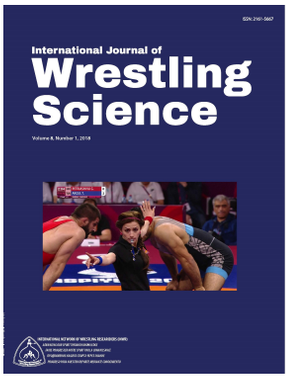

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METHODOLOGICAL DEVELOPMENT OF WRESTLING SHUTTLE TEST

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ABSTRACT
The purpose of this study was to develop a wrestling shuttle test (WST) based upon four elements. Firstly, the WST was conducted on a regulation wrestling mat surface making it specific and familiar to a competition area. It is convenient to administer in a typical wrestling venue by a coach or tester. Secondly, the WST included movements in four different directions across the entire mat surface including wrestling-specific standing movements (side-stepping). Thirdly, the test was based on the international match length consistent with United World Wrestling (UWW) rules of match duration of two three-minute periods of activity with a 30 second rest period. Lastly, the shuttle test focused on the individuality of the participant, that is, without a partner or others, to ensure results are solely of the participants' individual effort.
Key words: wrestling shuttle test, specific movement test, metabolic demands, combat sports, wrestlers

INTRODUCTION
United World Wrestling (UWW) is the world governing organization for Olympic wrestling styles and oversees internationally sanctioned events, such as the Olympic Games, World Championships, World Cup, and other international events, over the three recognized styles for men and women – Greco-Roman, Freestyle, and Women's Wrestling. Among its responsibilities, the UWW establishes and disseminates the international rules for the different wrestling styles (United World Wrestling, 2016). International wrestling matches consist of two 3-minute periods with a 30-second rest interval between each period over a 9 meter circular mat surface.

Previous wrestling studies have shown that elite wrestlers have high aerobic and anaerobic capacities (Chaabene et al., 2017; James et al., 2016; Yoon, 2002), which are key physiological components for high performance wrestling (Demirkan et al., 2015; Kraemer et al., 2001). Laboratory testing of the metabolic demands of athletes is widespread, but it is limited because it is expensive, inconvenient to administer, and requires special equipment. Laboratory testing protocols also, often use a bicycle or running treadmill as the activity measured. These tests are more appropriate to running and cycling sports or similar activities. A limitation of laboratory testing is validity of findings as it relates to the real life dynamic movements and activity in a sport setting. Some sports use field tests in their respective practice or competition venues including, on the court (ground and gym floor), running track, ice arena, and tatami mats (Chamari et al., 2004; Chino et al., 2015; Hoffmann et al., 2014; Metaxas et al., 2005; Santos et al., 2010; Schwesig et al., 2017; Tabben et al., 2014). Field tests have several advantages compared to laboratory testing as they are, not only easier to administer, less costly and more specific to the sport, but they can be conducted throughout the season to show progression of the athletes. Currently, no assessment tool exists that includes wrestling-specific movements to evaluate a wrestler's fitness on the wrestling mat.

Wrestling demands physical fitness among several physical components, such as, strength, agility, power, as well as fitness in the aerobic and anaerobic energy systems (Chaabene et al., 2017; Yoon, 2002). Wrestlers move in many directions in a match depending on the actions and reactions of attack and defense, the tactics used, and the individual styles of the wrestlers. Wrestling movements involve moving forward, backwards and side-ways (side-stepping). Side-stepping allows for short circular movements, often to create an angle of attack or to prevent the opponent from gaining it. Side-stepping movements prevent crossing one's legs, and helps maintain a stable stance position when moving in standing wrestling.

METHOD
The wrestling shuttle test (WST) was designed specifically for wrestling based upon four elements specific to the sport.
1. The wrestling mat
The WST is performed on a mat surface that is commonplace in wrestling training facilities. This provides a practical and convenient place for testing that is familiar to participants. The participant-wrestler is also able to perform the WST in wrestling shoes, making it more realistic and sport specific. The WST can easily be administered during a regular practice session and with little equipment. Only a timer/clock, pen, and paper are required. Testing requires

two persons – a recorder to keep track of the number of shuttle lengths performed, and an assistant, who checks and calls out the time remaining, and can serve as a motivator for the participant. Those administering the test do not need special training and need only to understand how to administer the test. Description of the Wrestling Shuttle Test (WST).

The WST includes four directional movements on the wrestling mat (forward running, backward running, left side-stepping and right side-stepping). Each movement was four meters in length from the central circle on the mat. The participants were to complete as many movements as possible by continuously repeating shuttle lengths within two 3-minute periods with a 30 second rest period between periods (Figure 1). A visible time clock was set with an audible buzzer sounded at the time of expiration. The total number of completed shuttle lengths was recorded, and only the last fully completed length was recorded at the time of expiry.

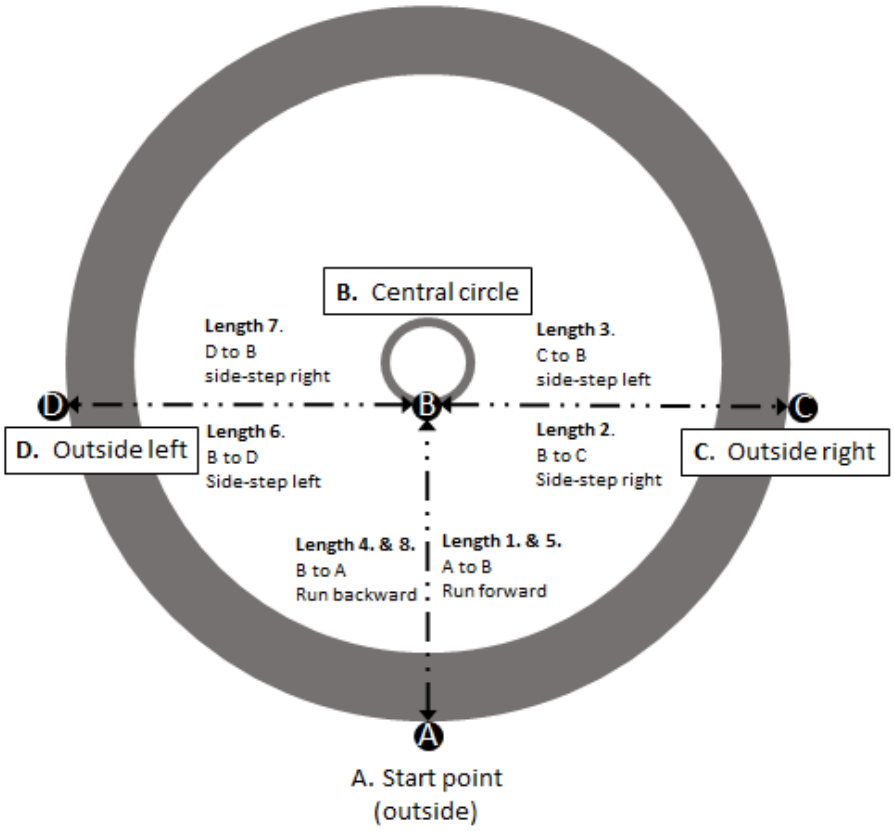

Figure 1. Procedure of the wrestling shuttle test. The participant will be recorded on the number of shuttle Lengths completed. The participant aims to complete as many shuttle lengths as possible by repeating Length cycles, e.g., Length 1, 2, 3, 4, 5, 6, 7, 8, 1, 2, 3, 4, 5, 6, 7, 8, 1, 2, and so on. Length 1: A. to B. From start point (A.) the participant will run forward to central circle (B.) Length 2: B. to C. From the central circle (B.) the participant will side-step right to the outside of the mat (C.) Length 3: C. to B. From outside of the mat (C.) the participant will side-step left towards the central circle (B.) Length 4: B. to A. From the central circle (B.) the participant will run backward to the start point (A.) The participant will continue the same pattern to the opposite side of the mat, as follows. Length 5: A. to B. From start point (A.) the participant will run forward to the central circle (B.) Length 6: B. to D. From the central circle (B.) the participant will side-step left to the outside of the mat (D.) Length 7: D. to B. From the outside of the mat (D.) the participant will side-step right to the central circle (B.) Length 8: B. to A. From the central circle (B.) the participant will run backward to the start point (A.) The participants will repeat and continue the above pattern for the duration of the WST (two 3-minute periods with a 30 second rest period between periods). The recorder will keep track of the number of shuttle lengths completed in period 1 and period 2, and sum together for a total overall score. Also, the number of lengths in the last 30 seconds of periods is recorded by the Assistant.

2. Using wrestling-specific movements

Many shuttle run tests only use forward running as the main action, interspersed with stops, turns, and starts (Domone et al., 2016; Mayorga-Vega et al., 2015). The WST included side-stepping movements similar to

movement actions in wrestling, such as, moving laterally and evading backwards by circling. Side-stepping is an important movement in wrestling because it allows the wrestler to move in relation to one's opponent, that is, to move "square" to keep one's opponent in front of you. Many of the movements across the mat are short in distance and repeated continuously.

Description of side-stepping movement

The participant will move in a lateral direction – either left or right.

The participant will start in a modified stance position, slightly crouched forward. Step to the side with the lead foot in the direction of movement, followed by the trail leg. Move quickly in a hopping motion to return to the modified stance position. Continuously repeat the movement to move laterally.

Key points:

- Attempt to maintain the modified stance position by crouching slightly forward with knees slightly bent. This will maintain a stable base position throughout movement.
- Do not cross legs or touch legs (ankles) to avoid coming out of the modified stance position (Figure 2).
- Stay "light" on the feet with weight off heels.

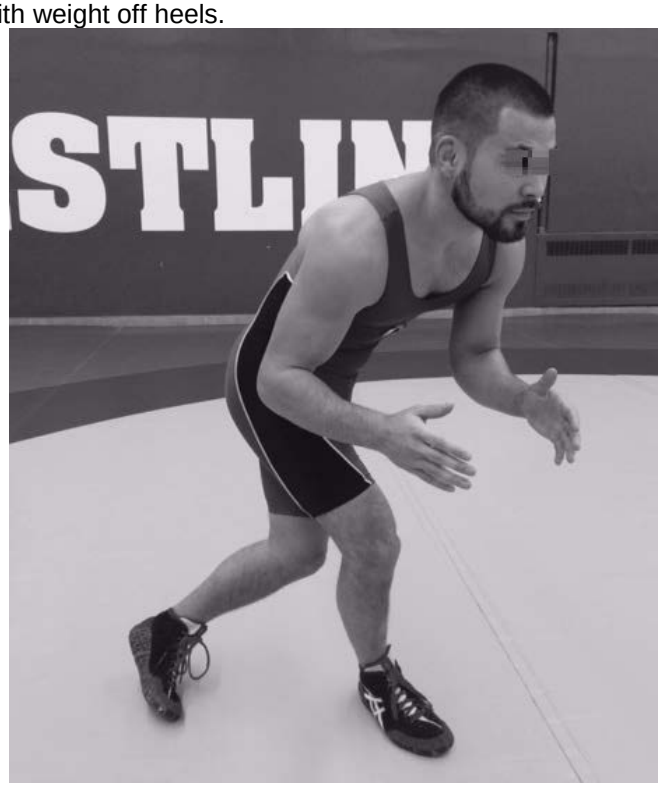

Figure 2. Restriction of crossing legs. Side-stepping movements prevent crossing one's leg while participants continue to step to a lateral direction (left or right). In this study, the side-steeping movements were designated as one of wrestling-specific standing movements.

3. United World Wrestling (UWW) specifications

The WST uses the specifications of the UWW wrestling mat (9 m diameter circle). The length of each shuttle (4 m from the central circle – Figure 1) allows the participant to cover the entire distance from the central circle to the outside boundary of the mat. Unlike some field tests where participants must run a linear distance, such as the 12 minute run, the WST has short shuttle lengths (4 m) allowing for agility of movements. Using the UWW wrestling mat allows for standardization, consistency in testing, and is sport specific.

The WST, also, replicates the length of a regulation match, which consists of two 3-minute periods with a 30 second rest period between periods. This makes the WST sport specific using UWW specifications.

4. Individuality

The individual focus of the WST provides the participant with direct individual results. There is no reliance on others, such as a partner, which eliminates any risk of inconsistencies due to variances in resistance and/or cooperation with others. The individual participant is also able to provide their best personal effort and motivation, which is important during the entire test and, in particular, during the last 30 seconds of the WST.

DISCUSSION

The main purpose of this study was to develop a wrestling shuttle test that used wrestling-specific movements that can be administered easily and conveniently within a typical wrestling program. The design of the test pattern allows up to two participants to be tested independently at one time, each covering half a mat surface (Figure 1). It is also possible that by altering the test pattern, up to four participants can be tested at one time by using one quarter of the mat surface and keeping the distance of each shuttle length the same. To do this, Lengths 6 and 7 would replicate Lengths 2 and 3 (Figure 1). This would reduce the time of administering the test to a large group of participants.

An all-out running test for 3-minutes has been shown to indicate aerobic and anaerobic abilities (Hoffman et al., 2016; Pettitt et al., 2012). The average speed of the last 30-seconds is an indicator of critical power (Pettitt et al., 2012). The 3-minute periods of the WST coincide with the 3-minute time test and lend support for future study, particularly to determine how aerobic and anaerobic capabilities can be assessed. Recording the number of shuttle lengths in the last 30 seconds can provided data on the participant's capabilities as it taxes the anaerobic system. Developing individual baseline standards over several tests can serve to determine how the participant is progressing throughout the season.

The individualized nature of the WST, where only the participant is tested, eliminates any distorting influence from a partner or opponent who may provide variances in resistance or cooperation. Wrestling matches by themselves do not provide accurate measures of intensity, since activity is influenced by several factors, including opponent performance level, tactics, techniques used, etc., to name a few. Individual motivation to perform well in the wrestling shuttle test is augmented by providing reliable individual and personal data of one's maximal effort, and possibly the recording assistant who may encourage and motivate the participant while performing the WST. The participant's motivation to push hard right to the end can be reflected by the number of shuttle lengths during the last 30 seconds.

A large sample size is needed and with a wider scope of wrestlers across a region or country that could provide further information on similarities or differences between them. Since wrestling includes separate age and weight divisions for both males and females, there is a need for further study on sample composition. This may also provide some insight on, for example, whether lightweights are different than heavyweights, or between genders. As well, additional consideration of the wrestler's competitive level, or rank at an elite level may provide useful information. Further testing and retesting is, therefore required to check the reliability and validity of the wrestling shuttle test. Additionally, further testing will provide more data to evaluate the physiological responses to the WST.

PRACTICAL IMPLICATIONS/ADVICE FOR ATHLETES AND COACHES

The WST can be easily performed with little disruption to a normal training routine. It also has applications for training depending on its intended purpose. For example, it could be used as a conditioning drill by altering the time and intensity, or as a drill to focus on footwork movement. Wrestling is one of several combat sports, and while each is unique, there are common characteristics, and some even have similar holds and techniques, e.g., in judo, sambo, and jiu-jitsu. The wrestling shuttle test may have useful applications to other combative sports and be easily applied as a field test given similar mat surface dimensions.

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