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# Effect of gender on fatigue and recovery following maximal intensity repeated sprint performance

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***Aim*. This study investigated the effects of gender on repeated, maximal-intensity intermittent sprint exercise following variable day-to-day recovery periods.**
***Methods*. Sixteen volunteers (8 men, 8 women) performed four trials of high-intensity intermittent sprint exercise consisting of three bouts of eight 30 m sprints (total of 24 sprints). Following completion of the baseline trial, in repeated-measures design, participants were assigned, in counter-balanced order, variable recovery periods of 24, 48, and 72 h whereupon they repeated an identical exercise trial.**
***Results*. Results from a series of 4 (trial) x 3 (bout) repeated measures ANOVAs revealed men produced significantly ($P < 0.01$) faster times throughout all bouts and trials of repeated sprint exercise. Additionally, women exhibited significantly lower ($P < 0.05$) blood lactate concentration and significantly lower ($P < 0.05$) decrement in performance, indicating increased resistance to fatigue during repeated exercise sessions. There were no significant differences ($P > 0.05$) between genders for heart rate or rating of perceived exertion during or following trials. There were no significant differences for overall sprint performance within either gender among trials.**
***Conclusions*. These results indicate men, while able to produce higher absolute power outputs (i.e., lower sprint time), demonstrate higher decrement scores within a trial compared to women, thus suggesting women may recover faster and fatigue less. Also, gender differences affecting recovery within in a trial were observed to be diminished between trials (i.e., day-to-day recovery) of maximal intermittent sprint work evidenced by the observed stability of performance between trials following various recovery durations.**

KEY WORDS: Men - Women - Anaerobic threshold - Sprint.

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There is considerable research regarding the role of gender on fatigue during exercise. Compared to women, men typically are leaner, larger, produce higher absolute force and consequently, higher speeds during maximal sprint performance. However women demonstrate greater resistance to fatigue during some intermittent exercise protocols.[1,2] Whereas a number of explanations are offered, the most plausible relates to differences between men and women in muscle mass, substrate utilization, and muscle morphology.[1,3-8] Recently, Perez-Gomez *et al*.[7] found that gender differences in power output during Wingate performance were primarily attributable to reduced lower limb muscle mass in women. Further, there have been a number of studies detailing metabolic differences (i.e., lower resting phosphagen stores, lower glycolytic capacity, increased fat oxidation) between women and men, respectively.[1-3,8] Additionally, some studies demonstrate that men possess a proportionally larger cross-sectional area of Type II muscle fibers.[1,9] Most studies investigating fatigue between men and women have been conducted under tightly controlled laboratory conditions with designs frequently employing isometric contractions (for review see Hicks *et al.*[1]). Consequently, results may not transfer well to actual sport or exercise performances requiring more open-chain, rhythmic, dynamic movement patterns (e.g., sprinting).

High-intensity intermittent sprint training is a popular and effective training modality as it closely replicates the undulating energy expenditure patterns associated with popular sports such as soccer, basketball, volleyball and tennis.[3, 10] There has been considerable attention given to prescribing optimal work-to-rest ratios to determine the minimum acute recovery needed to ensure optimal effort and power output in repeated sprint efforts.[3, 11-14] Indeed, ensuring an optimal recovery has long been considered an integral component of training and, consequently, insufficient recovery may lead to pre-mature fatigue and/or sub-optimal performance during sport training or performance which may increase in an individual's predisposition to injury or lead to overtraining.[15] While considerations for acute recovery (e.g., between sprints) have been well-studied, the pattern for day-to-day recovery is not well-understood and has received little attention. Further, there is a paucity of data regarding optimal recovery patterns for men compared to women. For intermittent training to be beneficial, an individual must be adequately overloaded to manifest desired physiological, biochemical and psychological adaptations.[12, 16, 17] Proximal to such overload should be an optimal recovery period that allows the participant a return to baseline (i.e., restoration of homeostasis) prior to initiating subsequent physical training. This training principle is appropriate not only between individual sprints but also between training sessions.

Recently, Albert et al.[11] reported that, compared to men, women demonstrated greater fatigue resistance and were able to produce relatively higher power outputs during isometric contractions. Further, Wust *et al.*[18] confirmed previous findings suggesting women exhibit a greater resistance to fatigue during lower body isometric exercise. Additionally, Esbjornsson-Liljedahl *et al.*[19] found that women recovered (i.e., able to produce higher relative power output) faster following repeated bouts of maximal 30 s cycling sprints. Accordingly, if women fatigue comparatively slower and recover faster there may be a need to alter the training stimulus or recovery duration to optimize adaptation. However, because of the paucity of data addressing not only appropriate recovery patterns but also the rate of fatigue between gender during intermittent exercise, the prescription process is largely based on supposition. Thus, intermittent training provides a relevant paradigm to investigate the possible impact of gender during repeated maximal sprint performance and on subsequent sprint exercise following variable recovery durations. Because it is proposed that women fatigue at a slower rate and recover more quickly than men [3, 11, 18, 19] it is plausible that current work-to-rest ratios and recovery recommendations are not appropriate for women utilizing this mode of training.

Therefore, the purposes of this study were to: 1) compare rates of fatigue response between men and women performing identical intermittent sprinting bouts and 2) to identify the appropriate recovery period needed to return to baseline levels in men and women. It was hypothesized that men would exhibit a higher rate of fatigue than women during intermittent sprint exercise and that the women would be able to exhibit better day-to-day recovery than the men.

## Materials and methods

### *Participants*

Sixteen (8 men, 8 women) participants provided written, informed consent prior to testing in accordance with the local institutional review board. All individuals were at least moderately active (assessed via questionnaire) and participated in intermittent high-intensity work at least once a week. Prior to data collection, all individuals were assessed for height (cm) and total body mass (kg) using a calibrated stadiometer and beam scale, with body fat percentage estimated utilizing by skinfold calipers (Lange, Cambridge, MD) using the standardized three-site method (men: chest, abdomen, thigh; women: tricep, iliac, thigh).[20]

All participants arrived at the university recreational fields at least 3 h post-absorptive and were instructed to be adequately hydrated, to abstain from caffeine at least 4 h, and alcohol 24 h, prior to each testing session. Also, participants were instructed to eliminate any structured exercise (except for the experimental trials) throughout the data collection period, which lasted a total of six days. Participants were also asked to get a good night's sleep and to replicate dietary intake on days prior to exercise testing. Prior to beginning each trial, participants were queried regarding the adherence to the guidelines about dietary issues, sleep,

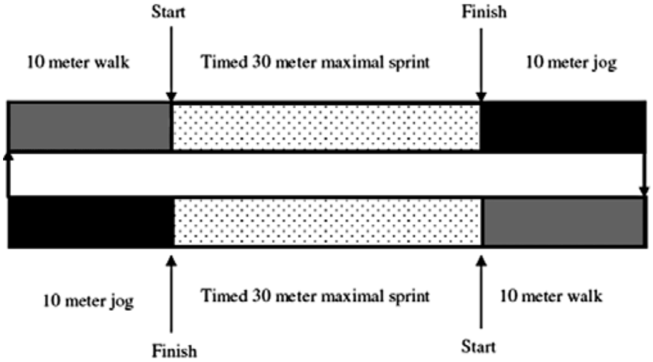


Figure 1.—Schematic illustration of the 30 m intermittent sprints.

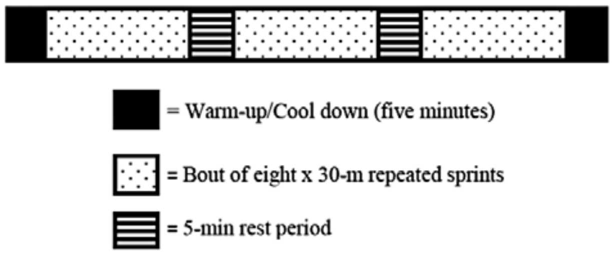


Figure 2.—Schematic illustration of the repeated sprint exercise session.

and physical activity. Each individual was asked to report any previously-existing illness, injury or any other physical/emotional issue that would hinder their performance. Criteria for exclusion from the study involved the acknowledgement or observed evidence of any medical or orthopedic problem severe enough to disrupt the participant's performance or endanger his or her health or a self-reported fitness classification below moderately active.

### *Procedures*

To examine potential gender differences in rate of fatigue and, subsequently, the appropriate recovery duration needed for optimal performance restoration, participants completed four separate trials of repeated maximal sprinting on four separate days utilizing different recovery periods. Each subject completed a familiarization trial that consisted of three bouts of eight repetitions of 30 m repeated sprints (Figure 1) at least one week prior to beginning experimental trials, however no perceptual, performance, or physiological data were collected. Each subject's foot position, as an individual preference, was recorded during the familiarization session and replicated throughout the trials.

Following familiarization, participants completed a baseline trial and three subsequent trials of repeated intermittent sprint exercise. All testing took place outdoors on a level, grass, playing surface during fall months in the southeastern United States. Prior to each exercise trial, the environmental conditions were assessed and there were no significant differences between trials for air temperature (P=0.20), humidity (P=0.49) or wind speed (P=0.56). The intermittent exercise protocol consisted of three bouts of eight (total of 24 sprints) 30-m sprints and was conducted on four separate days with each trial being separated by 24, 48, or 72 h following each previous bout. The recovery periods were assigned in a counterbalanced order after completion of the baseline trial. This protocol of assessing recovery after fatiguing exercise has been utilized in previous work.[21-22]

The protocol of the 30 m intermittent sprints as well as the total exercise session protocol is detailed in Figures 1 and 2, respectively. On each testing day, participants arrived at the same time of day and performed a warm-up that consisted of ~300 m of light running, five minutes of dynamic stretching exercises (e.g., high-knee, carioca) followed by two practice repetitions of the 30 m intermittent sprint. Following the warm-up, participants performed three bouts of intermittent sprinting. Each bout consisted of eight maximal sprints of 30-m (Figure 1) incorporating an electronically-timed 30 m maximal sprint (Speed trap II wireless timing system, Power-Systems Inc. Knoxville, TN) followed by a 45 s recovery period that consisted of a 10 m "easy" jog (i.e., deceleration) followed by a 10 m walk with the remainder of the recovery period being passive. After each 45 s rest period, participants were prompted to immediately perform another sprint. Participants were instructed to approach the line 10 s prior to initiating each sprint and were given a five second countdown to signal the start. The infrared timing system was set at an appropriate lower leg height, as per the manufacturer's instructions, and was used to record the duration to the nearest hundredth of a second of each 30 m maximal-effort sprint.

As shown in Figure 2, participants were given a five minute rest period after completing each set of eight sprints. Prior to initiating each sprint, ratings of perceived exertion (RPE) using the OMNI scale [23] were recorded. Heart rate (HR) was observed prior to and immediately following each sprint utilizing a Polar heart rate monitor that the subject wore throughout each trial. Following the completion of each bout of eight sprints, each individual's blood lactate concentration was assessed using capillary blood samples taken from the fingertip and analyzed using an enzymatic portable lactate system (Lactate Pro, Arkray Inc, Kyoto, Japan), which has been validated.[24] The system was calibrated in accordance with manufacturer's instructions prior to each trial and each blood draw was analyzed in duplicate to ensure reliability. Also, participants provided a session RPE (SRPE) using the OMNI scale to rate the global difficulty of the exercise bout [25] approximately 20 min following each trial (Figures 1, 2).

In order to determine the rate of fatigue, a decrement score (DEC), which was calculated as a percent, was determined in accordance with Oliver [26] for each bout of each trial. The DEC was calculated by dividing the difference between the average sprint time (AST) of the bout and fastest sprint time (FST) of the bout by the FST of the bout and multiplying by 100. For example, a participant whose AST for bout 1 was 4.3 s and their FST was 3.9 s would have a DEC for bout 1 of 10.3% ((4.3-3.9/3.9)*100). That is, during the first bout of eight sprints this individual's sprint performance declined ~10% from their optimal performance (i.e., fastest sprint time). A lower decrement reflects relatively greater ability to sustain performance or less fatigue incurred.

### *Statistical analysis*

All data were analyzed using the Statistical Package for Social Sciences (SPSS, Inc., Chicago, IL). Descriptive and anthropometric data were analyzed to identify any differences between men and women using independent t-tests. In order to determine any significant main effect within each gender, a series of 4 (trial) x 3 (bout of sprints) repeated measures ANOVA were performed for both men and women. When appropriate, post-hoc measures including Fisher's LSD were performed to identify where significant differences occurred. In order to compare the perceptual and physiological response as well as sprint performance between men and women, a one-way ANOVA was performed. Effect size, eta squared (ES) and statistical power (N – B) were also calculated and are reported with the data. All data are reported as the mean ± SD. Statistical significance was determined *a priori* at 0.05.

TABLE I.—*Descriptive characteristics of the participants (N=16).*

| Variable | Men (N = 8) | Women (N = 8) |
|---|---|---|
| Age (yr) | 23.4 ± 2.5 | 21.8 ± 1.0 |
| Height (cm) | 176.2 ± 4.5 | 169.1 ± 5.6 * |
| Body mass (kg) | 89.1 ± 26.5 | 60.7 ± 7.1 * |
| Body fat (%) | 14.0 ± 4.7 | 16.6 ± 1.9 * |

* Significant difference ($P < 0.05$) between men and women.

## Results

The descriptive characteristics of both the men and women are presented in Table I. There were no significant differences in the age between men and women (P=0.11). However, men were significantly taller (P=0.01) had significantly higher body mass (P=0.01) and significantly lower body fat (P=0.01) than women.

### *Sprint time*

Comparisons of the mean sprint times for each bout across all four trials for both men and women are shown in Figure 3. There was no significant main effect of sprint time between trials within the men or women participants (P=0.63 and P=0.27, respectively). However, there was a significant main effect between bouts regarding sprint time, with post-hoc measures revealing both men and women produced significantly slower ($P < 0.05$) sprint time with each successive bout across all trials. Additionally men generated significantly faster ($P < 0.05$) sprint times across all trials and all time points compared to women.

### *Decrement scores*

The mean percent decrements for men and women observed during all three bouts across the four exercise trials are shown in Figure 4. Results from the repeated measures ANOVA revealed no significant main effect between trials (P=0.23) or within trials between bouts of sprints (P=0.09) for men. While women did not demonstrate any significant main effect across bouts of sprints (P=0.82) there was a significant

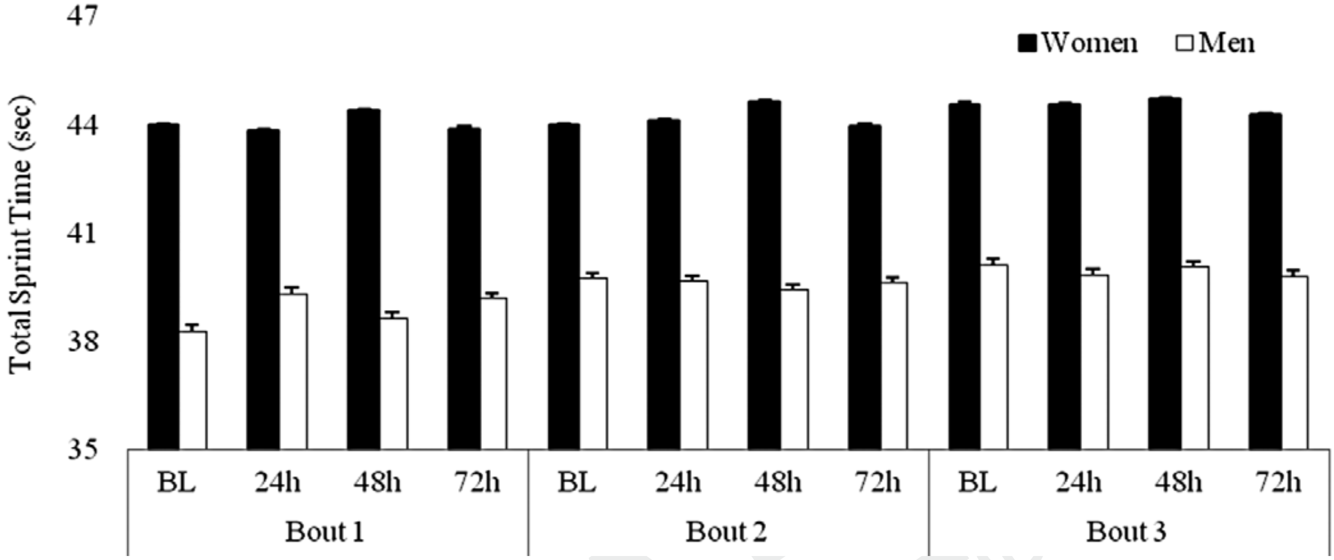


Figure 3.—Total sprint times across all three bouts of eight 30 m maximal sprints between men and women during baseline and following 24, 48, and 72 h of recovery (N = 8w, 8m). *Significant difference (P < 0.05) between men and women.

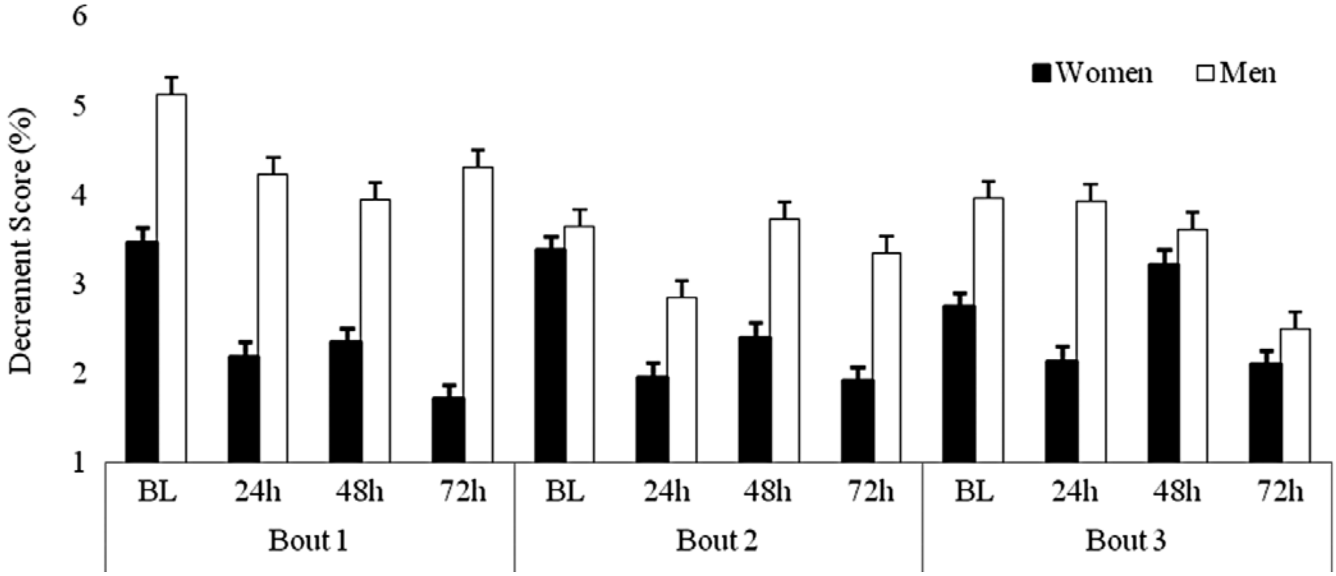


Figure 4.—Decrement scores across all three bouts of eight 30 m maximal sprints between men and women during baseline and following 24, 48, and 72 h of recovery (N = 8w, 8m). *Significant difference (P < 0.05) between women and men. # Approaching significance (P=0.06-0.09) between women and men.

main effect between trials ($F_{3,21}$=12.5; P<0.01; ES=0.64; N – B=0.99). Post-hoc measures showed DEC scores during the baseline trial were significantly higher than 24 h and 72 h (P<0.01, respectively) and approached significance when compared to the 48 h DEC (P=0.06). The 48 h DEC scores were also significantly higher than the 24 h and 72 h DEC scores (P=0.01).

As shown in Figure 4, men consistently evidenced a higher rate of fatigue than women with the differences

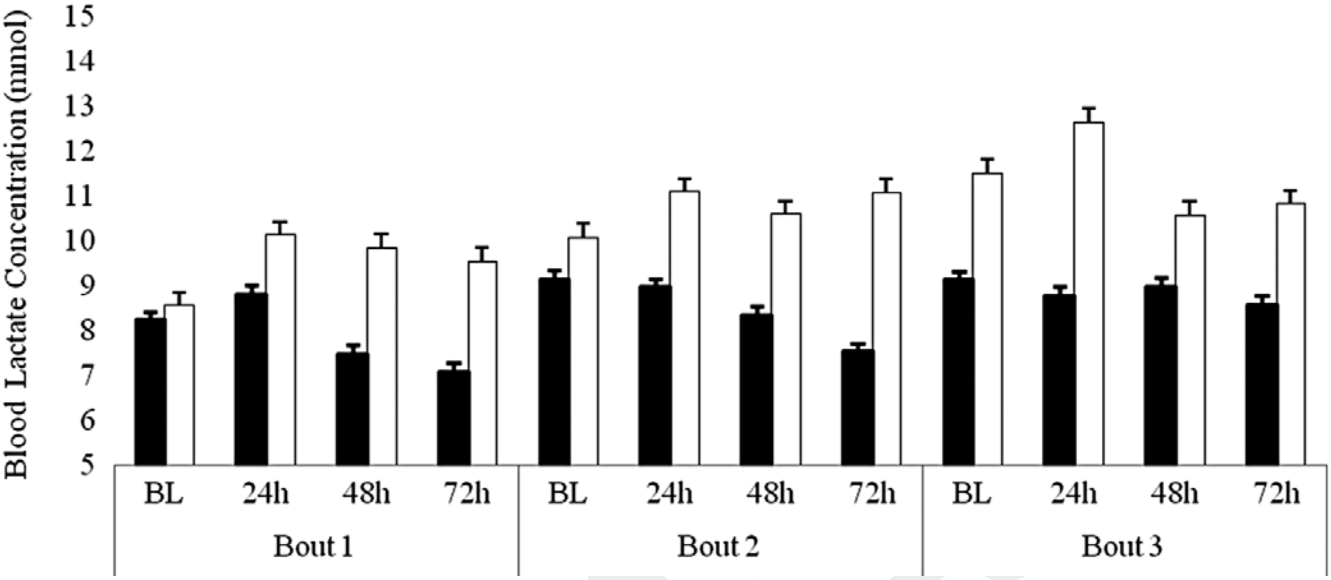


Figure 5.—Blood lactate concentration across all three bouts of eight 30 m maximal sprints between men and women during baseline and following 24, 48, and 72 h of recovery (N = 8w, 8m). * Significant difference (P < 0.05) between women and men. #Approaching significance (P=0.06-0.09) between women and men.

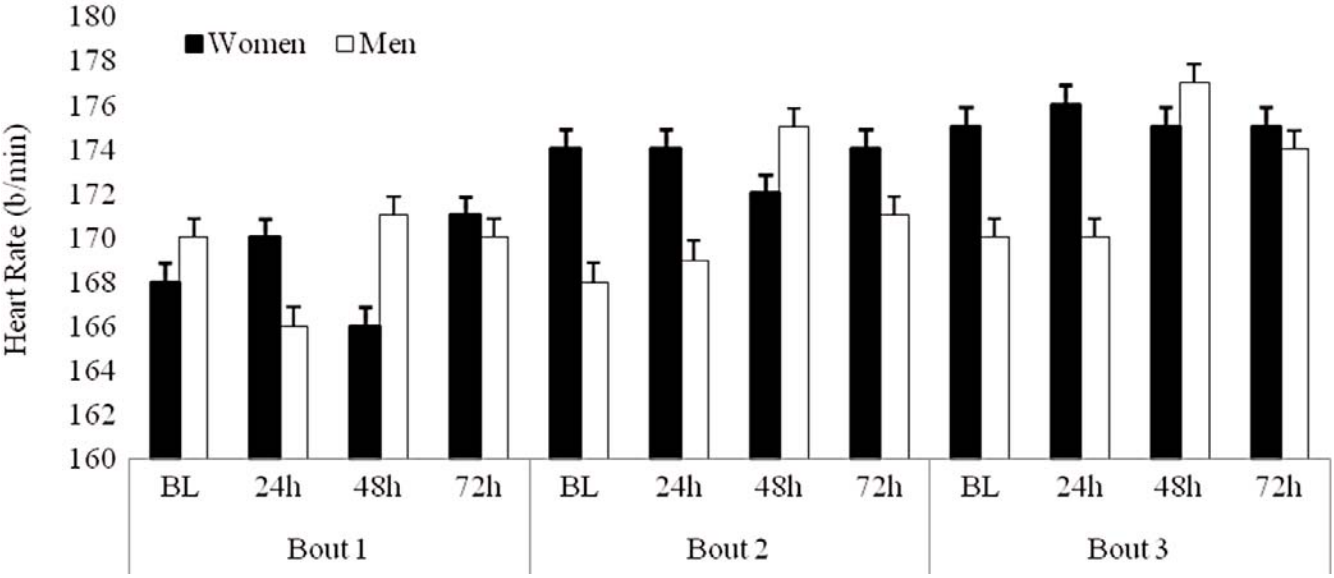


Figure 6.—Observed heart rate response across all three bouts of eight 30 m maximal sprints between men and women during baseline and following 24, 48, and 72 h of recovery (N = 8w, 8m).

reaching significance in the first bout of sprints during the 24 h (P=0.02), 48 h (P=0.03) and 72 h (P < 0.01) trials as well as during the second bout of sprints during the 48 h trial (*P=0.*02). There were also differences approaching significance between DEC of men compared to women in the third bout of sprints during the baseline and 24 h trials (P=0.06 and P=0.08, respectively).

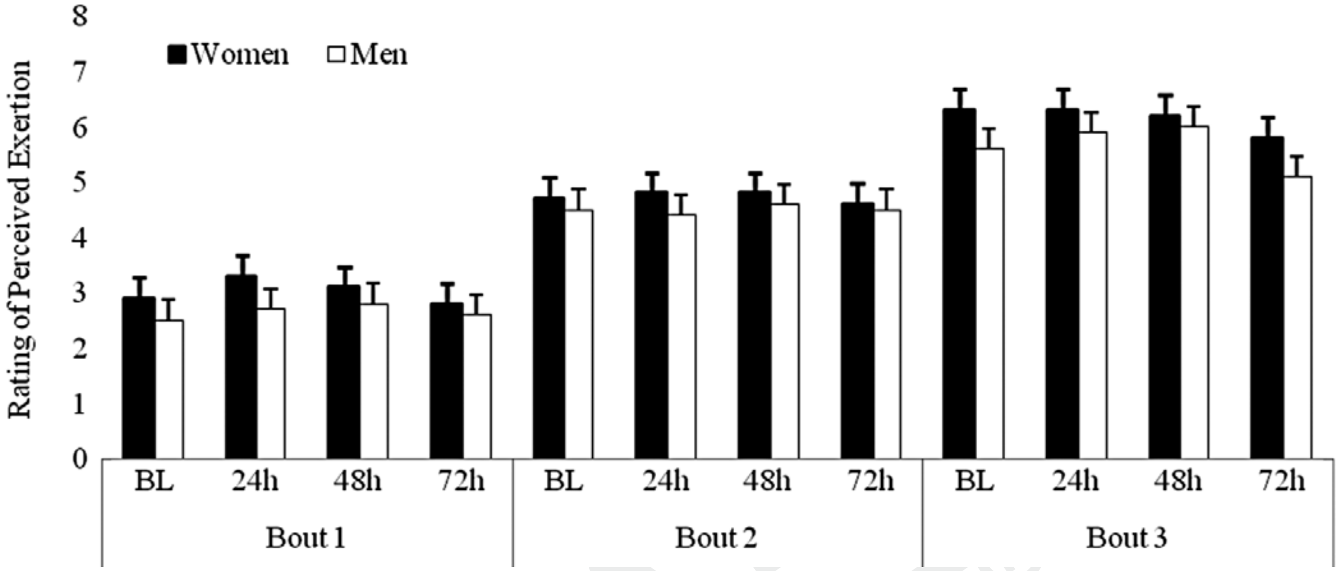


Figure 7.—Ratings of perceived exertion across all three bouts of eight 30 m maximal sprints between men and women during baseline and following 24, 48, and 72 h of recovery (N = 8w, 8m).

*Blood lactate concentration*

Figure 5 shows the mean [La] response for both men and women across the three bouts of sprints during the four experimental trials. The repeated measures ANOVA performed for men and women revealed no significant main effect between trials on [La] (P=0.21 and P=0.30, respectively). Additionally, women demonstrated no significant differences for [La] across any of the three bouts within the trials (P=00.15). However, there was a significant main effect of bout of sprints on [La] ($F_{2,14}$=37.1; P<0.01; ES=0.84; N – B=01.0). Univariate post-hoc analyses identified significantly increased [La] for bout three versus bout two (P < 0.01) and bout one (P < 0.01), while bout two was significantly higher than bout one (P < 0.01). Between genders, there was a general trend for men to experience higher [La] across all trials and within all trials across the three bouts of repeated sprints. These differences reached significance during the second bout of sprints during the 72 h trial (P=0.02) and approached significance (P=0.06 – 0.09) during the second bout of the 48 h trial as well as the third bout of sprints during baseline and 24 h trials.

*Heart rate*

Figure 6 shows the average HR response of men and women during the three bouts of repeated sprints

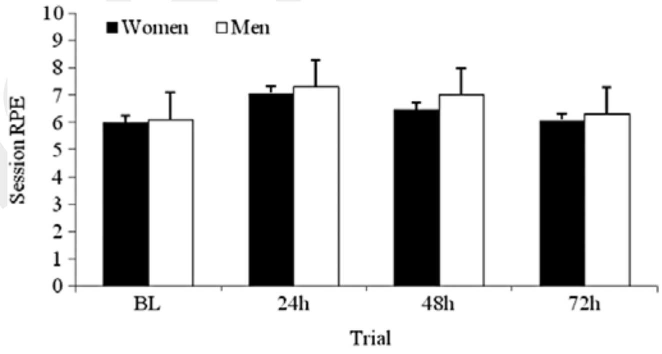


Figure 8.—Session RPE values of men and women following the baseline trial, and after 24, 48, and 72 h of recovery (N = 8w, 8m). †Significantly different (P < 0.05) than BL, 48 h, and 72 h. *Significantly different (P < 0.05) than BL and 72 h. #Significantly different (P < 0.05) than BL and approaches significance between 72 h (P=0.08). ‡Significantly different (P < 0.05) than BL and approaches significance between 72 h (P=0.08). .

across all four trials. Results from the repeated measures ANOVA revealed no significant main effect for men (P=00.46) or women across trial (P=00.39). There was also no significant effect on HR for men within trial for bout (P=00.13); however, there was a significant main effect of bout on HR for women ($F_{2,14}$=15.7; P < 0.01; ES=0.69; N – B=0.99). The post-hoc measures showed significantly higher HR values during bout three compared to bout two (P=0.03) and bout one (P < 0.01), while bout two HR was also significantly higher than bout one (P=0.01). There were no significant differences in HR between gender across any time point in any trial.

*Perceived exertion*

The mean RPE response for men and women during each bout of eight sprints across all four experimental trials are shown in Figure 7. Results for the repeated measures ANOVA revealed no significant main effect between trials on RPE for either men (P=0.31) or women (P=0.65). For both men and women, there was a significant main effect for RPE across bouts. In both genders, bout one RPEs were significantly lower (P < 0.01) than RPEs during bout two and bout three with bout two also being significantly lower (P < 0.01) than bout three. There were no significant differences between RPE values across any trial or any bout between men and women.

*Session RPE*

Results from a one-way repeated measures ANOVA revealed a significant main effect across trials regarding SRPE values for both men ($F_{3,21}$=4.1; P=0.02; ES=0.37; N – B=0.78) and women ($F_{3,21}$=6.2; P=0.02; ES=0.47; N – B=0.75). As shown in Figure 8, men reported significantly higher SRPE values following the 24 h trial versus BL (P=0.04) and the 72 h trial (P=0.03) but not the 48 h trial (P=0.35). The 48 h SRPE values were also significantly higher than the BL trial (P=0.04) and approached significance when compared to the 72-h trial (P=0.08). There was no significant difference between BL and 72 h SRPE for men. Within women there was a significantly higher SRPE following the 24 h trial than BL (P < 0.01), 48-h (P=0.05) and 72 h (P=0.05) trials. The 48-h trial also produced significantly higher SRPE values than BL (P < 0.01) and approached significance compared to 72 h (P=0.08). However, there were no significant differences between men and women for SRPE following any of the trials.

## Discussion

The current study was designed to investigate the possible effect of gender on repeated sprint performance as well as rate of recovery during the trials and following variable recovery periods between trials. The novel aspect of the current study is that it was performed in an ecologically valid setting for many team sport athletics (i.e., sprinting outdoors), which allowed for greater inference of fatigue and recovery differences between genders in a sport specific setting. The primary findings from this study confirm, in this paradigm, the notion that men tend to demonstrate a higher rate of fatigue within a trial when compared to women. Men, in general, experienced higher metabolic strain (reflected in [La]), while women demonstrated consistently, although not significantly, higher cardiovascular strain (HR). Additionally, RPE for men and women consistently increased across bouts during each trial and seemed to mirror the variable recovery periods; however, differences were not significant between trials regarding acute RPE. There were significant differences between trials regarding the global difficulty experienced by both men and women (SRPE), with shorter recovery trials (i.e., 24 h and 48 h) yielding significantly higher SRPE values than the BL and 72 h trials. Ultimately, despite the observed performance and physiologic differences between men and women during exercise trials, there does not appear to be a negative impact of gender on day-to-day recovery following repeated, maximal sprint exercise.

The observed significant differences in anthropometric variables and power output (i.e., sprint times) between men and women were not surprising. Indeed, it is well documented that men, in general, will be heavier, leaner and able to generate higher power (absolute and relative to body mass).[4, 18] Findings from this study extend confirmation of these previous observations into an ecologically valid setting (i.e., sprinting outdoors). Additionally, this study confirms previous research [3, 7, 11] indicating that men demonstrate a higher degree of fatigue than women throughout a bout of repeated, high-intensity exercise. The women in this study consistently produced lower DEC scores, indicating higher percent of performance maintained throughout the trials when compared to men. There have been myriad of factors proposed to mediate these differences in rate of power decline between genders however, the most likely causal factors are differences related to muscle mass, muscle type distribution, and/or differences in metabolic activity.[1-7]

The women in this study, as expected, possessed significantly higher percent body fat than men. It has been documented that a higher body fat percentage does, indeed, correlate to diminished power output during anaerobic-type exercise and is considered a primary factor separating men and women in overall sprint speed and power output during bouts of sprint cycling.[7, 27] A recent study by Perez-Gomez et al.[7] revealed that differences in power output during Wingate testing between men and women were largely attributable to the reduced muscle mass found in women. Similarly, Billaut *et al.*[3] have noted the negative impact of lower muscle mass on repeated sprint ability in women. Recent studies have advocated the need for sophisticated scaling techniques to be applied to resulting power output data when investigating gender differences in anaerobic type exercise [7, 27] however, to maintain ecological validity the current study presents unscaled data to detail the possible impact of gender and plausible factors that may affect rate of recovery and subsequent power output, as would be observed during day-to-day training sessions. To that end, current results further implicate the role of decreased muscle mass, as would be expected between genders, to have a negative impact on power outputs.

Beyond differences in absolute muscle mass that exist between men and women involved in repeated sprint-type sports, there is also a documented difference in cross-sectional area and relative muscle fiber type distribution.[3, 9] In general, men possess a higher cross-sectional area and higher concentration and activation rate of Type II muscle fibers which has been attributed to the documented higher overall sprint speeds when compared to women. Moreover, the differences in muscle fiber type will impact energy substrate utilization and time course to fatigue as Type II fibers rely heavily on substrate level phosphorylation (i.e., ATP-PC system) and glycolytic pathways much more than Type I fibers and, subsequently, possess a lower fatigue threshold. While muscle fiber type was not assessed directly in this study, there exists indirect evidence supporting this theory. As seen in Figure 5, men consistently produced significantly higher [La] compared to women. This may suggest a higher glycolytic rate and thus a higher level of Type II muscle fiber activation.

Others have proposed that, during intermittent-type exercise, observed differences in muscle metabolism (i.e., Type II vs. Type I) between genders may not be attributable to the activation rate of Type II muscle fibers rather, it is a product of increased cross-sectional area of Type I muscle fibers in women and the resulting hormonal and metabolic consequences.[19, 28] Specifically, increases in cross-sectional area of Type I fibers have been proposed to lead to a reduction in the rate of glycogenolysis. This is theoretically achieved by down-regulation of key enzymes, specifically PFK and/or LDH inhibition as a result of diminished cAMP activity, ultimately limiting the rate of lactate production at the level of the muscle.[19, 28] Additional research has also revealed that, during periods of recovery between individual sprints, women demonstrate increased rate of ATP regeneration.[28] This lends explanation to the observed lower [La] levels as well as attenuated DEC scores between the women when compared to men in the current study. It must be noted that this rationale, while reasonable, should be interpreted with caution relative to the data from the current study as there were no direct measurements taken at the level of the muscle. Nevertheless, the resulting difference in metabolic disruption between genders observed in this study, regardless of the contributing mechanism, offers a plausible explanation regarding the concomitant increase in metabolic strain (i.e., [La]) and rate of fatigue in men compared to women during repeated bouts of intermittent sprint work.

Despite significant differences in power output, DEC scores and [La] between genders there were no significant differences in the level of perceived exertion experienced throughout or following the trials. It is interesting, however, to note that there was a trend for women to demonstrate slightly elevated levels of acute RPE during the sprints while men consistently produced higher global perception of trial difficulty following the trials (Figures 7, 8). The specific factors to explain men reporting lower acute RPE values during a trial while reporting higher SRPE (global difficulty) following a trial are not clear. Nevertheless, the similarities in perceptual strain observed during the current investigation is in line with others reporting no significant gender effect on RPE during similar exercises that are performed at a relative intensity.[29, 30] Robertson *et al.*[29] found no significant impact of gender on RPE during exercise performed at relative intensity during high-intensity (90% $VO_{2max}$) treadmill running. Similarly, Green *et al.*[30] found no RPE differences at respective respiratory compensation threshold between men and women during treadmill exercise.

It was hypothesized that women would demonstrate the ability to prolong fatigue during a bout as well as recover faster following variable day-to-day recovery periods. Results from this study confirmed that, in general, women were able to maintain higher levels of their maximal output (albeit significantly lower than men) and demonstrated the ability to recover similarly to men both during and following the trials. While the former points were to be expected, this is the first study that has investigated the role of gender and its possible impact on subsequent performance following variable recovery periods. The lack of significant differences between sprint times during each respective bout relative to the subsequent bout of exercise for men and women suggest that the detrimental gender effect observed within a trial for men may be diminished between trials. That is, although men may exhibit significantly higher rates of decline, metabolic strain and perceived global difficulty of the bout, it does not impact their ability to perform optimally following 24, 48, or 72 h of recovery, respectively. It may be that the workload completed during the trials was not vigorous enough to elicit performance declines despite only 24 h of rest. However, the level of [La] achieved as well as the elevated HR and perceptual responses observed are indicative of a fatiguing bout of exercise. Indeed, the majority of participants (both men and women) neared maximal HR levels towards the completion of each bout and consistently reported RPEs of 9-10 during the final sprints. Thus it seems that the effect of gender on the ability to recover is diminished rapidly after the cessation of a bout of repeated, intermittent sprint exercise.

## Conclusions

In summary, these results support the theory that women demonstrate the ability to delay fatigue when compared to men during a bout of repeated high-intensity intermittent sprint work. While there are multiple factors that may be implicated (either synergistically or independent) in the resulting phenomenon, the most likely mediating factors are attributed to differences in muscle mass, muscle fiber type properties and the metabolic consequence relative to muscle fiber type. Additionally, both genders were able to successfully reproduce sprint performance with as little as 24 h of rest, suggesting that the relative impact of gender on the ability to recover is resolved following the completion of an exercise session, at least following repeated intermittent maximal sprint work of this intensity and volume. Investigations incorporating more difficult trials utilizing shorter work-to-rest ratios and/or an increase in total sprints performed may be helpful in identifying possible gender influences that may exist in day-to-day performance. That notwithstanding, results from this study ultimately confirm previous studies suggesting that men will produce significantly higher absolute sprint speeds but will exhibit an increased rate of fatigue throughout a trial compared to women.

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