Metabolic and Perceptual Responses during Spinning® Cycle Exercise

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[1]*Department of Health and Exercise Science, The College of New Jersey, Ewing, NJ;* [2]*Department of Health and Exercise Science, Rowan University, Glassboro, NJ; and* [3]*Program in Physical Therapy, Richard Stockton College of New Jersey, Pomona, NJ*

ABSTRACT

KANG, J., E. C. CHALOUPKA, M. A. MASTRANGELO, J. R. HOFFMAN, N. A. RATAMESS, and E. O'CONNOR. Metabolic and Perceptual Responses during Spinning® Cycle Exercise. *Med. Sci. Sports Exerc.*, Vol. 37, No. 5, pp. 853–859, 2005. **Purpose:** The present investigation was undertaken to compare metabolic and perceptual responses between exercise performed at constant intensity (CON) and with a Spinning® protocol of variable intensity (VAR). **Method:** Fifteen subjects, including seven males and eight females (23 ± 5 yr, 72 ± 17 kg, and 171 ± 10 cm), underwent two experimental trials. During each trial, subjects performed a 30-min cycle exercise protocol that was followed by a 30-min recovery period. Exercise was performed at 67 ± 3% (means ± SD) of HR_{max} in CON. In VAR, the similar intensity (68 ± 4% HR_{max}) was also achieved, although the protocol entailed alternating phases of both higher and lower intensity arranged similarly to what is designed for a typical Spinning® workout. Oxygen uptake ($\dot{V}O_2$) and HR were measured at rest and throughout both exercise and recovery, whereas RPE were recorded during exercise only. Plasma lactate concentrations [La] were determined at rest, the end of exercise, and the end of recovery. **Results:** No differences in average $\dot{V}O_2$, HR, and RPE were found during exercise between CON and VAR. However, average $\dot{V}O_2$ and HR were higher ($P < 0.05$) in VAR than CON (0.33 ± 0.03 vs 0.26 ± 0.02 $L \cdot min^{-1}$ and 91 ± 3 vs 80 ± 2 $beats \cdot min^{-1}$, respectively). [La] was higher ($P < 0.05$) at the end of exercise in VAR than CON (7.2 ± 0.8 vs 2.7 ± 0.3 $mmol \cdot L^{-1}$), but became similar at the end of recovery. **Conclusion:** An exercise regimen in which intensity varies exerts no added effect on metabolic and perceptual responses during exercise as long as the average intensity is kept the same. However, VAR resulted in a greater $\dot{V}O_2$ after exercise, and this augmented postexercise oxygen consumption may be mediated in part by elevated plasma [La]. **Key Words:** OXYGEN UPTAKE, HEART RATE, LACTATE, RESPIRATORY EXCHANGE RATIO, RATINGS OF PERCEIVED EXERTION, RECOVERY

Aerobic exercise performed at variable intensities, such as in Spinning®, has gained popularity within recent years in the fitness industry (6). Such a variable intensity exercise is typically accomplished by changing workload during different stages of the workout to reach different target HR throughout exercise (Fig. 1). This exercise of changing intensity replicates the experience of outdoor cycling during which intensity often varies. As such, despite the fact that the workout regimen entails multiple moments of relatively higher intensity exercise, it can still be effective in engaging exercise participants, especially when conducted to the accompaniment of music and/or visualization (6).

However, direct comparisons as to whether an exercise of variable intensity is indeed more demanding physiologically or perceptually than constant intensity exercise have not been undertaken. In particular, it is questionable whether an exercise of variable intensity would help produce greater metabolic responses, although not necessarily being perceived more demanding as compared with an exercise of constant intensity, given that the overall average exercise intensity is kept the same. Using an intermittent exercise, which is characterized by periods of exercise separated by periods of rest, earlier studies by Astrand et al. (3) and Saltin et al. (18) have demonstrated lower oxygen uptake ($\dot{V}O_2$), HR, and blood lactate concentration ([La]) as compared with continuous exercise in young individuals. Recently, Morris et al. (15) have also shown attenuated physiological responses after intermittent exercise in older men. It must be recognized that much of the current literature concerning variable intensity has been associated with intermittent exercises that should differ from exercise of variable intensity. The latter is the exercise in which there is no rest period and intensity fluctuates in a repeating pattern.

It may be assumed that inserting multiple periods of more intense exercise would help in eliciting a greater metabolic cost. It has been well documented that once an exercise is performed at an intensity near or above the lactate threshold, there would be a gradual but sustained rise in $\dot{V}O_2$ that is often regarded as a slow component despite unchanging intensity (8). However, this slow component of $\dot{V}O_2$ is

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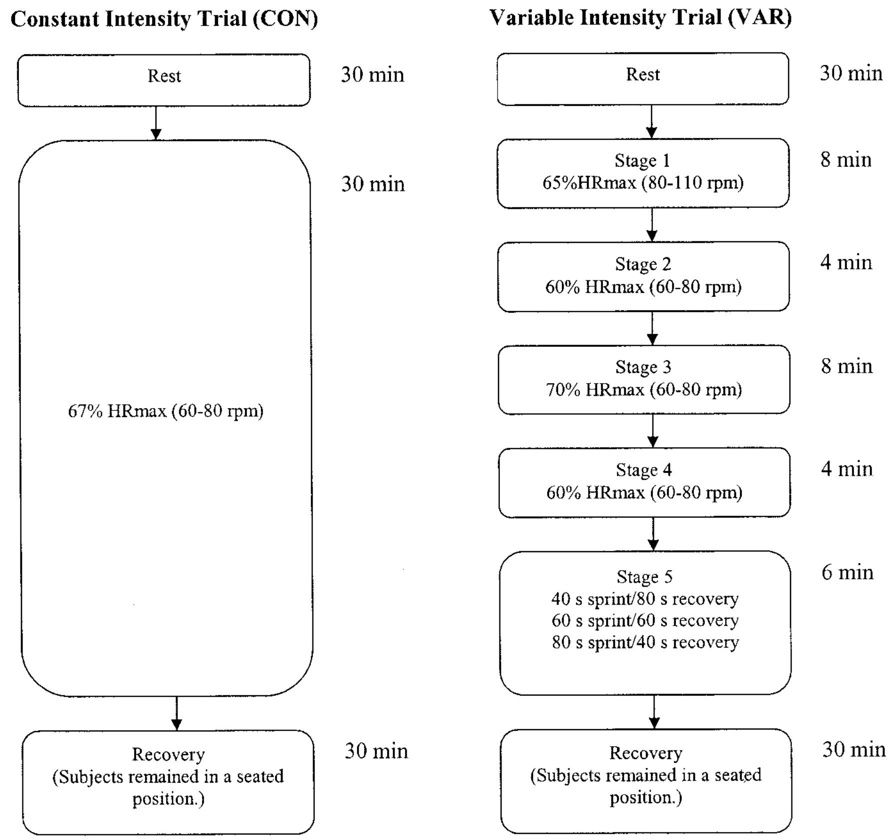

FIGURE 1—Schematic illustration of experimental protocol. Derived from *Johnny G.'s Spinning® Instructor Manual* (12).

associated with an increase in [La], and in this regard a concern may be raised as to whether a variable intensity exercise bout would be felt as more fatiguing. It may also be argued that an exercise in which intensity fluctuates would augment the level of postexercise metabolism to a greater extent. This is because an exercise involving a more frequent change in intensity may have the potential to disturb the body's homeostasis to a greater extent. Almuzaini et al. (1) have found that splitting a 30-min session into two 15-min sessions elicited a greater postexercise $\dot{V}O_2$.

The purpose of this investigation was to compare metabolic and perceptual responses to exercise of variable (VAR) and constant (CON) intensity while the average intensity measured as $\%HR_{max}$ was kept similar between the two exercise conditions. Comparisons were made during both exercise and recovery. It was our hypothesis that $\dot{V}O_2$ would increase to a greater extent during exercise and recovery in VAR as compared with CON, and this differential response in $\dot{V}O_2$ would be mediated by [La].

METHODS

Subjects. Fifteen subjects, seven males and eight females, volunteered to participate in this study. These subjects were healthy and physically active. However, none of the subjects were engaged in a competitive sport at the time of the study and each was free of any orthopedic injury. Subjects were informed of the purpose and testing procedures of the study and each gave their written consent to participate. All experimental procedures were evaluated and approved by The College of New Jersey Institutional Review Boards for Human Subjects Experimentation. The physical and physiological characteristics of subjects are presented in Table 1.

Experimental design. Each subject completed an orientation session, a maximal $\dot{V}O_2$ test, and two experimental trials on a stationary cycle ergometer. The maximal test was administered to establish $\dot{V}O_{2peak}$ and to prescribe workloads for the subsequent experimental trials. The two experimental trials occurred in a counterbalanced order with each subject randomly assigned to a predetermined order. During each experimental trial, the subjects first performed a 30-min exercise bout at either VAR or CON intensity. There was a 5-min warm-up period before the exercise began. Each exercise was then followed by a 30-min recovery period. The average exercise intensity was kept the same at approximately 67% HR_{max} in VAR and in CON. This

TABLE 1. Physical and physiological characteristics of subjects.

	Males	Females	Total
No.	7	8	15
Age (yr)	23 ± 1	24 ± 7	23 ± 5
Height (cm)	177 ± 8	165 ± 7	171 ± 10
Body mass (kg)	83.4 ± 19.1	64.2 ± 8.9	72.5 ± 17.65
HR_{max} (beats·min^{-1})	187 ± 9	184 ± 5	185 ± 7.1
$\dot{V}O_{2peak}$ (L·min^{-1})	3.10 ± 0.82	2.08 ± 0.58	2.59 ± 0.83
$\dot{V}O_{2peak}$ (mL·kg^{-1}·min^{-1})	37.8 ± 8.2	32.25 ± 8.1	35.9 ± 8.8
$\dot{V}E_{BTPSmax}$ (L·min^{-1})	92.8 ± 33.2	65.2 ± 23.6	79.2 ± 30.1
RER_{max}	1.09 ± 0.09	1.05 ± 0.06	1.07 ± 0.08

Values are means ± SD.

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intensity remained unchanged throughout CON, and subjects were instructed to alter their intensity in a way similar to a typical Spinning® workout in VAR (12). The experimental trials were separated by at least 2 d and completed within a 3-wk period. We ran our experiments both in the morning and afternoon. However, for each subject, both CON and VAR were conducted at the same time of the day. All subjects were in a 3-h postabsorptive state before testing.

$\dot{V}O_{2peak}$ test. The $\dot{V}O_{2peak}$ test was used to ascertain the subject's cardiovascular fitness and to establish anchors for ratings of perceived exertion. It was conducted on a stationary cycle ergometer and followed an incremental protocol as previously described (14). Each subject was verbally encouraged to continue exercise until volitional exhaustion. $\dot{V}O_2$, minute ventilation ($\dot{V}_E$), and RER were measured every 30 s. HR was measured during the last 15 s of each minute. The maximal value for $\dot{V}O_2$ was taken as the average of the two highest consecutive values. The test was terminated when the subjects met at least two of the following three criteria: failing to maintain the peak power output for 15 consecutive seconds, an increase in $\dot{V}O_2$ of less than 100 $mL \cdot min^{-1}$ despite an increase in workload, and a RER greater than 1.05. A best-fit linear regression equation, in which HR was plotted as a function of power output (PO), was developed for each subject. This equation was then used to determine PO corresponding to a given $\%HR_{max}$ for the subsequent experimental trials.

Before beginning this maximal test, the subjects were introduced to the Borg 15-point category ratings of perceived exertion scale (4). They read a brief set of perceptual scaling instructions as used in our previous investigation (13) and were instructed to rate their overall exertion arising not only from exercising limbs but also from pulmonary respiration as well as the rest of the body. Any questions concerning the procedures for rating the intensity of exertion were answered at this time. During the maximal test, both low and high anchors for RPE scale were established. The low anchor was equated with the exertion experienced during the first stage of the test in which subjects pedaled at about 50 rpm against no resistance. The high anchor was equated with the exertion experienced during the last stage of the test in which subjects reached their maximal capacity.

Experimental trials. Before each experimental trial, subjects were measured for their resting metabolic rate (RMR). They rested quietly in a sitting position for 30 min with $\dot{V}O_2$, RER, and HR measured every minute during the last 5 min of the resting phase. At the end this resting phase, the baseline [La] was also determined.

During each experimental trial, subjects performed a 30-min exercise bout on a leg cycle ergometer (Monark 868E, Monark-Crescent, Varberg, Sweden). In CON, subjects self-selected a constant pedaling frequency (between 60 and 80 rpm) and constant cycle resistance (W) to elicit a target HR of 67% HR_{max}. This intensity was chosen because it meets standards for the recommended quantity and quality of exercise for developing and maintaining fitness in healthy adults (2). This moderate intensity also provided room for us to increase intensity in VAR that would not exceed the recommended training range. Throughout the exercise, $\dot{V}O_2$, and RER were measured every minute, whereas HR and undifferentiated RPE were recorded every 3 min. In addition, [La] was determined immediately after the cessation of the exercise.

In VAR, the 30-min exercise bout was divided into five different stages according to the described Spinning® protocol (12). As shown in Figure 1, each stage was associated with a predetermined target HR ranging from 60% to 80% HR_{max} (12). In our pilot trials, we have tested out and observed that during the last stage (i.e., stage 5) of VAR, HR can rise to approximately 80% HR_{max}. It is because of this observation that we were able to establish target $\%HR_{max}$ values for other phases during VAR as shown in Figure 1. These $\%HR_{max}$ values were determined by also weighing the duration of each stage. The length of time for each stage was made proportional to what is being done in the real setting. In each stage, subjects were instructed to follow the recommended pedaling frequency and brake resistance in an effort to achieve the stage-specific target HR. The exercise program that was prescribed for each individual was illustrated on a chalkboard in front of the subjects so that they knew exactly when and by how much exercise workload should be changed. Changes in exercise workload were made by subjects. However, this process was always prompted and verified by an investigator. Throughout the exercise, $\dot{V}O_2$ and RER were measured every minute, whereas HR and undifferentiated RPE were measured every 2 min in stages 1–4 and at the end of each sprint/recovery phase in stage 5. In addition, [La] was determined immediately after the cessation of the exercise bout.

Each exercise trial was followed by a 30-min recovery phase in which the subject remained in a seated position. During this recovery phase, $\dot{V}O_2$ and RER were measured every minute, whereas HR was measured every 3 min. In addition, [La] was determined once again at the end of recovery.

Measurements. $\dot{V}O_2$ and RER were determined using a two-way T-shaped breathing valve (2700 series, Hans Rudolph, Inc., Kansas City, MO) and an open-circuit respiratory-metabolic system (Metabolic Measurement Cart 2900, SensorMedics, Inc., Yorba Linda, CA). HR was determined using an HR monitor (Pacer, Polar CIC, Inc., Port Washington, NY). [La] was analyzed from a sampling of fingertip whole capillary blood using a lancet procedure and a portable lactate analyzer (Accusport Portable Lactate Analyzer, Sports Resource Group, Hawthorne, NY). Ratings of perceived exertion were determined according to the Borg 15-point category scale (4). All trials were conducted in the laboratory where the mean barometric pressure and laboratory temperature were 755 ± 2 mm Hg and 23 ± 1°C, respectively.

Statistical analysis. To better represent the metabolic cost of each exercise condition, all dependent variables, including $\dot{V}O_2$, RER, HR, and RPE were averaged over the 30-min period of exercise. This averaging was also performed for the recovery phase. In addition, a total oxygen

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cost during exercise and recovery was calculated by summing all 30 $\dot{V}O_2$ values ($L \cdot min^{-1}$) collected during exercise and recovery, respectively. Paired *t*-tests were then used to compare these averaged and summed dependent variables between the two exercise conditions. For all statistical tests, a probability level of 0.05 was established to denote statistical significance.

RESULTS

Exercise phase. $\dot{V}O_2$ and HR increased during exercise, and their responses mirrored the changing pattern of exercise intensity as prescribed during VAR (Fig. 2). During CON, after its initial rise, $\dot{V}O_2$ and HR remained constant throughout the trial until the exercise termination. Despite such differential responses over time, no difference in average $\dot{V}O_2$ or HR was observed between the two exercise conditions (Table 2). In addition, the total oxygen cost during exercise remained the same between the two exercise conditions (Fig. 5).

The increases in RER were more profound and persistent during VAR as compared with CON, with its peak reaching well over 1.0 at the end of each high-intensity bout in VAR (Fig. 2). Consequently, the average RER was higher ($P < 0.05$) in VAR than CON (Table 2).

RPE was recorded only during exercise, and its responses were similar to those of $\dot{V}O_2$ and HR during both VAR and CON (Fig. 3). There was a trend ($P = 0.12$) toward a lower average RPE during VAR than CON (Table 2). However, these differences did not reach statistical significance.

No difference in [La] was observed at rest before exercise between the two exercise conditions (Fig. 4). However, [La] was much greater ($P < 0.05$) at the end of VAR than CON. The nearly threefold increase in [La] in VAR, together with the fact that RER surged over 1.0 repeatedly, clearly indicates that VAR used in the present study was associated with a greater reliance on anaerobic metabolism.

Recovery phase. Both $\dot{V}O_2$ and HR decreased similarly during the recovery (Fig. 2). However, the average $\dot{V}O_2$ and HR were higher ($P < 0.05$) in VAR than in CON (Table 2). Furthermore, because $\dot{V}O_2$ remained relatively higher, especially during the early phase of recovery, the accumulated total oxygen cost was also higher in VAR than CON (10.1 ± 0.9 L vs 7.75 ± 0.5 L, $P < 0.05$) (Fig. 5).

The pattern of decrease in RER was similar to that observed for HR and $\dot{V}O_2$ after the cessation of exercise (Fig. 2 and Table 2). Perhaps because RER was higher at the exercise termination, it remained higher during the first 6 min of recovery in VAR than in CON. This between-trial difference, however, became reversed during the later phase of recovery because RER was lower ($P < 0.05$) for the most part during the last 20 min of recovery in VAR than CON. As a result of this reversal, no difference in the average RER was found between VAR and CON.

Despite the fact that [La] was much greater at the exercise termination in VAR than in CON, no difference in [La] was found at the end of recovery between the two trials (Fig. 4).

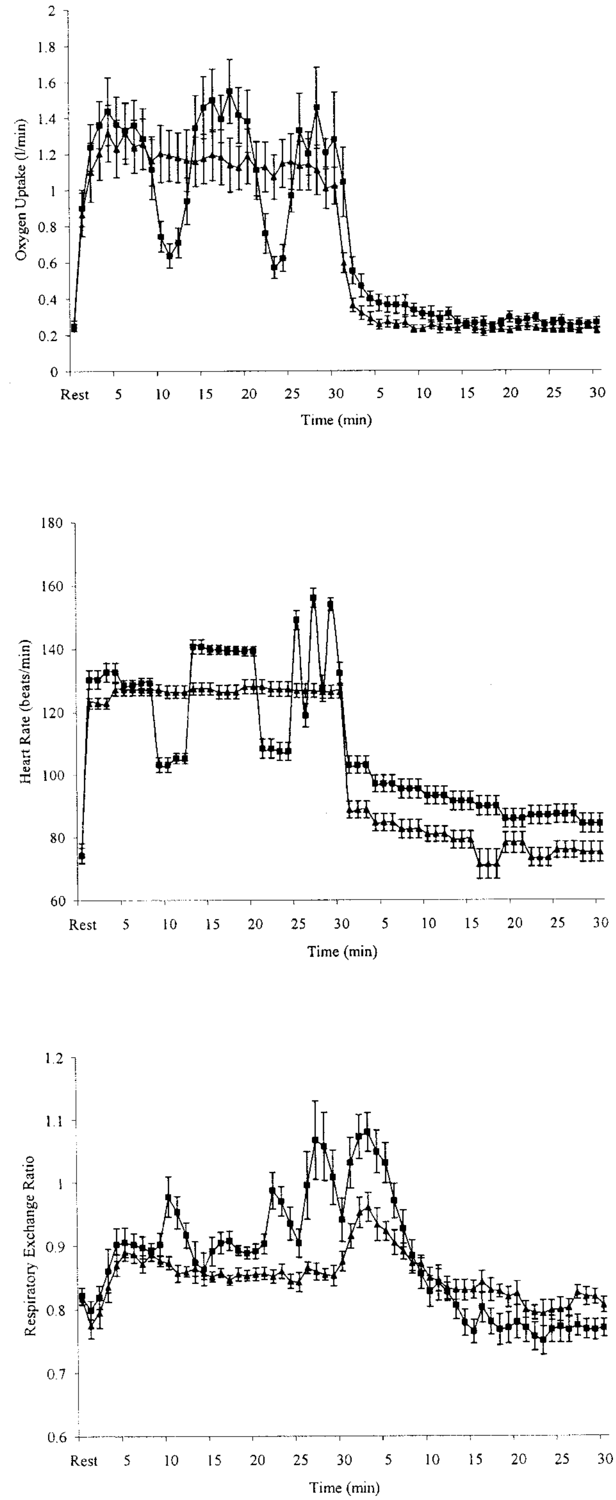

FIGURE 2—Time course of oxygen uptake, heart rate, and respiratory exchange ratio during and after exercise of constant (▲) and variable (■) intensity. Values are means ± SE.

DISCUSSION

An exercise routine in which intensity changes systemically has been widely adopted in many fitness settings. However, the physiology behind this exercise technique is much less understood. Because an exercise of variable in-

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TABLE 2. Comparisons of average physiological and perceptual responses between CON and VAR during exercise and recovery.

Variable	Exercise		Recovery	
	CON	VAR	CON	VAR
$\dot{V}O_2$ (L·min^{-1})	1.15 ± 0.14	1.17 ± 0.11	0.26 ± 0.02	0.33 ± 0.03*
RER	0.86 ± 0.01	0.92 ± 0.01*	0.85 ± 0.01	0.84 ± 0.02
HR (beats·min^{-1})	127 ± 2	130 ± 2	80 ± 2	91 ± 3*
RPE	9.7 ± 0.7	8.9 ± 0.5		

CON, constant intensity; VAR, variable intensity.
Values are means ± SE.
* Significantly different between the two exercise conditions, $P < 0.05$.

tensity entails some moments of high-intensity exercise, it is possible that this technique would help produce greater metabolic responses. Because this type of exercise has been claimed to be more effective in engaging participants, it is also likely that performing such exercise would be felt less demanding perceptually as compared with a typical exercise of constant intensity. In the present study, we attempted to examine these unproven hypotheses by adopting a commonly used Spinning® exercise protocol to create an exercise condition of VAR, and compared the metabolic and perceptual responses that it elicited with those produced during an exercise of CON. Despite alterations in exercise intensity in VAR, which was not the case in CON, the overall average intensity was kept similar between the two exercise conditions, so that the impact of intensity fluctuation on metabolic and perceptual responses could be examined.

In VAR, $\dot{V}O_2$ reflected quite accurately the changing pattern of exercise intensity as described. They were higher and lower than those elicited during CON at times when intensity was increased and decreased, respectively. However, no differences were found in the average $\dot{V}O_2$ between VAR and CON. In addition, the total oxygen cost of exercise was also similar between the two exercise conditions. This finding may be expected, because the overall average intensity was comparable between VAR and CON. However, we have postulated that as long as an exercise regimen contains some moments of vigorous intensity, there should be a subsequent elevation in $\dot{V}O_2$ due to the phenomenon of the slow component of $\dot{V}O_2$. The lack of discrepancy in $\dot{V}O_2$ between the two exercise conditions may be attributable to the fact that in VAR each higher intensity phase did not last long enough, and was always followed by a period of milder workload. It has been suggested that the slow component of $\dot{V}O_2$ kinetics is typically noted after 3 min of exercise (8). Given that the Spinning® protocol that we used was relatively mild, it is also possible that the intensity that was achieved during more vigorous periods may have been below lactate threshold in our subjects who were relatively fit. It must be recognized that the magnitude of the slow component of $\dot{V}O_2$ is largely determined by the extent to which exercise intensity exceeds the lactate threshold (8). [La] did exceed 7 mmol·L^{-1} at the end of VAR. However, this surge in [La] could have been the result of the last phase of intermittent sprinting, and thus may have been too late to influence the slow component of $\dot{V}O_2$.

During recovery, both the average $\dot{V}O_2$ and overall oxygen cost of exercise were found to be significantly higher in VAR than in CON. These findings suggest that performing an exercise in which intensity varies is more advantageous in augmenting energy metabolism after the cessation of exercise. For example, given the differences in average $\dot{V}O_2$, as shown in Table 2, one should expect a 25% increase in energy expenditure after VAR (i.e., 49.5 kcal) as compared with CON (i.e., 30.0 kcal). The precise mechanism that may have caused this increase in postexercise $\dot{V}O_2$ is not readily apparent. It is possible that such an increased postexercise energy cost may have been mediated by a nearly threefold increase in end-exercise blood [La], although other contributors that were not measured currently, such as blood catecholamine and body temperature, cannot be eliminated (5,7,9,11,19). Although this explanation remains plausible, it must be kept in mind that both the exercise duration and average intensity were similar between the two exercise conditions. Given that postexercise $\dot{V}O_2$ declined at a similar rate between the two exercise conditions, it may be further postulated that the greater postexercise $\dot{V}O_2$ seen in VAR is simply due to the fact that the sprinting phase was placed at the end of VAR so that $\dot{V}O_2$ was brought up before the commencement of recovery. In other words, it is unknown whether the outcome will remain the same if this most demanding phase is placed earlier during exercise.

The greater postexercise $\dot{V}O_2$ seen in VAR may also be associated with the fluctuation of exercise intensity *per se*. Based on a previous study by Almuzaini et al. (1), who found that splitting a 30-min session into two 15-min sessions elicited a greater postexercise $\dot{V}O_2$ than 30 min of continuous exercise, it appears that the rest-to-exercise transition or changing of exercise intensity can play a role in mediating postexercise energy expenditure. Indeed, the magnitude of increase in $\dot{V}O_2$ after a given exercise has been largely attributed to the oxygen deficit that often occurs at the onset of the exercise in which there is an increment in intensity (5,7,10). In this context, the greater postexercise $\dot{V}O_2$ seen in VAR may have simply resulted from the fact that exercise intensity has changed a number of times in VAR, whereas this was not the case in CON. In other words, the more frequently the exercise intensity fluctuates, the greater is the disturbance to homeostasis and therefore the greater the postexercise energy expenditure. This contention remains hypothetical. Further studies aimed at testing this hypothesis should consider an experimental approach in which both the magnitude and frequency of intensity fluctuation can be manipulated as independent variables.

As with $\dot{V}O_2$ and HR, the average RPE during exercise did not differ between VAR and CON. It appears that as long as the average intensity remains similar, the overall perception of exertion would stay unchanged despite the fact that RPE fluctuated in accordance with the change in exercise intensity. Particularly noteworthy is that there was a tendency toward a lower RPE during VAR, although this difference did not reach significance. This slightly lower RPE appears to be the result that the abatement in exertion during those low-intensity phases outweighed its rise due to

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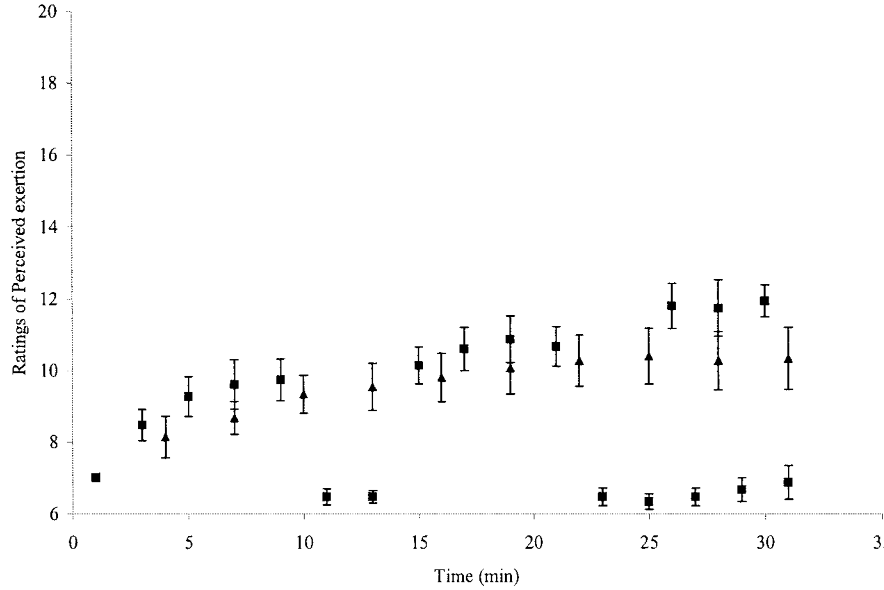

FIGURE 3—Time course of ratings of perceived exertion during and after exercise of constant (▲) and variable (■) intensity. Values are means ± SE.

an increase in workload. Indeed, we observed that during lower intensity phases, most subjects tended to rate their effort lower than what their physiological responses would indicate. Given that VAR is capable of eliciting greater postexercise energy expenditure, the finding that the average RPE did not differ may be viewed as additional evidence to support the use of this exercise technique in that such an increase in energy expenditure would not necessarily be associated with an increased perception of exertion.

It has been evidenced that RPE directly correlates with metabolic demand of exercise as measured by $\dot{V}O_2$ or HR (16). Such a psychophysiological relationship was also observed in the present study, as the changing pattern of RPE mirrored fluctuations of both $\dot{V}O_2$ and HR during VAR. However, in evaluating the magnitude of responses, we noticed that the intensity we used (i.e., 67% HR_{max}) elicited comparatively lower RPE responses ranging from 9 to 10 in both CON and VAR. This finding may be due at least in part to the fact that our subjects were requested to rate their effort based on their overall feeling of exercise rather than exertion derived primarily from exercising limbs. Based on the previous studies that used both the differentiated and undifferentiated RPE, it was found that the differentiated RPE arising from exercising limbs were higher than the overall and undifferentiated RPE (13,17). RPE is also mediated by metabolic acidosis (16). Nevertheless, in the present study, we noted a similarity in RPE between CON and VAR despite the fact that blood lactate increased significantly in VAR but not in CON. This finding disagrees with that of Steed et al. (20) and that of Stoudemire et al. (21), who have found coherent responses between RPE and [La] during 30 min of submaximal running at a constant intensity. The divergence between [La] and RPE found currently may be explained in light of our speculation that the increase in [La]

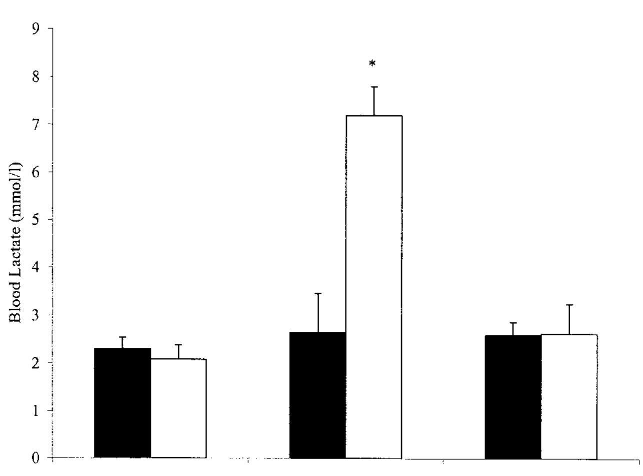

FIGURE 4—Comparisons of plasma lactate concentrations between constant (*solid columns*) and variable (*open columns*) exercise conditions. Values are means ± SE. *Significantly different between the two exercise conditions, $P < 0.05$.

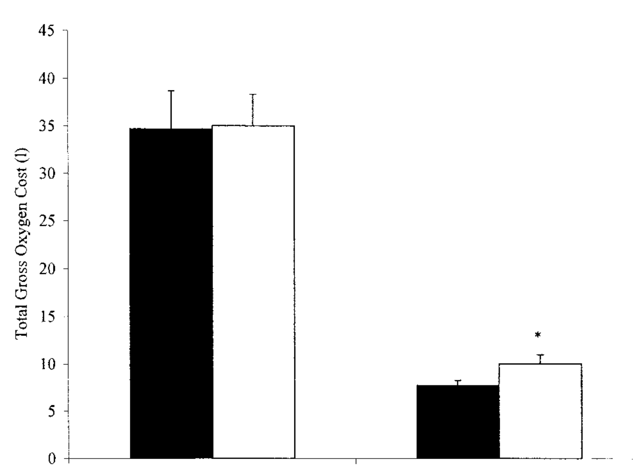

FIGURE 5—Comparisons of total gross oxygen cost between constant (*solid columns*) and variable (*open columns*) exercise conditions. Values are means ± SE. *Significantly different between the two exercise conditions, $P < 0.05$.

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may have occurred toward the end of exercise while subjects were performing intermittent sprinting, so that it could be too late for [La] to exert its impact on the perception of exertion.

In conclusion, we found that an exercise regimen in which intensity varies exerted no added effect on metabolic and perceptual responses during exercise as long as the overall intensity is kept the same. However, this exercise arrangement elicited a greater $\dot{V}O_2$ after the cessation of exercise. This augmented postexercise metabolism may be mediated in part by elevated plasma [La]. It could also be the result of multiple changes in exercise intensity. The present study supports the use of variable intensity exercise as an attractive alternative because it has the potential to augment postexercise energy expenditure and is not associated with an increase in the perception of exertion while performing the exercise. Further studies may be undertaken to examine whether this more dynamic exercise protocol would provoke greater energy expenditure if it is conducted with greater and/or more frequent intensity fluctuation.

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