicking Speed between Preferred and Non-preferred Leg in Young Soccer Players

Ante Rađa¹, Jakov Marasović¹, Marko Erceg¹

¹University of Split, Faculty of Kinesiology, Split, Croatia

Abstract

Kicking ability is one of the most important skills in soccer. It is very important to have a good kicking ability with both feet. The main goal of this research was to determine a ball kicking asymmetry (KA) between preferred and non-preferred leg in young soccer players for the U-15 and the U-17 age category. The second goal was to determine differences in kicking asymmetry (KA) between players of different playing positions. 183 young players in U-15 category as well as 87 players from U-17 age category were tested with simple soccer specific test to evaluate kicking velocity (km/h) with preferred and non-preferred leg using Pocket radar. Testing took place on the artificial grass during dry and warm weather and ball was kicked while stationary at the 11-m spot. Results obtained with Student's T-test showed that differences in the maximum kicking velocity with the preferred and non-preferred leg were statistically significant ($p \leq 0.05$) in both age groups (90.2 ± 8.8 km/h / 78.5 ± 9.8 km/h for U-15) and (102.7 ± 6.4 km/h / 89.5 ± 9.4 km/h for U-17) which confirmed KA is present. Additionally, univariate analysis of variance (ANOVA) showed that there were significant differences in KA between different playing positions in U-17 group (KA=14.57/9.72/14.1 for defenders, midfielders and attackers, respectively). Soccer kicking can be a quality indicator for assessing the soccer kicking ability. By assessing kicking ability, relevant results can be obtained in a fast, and efficient way and can be utilized in the selection process of young talents.

Keywords: kicking asymmetry, instep kick, soccer, youth players, playing positions

Introduction

Football is one of the most popular sports in the world, played by more than 200 million people, including professionals and amateurs (Dvorak et al., 2000). It is a sport that is both extremely energetically and physically demanding due to various accelerations, decelerations, sliding on the ball and hitting (Reilly et al., 2000; Marques et al., 2011). In order to win games, the objective of football is to score as many goals as possible. Number of shots on goal is previously highlighted as a predictor for winning (Lago-Peñas & Lago-Ballesteros, 2011; Bjelica, Popović, & Petković, 2013). Ball kicking is one of the most important skills in football (Bačvarević et al., 2012). There are a few basic types of shot but instep kick is the

fastest kick in football and is often used as the main tool for scoring goals (Nunome et al., 2002; Arpinar-Avsar & Soyulu, 2010; Sterzing et al., 2009). Faster kicks have higher chance to be successful (Dorge et al., 2002; Marković, Dizdar, & Jarić, 2006; Sinclair et al., 2014). Measuring the speed of the kick is a simple, fast and affordable way to assess the quality of a soccer kick, which is desirable for the sport. Today, football is played faster than ever and there is no time to adjust on better leg, therefore players should have both legs equally developed. Many coaches believe that it is desirable for players to be able to use either foot equally well and that excessive one-sidedness would be a disadvantage. Some studies suggest that it could be advantageous for players to possess a good technique and abil-



Correspondence:

Ante Rađa
University of Split, Faculty of Kinesiology, Teslina 6, Split, Croatia
E-mail: ante.rada@kifst.eu

ity to kick the ball equally with both feet (McLean & Tumilty, 1993; Grouios et al., 2002; Nunome et al., 2006; Bjelica, Popović, & Petković, 2013). Asymmetry in ball kicking speed (KA-kicking asymmetry) should be as low as possible to have as much chance for success as possible. Therefore, maximal kicking velocity with both the preferred and non-preferred leg must be an important objective for soccer coaches (Sterzing et al., 2009). Some authors (Rodríguez-Lorenzo et al., 2016) suggest kicking deficit as the percentage of the difference between the maximum ball velocity each player achieves by the non-preferred leg kick in relation to the preferred leg kick. Due to its popularity and extreme competition, it is of great interest for clubs and coaches to assess as much attributes from young players as possible. That way, training program and selection process of players are more complete and there is less chance to make mistakes. Several studies examined ball velocity with preferred and non-preferred leg (Bjelica, Popović, & Petković, 2013; Rađa, Erceg, & Grgantov, 2016; Maly et al., 2018). Rodríguez-Lorenzo et al. (2016) did research paper with age groups (G-14) and (G+14) regarding kicking deficit (KD) between preferred and non-preferred leg which was first such finding. Findings about kicking asymmetry of young soccer players of different age groups such as pioneers (U-15) and cadets (U-17) are scarce. To the best of authors' knowledge, there is limited or none scientific information regarding positional differences in KA between defenders, midfielders and attackers. Therefore, the main goal of this research was to determine if there is a kicking asymmetry (KA) in the kick speed of U-15 and U-17 young football players. Additionally, differences in kicking asymmetry (KA) between different playing positions were evaluated.

Methods

Participants

Two hundred and sixty male participants that play in Croatian youth soccer leagues were recruited for participation in the present investigation. Written consent for participation in this study was obtained from the subjects' parents/guardians after being thoroughly informed about the purpose, benefits, and the potential risks of this study. Consent forms were specifically approved by the "The Ethical Committee of the Faculty of Kinesiology" approval number: 2181-205-02-05-23-018 (Split, Croatia). This committee approved the entire study design, which was conducted according to the ethical standards of the 1964 Helsinki Declaration and its subsequent amendments. Inclusion criteria to participate in the study were: i) participation in at least 85% of the training sessions, ii) regularly participating in the previous competitive seasons, iii) having a valid sport medical certification, and iv) being healthy (no pain or injury) and clear of any drug consumption. All players had Croatian Soccer Federation identity card signed and were fully healthy and medically examined by a local sport specialist doctor. Participants refrained from drinking caffeine-containing beverages for 24 hours and did not eat for 2 hours prior to testing in order to reduce any possible interference with the experiment.

Design and procedures

This study is a cross-sectional investigation with two main objectives: to determine ball kicking asymmetry with dominant and non-dominant leg, and to determine kicking asymmetry between players of different playing posi-

tions. Participants were divided according to different age groups (U-15, U-17). Effective playing time was not taken into consideration. The current research took place in June at the end of competition season 2016/2017. Each participant completed all trials in the same time period of the testing day and under the same climate conditions (4–7 p.m., 25.6±0.8°C temperature, and 36.3±2.5% relative humidity). Participants were asked to avoid any stressful activity during testing or between training sessions.

Measurements

Asymmetry coefficient was calculated with formula (Rodríguez-Lorenzo et al., 2016):

$$KA = \left(\frac{KV_{domMax} - KV_{nodomMax}}{KV_{domMax}} \right) * 100$$

KV_{domMax} refers to kicking velocity with dominant (preferred) leg (IKPL), while KV_{nodomMax} refers to kicking velocity with nondominant (non-preferred) leg (IKNL). Anthropometric data were measured with a portable stadiometer (SECA, Leicester, UK; for height) and an electronic scale (HD-351, Tanita, Arlington Heights, USA; for body mass). Testing protocol included a standard warm-up of 45 minutes (with 50% of theoretical maximal heart rate [220-age in yrs] as target value). Warm-up included sequences of 10 minutes of jogging with and without the ball as well as 10 minutes of dynamic stretching with a strong focus on leg and abdominal muscles. During the last 15 minutes, approaching testing and for familiarization purpose, participants were passing and shooting with the instep kick using dominant and non-dominant leg, alternatively. Players slowly increased their kicking speed as warm-up progressed as well as kicking distance. Testing took place on the artificial grass during dry and warm weather and ball was placed on the 11-m spot. Participants were wearing their own soccer shoes and the balls used were Jabulani football (Adidas, Germany; 69.0±0.2 cm in circumference and 440±0.2 g in mass). Participants shot the ball three times with instep kick using dominant and non-dominant leg, alternatively, which makes a total of 6 shots. Fastest kick per each type/leg was considered for further analysis. Players were instructed to shoot the ball from 11m as fast as they could and straight to the center of the goal. After each player would shoot, he was instructed to go to the end of the line to avoid any potential influence of fatigue. That way, every player had at least 3 minutes of rest between repeated shots. During the tests, a sport scientist was involved to provide better control and manage tasks. He had to give instruction: "Ready-Set-Go", so at "Go" the player started the running kick, while another sport scientist took the measures with a pocket radar (Pocket Radar, Inc. Santa Rosa, California), with ±2 km/h accuracy, 1m behind the goal at ball height during the kick.

Statistical analysis

Basic descriptive statistics were calculated and namely as means or average score (AS), standard deviation (SD), range–minimum and maximum results (Min., Max.) for the anthropometric status of the participants. Systematic bias of kicking performance variables was determined by using 1-way analysis of variance (ANOVA) for repeated measures, with Fischer LSD post-hoc test for eventual significant comparisons. The kicking asymmetry (KA) was calculated and conclusions were drawn about differences between players

of different playing positions. To evaluate the magnitude of differences, the partial eta squared (η^2) effect size was calculated. Threshold values to interpret the effect size were >0.01 (small effect), 0.06 to 0.13 (medium effect), >0.14 (large effect). Figures with a P-value of less than 0.05 were regarded as statistically significant. All statistical analyses were carried out using the commercial Statistica software version 13.0 (Dell Inc., Round Rock, TX USA).

Results

The current study included 260 young football players, 173 of which were U-15 players and 87 of which were U-17 players. Anthropometric data are presented in Table 1. Body height and weight for U-15 group was 167.22 ± 9.80 cm and 54.24 ± 10.42 kg respectively. Body height and weight for U-17 group was 177.32 ± 6.63 cm 67.22 ± 7.81 kg respectively. Body mass index for U-15 category was 19.21 ± 2.05

Table 1. Basic anthropometry of participants

	U-15 (N=173)		U-17 (N=87)	
	MEAN \pm SD	Range	MEAN \pm SD	Range
BH	167.22 \pm 9.80	145.05-194.30	177.32 \pm 6.63	155.60-195.50
BM	54.24 \pm 10.42	30.80-82.60	67.22 \pm 7.81	37.20-83.70
BMI	19.21 \pm 2.05	13.90-25.70	21.34 \pm 1.88	15.36-26.37
TA	6.53 \pm 1.74	1.00-9.00	8.66 \pm 1.42	2.00-11.00

Legend: BH-body height, BM-body mass, BMI-body mass index, TA-training age, MEAN-arithmetic mean, SD- standard deviation, Range- minimum and maximum results.

Table 2. T-test, differences ball speed with preferred and non-preferred leg

		MEAN \pm SD	t	df	p
U-15	IKPL (km/h)	90.2 \pm 8.8	22.96	172	0.00
	IKNL (km/h)	78.5 \pm 9.8			
U-17	IKPL (km/h)	102.7 \pm 6.4	14.97	86	0.00
	IKNL (km/h)	89.5 \pm 9.4			

Legend: IKPL-instep kick preferred leg, IKNL- instep kick non-preferred leg, MEAN- arithmetic mean, SD- standard deviation, t- t value, df- degree of freedom, p- p value.

and 21.34 ± 1.88 for U-17 age group. Training age for U-15 participants was 6.53 ± 1.74 age and 8.66 ± 1.42 age for U-17 participants.

Results obtained with Student's T-test (table 2) showed that differences in the maximum kicking velocity with the preferred and non-preferred leg were statistically significant ($p \leq 0.05$) in both age groups (90.2 ± 8.8 km/h / 78.5 ± 9.8 km/h for U-15) and (102.7 ± 6.4 km/h / 89.5 ± 9.4 km/h for U-17) which confirmed

kicking asymmetry (KA) was present. Furthermore, univariate analysis of variance ANOVA was used (presented in table 3 and table 4). With $p=0.023$ and $\eta^2=0.086$ for U-17 age group ANOVA showed that there were statistically significant differences and medium effect size in KA between different playing positions ($KA=14.57/9.72/14.1$ for defenders, midfielders and attackers, respectively). There were no significant differences in KA between playing positions for U-15 age group. Range of results for

Table 3. Kicking asymmetry (KA), ANOVA - differences between playing positions

	KA MEAN \pm SD	Range	CI	F	p	η^2
U-15	12.94 \pm 7.46	1.02-43.24	6.75-8.34	0.145	0.865	0.002
U-17	12.79 \pm 7.68	0.94-47.37	6.68-9.03	3.930	0.023	0.086

Legend: KA - kicking asymmetry, MEAN- arithmetic mean, SD- standard deviation, Range - minimum and maximum results, CI - confidence intervals, F- F value, p- value, η^2 - partial eta squared.

Table 4. Fischer LSD post hoc, differences between positions for U-17 players

	(d) KA=14.57	(m) KA=9.72	(a) KA=14.10
(d)		0.01	0.82
(m)	0.01		0.04
(a)	0.82	0.04	

Legend: d-defenders, m-midfielders, a-attackers, KA - kicking asymmetry.

KA ($1.02-43.24/0.94-47.37$ for U-15 and U-17 respectively) suggest quite a diverse ability to kick the ball with both feet.

Using Post-Hoc (presented in table 4 and figure 1), statistically significant differences were found between midfielders and defenders ($p=0.01$) and between midfielders

and attackers ($p=0.04$). There were no statistically significant differences between attackers and defenders ($p=0.82$). Within figure 1 it is visible that KA averages (in km/h) of midfielders are significantly lower than the ones from attackers and defenders.

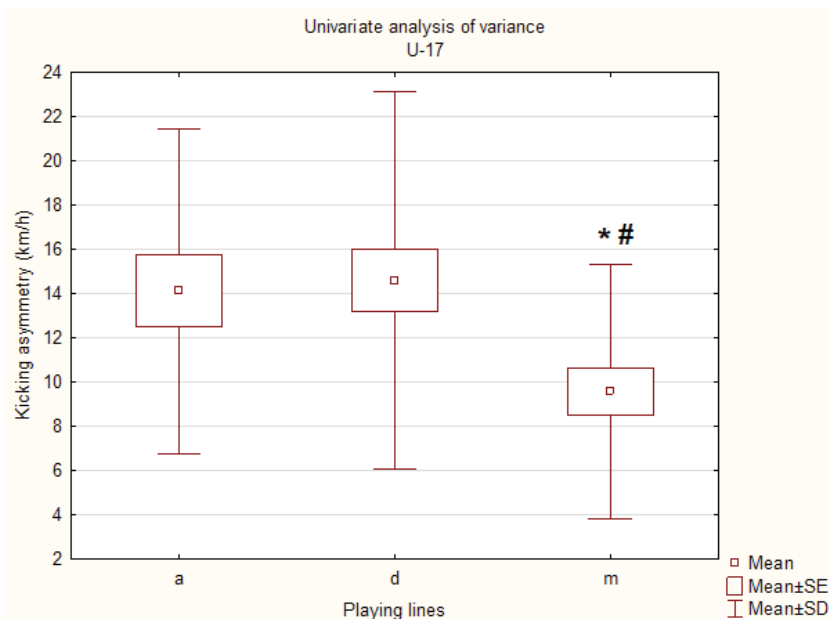


FIGURE 1. Differences between playing positions (U-17)

* significant differences from attackers; # significant differences from defenders

Discussion

Results showed that there were statistically significant differences in maximum kicking velocity with the preferred and non-preferred leg for both groups which confirmed KA is present. Also, there were statistically significant differences between different playing positions for U-17 age group, but there were no significant differences in KA between playing positions for U-15 group.

It is important to note, that to the best of our knowledge, there were very few scientific papers regarding asymmetry in ball velocities with preferred and non-preferred leg in soccer, especially for young players. Previous studies focused primarily on preferred / non-preferred leg asymmetries regarding strength and flexibility. However, we believe that implementation of simple soccer specific tests such as the one done in this research could improve knowledge regarding the mentioned problem. In this research, significant differences in ball velocities between preferred and non-preferred leg were obtained which confirmed KA. These findings correlate with some previous studies (Nunome et al., 2006; Rodríguez-Lorenzo et al., 2016). KA results from this study 12.94 ± 7.46 group for U-15 and 12.79 ± 7.68 for U-17 group are lower values than the ones found in Rodríguez-Lorenzo et al. (2016) for elite youth level players from Spain ($15.31 \pm 7.32 / 15.83 \pm 7.88$ for group -14 and group +14, respectively). Interestingly, Oliveira, Barbieri and Gonçalves (2013) found differences in kick distance between dominant and non-dominant leg for senior soccer players and for active men. This could suggest differences in ball speed when kicking the ball with preferred and non-preferred leg. Also, in this research statistically significant differences in KA between different playing positions for U-17 players were found. As mentioned previously, differences in kicking asymmetry between positions is a topic yet to be fully explored scientifically. However, several studies tested the differences between playing positions in ball velocities (Rađa, Erceg, & Grgantov 2016; Arafat, Rickta, & Mukta 2020). Rađa, Erceg and Grgantov (2016) found differences in ball speed with in-step kick and with side foot kick with both feet for different playing positions. Defenders performed significantly worse

than midfielders with preferred and with non-preferred leg, however, KA was not calculated. In research done by Arafat, Rickta and Mukta (2020) there were no significant differences in kicking velocities between defenders, midfielders and attackers for senior players ($82.14 / 79.77 / 79$ km/h, respectively).

As presented in table 3, there were no statistically significant differences in KA between different playing positions for U-15 age group. Possible reasons for these findings could be that there is much less player specialization at that age and each player probably plays more than one position. That way, it is possible that there are still a lot of players that will change position or have some other roles in the team as time passes by. On the other hand, U-17 players are closer to professional status and probably already solely play at their natural or best positions. Midfielders had the smallest asymmetry in ball speed between legs (KA=9.72) in U-17 age group. That was somewhat expected because of the game role and assignments they do during the game. Also, selection of players is such that one of the most desired abilities for midfielders is actually ball kicking ability with both feet. Either while passing the ball or trying to score the goal, midfielders are often in the different areas of the pitch and need to possess good kicking ability with both feet. On the other hand, defenders and attackers had similar kicking asymmetry results (KA=14.57/14.1, respectively). This type of results suggests that attackers and defenders have much more one footedness than midfielders. Whether it is because of the selection process or because of the game situations they often perform during the match, it seems that attackers and defenders have less adaptation of ball kicking with non-preferred leg than midfielders. Kicking asymmetry is one of the relatively unexplored and a new possible way of looking at kicking ability which could further enhance our understanding of soccer. This study, as presented offers another way of assessing players' skill and potential talent in youth soccer. Unfortunately, this study had a few limitations. Players were divided in only three playing positions (defenders, midfielders and attackers) without goalkeepers, whereas it would be better in future research to divide them with even more specific classification with full backs and wingers. Future research should also include young-

er players in youth academies as well as senior players in order to make conclusions regarding KA throughout players soccer development and career. That way, scientists could detect certain occurrences of KA in different age groups and soccer coaches would be able to make appropriate changes in training routines regarding scientific guidelines.

Conclusion

Kicking asymmetry (KA) between preferred and non-preferred leg using soccer instep kick is evident and seems to re-

Acknowledgements

There are no acknowledgements.

Conflict of Interest

The authors declare that there is no conflict of interest.

Received: 05 September 2023 | **Accepted:** 27 September 2023 | **Published:** 01 October 2023

References

- Arafat, M. Y., Rickta, J. F., & Mukta, F. T. J. (2020). Analysis of ball velocity for different groups of positional soccer players. *International Journal of Physical Education Sports Management and Yogic Sciences*, 10(4), 19-24.
- Arpinar-Avsar, P., & Soyulu, A. R. (2010). Consistency in acceleration patterns of football players with different skill levels. *Journal of Sports Science & Medicine*, 9(3), 382.
- Bacvarevic, B. B., Pazin, N., Bozic, P. R., Mirkov, D., Kukolj, M., & Jaric, S. (2012). Evaluation of a composite test of kicking performance. *The Journal of Strength & Conditioning Research*, 26(7), 1945-1952.
- Bjelica, D., Popovic, S., & Petkovic, J. (2013). Comparison of instep kicking between preferred and non-preferred leg in young football players. *Montenegrin Journal of Sports Science and Medicine*, 2(1), 5-10.
- Dörge, H. C., Andersen, T. B., Sørensen, H., & Simonsen, E. B. (2002). Biomechanical differences in soccer kicking with the preferred and the non-preferred leg. *Journal of Sports Sciences*, 20(4), 293-299.
- Dvorak, J., Graf-Baumann, T., Peterson, L., & Junge, A. (2000). Football, or soccer, as it is called in North America, is the most popular sport worldwide. *American Journal of Sports Medicine*, 28(5 Suppl), S1-2.
- Grouios, G., Kollias, N., & Tsoarbatzoudis, H. (2002). Footedness among professional. *Journal of Human Movement Studies*, 42, 019-029.
- Lago-Peñas, C., Lago-Ballesteros, J., Dellal, A., & Gómez, M. (2010). Game-related statistics that discriminated winning, drawing and losing teams from the Spanish soccer league. *Journal of Sports Science and Medicine*, 9(2), 288-293.
- Maly, T., Sugimoto, D., Izovska, J., Zahalka, F., & Mala, L. (2018). Effect of muscular strength, asymmetries and fatigue on kicking performance in soccer players. *International Journal of Sports Medicine*, 39(04), 297-303.
- Markovic, G., Dizdar, D., & Jaric, S. (2006). Evaluation of tests of maximum kicking performance. *Journal of Sports Medicine and Physical Fitness*, 46(2), 215-220.
- Marques, M. C., Pereira, F., Marinho, D. A., Reis, M., Cretu, M., & Van Den Tillaar, R. (2011). A comparison of ball velocity in different kicking positions with dominant and non-dominant leg in junior soccer players. *Journal of Physical Education & Sport/Citius Altius Fortius*, 11(2), 49-56.
- McLean, B. D., & Tumlilty, D. M. (1993). Left-right asymmetry in two types of soccer kick. *British Journal of Sports Medicine*, 27(4), 260-262.
- Nunome, H., Asai, T., Ikegami, Y., & Sakurai, S. (2002). Three-dimensional kinetic analysis of side-foot and instep soccer kicks. *Medicine and Science in Sports and Exercise*, 34(12), 2028-2036.
- Nunome, H., Ikegami, Y., Kozakai, R., Apriantono, T., & Sano, S. (2006). Segmental dynamics of soccer instep kicking with the preferred and non-preferred leg. *Journal of Sports Sciences*, 24(05), 529-541.
- Oliveira, A. S. C., Barbieri, F. A., & Gonçalves, M. (2013). Flexibility, torque and kick performance in soccer: Effect of dominance. *Science & Sports*, 28(3), e67-e70.
- Rada, A., Erceg, M., & Grgantov, Z. (2016). Inter and intra positional differences in ball kicking between U-16 Croatian soccer players. *Montenegrin Journal of Sports Science and Medicine*, 5(2), 11-15.
- Reilly, T., Williams, A.M., Nevill, A., Franks, A., (2000). A multidisciplinary approach to talent identification in soccer. *Journal of Sports Sciences*, 18, 695-702.
- Rodríguez-Lorenzo, L., Fernández-Del Olmo, M., Sánchez-Molina, J. A., & Martín-Acero, R. (2016). Kicking ability and kicking deficit in young elite soccer players. *Kinesiology*, 50(2), 194-203.
- Sinclair, J., Fewtrell, D., Taylor, P. J., Atkins, S., Bottoms, L., & Hobbs, S. J. (2014). Three-dimensional kinematic differences between the preferred and non-preferred limbs during maximal instep soccer kicking. *Journal of Sports Sciences*, 32(20), 1914-1923.
- Sterzing, T., Lange, J. S., Wächtler, T., Müller, C., & Milani, T. L. (2009). Velocity and accuracy as performance criteria for three different soccer kicking techniques. In *ISBS-Conference Proceedings Archive*.

main similar in different age groups (U-15 and U-17). These results suggest that KA is possibly present during whole soccer development. Midfielders demonstrated a higher level of bilateral kicking ability when compared to other playing positions in older group of respondents (U-17), which suggests a certain level of positional specialization. Soccer kicking can be a quality indicator for assessing the soccer kicking ability. By assessing kicking ability with both feet and subsequently KA, relevant results can be obtained in a fast, and efficient way and can be utilized in the selection process of young talents.