VALIDITY OF THE RUNNING ANAEROBIC SPRINT TEST FOR ASSESSING ANAEROBIC POWER AND PREDICTING SHORT-DISTANCE PERFORMANCES

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ABSTRACT

Zagatto, AM, Beck, WR, and Gobatto, CA. Validity of the running anaerobic sprint test for assessing anaerobic power and predicting short-distance performances. J Strength Cond Res 23(6): 1820–1827, 2009—The purpose of this study was to investigate the reliability and validity of the running anaerobic sprint test (RAST) in anaerobic assessment and predicting short-distance performance. Forty members of the armed forces were recruited for this study (age 19.78 ± 1.18 years; body mass 70.34 ± 8.10 kg; height 1.76 ± 0.53 m; body fat 15.30 ± 5.65 %). The RAST test was applied to six 35-meter maximal running performances with a 10-second recovery between each run; the peak power, mean power, and the fatigue index were measured. The study was divided in two stages. The first stage investigated the reliability of the RAST using a test-retest method; the second stage aimed to evaluate the validity of the RAST comparing the results with the Wingate test and running performances of 35, 50, 100, 200, and 400 m. There were not significant differences between test-retest scores in the first stage of the study (p > 0.05) and were found significant correlations between these variables (intraclass correlation coefficient = 0.88). The RAST had significant correlations with the Wingate test (peak power r = 0.46; mean power r = 0.53; fatigue index r = 0.63) and 35, 50, 100, 200, and 400 m performances scores (p < 0.05). The advantage of using the RAST for measuring anaerobic power is that it allows for the execution of movements more specific to sporting events that use running as the principal style of locomotion, is easily applied and low cost, and due to its simplicity can easily be incorporated into routine training. We concluded that this procedure is reliable and valid, and can be used to measure running anaerobic power and predict short-distance performances.

KEY WORDS running test, anaerobic component, running performance, Wingate test, lactate

INTRODUCTION

Several procedures have been developed to estimate the power and/or capacity of the skeletal muscle energy production in the anaerobic pathway. Some of these procedures used to estimate this parameter are maximum accumulated oxygen deficit (MAOD) (11,14), Wingate test (WAnT) (2,4,7), maximal anaerobic running test (MART) (17), Margaria staircase running test (16), tethered tests (8,9,17), vertical jump tests (17), and many others. However, even though these procedures are the most commonly used, there is not a gold standard procedure for evaluating anaerobic capacity and power (17). The MAOD and WAnT are the best known and accepted protocols in this category, measuring anaerobic capacity and anaerobic power and capacity, respectively (26). The practical uses of some these tests do not normally require the use of expensive equipment and/or much time for application. The WAnT is easier to apply as it only needs 30 seconds on a cycle ergometer (1,4,7). It has been shown to be an excellent predictor of anaerobic power (10,26), is reproducible (27), and is a good performance predictor in short-distance sporting events (7,13,22).

Because of its scientific acceptance as a good procedure for assessment of anaerobic power and capacity, the cycling WAnT has been used as standard procedure to verify the validity of anaerobic evaluation tests in different sportive modalities, such as MART (17) and the tethered running test (14,30) in running, anaerobic work capacity from the critical power model (AWC) in table tennis (29), and others. The WAnT has also been used to evaluate the anaerobic training status of runners (9) and is a good predictor of short-distance performances in running (15,22,24). However, for more specificity in the evaluation procedure, the cycling WAnT has been adapted to other motor events, such as the arm ergometer (6,10), tethered swimming (specifically for swimming) (18,20), tethered running (14,30), and recently the running anaerobic sprint test (RAST) (28).
The RAST was developed by Wolverhampton University (United Kingdom) adapted from the original WAnT to assess the anaerobic power and capacity measuring the peak power (PP), mean power (MP), and fatigue index (FI) variables (28). The RAST consists of six 35-m maximal sprints with a 10-second recovery. By measuring body mass and running times, it is possible to determine the power of effort in each sprint (power = (body mass × distance²)/time³). The results of the RAST can give an estimate of the neuromuscular and energy determinants of maximal anaerobic performance, and it seems to be a good option for the evaluation protocol for to be used in sports that have the running as principal form of locomotion, such as soccer, athletics, basketball, and handball (1).

In recent studies, the RAST has been significantly correlated with AWC and WAnT, which suggests that the RAST could be used to assess the anaerobic power and capacity in running (28). The RAST is a very attractive procedure for practical application because it is an easily applied method. In practice, however, the RAST test still needs more investigation about the test-retest reliability and validity of this protocol of evaluation. Therefore, the purposes of this study were: (a) to evaluate of the RAST test-retest reliability; (b) to investigate the validity of the RAST as a protocol for assessing anaerobic power; and (c) to determine if the RAST is a good predictor of performance in short-distance events. The research hypotheses in the study were that test-retest RAST scores give similar results in all variables; there are significant correlations between RAST and WAnT scores; and the RAST is a good predictor of 35-, 50-, 100-, 200-, and 400-meter performances.

METHODS

Experimental Approach to the Problem

The muscle strength, power, FI, and aerobic and anaerobic capacity of the athletes and nonathletes can be measured using field and laboratory tests. The WAnT is an important tool for measuring anaerobic power and capacity of humans (2,4,7,20,23,30) and it has been commonly used to evaluate sporting performance by measuring muscle power and obtaining knowledge about muscle metabolism during short-term, high-intensity exercise (3). The WAnT has been an important test for validation of other anaerobic tests, and not only used in cycling, but also in specific tests for running (14,17,28,30), table tennis (29), and other ergometers and sports, and used for prediction of performance in running (15,24). Because of the scientific acceptance of WAnT, it was used to verify the validity of RAST, which is an adaptation of WAnT for running. The development of anaerobic specific tests for running that are easily applied and low cost is very interesting for practical application.

For it to be applied in track running events and without use of sophisticated equipment or ergometer, the RAST has an advantage over other anaerobic tests, such as the MART (17), tethered running (14,30) or Margaria staircase test. The other tests require expensive equipment and sophisticated technological apparatuses (e.g., MART and tethered running) or are performed in running up and down staircases, which is not performed in a sporting activity (e.g., Margarita staircase test). Thus, this study aimed to verify the reliability and validity of a simple running test application. This study also aims to show whether a significant correlation exists between the RAST scores and short-distance performances.

Experimental Procedures

The research was conducted in the Laboratory of Research in Exercise Physiology, Federal University of Mato Grosso do Sul, Mato Grosso do Sul, Brazil. The study was performed in two stages. The first stage aimed to evaluate the reliability of the RAST test performed twice (test and a retest) with a minimum interval of 48 hours between assessments; the second stage aimed to evaluate the validity of RAST as an anaerobic test verifying correlation with the WAnT and with the 35-, 50-, 100-, 200-, and 400-m performances. Before each procedure, the participants performed a 5-minute moderate intensity warm-up and the tests were started approximately 5 minutes after warm-up. All procedures were applied at the same time of day, with the RAST and running performances test performed on a 400-meter running track and the WAnT performed on a Monark cycle ergometer (Monark Ergomedic 894 E, Monark, Sweden). The subjects performed the tests with clothes and shoes specifically designed for running. Verbal encouragement was used in all tests to maintain the maximum effort.

Subjects

Forty members of the armed forces were recruited to participate in the study, all male volunteers (age 19.78 ± 1.18 years; body mass 70.34 ± 8.10 kg; height 1.76 ± 0.53 m; body fat 15.30 ± 5.65%; body mass index 22.67 ± 2.08 kg·m⁻²). The subjects were moderately active; performed military training including exercise; and some subjects were involved in soccer, basketball, volleyball and athletics recreationally. They all attended military training sessions 6 days a week for at least 3 years. Not all of the subjects participated in both stages of the study, but in each stage the same participants performed all the tests (n = 24 in first stage and n = 17 in second stage; only one subject participated in both stages). The subjects were informed of the risks and the benefits of the tests and then signed an informed consent form prior to testing approved by the Ethics Committee of the Federal University of Mato Grosso do Sul, Brazil.

Running Anaerobic Sprint Test

Initially, the body mass was measured with all clothes used in the RAST test. The RAST was applied with the participants performing six 35-m maximal sprints with a 10-second interval between each sprint. The time for each run was measured by two photocells (CEFIS standard photocells, Brazil) and the start for each sprint (10-second interval) occurred with a beep from the photocell equipment. Velocity
and acceleration were determined by Speed Test Version 6.0 (CEFISE, Brazil), and the power in each sprint was then calculated by the formula: 

\[ \text{Power} = \frac{\text{Body Mass} \times \text{Distance}^2}{\text{Time}^3} \]

After the RAST, 25 μL of blood were collected from the ear lobe at 1, 3, 5, and 7 minutes to determine lactatemia. This procedure was applied three times: in the first stage of the study to analyze reliability (test and retest method) and also in the second stage to evaluate associations with the other procedures.

**Wingate Test**

Initially, the warm-up was performed (5 minutes) with 2- to 3-second duration flat-out sprints performed at the beginning of the fourth minute of warm-up. Tests were started 5 minutes after the end of the warm-up period. The WAnT consisted of exercise performed at maximal power for 30 seconds with an external resistance corresponding to 75 g·kg\(^{-1}\) body mass. The cycle ergometer (Monark Ergomedic 894-E, Sweden) protocol began without external resistance, which was added immediately after the test was initiated. Exercise time was recorded only after the external resistance was applied. After 30 seconds of effort, blood samples were collected at 1, 3, 5, and 7 minutes for analysis of blood lactate concentration. Pedal revolution rate was determined by Monark Anaerobic Test Software. Values were obtained at 5-second intervals and after calculated the peak power (PP) in the initial 5-second period, mean power (MP) for 30 seconds, peak power per weight (PP/Wkg), mean power per weight (MP/Wkg), and the fatigue index (FI = (peak power - minimum power)/peak power) × 100).

**Running performance Tests**

Five running performances tests were randomly applied in distances of 35, 50, 100, 200, and 400 meters. The subjects were instructed to perform the runs in the shortest time possible. Times of runs were recorded using two photocells (CEFISE standard photocells). The shortest RAST time was considered as the 35-m performance value. The minimum interval between each distance was 24 hours. After each run, blood samples were collected (25 μL) at 1, 3, 5, and 7 minutes to lactatemia analysis. The absolute time of each run was

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**TABLE 1.** Results of running anaerobic sprint test (RAST) and the intraclass correlation between variables obtained in first stage of study.

<table>
<thead>
<tr>
<th></th>
<th>RAST test (n = 24)</th>
<th>RAST retest (n = 24)</th>
<th>Intraclass correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>Range</td>
<td>Mean ± SD</td>
</tr>
<tr>
<td>Peak power (W)</td>
<td>751.04 ± 123.63</td>
<td>538.30–961.41</td>
<td>730.33 ± 89.90</td>
</tr>
<tr>
<td>Mean power (W)</td>
<td>590.62 ± 90.79</td>
<td>388.86–736.48</td>
<td>591.08 ± 86.10</td>
</tr>
<tr>
<td>Peak power per weight (W·kg(^{-1}))</td>
<td>10.38 ± 1.74</td>
<td>7.81–13.48</td>
<td>10.19 ± 1.30</td>
</tr>
<tr>
<td>Mean power per weight (W·kg(^{-1}))</td>
<td>8.20 ± 1.34</td>
<td>5.78–10.33</td>
<td>8.19 ± 1.12</td>
</tr>
<tr>
<td>Fatigue index (%)</td>
<td>40.62 ± 9.11</td>
<td>28.03–56.74</td>
<td>38.42 ± 6.56</td>
</tr>
<tr>
<td>Peak blood lactate</td>
<td>14.23 ± 2.68</td>
<td>8.67–19.44</td>
<td>14.16 ± 2.65</td>
</tr>
<tr>
<td>Peak speed (m·s(^{-1}))</td>
<td>7.09 ± 0.38</td>
<td>6.50–7.80</td>
<td>7.07 ± 0.29</td>
</tr>
<tr>
<td>Mean speed (m·s(^{-1}))</td>
<td>6.54 ± 0.37</td>
<td>5.80–7.10</td>
<td>6.55 ± 0.31</td>
</tr>
<tr>
<td>Total effort time (s)</td>
<td>32.47 ± 2.05</td>
<td>29.73–36.47</td>
<td>32.36 ± 1.50</td>
</tr>
</tbody>
</table>

\(^{*}p < 0.05.\)
taken as running performance (T35, T50, T100, T200, and T400).

**Blood Analysis**

Blood samples (25 μL) were collected from a participant’s ear lobe and transferred to a 1.5-mL Eppendorf tube containing 50 μL NaF (1% sodium fluoride). The homogenate was injected (25 μL) into an electrochemical lactate analyzer (YSI 1500 Sport, Yellow Springs, OH). The electrochemical lactate analyzer was calibrated after every 5 blood samples with standard 5.0 mmol/L lactate solution. Blood lactate concentrations are expressed in millimoles per liter (mmol·L⁻¹).

**Statistical Analyses**

Results are expressed as mean ± SD or SE (Figure 1). Initially the Kolmogorov-Smirnov and Liliefors tests were used to analyze variable normality. All scores showed normality. In the first stage, the RAST reliability was analyzed using the Student’s t-test for dependent samples, the intraclass correlation test (ICC; two-way fixed model, consistency option, single score) and the Bland-Altman plots (1,3,5). In the second stage, analysis of variance repeated measure was used to compare lactate concentrations in the RAST, Wingate, and performance tests, and product-moment correlation analysis among RAST, WAnT and running performances. In all cases, a probability level of 95% (p ≤ 0.05) was used for statistical significance.

**RESULTS**

**First Stage**

The aim of this stage was verify the reliability of the RAST. These results of RAST test performed twice are showed in the Table 1. No significant differences were found between RAST variables in two tests (test and retest), and these variables showed significant correlation in the ICC test (Table 1), verifying the reliability of test. Figure 1 shows the power generation in each sprint of the RAST obtained in test and retest methods. The other factors that corroborated RAST’s reliability were Bland-Altman plots (5), which showed excellent results of concordance in all variables (Figure 2).

<table>
<thead>
<tr>
<th>Table 2. Results of running anaerobic sprint test and Wingate test.</th>
</tr>
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<tbody>
<tr>
<td><strong>Running anaerobic sprint test (n = 17)</strong></td>
</tr>
<tr>
<td>Mean ± SD</td>
</tr>
<tr>
<td>Peak power (W)</td>
</tr>
<tr>
<td>Mean power (W)</td>
</tr>
<tr>
<td>Fatigue index (%)</td>
</tr>
<tr>
<td>Peak power per weight (W·Kg⁻¹)</td>
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<tr>
<td>Mean power per weight (W·Kg⁻¹)</td>
</tr>
<tr>
<td>Peak blood lactate concentration (mmol·L⁻¹)</td>
</tr>
</tbody>
</table>

* p < 0.05.
† p < 0.01.

<table>
<thead>
<tr>
<th>Table 3. Results of 35-, 50-, 100-, 200-, and 400-meter performance tests (n = 17).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed (m·s⁻¹)</td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td>Peak power (W)</td>
</tr>
<tr>
<td>Mean power (W)</td>
</tr>
<tr>
<td>Time (s)</td>
</tr>
<tr>
<td>Peak blood lactate concentration (mmol·L⁻¹)</td>
</tr>
</tbody>
</table>

* p < 0.01 versus 35-m score.
† p < 0.01 versus 50-m score.
‡ p < 0.05 versus 100-m score.
§ p < 0.01 versus 200-m score.
33.06 ± 1.63 s. All the RAST variables were significantly lower than WAnT scores (Table 2), but there were significant correlations found between the PP (r = 0.46), MP (r = 0.53), and FI (r = 0.63). Peak blood lactate concentration (LACpeak) from the RAST only was significantly correlated with the FI (r = 0.48). However, in the WAnT, the peak lactate (LACpeak) was correlated with PP (r = 0.54), PP/Wkg (r = 0.63), and MP/Wkg (r = 0.62).

The running performances ranged from 4.61–5.74 (T35), 6.47–8.09 (T50), 12.75–14.70 (T100), 27.03–34.18 (T200), and 60.11–77.21 seconds (T400). The results of running performances are shown in Table 3. Nearly all the RAST variables (with exception of FI and LACpeak) were significantly correlated with all performances, but the MP/Wkg was not correlated with the performance at 100 m (Table 4). For the Wingate test variables, there were significant correlations between the PP and the velocity at 35 m and between the MP/Wkg and the velocity at 200 m (Table 5).

### TABLE 4. Correlations between the running anaerobic sprint test (RAST) variables and performances scores of 35 (T35), 50 (T50), 100 (T100), 200 (T200) and 400 (T400) meters.

<table>
<thead>
<tr>
<th>RAST</th>
<th>PP</th>
<th>MP</th>
<th>FI</th>
<th>PP/Wkg</th>
<th>MP/Wkg</th>
<th>LACpeak</th>
<th>TT</th>
</tr>
</thead>
<tbody>
<tr>
<td>T35</td>
<td>−0.99†</td>
<td>−0.86‡</td>
<td>−0.47†</td>
<td>−0.77‡</td>
<td>−0.57‡</td>
<td>−0.34</td>
<td>0.92‡</td>
</tr>
<tr>
<td>T50</td>
<td>−0.78†</td>
<td>−0.68‡</td>
<td>−0.34</td>
<td>−0.63‡</td>
<td>−0.46†</td>
<td>−0.02</td>
<td>0.78‡</td>
</tr>
<tr>
<td>T100</td>
<td>−0.62‡</td>
<td>−0.64‡</td>
<td>0.00</td>
<td>−0.51†</td>
<td>0.45</td>
<td>−0.31</td>
<td>0.57†</td>
</tr>
<tr>
<td>T200</td>
<td>−0.67‡</td>
<td>−0.76‡</td>
<td>−0.12</td>
<td>−0.52†</td>
<td>−0.51†</td>
<td>−0.17</td>
<td>0.78‡</td>
</tr>
<tr>
<td>T400</td>
<td>−0.46‡</td>
<td>−0.68‡</td>
<td>0.13</td>
<td>−0.45†</td>
<td>−0.59‡</td>
<td>0.25</td>
<td>0.74‡</td>
</tr>
</tbody>
</table>

*PP = peak power; MP = mean power; FI = fatigue index; PP/Wkg = peak power per weight; MP/Wkg = mean power per weight; LACpeak = peak blood lactate concentration; TT = total effort time.
†p < 0.05.
‡p < 0.01.

### TABLE 5. Correlations between the Wingate test variables and performances scores of 35 (T35), 50 (T50), 100 (T100), 200 (T200) and 400 (T400) meters.*

<table>
<thead>
<tr>
<th>Wingate</th>
<th>PP</th>
<th>MP</th>
<th>FI</th>
<th>PP/Wkg</th>
<th>MP/Wkg</th>
<th>LACpeak</th>
</tr>
</thead>
<tbody>
<tr>
<td>T35</td>
<td>−0.44</td>
<td>−0.47†</td>
<td>−0.13</td>
<td>−0.38</td>
<td>−0.52†</td>
<td>−0.10</td>
</tr>
<tr>
<td>T50</td>
<td>−0.31</td>
<td>−0.38</td>
<td>−0.11</td>
<td>−0.27</td>
<td>−0.46†</td>
<td>−0.32</td>
</tr>
<tr>
<td>T100</td>
<td>−0.24</td>
<td>−0.28</td>
<td>−0.05</td>
<td>−0.26</td>
<td>−0.42</td>
<td>−0.46</td>
</tr>
<tr>
<td>T200</td>
<td>−0.36</td>
<td>−0.34</td>
<td>−0.26</td>
<td>−0.41</td>
<td>−0.51†</td>
<td>−0.17</td>
</tr>
<tr>
<td>T400</td>
<td>−0.25</td>
<td>−0.41</td>
<td>0.23</td>
<td>−0.17</td>
<td>−0.49</td>
<td>0.14</td>
</tr>
</tbody>
</table>

*PP = peak power; MP = mean power; FI = fatigue index; PP/Wkg = peak power per weight; MP/Wkg = mean power per weight; LACpeak = peak blood lactate concentration.
†p < 0.05.

### DISCUSSION

The intent of this study was to verify the reliability of the RAST variables in the first stage of the study. There were no significant differences between the RAST using the test-retest method, which showed significant and high correlations verified by ICC test (1,3), and there was a high level of concordance between scores verified by Bland-Altman plots (5). In these Bland-Altman analyses (5), however, some results were outside the limits of agreement (outliers); both means of differences and limits of agreement were found to be low, resulting in good reliability.

RAST reliability was initially investigated by Balciunas et al. (1), which used young basketball athletes. They reported high RAST reliability verified by product-moment coefficient (r = 0.90). However, these authors did not mention which variable of the RAST was analyzed. The reliability of the RAST is similar to that obtained in WAnT (7,29), maximal anaerobic running test (17), and tethered swimming (19). Verifying the reliability and reproducibility of an evaluation procedure is important for it to be scientifically accepted and for its routine application in training (25). The RAST is an adaptation of WAnT for running, in which the time of exercise is very similar (±32 s in RAST and 30 s in WAnT), but in the RAST test the time and effort are dependent on the physical ability of the subject to perform test. Spencer et al. (23) investigated a reliability of a similar test for hockey Bland-Altman plots (5). In these Bland-Altman analyses (5), however, some results were outside the limits of agreement (outliers); both means of differences and limits of agreement were found to be low, resulting in good reliability.

Second Stage

This stage investigated the validity of RAST for assessment the anaerobic power and its ability to predict short-distance performances. The total effort time (TT) found in RAST was 33.06 ± 1.63 s. All the RAST variables were significantly lower than WAnT scores (Table 2), but there were significant correlations found between the PP (r = 0.46), MP (r = 0.53), and FI (r = 0.63). Peak blood lactate concentration (LACpeak) from the RAST only was significantly correlated with the FI (r = 0.48). However, in the WAnT, the peak lactate (LACpeak) was correlated with PP (r = 0.54), PP/Wkg (r = 0.63), and MP/Wkg (r = 0.62).

The running performances ranged from 4.61–5.74 (T35), 6.47–8.09 (T50), 12.75–14.70 (T100), 27.03–34.18 (T200), and 60.11–77.21 seconds (T400). The results of running performances are shown in Table 3. Nearly all the RAST variables (with exception of FI and LACpeak) were significantly correlated with all performances, but the MP/Wkg was not correlated with the performance at 100 m (Table 4). For the Wingate test variables, there were significant correlations between the PP and the velocity at 35 m and between the MP/Wkg and the velocity at 200 m (Table 5).
applying $6 \times 30$ meter repeated sprints with 20 seconds of recovery.

The RAST was first investigated by Zacharogiannis et al. (28), who verified significant correlations between the RAST and the $\text{WAnT}$ for PP and MP variables ($r = 0.82$ and $r = 0.75$, respectively) and related that the RAST could be used to measure the anaerobic capacity and power. Hodson and Jones (12) also used the RAST test to evaluate the influence of caffeine ingestion on repeated sprint performance. In our study, despite significant differences being found between the RAST and Wingate scores, there were significant correlations between PP, MP, and FI variables, but these correlations were not high ($r = 0.46$; $r = 0.53$; and $r = 0.63$, respectively). Nummela et al. (17) used the cycling $\text{WAnT}$ to validate an anaerobic running test called MART; there were significant correlations between the two tests. Zemkova and Hamar (30) also found significant correlation between cycling $\text{WAnT}$ and a tethered running on the treadmill and concluded this tethered running test as valid for measuring anaerobic power. Similar results by Lima (14) found significant correlations between PP ($r = 0.82$) and PM ($r = 0.79$) of the $\text{WAnT}$ and of the tethered track running tests.

The RAST procedure can measure a power output of inferior limbs similar to the $\text{WAnT}$, but uses running instead of cycling and measures the power of effort using the individual body mass. The RAST, as well as $\text{WAnT}$, can be used to measure muscular strength and the capacity of the legs to generate power. In sports such as soccer, basketball, and others, the use of this test is very interesting because of reduced financial costs and easy application. Anaerobic components are evaluated through repeated sprints such as those performed in several sports (12,21).

The RAST also seems to be a good procedure for prediction of running performance, verified by high correlations between the RAST variables and the performances at 35, 50, 100, 200, and 400 meters. The anaerobic contribution of these distances is very high and these correlations corroborate for the anaerobic characteristics of the RAST test. Only the FI and the LACpeak of the RAST did not show significant correlations with the performance scores. Although FI and LACpeak have been mentioned in literature as anaerobic glycolytic capacity predictors (2), the relationship between these variables and performance was not verified in this study. But, the LACpeak found after RAST was approximately 15 mmol·L$^{-1}$, exhibiting a significant contribution of glycolytic pathway. Strangely, velocity over 100 m was significantly higher than over 35 and 50 m. Possibly these individuals had a higher anaerobic glycolytic system in relation to the phos phagenic system, verified by the high mean velocities at 100, 200, and 400 m distances and by the higher correlation values between MP than PP with performances over these distances. Lima (14) also adapted the $\text{WAnT}$ for tethered track running and also found significant correlations between performances over 60, 120, 240, and 300 m.

Different studies have described correlations between $\text{WAnT}$ and performances scores, and their findings are in investigations that used cycling $\text{WAnT}$ and adapted the Wingate test with muscular activities similar to sports activities (10,20). When applying the procedures to running, body weight needs to be supported during effort in the same way as in specific running tests. Therefore, as well as the possibility of assessing anaerobic power, the evaluation procedure called RAST seems to also be best suited for short-distance performance prediction confirming the hypotheses generated from the study.

**Practical Applications**

The findings of this study have shown the reliability and validity of the RAST as an anaerobic evaluation procedure in running. In many studies and also in daily routine training, the $\text{WAnT}$ test has been used as a method of measuring anaerobic power in several sports. However, the use of the cycle ergometer for evaluation cannot be used to represent the complete muscular and motor activities found in most sports. The advantage of using the RAST to measure anaerobic power is that it allows the execution of movements more specific to sporting events that use running as their principal form of locomotion, and it can be easily applied by trainers and coaches in training. To use RAST, one only needs to record the period of effort and measure body mass. Although there are other anaerobic running tests mentioned in literature, such as MART (17), tethered running (30) on the treadmill and on the track (14), or the Margaria staircase test, these tests need expensive equipment and sophisticated technological apparatuses, such as MART and tethered running, or are performed in running on staircase, which is not used in a sporting activity. Therefore, the RAST has practical advantages over these other running methods.

Coaches and trainers can use a simple method of anaerobic assessment that does not require the use of sophisticated and expensive equipment or running performed on a staircase or inclination conditioning and performed in repeated sprints, as occurs in some sports. However, more studies on this procedure are required, measuring other parameters of RAST, such as anaerobic contribution and oxygen debit in tests. Our results have shown that the RAST is not only a reliable and valid procedure to assess anaerobic power, but also a good predictor of short-distance running performances. Because of its simplicity, it can easily be incorporated into routine training.

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