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EFFECT OF TWO DIFFERENT LONG-SPRINT TRAINING REGIMENS ON SPRINT PERFORMANCE AND ASSOCIATED METABOLIC RESPONSES

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ABSTRACT

Hanon, C, Bernard, O, Rabate, M, and Claire, T. Effect of two different long-sprint training regimens on sprint performance and associated metabolic responses. *J Strength Cond Res* 26(6): 1551–1557, 2012—The purpose of this study was to analyze 2 different long-sprint training programs (TPs) of equal total work load, completed either with short recovery (SR) or long recovery (LR) between sets and to compare the effects of 6 long-sprint training sessions (TSs) conducted over a 2-week period on a 300-m performance. Fourteen trained subjects performed 3 pretraining maximal sprints (50-, 100-, and 300-m), were paired according to their 300-m performance, and randomly allocated to an LR or SR group, which performed 6 TSs consisting of sets of 150, 200, or 250 m. The recovery in the LR group was double that of the SR group. During the third TS and the 300-m pretest and posttest, blood pH, bicarbonate concentration ($[\text{HCO}_3^-]$), excess-base (EB), and lactate concentration were recorded. Compared with a similar TS performed with SR, the LR training tends to induce a greater alteration of the acid-base balance: pH: 7.09 ± 0.08 (LR) and 7.14 ± 0.05 (SR) ($p = 0.10$), $[\text{HCO}_3^-]$: 7.8 ± 1.9 (LR) and 9.6 ± 2.7 (SR) ($p = 0.04$), and EB: -21.1 ± 3.8 (LR) and -17.7 ± 2.8 (SR) ($p = 0.11$). A significant improvement in the 300-m performance between pre-TP and post-TP (42.45 ± 2.64 vs. 41.52 ± 2.45 , $p = 0.01$) and significant decreases in pH ($p < 0.01$), EB ($p < 0.001$) and increase in [La] ($p < 0.001$) have been observed post-TP compared with those pre-TP. Although sprint training with longer recovery induces higher metabolic disturbances, both sprint training regimens allow a similar 300-m performance improvement with no concomitant significant progress in the 50- and 100-m performance.

KEY WORDS running training, blood lactate concentration, acid-base balance, recovery duration

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INTRODUCTION

Long sprint exercises (~30 seconds), currently described in the literature ([25] for review), result in a marked elevation in adenosine triphosphate (ATP) use and provoke considerable muscle metabolic and ionic alterations, such as decrease in muscle pH. When exercise is repeated over weeks (i.e., during a training program [TP]), many adaptations occur within the muscle such as metabolic pathways of energy, which are associated with the ability to combat the accumulation of certain metabolites associated with fatigue (26). To date, most studies on long-sprint have focused on interval training regimens with a ratio of 1:3–1:10 between sprints and recovery durations (recovery periods never exceed 4.5 minutes) (1,5–8,14,17,21). These relatively short recoveries induce a decrease in the intensity of the repeated sprint exercises (2) associated with a decrease in the anaerobic glycolytic contribution to the ATP resynthesis, whereas the amount of energy derived from aerobic metabolism progressively increased (4,18). These long-sprint TPs with relatively short recovery (SR) times have been shown to improve both the performance on 30-second all-out test (14) and the activity of the aerobic enzymes (6,8).

Similarly, longer recovery between sets improves the rate of the anaerobic glycolysis, increases the phosphofructokinase activity in strength enhancement (16), alters the acid-base balance (22), and minimizes the demand on the aerobic system (25), which could explain why conventional textbooks on training (23) also recommend interval sprint training with long recoveries (up to 20 minutes with an exercise/recovery ratio of 1:20) for the enhancement of long-sprint performance. Therefore, although sprints performed with long recovery (LR) could also be an effective way of training, the effects of sprint training with LR on performance and the precise glycolytic and acid-base responses of sprint training elicited by different lengths of recovery are poorly documented. The only study allowing an LR period (10 minutes) between 2×30 -second exercises has observed a postexercise increase in muscle lactate concentration and a decrease in blood pH (22), but the TP was not based on long-sprint training only.

Consequently, the aims of this study were (a) to characterize the glycolytic and acid-base responses elicited by LR sprint training sessions (TSs) (LR group, ratio of ~1:20) and to compare them with short recovery TS (SR group, ratio of ~1:10) of equal total work load and (b) to compare the effects of 2 weeks of both TPs on 50-, 100-, and 300-m sprint performances.

As the metabolic responses elicited by sprint interval training may differ depending on the length of the recovery (26), we hypothesized that LR compared with SR TSs will induce greater alterations in the postexercise acid-base balance. We also postulate that LR, as for SR TPs, could improve 300-m performance but with a greater demand and enhancement of the glycolytic pathways and therefore a concomitant increase in 100-m performance, which is supposed to be representative of the impact of improved glycolysis (28).

METHODS

Experimental Approach to the Problem

The protocol included a pretraining test, a TP, and post-training test and was completed before the summer competition period. In the pretraining and posttraining tests, the subjects performed 3 maximal sprint tests (50, 100, and 300 m) on an indoor track.

Subjects

Fourteen male subjects (age: 21.9 ± 3.2 years, height: 177.8 ± 7.1 cm, and body mass: 72.5 ± 11.0 kg) took part in this study. All of them were regional track and field competitive 800-m runners or competitive soccer or rugby players and currently following aerobic and sprint training (3–5 TSs a week). The tests were performed during a regular TS, at the beginning of the competition phase during late afternoon (between 4 and 6 PM) at least 4 hours after the last meal. The subjects were instructed not to consume food and beverages (other than water) in the 2 hours before testing. All the participants were also asked to refrain from alcohol consumption and not to perform vigorous exercise in the 24 hours preceding testing. All the participants were notified of the research procedures, requirements, benefits, and risks before providing informed consent. The Institutional Research Ethics Committee granted approval for the study.

Procedures

After the first test session, the subjects were matched in pairs according to their 300-m performance and then randomly allocated to one of the long sprint TPs (LR for the long-recovery group; SR for the short-recovery group). Both groups subsequently undertook 2 weeks of sprint training (i.e., 6 long sprint TSs) described in Table 1. The TP had the same total work load with either LR time (LR group, work-rest ratio about 1:20) and then high running velocity, or SR time (SR group, work-rest ratio about 1:10) with slower velocity. The subjects were asked to treat each interval session as a “high-intensity” and select the intensity of the first distance

throughout each TS in response to the standardized work prescription; conditions that are similar to how sprint athletes normally train. They were also instructed to attempt to maintain the highest average running velocity they could across all the successive sessions. The athletes were regularly updated about the time remaining in each rest period. All TSs were separated by at least 48 hours. The posttraining tests were performed 5 days after the last TS.

Sprint Training Program Design. Tests and training programs are given in Table 1.

Fifty-, Hundred-, and Three-Hundred-Meter Sprint Tests. These tests were 50-, 100-, and 300-m races performed on a synthetic indoor track before and after the training procedure. The final 50-, 100-, and 300-m times were measured using photoelectric cells (Microgate, Bolzano, Italy). The warm-up was standardized according to a regular preevent competition warm-up (15 minutes of jogging, stretching, warm-up short sprints). The tests were performed late afternoon at least 4 hours after the last meal with a recovery of 7 minutes between each distance for the 2 groups. The athletes were asked to run as fast as possible, and strong vocal support was given from the start to the finish line.

Blood samples were taken from the ear lobe just before the start of the 50 m (7 minutes after the end of the warm-up), 1 and 4 minutes from the onset of the passive recovery after the 300-m test.

Analysis of the Third Training Session: 3 × 250 m. A standardized warm-up (15 minutes of jogging, stretching, 2 successive sprints: 2 × 80 m) followed by a 7-minute recovery period preceded the TS. The passive recovery was 12 minutes (LR) and 6 minutes (SR) between each of the 250-m races for each training group, respectively. Each athlete was asked to run alone as fast as possible, and each 250-m time was recorded. The index of fatigue (percent) ($[(\text{third } 250 \text{ m} - \text{first } 250 \text{ m}) / \text{first } 250 \text{ m}]$) was determined for each subject. Strong vocal support was given from the start to the finish line.

During this TS, several blood samples were obtained for biological analysis: before the start of the TS (postwarm-up), before the third 250 m (intermediate blood sample), 1 and 4 minutes after the third 250 m.

Blood Samples. Arterialized capillary blood samples (85 μ l) were taken from hyperemized ear-lobes to measure blood pH, bicarbonate concentration ($[\text{HCO}_3^-]$), excess base (EB), and lactate concentration [La] with an i-STAT dry chemistry analyzer (Abbott, Les Ulis, France).

Statistical Analyses

The data are presented as means \pm SD. A 2-way analysis of variance for comparison of training groups (LR vs. SR) and repeated measures (the 3 running velocities and the 4 blood samples) were used to analyze the third TS.

A 2- or 3-way analysis of variance was used to test for interactions and main effects of training groups (LR vs. SR), TP

TABLE 1. Tests and training programs.*†

	Day	Exercise	LR group	SR group
Pre-test	3	50, 100, 300 m		
Session 1	1	2 × (3 × 150 m)	r: 8 min, R: 15 min	r: 4 min, R: 7 min 30 s
	2	Rest		
Session 2	3	2 × (150–200–150 m)	r: 8 min, R: 15 min	r: 4 min, R: 7 min 30 s
	4	Rest		
	5	Rest		
Session 3	6	3 × 250 m	r: 12 min	r: 6 min
	7	Rest		
	8	Rest		
Session 4	9	6 × 150 m	r: 8 min	r: 4 min
	10	Rest		
Session 5	11	4 × 200 m	r: 10 min	r: 5 min
	12	Rest		
	13	Rest		
Session 6	14	3 × 250 m	r: 15 min	r: 7 min 30 s
	15	Rest		
	16	Rest		
	17	Rest		
	18	Rest		
Post-test	19	50, 100, 300 m		

*r = short recovery within the series; R = long recovery between the series; LR = long recovery group; SR = short recovery group.

†For example, in session 2, the recovery (r) after the 200 m is 8 minutes in LR and 4 minutes in SR, the recovery (R) after the end of the first series (second 150 m) is 15 and 7 minutes 30 seconds in LR and SR, respectively.

effect (pretraining vs. posttraining), and repeated measures on blood samples (rest, first minute of recovery, fourth minute of recovery) on the dependent variables, expressed as absolute values or variations from postwarm-up values. In the case of a significant main effect on repeated measures or a significant interaction, a post hoc test (Newman Keuls) was performed to determine where the difference occurred. The alpha level for statistical significance was set at 0.05.

In addition, as the expected effect on performance in trained subjects is rather small, the effect size (ES) was calculated for the results that approached significance ($0.05 < p < 0.11$). Cohen's conventions for ES were used for interpretation, where $ES < 0.2$, 0.5, and 0.8 are considered as small, medium, and large, respectively.

All statistical analyses were conducted using Statistica software (version 5.5) except for ES (Watkins, Pennsylvania State University, 2002).

RESULTS

Running Velocities during the Third Training Session

The velocities performed during the 3×250 -m TS are presented in Figure 1. The average velocities for each group (7.18 ± 0.3 [LR] and 6.96 ± 0.5 m·s⁻¹ [SR]) are not significantly (NS) different ($p = 0.34$). However, interaction between both main effects (training groups and repeated measures) reveals that a significant decrease in velocity occurred from the first to the last 250 m in LR ($p < 0.01$) but

not in SR (NS). The index of fatigue for LR (7.9%) was significantly greater than the index of fatigue for SR (2.1%) ($p < 0.05$). As observed in Figure 1, the LR velocity is significantly greater than the SR velocity during the first repetition ($p < 0.05$), but no significant difference was observed during the second and third 250-m exercises.

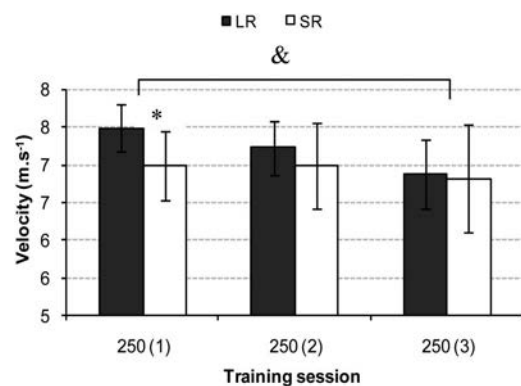


Figure 1. Evolution of the velocity during the third training session (3×250 m) 250 (1, 2, or 3): first 250 m, second and last 250-m exercise. *: Significant difference between LR (long recovery group) and SR (short recovery group) velocity, &: significant decrease in velocity from the first to the last 250 m in the LR group, $p < 0.05$.

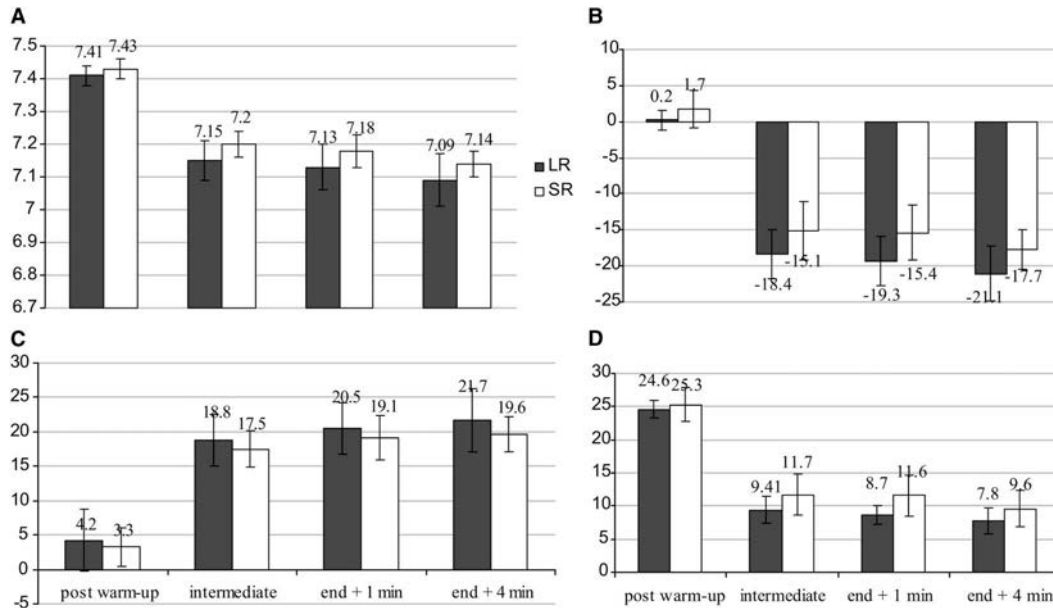


Figure 2. Evolution of pH (A), excess base (B), [lactate] (C), and [HCO₃⁻] (D) before, during, and after the TS: 3 × 250 m. The values are recorded postwarm-up and just before the first 250 m (postwarm-up), before the third 250 m (intermediate), and 1 minute (end + 1 minute) and 4 minutes (end + 4 minute) after the last 250 m. C, D): in millimoles per liter. LR and SR groups = long and short recovery groups.

Biological Responses during the Third Training Session

The metabolic data comprising blood pH, [HCO₃⁻], EB, and [La] recorded during the third TS are presented in Figure 2.

In both groups, a significant effect of time ($p < 0.0001$) was observed in all 4 variables, with a progressive decrease from warm-up to the end of the TS for pH, [HCO₃⁻], and EB and a concomitant progressive increase in [La]. No significant main effect of the TP was observed for pH, EB, and [La] but the LR TS induced a significantly lesser [HCO₃⁻] compared with SR ($p = 0.04$, ES = 0.81). However, p and ES were

0.10 (0.71) for pH and 0.11 (0.76) for EB, which could indicate a tendency for a larger alteration of the acid-base balance in the LR group.

Effect of Training Program on 50-, 100-, and 300-m Performance

The pretraining and posttraining performances performed on the 3 distances (50, 100, and 300 m) are presented in Table 2. When considering both groups together, no significant effect of TP (pretraining vs. posttraining velocities) has been observed

TABLE 2. Chronometric performances (50, 100, and 300-m) pretraining and posttraining programs.*†‡

	Total		LR		SR	
	Pre	Post	Pre	Post	Pre	Post
50 m (s)	6.42 ± 0.32	6.38 ± 0.27	6.42 ± 0.31	6.37 ± 0.28	6.42 ± 0.34	6.38 ± 0.28
100 m (s)	12.41 ± 0.56	12.36 ± 0.57	12.9 ± 0.48	12.43 ± 0.66	12.31 ± 0.53	12.33 ± 0.65
300 m (s)	42.63 ± 2.63	41.75 ± 2.53	42.77 ± 2.31	41.81 ± 2.56	42.46 ± 3.14	41.67 ± 2.69
300 m (%)	100 ± 0.00	97.93 ± 2.63	100 ± 0.00	97.77 ± 2.94	100 ± 0.00	98.13 ± 2.41

*LR = long recovery group; SR = short recovery group; total = the 2 groups are mixed; pre and post = before and after the 2-week sprint program.

†Values are mean ± SD.

‡In %: relatively to the pretraining 300-m performance, in bold: significant difference with pretest, $p < 0.01$, effect size for LR: 0.60 and 0.61 for 100- and 300-m test, respectively.

TABLE 3. Metabolic data after the 300-m test pretraining and posttraining programs for LR and SR.*†‡

	LR (<i>n</i> = 7)		SR (<i>n</i> = 7)	
	Pre	Post	Pre	Post
Post Warm-up				
pH	7.34 ± 0.07	7.36 ± 0.03	7.38 ± 0.05	7.35 ± 0.03
[HCO ₃ ⁻]	18.5 ± 4.2	20.3 ± 2.0	20.4 ± 3.2	19.3 ± 2.4
EB	-7.0 ± 2.8	-4.4 ± 2.7	-6.7 ± 3.0	-5.5 ± 2.9
[Lactate]	9.6 ± 4.7	8.6 ± 3.1	10.6 ± 3.0	9.9 ± 3.8
1 min				
pH	7.25 ± 0.08	7.20 ± 0.09	7.25 ± 0.03	7.20 ± 0.03
[HCO ₃ ⁻]	13.4 ± 2.9	13.0 ± 1.4	15.5 ± 2.2	14.6 ± 1.7§
EB	-13.5 ± 4.1	-14.3 ± 1.9	-10.8 ± 2.2	-12.8 ± 2.3
[Lactate]	16.2 ± 2.7	17.6 ± 1.6	15.5 ± 1.9	16.0 ± 1.6
4 min				
pH	7.13 ± 0.04	7.14 ± 0.05	7.18 ± 0.03	7.15 ± 0.04
[HCO ₃ ⁻]	9.3 ± 1.8	9.1 ± 1.5	11.4 ± 2.2	10.6 ± 1.6§
EB	-19.2 ± 2.5	-18.1 ± 2.5	-16.5 ± 2.5	-16.5 ± 2.1
[Lactate]	20.2 ± 2.5	19.8 ± 1.1	18.5 ± 1.5	19.6 ± 2.6

*LR = long recovery group; SR = short recovery group; EB = excess base; [HCO₃⁻] = bicarbonate concentration; [lactate] = lactate concentration in millimoles per liter; pre and post = before and after the 2-week sprint program.

†Values are mean ± SD (*n* = 14).

‡The data are recorded postwarm-up and just before the 300-m test, 1 or 4 minutes after the end of the 300-m test.

§Significant difference in the effect of the TP (difference between LR and SR adaptations).

on 50 and 100 m ($p = 0.11$ and 0.18 , respectively), the difference between pre and post TP was only significant for the 300-m distance ($p < 0.01$). Whatever the distance, no significant difference between the 2 TP has been reported (NS). It is to be noted, however, that the 100-m performance tends to be improved with LR (+0.06 seconds) but not with SR TP (-0.02 seconds).

Effect of Training Program on Blood pH, [HCO₃⁻], Excess Base, and Lactate

The blood data recorded 1 and 4 minutes after the 300-m test are presented in Table 3 for LR and SR. Both groups considered together, the analysis of variance reveals that the 300-m test induced a significant decrease in blood pH, [HCO₃⁻], and EB and a significant increase in [La] ($p < 0.0001$).

Moreover, considering both groups together, the variation post TP of these metabolic data (when expressed relative to postwarm-up values) is significantly greater during the post-TP than during the pre-TP ($p < 0.05$).

After 1 minute of recovery, decreases in pH compared with postwarm-up values equal 0.12 ± 0.07 and 0.16 ± 0.04 , in pretraining and posttraining conditions, respectively ($p < 0.01$); [HCO₃⁻] decreases equal 4.4 ± 2.9 and 6.7 ± 2.3 mmol·L⁻¹, in pre-TP and post-TP, respectively ($p < 0.001$); EB decreases equal 5.9 ± 4.2 and 9.5 ± 2.6 , in pretraining and posttraining conditions, respectively ($p < 0.001$); [La] increases equal 5.8 ± 3.2 and 8.7 ± 3.2 mmol·L⁻¹,

in pretraining and posttraining conditions, respectively ($p < 0.001$).

After 4 minutes of recovery, [HCO₃⁻] decrements equal 8.5 ± 3.0 and 10.1 ± 2.3 mmol·L⁻¹, in pretraining and posttraining conditions, respectively ($p < 0.001$); [La] increments equal 9.4 ± 3.3 and 10.9 ± 3.2 mmol·L⁻¹, in pre-TP and post-TP conditions, respectively ($p < 0.02$).

Nevertheless, whatever the metabolic data, no significant differences are observed between both groups (LR vs. SR) ($p > 0.05$). The only significant difference in the effects of the 2 TP is a higher decrease posttraining [HCO₃⁻] in the SR group compared with that in the LR group.

DISCUSSION

This study demonstrates (a) a larger alteration of the blood-acid base balance with long- rather than with short-recovery durations in a particular TS (3×250 m), (b) a significant improvement in the 300-m performance after 2 weeks of sprint training associated with modified metabolic responses (greater acid-base balance alterations and [La] increase) with no difference between the 2 TP, (c) no concomitant significant improvement in the 50- and 100-m performance.

The duration of the present protocol is short compared with that usually used in the studies aiming to analyze the impact of a particular type of training (5–8 weeks) on acid-base balance (26). Considering the nature of this very demanding training, it seems very difficult to extend the training duration without

risking that subjects lose interest, injure themselves, or even burn out. For this reason, Burgomaster et al. (6) tested with recreationally active subjects, the effects of only 6 TSs (Sprint Interval Training) and still observed a progress of 5% in a Wingate test peak power. Furthermore, the subjects involved in the usual training designs are recreationally active students, whereas we used regularly trained athletes.

Even in this population, 6 sessions of a specific long sprint TP have been shown to be sufficient to obtain a significantly improved 300-m performance, but the magnitude of the progress was about 2% in our study, which is lower than the progress currently observed in the literature (7,9,14) (usually between 5 and 12%). It is to be noted that the only subject who did not improve his 300-m performance was the best runner (<1 minute 50 seconds in the 800-m distance). Interestingly, this negative effect in a well-trained athlete has already been observed (6,8) and raises the question of the relevance of this unusual charge of anaerobic training in well-trained athletes.

The concomitant metabolic changes induced by SR and LR sprint training are the increase in the [La] post 300-m test and the concomitant alteration in the acid-base balance that confirm the results already observed in studies in which 30 second all-out tests were used to evaluate the training effect (14,22). This greater blood acidosis observed after sprint training could be the consequence of a lower plasma strong ion difference [SID] and higher plasma [La⁻] (20). Although speculative, the hypothesis of a greater activity of Na⁺/K⁺ pumps (24) and a greater capacity or amount of mono-carboxylate transporters (5) can favor this lower SID.

When elaborating the TP of both groups, our hypothesis was that a 12-minute duration would be long enough to allow a near-complete muscular recovery. This was supported by a recent study (27), which showed that the performance on long maximal sprints (100-m crawl) was not altered with a recovery duration (15 minutes) similar to the duration of our LR TP. Several studies (3,11) have suggested that 15 minutes of recovery is long enough for the complete PCr restoration and for a large removal of cellular metabolites (lactate and H⁺, especially). Nevertheless, these particular studies performed with less trained subjects and less severe TP did not induce as great alterations of the acid-base balance.

Furthermore, because long rest between sets and exercises has been shown to induce a more optimal motor unit recruitment (19), we had postulated progress in the 100-m performance. As expected, only the LR training results in a moderate progression (+4%) on the 100-m performance, but this nonsignificant effect has to be considered as moderate ($p > 0.05$, ES = 0.64) indicating that long-sprint training alone is not adapted to improving 100-m performance.

The evolution of the velocity and the metabolic responses of a particular TS could help to explain the consequence of the TP on performances. In fact, both TPs induced a progressive

decrease in the TS velocity as usually observed in such a sprint training (13,20). Because the subjects knew the duration of recovery, they adopted a greater velocity during the first repetition, and therefore, the decrease in velocity was greater in LR than in SR TS. Despite being the longest recovery duration ever tested during sprint exercises, 12 minutes was not long enough to allow the velocity to be maintained until the end of the session. Otherwise, this result is quite different from those obtained with shorter exercise durations (10 seconds) where a 2-minute recovery induced a velocity similar to that of a 4-minute recovery (15) and so points out the importance of the exercise duration determining recovery duration.

Nevertheless, a main effect of the recovery duration was observed in the metabolic responses (p was between 0.04 and 0.10, but ES was around 0.80) indicating that long rest duration and therefore greater velocity tend to induce a larger alteration of the acid-base balance compared with shorter recovery. Because of the greatest velocity in LR compared with that in the SR group, the rate of ATP hydrolysis should be higher and subsequently the rate of glycolytic ATP resynthesis greater during the first repetition in LR condition. As has been suggested that short rest periods could reduce the use of fast-twitch glycolytic fibers and therefore increase the reliance on slow-twitch oxidative fibers (10), the accumulation of H⁺ can be reduced with short-recovery duration. Indeed, energy supply during later repeated-sprints (10 × 6 seconds) has been shown to rely less on anaerobic glycolysis and proportionately more on oxidative metabolism (12). So, as of the second repetition, aerobic ATP resynthesis could be increased with SR (25), whereas the longest recovery duration should have limited the participation of the aerobic system and therefore allowed a greater anaerobic stimulation as shown by the lower [HCO₃⁻] in LR compared with SR. Nevertheless, despite this difference in the third TS, our data, demonstrating an improvement in the 300-m performance without concomitant improvement in shorter distances, indicate that the maintenance of velocity rather than the maximal rate of anaerobic energy is improved by the 2 ways of training.

For the first time ever, we have compared 2 ways of training currently used by runners. As expected, we demonstrate that doubled recoveries between the exercises of a TS induce a larger alteration of the acid-base balance but observe that a 15-minute recovery between long sprint exercises is not long enough in trained runners to allow a restored homeostasis.

Furthermore, we demonstrate that the effects on the 300-m performance are not significantly different between the LR and SR groups and that contrary to our second hypothesis the LR TP does not significantly improve the 100-m performance in well-trained subjects ($p > 0.05$, ES = 0.64). Further studies based on sprint training with LR as regularly used by long-sprint coaches are needed to understand the effect of such

a training procedure on skeletal muscle ion transport proteins and fatigue development.

PRACTICAL APPLICATIONS

Based on the result of the third TS, the SR and LR TS appear to be performed with both low pH (~7.10) and $[\text{HCO}_3^-]$ (~10 mmol·L⁻¹) values that could induce in the subjects the capacity to reach lower post-TP pH values before inhibitions occur and allow improvement of the 300-m performance. A 12-minute recovery appears to be not long enough (a) to sufficiently restore the preexercise metabolic status and (b) to differ strongly from a 6-minute recovery. So, coaches aiming particularly to stimulate the rate of the anaerobic ATP resynthesis must keep in mind that only short-sprint exercises achieve this objective and that other mechanisms such as ionic regulation are probably involved in long-sprint training no matter if the recovery is 6- or 12-minute duration. Furthermore, this study confirms a negative effect of this unusual load of long sprint training in the best trained athletes and suggests that the results obtained with less experienced subjects are not easily transferable to well-trained runners.

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