Original Article

Concurrent validity of the athla velocity application for measuring tennis service ball velocity

BARIŞCAN ÖZTÜRK[1] ✉ , BILGIHAN BÜYÜKTAŞ[1], İBRAHIM BAHÇIVAN[1], MURAT BALIKÇI[2], LEVENT SANGÜN[3]

[1]Faculty of Sport Sciences. Cukurova University. Turkey.
[2]Faculty of Sport Sciences. Marmara University. Turkey.
[3]Vocational High School. Cukurova University. Turkey.

ABSTRACT

Aim: To analyse the validity of the mobile application (Athla Velocity) used to measure ball speed. Method: A total of 67 volunteer male tennis players with a mean age of 24.94 ± 4.91 years participated in the study. In all measurements, the successful 10 service strike velocity made by the athletes in the determined area were evaluated. Each service strike was measured concurrently using both the Stalker Solo 2 radar device and the Athla Velocity application. Bland-Altman and regression analyses were used to determine the validity. Results: A high positive correlation was found between the radar device and Athla Velocity Application measurements (ICC = 0.970, r^2 = .989). In addition, according to the Bland-Altman analysis, the measurement results of the two methods were found to be within the calculated limited area to a large extent. Conclusion: It has been determined that the Athla Velocity application can measure 98% close to the Stalker Pro 2 device in ball velocity measurement. As a result, it can be said that the Athla Velocity application can be used validly in ball velocity measurements.

Keywords: Performance analysis of sport, Tennis, Ball velocity, Gun radar, Athla Velocity App.

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✉ **Corresponding author.** *Faculty of Sport Sciences. Cukurova University. Adana, Turkey.* https://orcid.org/0000-0001-7001-3032
E-mail: bariscan.ozturk.bc@gmail.com
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INTRODUCTION

Ball velocity has been proven to be a predictive variable of performance in many sports such as tennis, football, and handball (Slowik et al., 2019; Granados et al., 2007; Whiteside and Reid, 2017; Rada et al., 2019). Considering the effect in many sports branches, there are few branches where the ball velocity directly affects the performance in the field. One of them is tennis. In elite tennis competitions, it is stated that the hitting velocity of the athlete, as well as the quality of the shot, significantly affect the number gain (Carlton, Chow, & Shim, 2006; Elliott, Reid, & Crespo, 2009). For this reason, successful performance in tennis is achieved by hitting the targets set from different angles quickly and accurately.

There are many methods used to evaluate ball velocity. Among these, video systems (Hawk-Eye), motion analysis systems, inertial sensors and various radar devices used in international matches are widely used today (Mecheri et al., 2016; Lin, Wu & Huang, 2011; Middleton et al., 2016; McGinnis and Perkins, 2012; Okholm Kryger et al., 2019; Brechbuhl et al., 2018; Delgado García et al., 2019; González-González et al., 2018). However, these devices are quite expensive, heavy and difficult to transport, which is a major disadvantage. Therefore, they are largely found in University laboratories or professional sports clubs.

Today, technological developments in phone applications have increased the usability of smartphones in the evaluation of many sportive performances (Balsalobre et al., 2015; Romero et al., 2017; Balsalobre, Agopian, & Morin, 2017; Hayne et al., 2019; Sanchez et al., 2019). Until recent years, although many performance parameters were evaluated using phone applications, there were no applications that could measure ball velocity.

Apple company has developed a new application that gives cheap, portable and accurate results in determining ball velocity. This application has the potential to directly measure ball velocity in various branches by using the high-velocity camera feature of iPhone devices. However, when the literature was examined, the research that determined that this application could measure the ball velocity accurately could not be reached. Based on this, in our study, it is aimed to reveal the usability of the iPhone application (Athla Velocity) as an alternative to the devices commonly used to measure ball velocity.

MATERIALS AND METHODS

Participants

A total of 67 volunteer male tennis players with 3.74 ± 2.73 years of sports history in the branch playing Tennis in Adana, with a mean age of 24.94 ± 4.91 years, participated in the study. Athletes were informed about the study protocol, and those who accepted signed a consent form stating the purpose and methods of the study.

Procedures

To determine the validity of the Athla Application, the Stalker Solo 2 radar device with a sampling frequency of 33 Hz was used as a reference criterion in concurrent measurements (Beato et al., 2018; Nagahara et al., 2017; Rampinini et al., 2015). The measurement accuracy of the device is ± 0.16 $km \cdot h^{-1}$. The radar device and the phone are placed side by side on tripods at a height of 120 cm from the ground, 5 meters behind the area where the athlete will shoot. In the service area, the athlete tried to serve the target area of 2 meters determined in the opposite field along the radar corridor. All athletes successfully performed 10 strokes, and their stroke velocity were measured concurrent with the radar device and phone application. The balls thrown out of the target were deemed unsuccessful and the athletes served again. In addition, the stroke velocity obtained from both devices after each stroke was instantly reported to the athlete.

Assessments

Stalker Solo 2 Radar

Stalker Solo 2 radar with 33 Hz sampling frequency was used as reference criterion for concurrent validity analysis (Beato et al. 2018; Nagahara et al., 2017; Rampinini et al., 2015). The measurement accuracy of the device is ±0.16 km·h^{-1} (Model ATS, Plano, Texas, USA). The device is placed 5 meters behind the athlete on a tripod at a height of 120 cm from the ground. The peak ball velocity of the athlete's were recorded.

Athla Velocity App

This application, specially developed for the Apple company, determined the ball velocity by using the high-speed camera (240 fps) feature of the phone thanks to the slow motion mode. The application is available in the App Store and is paid. In the ball velocity measurement, concurrent measurement was taken with the Radar device. At the same standards as the radar device, it was positioned 5 meters behind the athlete at a height of 120 cm from the ground, in line with the radar device, and measurements were taken.

Statistical analysis

Statistical analyses were performed using the SPSS 22.0 program. The demographic characteristics of the subjects were analysed with descriptive statistics. Results are given as arithmetic mean ± standard deviation ($\bar{x}$ ± SS). Bland-Altman graph analysis and regression analysis were used to determine the consistency (validity) between the data obtained from the Athla Velocity App and the Stalker Solo 2 radar device. (Bland and Altman, 1986).

RESULTS

Tennis players was found age of 24.94 ± 4.91 years, weight of 72.02 ± 11.76 kg, height of 1.72 ± 0.08 m, sport age of 3.74 ± 2.73 years, and BMI 24.17 ± 4.29 kg/m^2 respectively (Table 1).

Table 1. Demographic characteristics.

	n	$\bar{x}$	SS
Age (year)	67	24.94	4.91
Weight (kg)	67	72.02	11.76
Height (m)	67	1.72	0.08
BMI (kg/m^2)	67	24.17	4.29
Sport Age (years)	67	3.74	2.73

Table 2. Radar vs. Application measurement results.

	$\bar{X}$	Min.	Max.	SS	SEM	ICC	CI %95 Lower	CI %95 Upper
Stalker Solo 2 Radar (km/s)	64.22	40.00	96.00	15.43	1.88	0.97	0.96	0.98
Athla Velocity App. (km/s)	68.56	44.00	99.00	14.96	1.82			

Concurrently evaluated ball velocity were found to be 64.22 ± 15.43 km/h in the Stalker radar device and 68.56 ± 14.96 km/h in the Athla Application (Table 2). It is seen that the mean and standard deviation values of the ball velocity measurements obtained by both methods are very close to each other. In addition, when the concurrent validity analysis results were examined, a high level of correlation (ICC ≥ 0.97) was found between the results of the radar device and the phone application. Bland-Altman analysis was applied to the data and the findings regarding the deviations of the observation values from the mean are shown in Figure 1.

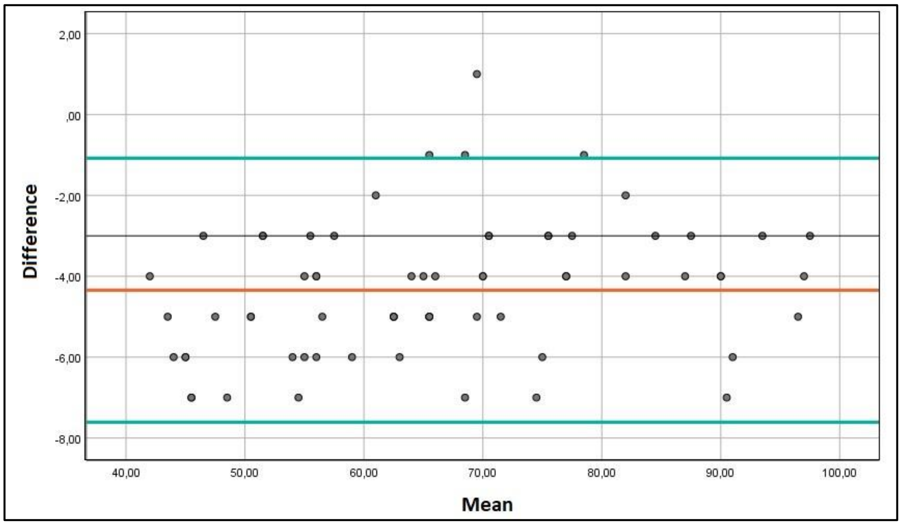

Figure 1. Bland-Altman plot of comparison of Radar and Mobile application results.

In Figure 1, it is seen that the averages of the differences of the ball velocity results obtained according to the two measurement methods are not systematically distributed but show a random distribution. The same is true when the logarithmic transformation is applied to the observation values. According to the Bland-Altman analysis, it can be said that there is a harmony between the two methods and they are alternatives to each other.

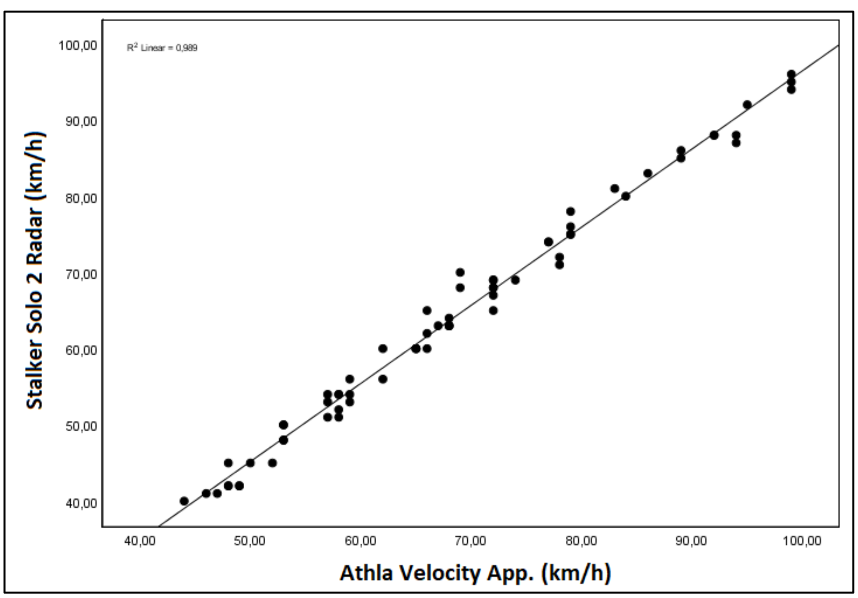

Figure 2. Regression analysis of Radar and Mobile application results.

The fact that 98.90% of the change in any of the radar device and phone application evaluated in the ball velocity measurement can be explained by the other method (r^2) is also an indicator of the harmony between them. Based on the high level (r^2 = .989) result between both measurements, it can be said that the two existing ball velocity measurement methods can be substituted for each other.

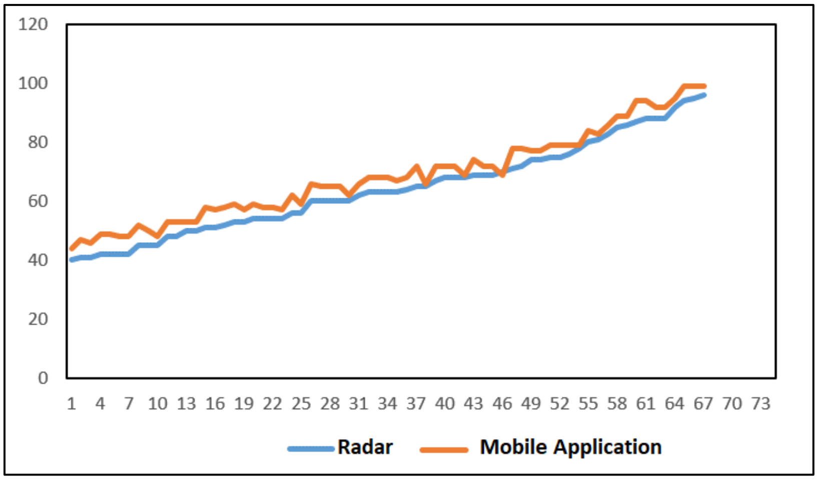

Figure 3. Radar and Mobile application measurement difference comparisons.

DISCUSSION AND CONCLUSION

The aim of this study is to determine the validity of the application called Athla Velocity, which can be used as an alternative to the Radar device used to determine the ball velocity in tennis. Radar device is widely used to measure ball velocity in tennis. However, the study in which phone applications were included in the measurements could not be reached. Therefore, in order to evaluate whether the ball velocity measurements of the application called Athla Velocity are valid or not, the ball velocity in the service strike was determined concurrently with the radar device and a validity study was carried out. The validity and compatibility of the two methods in ball velocity measurements were analysed by Bland-Altman and regression method.

According to the Bland Altman analysis result, it is seen that the difference averages of the ball velocity results obtained from the two measurement methods are not systematically distributed but show a random distribution. The same is true when the logarithmic transformation is applied to the observation values. According to the Bland-Altman analysis result, it can be said that there is a harmony between the two methods and they are alternatives to each other. Concurrently evaluated ball velocity were found to be 64.22 ± 15.43 km/h in the Stalker radar device and 68.56 ± 14.96 km/h in the Athla Application. It is seen that the mean and standard deviation values of the ball velocity measurements obtained by both methods are very close to each other. In addition, when the concurrent validity analysis results were examined, a high level of correlation (ICC ≥ 0.97) was found between the results of the radar device and the phone application (Table 2).

Hernandez and Sanchez (2020) examined the validity of the pocket radar with the Stalker Pro 2 device in their research. Between Stalker Pro 2 and Pocket radar, he found an ICC score of 0.98 and an r^2 value of .984. According to these results, they stated that pocket radar is valid in measuring ball velocity in tennis. Abdioğlu, Akyıldız and Clemente (2022) analysed the validity of Speedtrack X, a new radar device, with Pocket radar. According to the results, they found a high level (r = 0.93) correlation between the measurements of both devices. They also found the ICC score of the study to be 0.96. Campo et al. (2009) examined the validity of the video analysis application with the Stalker Pro device. As a result of this study, they found a high level (r = 0.99) relationship between the Stalker Pro device and the video analysis application. In another study, Cerrato et al. (2007) investigated the slam dunk of volleyball players with radar device and photometric method. In this study, the validity of the photometric method was analysed. As a result, they found a high level (r = 0.98) relationship between the photometric method and the radar device. These findings in the literature support the results of our study. In line with the high level (r^2 = .989) result between radar and mobile application, it can be said that the phone application can be used instead of the radar device.

As a result, it can be said that there is a positive and strong linear relationship between the observation values of the two methods examined and the two methods can be used as alternatives to each other. Sports professionals (Coach, conditioner, etc.) and researchers can obtain valid results by using the practical, accessible and economical application called Athla Velocity to measure ball velocity.

AUTHOR CONTRIBUTIONS

Idea, concept, and design: B. Ö., and B. B. Data collection and/or processing: B. B., B. Ö., İ. B., and M. B. Analysis and interpretation: B. Ö., and L. S. Literature review: B. B., B. Ö., İ. B., and M. B. Writing article: B. Ö., and L. S.

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DISCLOSURE STATEMENT

No potential conflict of interest were reported by the authors.

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