

Reliability in the Ability to Self-regulate Sprint Intensity in Male Professional Soccer Players

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Abstract: According with the purpose of this study, 15 professional male soccer players were recruited, and the sprint Vmax of 30 m were measured in partials of 60%, 70%, 80%, 90%, and 100% intensity, using Global Positioning Systems devices (GPS). The protocol of measurements was 2 days of testing separated by a week. The order was randomized both in the subjects and in the execution intensities. The statistical analysis was performed using Student's T-test for paired data, and a repeated measures ANOVA. Changes in Vmax were observed when it was requested to vary the intensity by 10% ($p < 0.05$). Without precision ($p < 0.05$) in the partials 60%, 70%, and 80%, the speed was higher than requested ($65.66\% \pm 5.64\%$, $74.65\% \pm 5.84\%$, and $86.1\% \pm 4.3\%$ of Vmax), while in the partial 90% ($87.93\% \pm 5.81\%$) the speed was similar to that requested ($p > 0.05$) although slightly lower. In conclusion, professional soccer players are capable of varying speed when a change in intensity is verbally requested, but without precision and exceeding the indicated intensity, except for intensities close to Vmax 90%), which are precise although slightly lower. According with the results of this research, the use of objective feedback methods may be necessary, when planning speed running close to submaximal speed.

Keywords: Sprint, Feedback, Soccer, Rehabilitation, Return to Play

1. Introduction

In recent years, football has evolved with an increase in both physical and technical requirements. Similarly, the profile of professional soccer players has also been modified. Total distance, distance covered at high intensity, number of high intensity actions, number of sprints, and number of successful passes are some of the parameters that have evidenced this change over time [1].

One of the parameters that has had the most relevance is the sprint. Evidence of this is that after conducting a search in the PubMed database on 10/16/2021, when performing a simple search, using only the term "Sprint", we found that since the beginning of the 21st century, they have been published 93 112 studies, of which more than 72% have been published in the last 10 years, and more than 46% in the last 5 years. Therefore, taking into account these data, we can affirm that the interest on the part of the scientific community for the

sprint has increased and with it its relevance.

Despite the fact that sprint speed is a crucial performance factor in football today, and that in training it is used to simulate biomechanical and physiological demands close to those experienced during competition in field and court sports [2-4], there are no training methods that have stood out for being more relevant in terms of improving sprint performance [5, 6]. Some typical load factors in speed training such as exercise type, distance, repetitions, and recovery times have been investigated, but training intensity has not yet been sufficiently studied.

Currently intensity is one of the parameters used to modify the load, and adapt the exercises to the requirements of the athlete in each situation. Workouts and warm-ups are some examples where different levels of running intensity, or percentage of Vmax, are used as one of the most important measurements to monitor [7, 9]. In the case of a recovery period after injury, Vmax becomes even more important, and it must be controlled and progressively increased before

returning to competition [8, 10-13].

Despite the fact that, as we have seen, Vmax is key for controlling intensity in sprinting tasks, and that today there are countless tools for evaluating performance, even in real time [14], these tasks are usually regulated by verbal commands, and there is no study that evaluates the ability of male professional soccer players to regulate this intensity with these types of indications.

The need to find methods that help athletes to perform tasks at a specific intensity is not clear, although it has been shown that this could benefit from feedback techniques, improving acute physical performance, and enhancing jumping adaptations speed and strength [15].

Some studies have investigated the capacity for self-regulation of sprint in athletes of secondary education [4], and in rugby players [8], but if we carry out a search on this type of research in amateur, semi-professional, or professional football, currently there is no type of scientific literature that has conducted studies in this area.

The objectives set out in this study are: To determine the ability of professional soccer players to run accurately at submaximal sprint intensities (60%, 70%, 80%, and 90%) in distances of 30 m, measured by Vmax achieved, under verbal instruction and without any objective feedback and to determine the ability of professional soccer players to vary the sprint speed when different intensities are indicated, through verbal instruction and without any objective feedback.

2. Method

2.1. Study Participants

Participation was proposed to a total of 23 subjects, of whom 15 professional male soccer players were recruited, from the FC Ararat-Armenia team (Yerevan, Armenia), of the first division of Armenia. Both the club managers and the soccer players were informed of the research project orally and in writing, including material and methods, objectives, and purposes of the study.

An oral translation, in real time, from Spanish to English was carried out by the project director, for those subjects who required it in any of the documents.

In those subjects who agreed to take part in the study, compliance with the selection criteria was assessed. Before starting the research project, the subjects filled out and signed the informed consent document, as well as a clinical record sheet.

Subjects with the following characteristics were included in the present study: soccer players; male sex; more than 8 years of sports practice in soccer; over 18 years; and that at the time of the study they participated in professional soccer competitions.

Similarly, those subjects who had some type of musculoskeletal injury at the time of the study, or in the 2 months prior to the start of the study, and who had not signed the informed consent document, were excluded.

Table 1. Descriptive Statistics.

Anthropometric variables	M \pm SD (range)
Age (Years)	25.07 \pm 4.40 (14)
Height (cm)	178.53 \pm 6.50 (20)
Weight (kg)	74.10 \pm 5.91 (21)
BMI (kg/m ²)	23.24 \pm 1.37 (4.43)

M: Average, SD: Standard Deviation, BMI: Body Mass Index.

2.2. Process

Initially, an informative document was provided to all subjects, making an oral translation into English if necessary. After obtaining the informed consent of the subjects, the pre-intervention questionnaires were carried out, consisting of a clinical record sheet providing information on date of birth, height, weight, BMI and injury in the last 60 days.

The measurements were divided into 2 days, separated by 1 week [8], and were recorded in a document for later analysis. The moment in which the measurements were taken was the same on both days, in the morning, with the same clothes and shoes, and under the same procedures. It was carried out during the team's training, in agreement with those responsible for physical preparation and team coaches. The type of terrain chosen was a football field 11 with natural grass, dry, that is, without having previously watered on that day, and outdoors. All measurements were carried out on the same pitch, coinciding with the players' usual training pitch. To avoid data distortion, the sprint direction was carried out perpendicular to the wind direction, avoiding forces for or against this cause.

The order in which the subjects were subjected to the measurements was random, both in the first and in the second measurement using an opaque bag from which papers were taken in which the different names were noted. At the time of the measurement, the usual training conditions were replicated, all the players, coaches and club staff were present as in a regular team training session. The results of the measurements were checked at the end of the training, and the investigator in charge of recording them was blinded with respect to the sprint intensity requested in each measurement. The researcher in charge of recording the measurements was a physical trainer from the club.

The sprint distance was 30 m in a straight line, marked with signs, at the start and at the end. Subjects stood 50 cm behind the starting line [14]. On the first day, the sprint measurement was performed at maximum intensity, 100%, to calculate the submaximal partials; and on the second day the submaximal partials were measured. Each submaximal partial was composed of 1 series of 3 repetitions, with 3 min of active rest between each repetition, composed of simple free exercises, passing and ball handling. The submaximal partials measured were 60%, 70%, 80%, and 90% of the maximum sprint intensity. The order of execution of the submaximal partials was randomized by means of an opaque bag from which papers were taken in which the different intensities were noted. The 3 repetitions of each partial were performed before changing to another submaximal partial. After the execution of the 3 repetitions and the corresponding active rest period,

the objective intensity of the next partial was reported verbally just before the beginning of the same, being the subject only aware of the objective intensity of the partial in which he was. The number of sprints, and therefore of measurements, carried out on the first day was 3 measurements for each subject; and the second day 12 for each subject.

The only information shared with the subjects was that strictly necessary for the correct execution of the test through verbal communication. No objective feedback or additional information was shared with any subject during or after the testing period. Prior to the execution of the test, the standardized FIFA 11+ [16] warm-up program was carried out for all subjects, serving as a warm-up for the training of the team.

Regarding the measurement protocol, marks were made on the ground and vertical signs were placed to indicate the start and end of the sprint, in addition both points were joined by a continuous straight line to indicate the route. For the measurement of the start / end distance of 30 m, a 50 m tape measure was used.

The variable Vmax achieved was measured in the different study evaluations. To measure the results, GPS devices, APEX Athlete Series Pod model (STATSport Group, Newry, Ireland, UK), with a frequency of 10 Hz, a 100 Hz accelerometer, a 100 Hz gyroscope, and a 10 Hz magnetometer were used. After the execution of the test, the data was extracted using the STATSports Apex software program, version 5.0.

3. Results

For statistical analysis, the IBM STATISTICS SPSS version 27 and Microsoft Excel version 2109 programs were used.

For the analysis of normality of the sample, the Shapiro-Wilk test ($n < 30$) was used. Before the beginning of the study there were no significant differences in any of the variables. Therefore, since $p > 0.05$ in most of the study variables, we accept the null hypothesis: most of the study variables have a normal distribution.

The T test showed statistically significant differences

between the initial (Theoretical) and final (Average) means in the variables 60%, 70% and 80%, with the magnitude of the difference being 1.58, 1.52, 0.87 respectively. There are no statistically significant differences in the 90% variable, the magnitude of the difference being 1.40. The sense of the difference indicates that the initial measurement worsened in the final evaluation in all variables except 90%.

A large effect size (ET) (> 0.8) of the difference between initial and final measurement has been found in the partials 60% (2.73), 70% (1.94), 80% (1.41) and with a positive sense, (indicating post speed increases). In the partial 90% (-0.67) the effect size has a medium effect (0.50), in the opposite direction (the post velocity decreases).

Table 2 shows the percentage of Vmax to which the subjects ran when instructed to run at 60, 70, 80, or 90% Vmax respectively; the range in percentages at each speed and the coefficient of variation. The speeds reached when running at 60% ($65.66 \pm 5.64\%$), 70% ($74.65 \pm 5.84\%$), and at 80% ($86.1 \pm 4.3\%$) of Vmax were higher than the requested Vmax, with statistically significant differences ($p < 0.05$). The speed reached when he was told to run at 90% ($87.93 \pm 5.81\%$) was similar ($p > 0.05$) to that requested. The range of speeds reached varied from 18.93% (77.51–58.57%) to 18.34% (86.81–68.47%) in the 60%, 70% and 90% ranges, and was reduced to 9.94% (89.56–79.62%) when it was executed at 80% Vmax. The coefficient of variation decreased from 8.59% to 4.26% from the slowest speed (60%) to the second fastest speed (80%) and increased again by 90% to 6.61%.

According to the Manchley test, the assumption of sphericity is fulfilled ($p = 0.106$ so $p > 0.05$) and the ANOVA can be interpreted. The F of ANOVA would be: $F(3, 42) = 133.551$; $p = 0.000$. According to this data, there are significant differences between the means of the intensities in the four evaluations.

According to tests two to two, the Vmax reached changed in each target speed partial (60%, 70%, 80%, and 90%) with respect to the other partial ($p = 0.00$ in all comparisons, except between 80% and 90%, $p = 0.02$).

Table 2. Percentage velocity reached by submaximal partials.

Speed Target	% Speed	% Min	% Max	% Variation	% Variation Coef
60% Vmax	$65.66 \pm 5.64^*$	77.51	58.57	18.93	8.59
70% Vmax	$74.65 \pm 5.84^*$	86.81	68.47	18.34	7.82
80% Vmax	$83.90 \pm 3.57^*$	89.56	79.62	9.94	4.26
90% Vmax	87.93 ± 5.81	95.93	77.10	18.83	6.61

* Statistically significant differences with the target speeds.

4. Discussion

The present study evaluated the ability of male professional soccer players to run accurately at submaximal sprint intensities, under initial verbal instruction and without any type of feedback.

The results showed that the players were not able to run accurately at the speeds of 60%, 70% and 80%, however, they

did so in the partial 90%. In the first three sets the speed at which the players ran was greater than the requested running at $65.66\% \pm 5.64\%$, $74.65\% \pm 5.84\%$, and $86.1\% \pm 4.3\%$ of Vmax, while in the last set the speed was similar to that requested (without significant differences) but slightly lower $87.93\% \pm 5.81\%$ (Table 2).

On the other hand, the players varied the speed in all the partials with respect to the rest of intensities significantly, therefore, it can be stated that after requesting a modification

of 10% in the intensity of execution, the players are capable of make changes in its intensity of execution with little precision in some sections and with good precision at intensities of 90%.

Throughout this study, measurements have been used without any type of feedback, however, there are similar studies in which real-time feedback methods have been used [5] or in which periods of familiarization with speeds have been proposed. execution [4], and there have been improvements in execution precision.

This study concludes that the speeds reached by the players in the required partials are higher than the demands, except for speeds close to V_{max} . These findings are similar to those found in other studies in which precision improved as speed increased, the most accurate being the fastest [4, 17, 18].

It will be very important to take these findings into account during periods in which it is necessary to carry out a progressive increase of the load, such as warm-ups or recovery periods [10], in addition it will also be relevant for situations in which the accuracy of the intensity is necessary. If the load exceeds the tissue capacity in the area of the injury, or in muscles that have not yet performed a correct activation, the player could be injured [10, 19, 21], or even in fatigue conditions, alterations in the central and peripheral nervous system within skeletal muscles [20, 22-25].

The present study was carried out in professional athletes with a mean age of 25.07 (± 4.39), with a minimum age of 19 and a maximum of 33 years. Most of the current studies with similar investigations were carried out with samples aged less than 18 years. [4, 8]. A recent study observed that athletic performance in the early teenage years is not a good predictor of the performance of older adults in long and high jump, and stated that it is reasonable to assume that similar results would be obtained in sprinting [26, 38-41]. Therefore, studies in ages under 18 years may not be reliable enough to draw conclusions about professional soccer players. [36, 37]

Due to the variability in the characteristics of the sprints in soccer, it would be interesting to evaluate measurements similar to those carried out in this study at distances less than 30 m. For this, other types of GPS devices with greater precision or other types of measurement devices should probably be used, since the validity of current GPS technology in monitoring sprint performance is only satisfactory for distances > 30-40 m and for evaluate top speed in team sports, but its reliability remains questionable, increasing the need for multiple observations. [14]. Although the reliability decreases the greater the intensity of movement [27, 29], the validity increases the longer the distance traveled, reducing the standard error by 67% when the sprint is compared over distances of 40 and 10 m [29]. However, direct comparison of GPS validity in team sports is difficult [27, 28, 30]. Several studies showed that athletes are able to maintain maximum speed for only about 10 - 30 m, depending on the level of performance and the state of training [31, 32], however, in soccer players this could vary and generate distortion with greater ease in the reliability of

measurements depending on the measuring device used. This should be taken into account when choosing the devices and the type of variable to be investigated. The most widely used methods to investigate the validity of a GPS in measuring speed are the use of photoelectric cells at the beginning and end [27, 30, 34] or a speed radar [27, 33, 42]. In the case of the present study, the measurement units used (10 Hz Viper GPS) have been examined and their reliability has been demonstrated.

Limitations of the study and future lines of research

The sample size of this study was only 15 subjects, of the 23 who were proposed to participate, all of them from the same soccer team. It would be interesting to reach a much larger sample size, and multicenter in nature, with players from different teams and competitions, in order to reach a representative sample of the population.

Within the professional soccer calendar there are few weeks in which a study of these characteristics can be carried out without the results being affected by the training load or matches. During the week of investigation there was a match that could generate distortions in the measurements. Because of this, it might be interesting to find periods within a competitive season in which there are no matches, or to wait until the end of the season.

In this research, the aim was to recreate conditions that were most similar to the usual training of the players, before the measurements all the information regarding this study was given, and on the day of execution the players could be influenced by it. It would be interesting to find some formula so that the subjects were blinded when measuring the variables.

The material available for the project was that used by the team itself, so it was limited, since there was no source of external funding. Measurement by other devices, such as photoelectric cells, or radar could be more interesting and accurate.

5. Conclusion

The results showed that the players were not able to run accurately at the speeds of 60%, 70% and 80%, however, they did so in the partial 90%. In the first three sets the speed at which the players ran was greater than the requested running at $65.66\% \pm 5.64\%$, $74.65\% \pm 5.84\%$, and $86.1\% \pm 4.3\%$ of V_{max} , while in the last set the speed was similar to that requested (without significant differences) but slightly lower $87.93\% \pm 5.81\%$. Taking into account the results presented, it can be seen how players may have difficulties in self-adjusting speed intensities at submaximal rates, (not at rates close to maximum), requiring the use of objective technologies, such as GPS devices. However, the advantages offered by this study and its conclusions are being able to subjectively use the control of the intensity of sprint efforts in situations where this type of training is present, such as speed training or in rehabilitation processes of injured players.

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