EVALUATION OF A NEW METHOD FOR THE ASSESSMENT OF REACTION TIMES OF FREESTYLE WRESTLING ATHLETES USING BARBAS "3D WRESTLING DUMMY"

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ABSTRACT
Olympic wrestling is a sport that requires a high level of development of all physical abilities (strength, speed, endurance, strength, flexibility, etc.), and good technical and tactical levels. Over the years and with the ever-increasing performances of its athletes, Olympic wrestling has evolved into an even more demanding sport, with many elements influencing high performance, and winning or losing depending on the details. The fast reaction time of athletes is one of the most important factors for performance in the sport of wrestling. The purpose of the research was to study the reliability of a new method of evaluating the reaction time of male and female wrestling athletes, in simulated movements of freestyle wrestling. The study involved 18 athletes, boys and girls, who volunteered. Of the 18 individuals in the sample, 6 were girls with a mean age of 15 ± 1.92 years and 12 boys with a mean age of 21.25 ± 2.39 years. The new method for evaluating the reaction time of freestyle wrestling athletes that was used combined the use of the Barbas 3D Wrestling Dummy, an extensiometer, and two force platforms on which the athletes were standing. The results showed that the reliability of the new method proved to be moderate to high. In conclusion, the reliability of the new method is considered acceptable, but further research is needed to determine the effects of user training on the reliability of this method.

Key Words: freestyle wrestling, reaction time

INTRODUCTION

Wrestling is considered one of the oldest sports. By its nature it is a challenging, complex sport that dictates the simultaneous and harmonious cooperation of body and mind. A wrestling athlete should have, developed at a high level all of his physical abilities (strength, speed, endurance, power, flexibility, etc.), and a good level of technique and tactics. Over the years and with the ever-increasing performance of its athletes, Olympic wrestling evolved into a sport of even higher demands, with elements that influence good performance to be many, and now victory or defeat depends on details. Reaction time is one of the most decisive elements for good performance in the sport of wrestling (Kaya, 2016). The reaction time is defined as the time elapses from the onset of a stimulus to the onset of the kinetic response by the athlete.

In a wrestling match the athlete is required to react as quickly as possible to any movement of his opponent as the time limits for a successful attack, defense or counterattack in wrestling are very small. Gierczuk et al. (2017) mention that a wrestler must react quickly to the movements of an opponent's limbs or torso, to the referee's indications, to the coach's remarks, to the public or to the data of a points table. Kaya (2016) characteristically states that wrestling athletes in a match must react quickly when they see the movement of an attack to the leg, by taking their leg away or going on a counterattack.

In this sense, reaction time is a decisive factor in performance and is closely correlated with the ability of the wrestlers to take immediate decisions, especially under the pressure of their opponents (Kaya, 2016; Yoon, 2002). The great importance of reaction time is highlighted by Iri, Aktug, Koc, Sahin and Murathan (2016), which state that reaction time is one of the most important factors influencing success in wrestling and sports generally. A wrestling athlete should have as short as possible reaction times as the success of a defense or an attack in a match is directly linked to the athlete's quick reaction and is determined to a large extent by it.

These works underscore the great importance of reaction time for good performance in the sport of wrestling. In their research the Celenk et al. (2015) mention that it is seen in a review of literature that the reaction time of athletes can be improved through training. As in any feature that improves through training, reaction time is also critical to evaluate so that it becomes known to the coaches, if the desired changes are made through training. It is therefore easy to conclude the great importance of the correct assessment of the reaction time of wrestling athletes.

So far, any research carried out on the evaluation of the wrestlers' reaction time used methods that included a reaction to an audio-visual stimulus that was a light or a signal on a screen or a sound and the response to these stimuli was the push of a button with the foot or the hand, as in the surveys of Celnek and et. al (2015), Kaya (2016), Gierczuk et. al (2017) and Iri et. al (2016).

Wrestling athletes in no circumstance during a fight are called to respond to a visual light stimulus. However, they are called to respond to visual stimuli derived from the movement of the opponent's limbs such as the forward or backward movement of a leg and many others. But whatever the stimulus is in a match, a wrestling athlete will never respond to it by pressing a button with fingers or toes or in a similar way seated in front of a screen.

Due to the great importance for performance, as demonstrated above, of the reaction time of athletes, it is considered useful to find a way of evaluating the reaction time that can better simulate the situations that take place in a wrestling match and can be more realistic so that both the stimuli and the reactions of the athletes to the stimuli are similar to those that would take place in a wrestling match. The aim of the research is to study the reliability of a new method that evaluates the reaction time of wrestling athletes, in simulated movements of the sport of freestyle wrestling. The new method combines the use of the Barbas 3D Wrestling Dummy (Figure 1) and force platforms on which the athletes were standing. The dummy simulates the size of an average person and stands in the same way as a wrestling athlete in a match.

METHODS

Sample

The research sample consisted of 18 wrestling athletes, boys and girls, who participated voluntarily in the research. Of the 18 subjects of the sample, 6 were girls with an average age of 15 ± 1.92 years and 12 boys with an average age of 21.25 ± 2.39 years. The athletes selected were from various parts of Greece, the girls were all members of the national team of Greece, as well as three of the boys in the categories of their age and weight, while the other participants were national level athletes. The selection of the athletes was based on their training and match – participation level and their ability to attend at the place where the research took place at the dates of the survey. All measurements were made at the biomechanics Laboratory of the School of Physical Education and Sport Science of the Democritus University of Thrace, which is based in Komotini. All participants were familiar with the use of the techniques used as responses to stimuli and their application on the dummy. The height of the athletes was measured by a measuring gauge and their weight using a force platform.

Description of the instruments used

The "Barbas 3D Wrestling Dummy" was used in the measurement process to produce stimuli and to perform techniques on it as a response from the participants (Figure 1). The dummy simulates the size of an average person and stands in the same way as a person that wrestles. The height of the dummy is 1.75 meters, so it can be easily used by short or tall athletes. This wrestling dummy simulates the human body and consists of 12 joints located in the upper part (shoulder, elbow and wrist) and lower limbs (hip, knee and ankle). The shoulders, elbows, hips and joints of the knees are loaded with a spring to provide resistance. The joints allow movements of the body parts to the sagittal plane (flexion/extension) and frontal level (conduction/abduction). Each joint is pre-curved so that the position of the dummy mimics the basic stance of an opponent in wrestling. The spine is represented by a large compression spring that gives the trunk freedom of movement on a three-dimensional level and returns to the neutral position after force application. Between the neck and the head there is no joint, and both parts of the body are joined together and there is no movement between them (Barbas et. al 2017).

Figure 1. "Barbas 3D Wrestling Dummy"

At the point of the ankle at the dummy's feet ropes were tied with the other end of which was tied to an improvised wooden construction that simulates the form of the wooden cross of a puppet. The cords of each of the two legs were attached to the left and right edges respectively of the horizontal wood of the structure (Figure 2). The ropes and the wooden construction served in the production of visual stimulus related to the sport of wrestling as it will be analyzed below.

Figure 2. Wooden construction and connection with the dummy's legs

An extensiometer (CD-60, Interfels) which was attached, with a thin rope extension, to the legs of the dummy at the point of the ankles, was used to mark the exact time of the appearance of the stimuli of the measurement process (Figure 3). Finally, two in-floor force platforms (Kistler) were used with the NEXUS (Vicon) software. The athletes were standing on the force platforms in order to record the first appearance of force at the beginning of the kinetic response after the stimulus. All data was sent to a computer on which the analysis was carried out.

Figure 3. Extensiometer

Trials Description

During the measurements the participants were called to respond as quickly as possible to a stimulus. Both the visual stimuli and the responses were in kinesiological relevance with wrestling. There were two stimuli given to the participants. One stimulus was the backward pulling of the left leg of the dummy that was carried out by pulling the corresponding cord with the use of wood construction, while the other stimulus was the backward pulling of the right leg of the dummy and was carried out by pulling the cord connected to the right leg. The participants had no visual contact with the operator of the wooden construction so that they could not figure out which of the ropes he was preparing to pull.

Each stimulus had only one response. When the stimulus was pulling the right leg of the dummy backwards, the examinees performed a low leg-snatch with a side slip (Figure 4). When the stimulus was pulling the left foot of the dummy backwards, the examinees performed a one leg takedown (Figure 5). The position of the examinees on the force platforms remained the same throughout the measurements

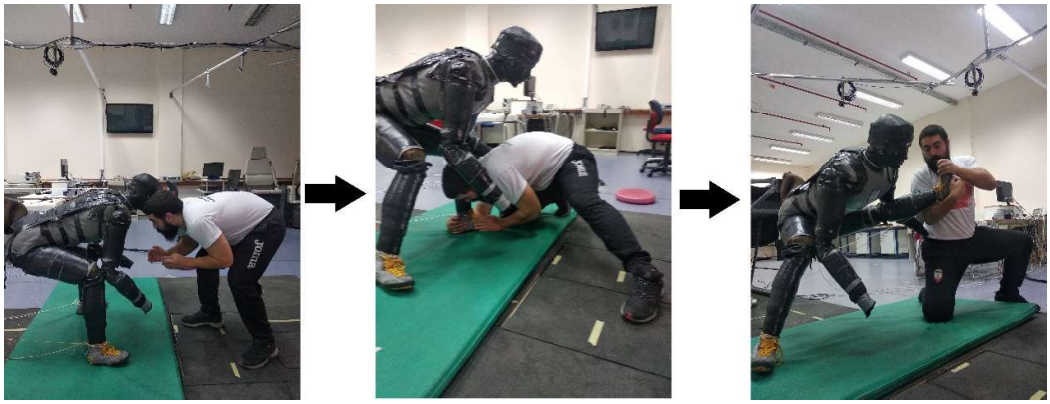

Figure 4. Low leg-snatch with a side slip

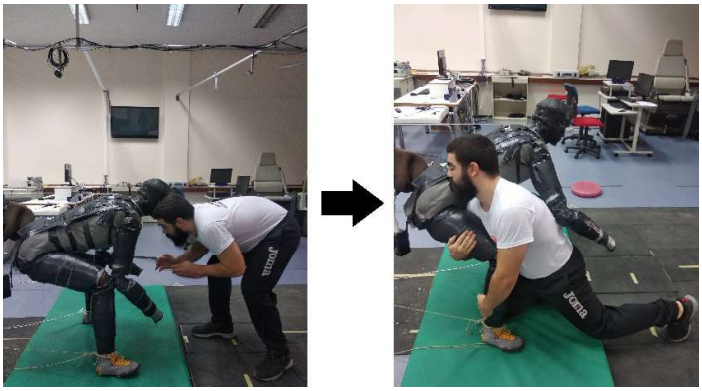

Figure 5. Head outside single leg takedown

Measurements procedure

The measurement process began by measuring the height and weighing of the participants. After that the examinees found the position of their feet on the two force platforms according to their wresting stance and the position of their feet was marked in order to maintain the same position throughout the hole duration of the measurements. Then the exact spot of the dummy's legs was marked, so that their positions would remain the same after the pulls throughout the measurements. Afterwards the athletes performed a test trial for each stimulus with the corresponding response. An attempt with the stimulus being pulling right leg backwards and an attempt with the stimulus being pulling the left leg backwards. In every stimulus the responses were the ones mentioned above. The actual measurements would start after the test tries were completed.

Each subject performed five consecutive attempts with each stimulus from which the first and the last one was excluded from the data analysis. There was a 10-seconds break between each attempt and a half-minute break between each set (five attempts).

Research design

In order to check the reliability, the Intra - class correlation coefficient (ICC) of the reaction time values in the three measurements was calculated. The ICC was calculated using a two-factor variance analysis model (two-way ANOVA) (Baumgartner, 1989):

$$ICC = \frac{MS_s - MS_i}{MS_s}$$

where, ICC: the internal correlation coefficient of measurements (score) MSs: the mean square between measurements (score), MSi: the mean square of the interaction between the measurements (score) and the subjects.

Pearson's correlation coefficient (R) between reaction time values in the various measurements was also calculated. In order to control the change in reaction time values in different measurements, variance analysis was performed for repeated measurements (3x2), with repeated factors measuring (1, 2, 3). For all statistical analyzes the level of statistical significance was set at $p < .05$.

RESULTS

Descriptive statistics – Averages

The averages and standard deviations of the kinetic stimulus reaction times in each measurement condition are presented for the three tries in figure 6 and table 1.

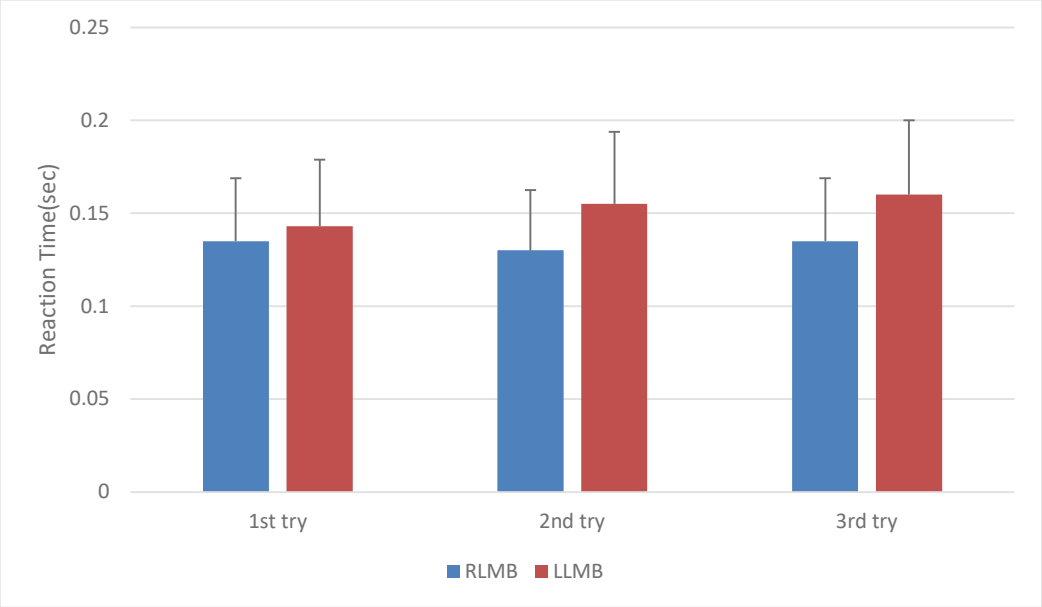

Figure 6. Averages and error lines of reaction time to kinetic stimulus in each measurement condition for the three attempts (RLMB: Right Leg moving backward, LLMB left Leg moving backward).

Table 1. Averages and standard deviations of the reaction time to a kinetic stimulus in each measurement condition are presented for the three attempts (RLMB: Right leg moving backward, LLMB left leg moving backward)

	1st Try		2nd Try		3rd Try	
RLMB	0.135	±0.023	0.130	±0.031	0.135	±0.041
LLMB	0.143	±0.042	0.155	±0.045	0.160	±0.045

Correlation analyses.

Table 2 presents the results of analyses of the relationship between the reaction time values of the kinetic stimulus in the three attempts.

Table 2. Correlation coefficients (R), intra-class correlation for a single measurement (ICC1) and intra-class correlation for the average of measurements (ICCavg) for each variable (RLMB: Right Leg Moving backward, LLMB: Left Leg move backward)

VARIABLES	**R**	**ICC_1**	**ICCavg**
RLMB	0.061 - 0.661	0.329	0.596
LLMB	0.401 - 0.755	0.571	0.800

As shown in table 3, the values of reaction time to kinetic stimulus for the three attempts exhibit moderate correlation. In addition, the reaction time for the attack on the left leg (RLMB) shows low intra-class correlation coefficients for a single measurement (ICC1) and moderate for the average of the three measurements (ICCavg). On the contrary, the reaction time for the attack on the right leg attack (LLMB) shows a moderate interclass correlation rate for a single measurement (ICC1) and a high coefficient for the average of the three measurements (ICCavg).

DISCUSSION

As mentioned above, the research on reaction time of wrestlers so far evaluated the reaction times of the athletes using methods that included as stimuli visual signals of light or shapes as well as beeps and as answers key/switches pressures with the athlete's limbs. Movements and stimuli that were not in relevance to the sport of Olympic wrestling. It was therefore considered necessary to seek a new way of evaluating reaction time and to study its reliability in order to establish whether the reaction time of wrestlers can be reliably measured in a new and more "practical" way.

In this context, the reliability of using a method that is in kinesiological relevance to the sport of wrestling was investigated. A method which includes kinetic stimuli that could be encountered by an athlete in a wrestling match, and at the same time this method could be standardized to ensure high reliability of reaction time measurements.

The aim of the research was therefore to study the reliability of a new method of evaluating the reaction time of wrestling athletes, in simulated movements of the freestyle wrestling sport, using the Barbas 3D Wrestling Dummy. The initial research hypothesis considered to be that the measurements of the reaction time of the wrestlers with the new method would be characterized by high reliability factors, expressed by the inter-class correlation coefficient between the repeated measurements, regardless of the type of stimulus.

From the results it was found that the reliability of the new method, for a single measurement, proved to be low to moderate. In particular, the reaction time for the attack on the left leg (RLMB) showed low intra-class correlation coefficients (ICC1 < 0.4) (RLMB: ICC1 = 0.329). Conversely, when the attack occurred on the right leg, the correlation coefficient for a single measurement (LLMB) proved to be moderate (0.4 < ICC1 < 0.7).
In regard to the reliability of the new method of evaluating the reaction time of wrestling athletes, when the average reaction time in more than one measure is taken as a performance, it has proved to be moderate to high. In more detail the reaction time values for the attack on the left leg (RLMB) show moderate interclass correlation coefficients for the average of the measurements (0.4 < ICCavg < 0.7) (RLMB: ICCavg = 0596). On the contrary, when the attack occurred on the right leg (LLMB), the reaction time values of wrestling athletes had a high correlation coefficient for the average of the measurements (ICCavg "0.7") (LLMB: ICCavg = 0800). In summary, the results of the present investigation found that the new method is characterized by an acceptable reliability regardless of the stimulus and the desired kinetic response for more than one measures and can be the basic method of evaluating reaction time of freestyle wrestling athletes.

The reliability of the new evaluation method is likely to have been influenced by the participant factor as the measuring instruments used were all proven to be valid and reliable. The wide range of the participants ' age is one of the factors that could have influenced the process of measurement as age is one of the factors influencing reaction time (Kolinski 2012). Also, the difference in experience, especially in the years of engaging with the sport, of each participant in relation to the others, probably influenced the reliability of the measurements. Another possible cause is that in their daily training as well as in their matching career, the participants do not all use in the same degree the techniques that were chosen in the research as response to the stimuli. The techniques used in the research were chosen so that all the participants knew their correct technical execution. Another reason for the techniques chosen was for them to be able to be performed on the "BARBAS 3D WRESTLING DUMMY" but also the participants to have prior familiarity with them, without that meaning these techniques were the main techniques used by the participants in their daily and favorite "repertoire" of techniques.

Another reason that could have influenced the reliability of research is that the reaction times of male and female athletes were evaluated and analyzed together although as reported by Kolinski (2012) the reaction time is influenced by gender. In addition, the reliability may have been influenced by the fact that the kinetic stimuli used for the attacks on the right or left leg were the movement of the opposite leg backwards, while it is more common in real conditions that the stimulus is the opposite, the movement of the right leg forward causes as a respond to the attack the right leg and respectively applies for the left.

CONCLUSIONS-SUGGESTIONS

As is evident from the above, the reliability of this method is considered to be entirely acceptable. In addition, the reliability was probably influenced by the characteristics of the participants. Therefore, researchers ' opinion is that possible changes in the level of the sample's performance and in the degree of their training to maximize the reaction time may increase the reliability of the research.

It is proposed to carry out further research on the reaction time in wrestling particularly with methods that are kinetic relevance with wrestling situations as was done in this investigation. In this direction it would be useful to measure teams of male and female athletes of higher and lower athletic levels in order to show and compare any differences in the results in terms of the reliability of the new method depending on the athletic level of the

participants. It would also be interesting if the athletes started the measurement while having contact with the dummy and not without touching the dummy as it happened in the current study as it may result changes in their reaction times.

Another proposal is to carry out a research with the same means, the same procedure and the same stimuli but with different kinetic responses, since from the 18 techniques that can be performed in this particular dummy only two were used in this research.

Finally, another proposal is to evaluate the reaction time of wrestling athletes with the same method that was used in this research before and after reaction time and to compare the results with previous similar studies, in which the athletes were not invited to respond to the stimuli by performing a wrestling technique.

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