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Factors associated with perceived performance drops and musculoskeletal injuries in Brazilian recreational triathletes

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Abstract. – OBJECTIVE: The aim of the study was to investigate sleep characteristics, use of supplements, and training volume of recreational triathletes, and to verify possible associations with perceived performance drops and occurrence of injuries.

MATERIALS AND METHODS: Recreational triathletes (n=942) answered a questionnaire inquiring about their demographic characteristics, performance, injuries and training volume.

RESULTS: When comparing athletes who slept more (9-10 hours) with those who slept less, less sleep was associated with a higher prevalence of perceived performance drops. Regarding difficulties in initiating sleep, the absence of initiating difficulties (*p*<0.001) was a protective factor against perceived performance drops. Regarding weekly training volume, compared to those who trained more than 20 hours, training less than 3 hours (*p*<0.001), 3-5 hours (*p*<0.001), or 12-14 hours (*p*<0.001) were protective factors against perceived performance drops. Concerning training volume and injuries, we found that compared to those who trained more than 20 hours, training 18-20 hours (*p*<0.001), 15-17 hours (*p*<0.001), 12-14 hours (*p*<0.001), 6-8 hours (*p*<0.001), or 3-5 hours (*p*<0.001) were protective factors against injuries.

CONCLUSIONS: Triathletes with a lower sleep quantity and those who have difficulties initiating sleep frequently experience drops in performance. Training volumes can influence both performance and the likelihood of injuries.

Key Words:
Cycling, Running, Swimming, Triathlon.

Introduction

Triathlon is an endurance sport that involves swimming, cycling, and running[1-3]. The main factor that leads to success in this discipline is aerobic fitness[1]. Moreover, morphological aspects, such as a low body fat percentage or high fat-free mass, also seem to be associated with better performances[4]. Traditionally, maximal oxygen uptake is used to assess aerobic fitness and has therefore been proposed as a determinant of triathlon performance[1].

Besides aerobic fitness, other aspects are paramount for triathlon performance, such as sleep characteristics and training volume. Previous studies have shown a positive relationship between sleep and performance, as adequate sleep may optimize physical recovery[5,6]. Nevertheless, sleep complaints are common among athletes[6]. Possible reasons for athletes' low quality of sleep have been related to their routine, training schedule, pre-competition anxiety, and long trips to competition sites[6,7]. Adults may need 7-9 hours of sleep per night, and athletes can need additional sleep due to their training routine[5]. In recreational triathletes, these issues can be aggravated. In addition to their training routine, recreational triathletes can face additional pressure stemming from professional, social, family, and economic commitments. Studies that investigate aspects related to sleep and its effect on performance in recreational triathletes are therefore necessary.

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As for training, it is important to determine the appropriate exercise intensity, volume, and frequency[8]. A previous study[9] showed that endurance athletes train 10-13 hours per week and that 80% of the session time is spent performing at low intensity and high volume. While high training volumes are frequent in endurance sports, it is possible that a high-volume training regime for recreational triathletes does not generate the desired performance results if they are not able to compensate with adequate recovery periods[4]. Additionally, it has been demonstrated that athletes who undergo excessive training that is not accompanied by an adequate recovery period may experience a perceived performance drop[4].

Regarding injuries, Collins et al[10] interviewed 257 Seafair Triathlon finalists and found that 49% of athletes reported an injury related to training. Andersen et al[11] found that in a sample of 174 athletes, a total of 87% suffered from some form of overuse injury over a 26-week training period. In a retrospective study of 656 participants in Ironman Europe, Egermann et al[12] reported at least one injury among 74.8% of the athletes since starting triathlon training. These findings show a high prevalence of injuries in triathletes. Further studies to investigate factors associated with musculoskeletal injuries in recreational triathletes are therefore needed to better understand this phenomenon.

The number of recreational athletes participating in triathlon competitions is increasing, and the circumstances of recreational triathletes differ from those of professional triathletes. For example, nutritional demands, training regimes, and family and work commitments may all be distinctly different between these two groups. Because of the lack of literature on recreational triathletes in general, it is important to investigate the factors associated with perceived performance drops and the occurrence of injuries in this specific group of triathletes. The present study, therefore, aimed at evaluating the use of supplements, sleep patterns, and training volumes of recreational triathletes and assess their associations with performances and the occurrence of musculoskeletal injuries. We hypothesized that high training volumes and insufficient sleep are associated with perceived performance drops and the occurrence of injuries.

Materials and Methods

Recreational triathletes that took part in the 2019 Ironman Brazil triathlon (held in Florianopolis, Brazil, in May 2019) completed an online questionnaire using the Google Forms digital platform (available at: https://goo.gl/forms/SfUp9sn4xLS314ew2) that was sent out 30 days before the race. The athletes were instructed to answer all questions according to their experiences during the week before the survey. The inclusion criteria were: aged ≥ 18 years and literate. The exclusion criteria were incomplete and inconsistent replies. Initially, a total of 1,075 responses were received. Of these 1,075 responses, 61 were excluded for being duplicates and 72 were excluded for not meeting the inclusion criteria. Therefore, the final sample included 942 respondents (724 men and 218 women). The participants' parameters are represented in Table I. All experimental procedures were approved by the Human Research Ethics Committee of the Federal University of Sao Paulo (approval number: 3,318,080) and conformed to the principles outlined in the Declaration of Helsinki. All participants voluntarily gave their informed consent to participate in the study, after having read the purpose of the study in the first section of the electronic survey.

The questionnaire was conducted in Brazilian Portuguese. A summary description of the questions is provided in Table II. It is important to note that we did not use a validated questionnaire be-

Table I. Parameters of the participants.

	Men (n = 724)	Women (n = 218)	Overall (n = 942)	
Variables	Median [IQR]	Median [IQR]	Median [IQR]	*p*-value
Age (years)	38.00 [10.00]	37.00 [10.00]	38.00 [10.00]	0.044[a]
Body mass (kg)	75.25 [12.00]	58.50 [9.00]	72.00 [14.00]	< 0.001[a]
Height (m)	1.77 [9.00]	1.64 [9.00]	1.74 [11.00]	< 0.001[a]
Body mass index (kg/m²)	24.16 [3.02]	21.63 [1.99]	23.46 [3.15]	< 0.001[a]
$\dot{V}O_2$ max (ml/kg/min)	47.58 [5.23]	38.97 [5.03]	46.15 [7.68]	< 0.001[a]

[a]$p < 0.05$ (men ≠ women); IQR: interquartile range; $\dot{V}O_2$ max: maximal oxygen uptake.

Table II. Variables used to evaluate nutritional aspects, sleep, training, perceived performance drops and musculoskeletal injuries in recreational triathletes.

Section	Questions
First	Name, sex (male or female), age (years), body mass (kg), height (m) and the email address.
Second	Questions (yes or no) regarding nutritional aspects, use of supplements and nutritional guidance by health providers.
Third	Questions about preventive medical follow-ups (yes or no) and medical specialty.
Fourth	Questions about sleep hygiene: Quantity of sleep (time in hours) (i.e., <3 hours, 4-6 hours, 7-8 hours or > 9 hours per night). Yes or No questions: Did you have difficulties initiating sleep last week? Did you feel rested after waking up last week? Did you notice worsening sleep quality last week? Have been feeling without energy during the day? Did notice frequent mood changes? Did you experience performance drops in the last week?
Fifth	Training volume swimming training hours per week in the last week (up to 2 hours per week, between 3 and 4 hours per week, >5 hours per week), cycling training hours per week in the last week (up to 6 hours per week, between 7 and 8 hours per week, > 9 hours per week), running training hours per week in the last week (up to 4 hours per week, between 5 and 6 hours per week, >7 hours per week), and total weekly training hours in the last week (less than 3 hours, 3-5 hours, 6-8 hours, 9-11 hours, 12-14 hours, 15-17 hours, 18-20 hours, and more than 20 hours per week).
Sixth	Amount of time taken off exercising due to the injury and type of the injury.

cause there is no validated questionnaire with a focus on the variables that were investigated in the present study. The questionnaire consisted of six sections as depicted in Table II.

Participants' $\dot{V}O_2$ max was estimated through the equation proposed by Jackson et al[13]: $\dot{V}O_2max = 56.363 + 1.921 \times PAF - 0.381 \times age - 0.754 \times BMI + 10.987 \times sex$, where PAF is the physical activity factor, age is in years, BMI is the body mass index in kg/m², and sex is denoted as 0 for females and 1 for males.

Statistical Analysis

The Shapiro-Wilk test was utilized to test data normality. The Mann-Whitney U test was used to compare the age, height, body mass, body mass index and $\dot{V}O_2$max between the sexes. A descriptive analysis was performed to summarize the performance, musculoskeletal injury, sleep characteristics, and training volume data. Descriptive data are presented as relative and/or absolute frequencies. A Chi-square independence test was used to assess associations between categorical variables. Cramér's V was used as a measure of the degree of association for the independent Chi-square test. The degree of association was classified as "trivial" ($V < 0.10$), "small" ($0.10 \leq V < 0.30$), "medium" ($0.30 \leq V < 0.50$), or "large" ($V \geq 0.50$)[14]. To identify the factors associated with musculoskeletal injuries and the perceived performance drops, crude and multivariate analyses were performed by estimating the prevalence ratios (PR) through Poisson regression.

The crude models contained each of the independent variables and the response variable (performance or musculoskeletal injuries). The variables for which *p*-values < 0.20 (Wald test) were candidates for multiple models. To calculate the adjusted PR, a significance level of 0.05 and a confidence interval (CI) of 95% were considered. Non-parametric data are presented as medians with interquartile ranges. All data were analyzed with JASP (version 0.12.2, Netherlands) and SPSS 23.0 (Statistical Package for the Social Sciences, IBM Corp., Armonk, NY, USA). The level of significance assumed was 0.05.

Results

A total of 20% (n=188) participants reported perceived performance drops during the last

Table III. Crude and multivariable prevalence ratios for independent variables in relation to perceived performance drops during the last week in recreational triathletes.

Variables	Prevalence %	Performance drops in the last week			
		Crude analysis		Multivariable analysis	
		PR (CI 95%)	*p*-value*	PR (CI 95%)	*p*-value*
Sex			0.160		0.011
Male	76.9	1		1	
Female	23.1	1.038 [0.986-1.092]		1.143 [1.031-1.267]	
Body mass			0.149		0.364
Body mass (kg)		0.999 [0.997-1.000]		0.999 [0.996-1.001]	
$\dot{V}O_2$max			0.056		0.012
$\dot{V}O_2$max (ml/kg/min)		0.996 [0.993-1.000]		0.995 [0.992-0.999]	
Dietary supplements use			0.169		0.629
Yes	90.6	1		1	
No	9.4	1.054 [0.978-1.137]		1.022 [0.935-1.117]	
Sleep					
Hours of sleep per night			<0.001		<0.001
<4 hours	0.6	0.917 [0.784-1.071]		0.880 [0.742-1.042]	
Of 4-6 hours	48.9	1.149 [0.980-1.347]		1.111 [0.940-1.313]	
Of 7-8 hours	49.3	1.055 [0.901-1.236]		1.026 [0.870-1.210]	
Of 9-10 hours	1.2	1		1	
Difficulty to start sleep			<0.001		<0.001
Yes	15.6	1		1	
No	84.4	0.844 [0.794-0.898]		0.862 [0.810-0.916]	
Worsening sleep quality in the last week			0.041		0.851
Yes	15.6	1		1	
No	84.4	0.938 [0.883-0.997]		0.987 [0.858-1.135]	
Training volume (hours/week)		<0.001		<0.001	
<3 hours	0.6	0.788 [0.748-0.830]		0.802 [0.738-0.870]	
Of 3-5 hours	4.9	0.839 [0.771-0.914]		0.860 [0.744-0.994]	
Of 6-8 hours	10.8	0.973 [0.894-1.060]		0.990 [0.859-1.141]	
Of 9-11 hours	21.5	0.897 [0.839-0.959]		0.923 [0.808-1.054]	
Of 12-14 hours	23.5	0.970 [0.905-1.039]		0.835 [0.726-0.961]	
Of 15-17 hours	14.2	0.882 [0.821-0.948]		0.898 [0.784-1.028]	
Of 18-20 hours	6.3	1.055 [0.951-1.171]		1.052 [0.902-1.227]	
>20 hours	18.2	1		1	

*Wald test. PR: prevalence ratio. $\dot{V}O_2$ max: maximal oxygen uptake. CI: confidence interval.

week. Table III shows the crude and multivariable PR to independent variables concerning perceived performance drops.

In the crude analysis, perceived performance drops during the last week were significantly associated with sex, body mass, $\dot{V}O_2$max, use of dietary supplements, amount of sleep, difficulty initiating sleep, worsening of sleep quality, and training volume. However, in the multivariable analysis, perceived performance drops during the last week remained significantly associated with training volume, difficulty initiating sleep, amount of sleep, $\dot{V}O_2$max, and sex. Females (PR = 1.143; CI 95% = 1.031-1.267; *p*-value = 0.011) presented a higher risk factor to the perceived performance drops compared to the males, while higher $\dot{V}O_2$max (PR = 0.995; CI 95% = 0.992-0.999; *p*-value = 0.012) was identified as a protective factor against the perceived performance drop. Compared to sleeping more (9-10 hours per night), sleeping less showed a higher PR to the perceived performance drops. Regarding difficulties initiating sleep, our analyses showed that having no difficulties initiating sleep (PR = 0.862; CI 95% = 0.810-0.916; *p*-value < 0.001) was a protective factor against perceived performance drop. As for training volume, compared to those who trained more than 20 hours each week, training less than 3 hours (PR = 0.802; CI 95% = 0.738-0.870; *p*-value < 0.001), 3-5 hours (PR = 0.860; CI 95% = 0.744-0.994; *p*-value < 0.001), and 12-14 hours (PR = 0.835; CI 95% = 0.726-0.961; *p*-value < 0.001) were seen as protective factors against the perceived performance drops. Moreover, the Chi-square independent test showed an association between feeling rested during the last week upon awakening and sex [X^2 (1) = 386.008; *p*-value < 0.001; Cramér's V = 0.640 "large"]. The

Table IV. Crude and multivariable prevalence ratios for all independent variables in relation to musculoskeletal injuries experienced during the last year in recreational triathletes.

Variables	Prevalence %	Occurrence of injuries during the last year			
		Crude analysis		Multivariable analysis	
		PR (CI 95%)	*p*-value*	PR (CI 95%)	*p*-value*
Sex			<0.001		0.082
Male	76.9	1		1	
Female	23.1	0.639 [0.624-0.654]		0.983 [0.965-1.002]	
Age			0.093		0.001
Age (years)		1.002 [1.000-1.005]		1.001 [1.001-1.002]	
Body mass index			<0.001		0.007
Body mass index (kg/m²)		1.022 [1.014-1.031]		0.997 [0.994-0.999]	
$\dot{V}O_2$max			0.150		0.701
$\dot{V}O_2$max (ml/kg/min)		0.997 [0.994-1.001]		1.000 [0.999-1.001]	
Dietary supplements use			<0.001		0.146
Yes	90.6	1		1	
No	9.4	0.676 [0.661-0.691]		1.004 [0.999-1.009]	
Sleep					
Hours of sleep per night			0.040		0.975
Less than 4 hours	0.6	0.965 [0.735-1.268]		1.002 [0.972-1.033]	
4-6 hours	48.9	0.819 [0.701-0.957]		1.003 [0.977-1.030]	
7-8 hours	49.3	0.836 [0.716-0.977]		1.005 [0.979-1.031]	
9-10 hours	1.2	1		1	
Difficulty initiating sleep			0.074		0.820
Yes	15.6	1		1	
No	84.4	1.058 [0.995-1.125]		1.002 [0.986-1.018]	
Rested when Waking up			<0.001		0.071
Yes	57.6	1		1	
No	42.4	0.570 [0.559-0.582]		0.990 [0.978-1.001]	
Worsening sleep quality during the last week			<0.001		0.196
Yes	15.6	1		1	
No	84.4	0.665 [0.649-0.681]		0.996 [0.989-1.002]	
Disposition			<0.001		0.176
Without disposition during the day					
Yes	33.7	1		1	
No	66.3	0.574 [0.560-0.588]		1.004 [0.998-1.009]	
Mood			<0.001		0.915
Frequent mood changes during the last month					
Yes	25.5	1		1	
No	74.5	0.620 [0.605-0.636]		1.000 [0.994-1.005]	
Training volume (hours/week)			<0.001		<0.001
Less than 3 hours	0.6	1.000 [1.000-1.000]		1.007 [0.993-1.021]	
3-5 hours	4.9	0.500 [0.500-0.500]		0.499 [0.495-0.504]	
6-8 hours	10.8	0.642 [0.600-0.687]		0.644 [0.601-0.689]	
9-11 hours	21.5	1.000 [1.000-1.000]		1.003 [0.995-1.010]	
12-14 hours	23.5	0.500 [0.500-0.500]		0.510 [0.499-0.521]	
15-17 hours	14.2	0.500 [0.500-0.500]		0.506 [0.499-0.512]	
18-20 hours	6.3	0.500 [0.500-0.500]		0.504 [0.498-0.510]	
More than 20 hours	18.2	1		1	

*Wald test; PR: prevalence ratio; $\dot{V}O_2$max: maximal oxygen uptake; CI: confidence interval.

analysis showed that 100% (n=218) of the female athletes did not feel rested after waking up.

A total of 43.4% (n=409) participants reported musculoskeletal injuries in the last year. Table IV shows the crude and multivariable PR for the independent variables concerning musculoskeletal injuries.

In the crude analysis, musculoskeletal injuries experienced during the last year were significantly associated with almost all variables investigated. However, in the multivariable analysis, the prevalence of musculoskeletal injuries remained significantly associated only with training volume, age, and body mass index. Age (PR = 1.001; CI 95% = 1.001-1.002; *p*-value = 0.001) was found to be a risk factor for musculoskeletal injuries, while a smaller body mass index (PR = 0.997; CI 95% = 0.994-0.999; *p*-value = 0.007) was a protective factor. As for the weekly training volume, we found that compared to those who trained more than 20 hours, training 18-20 hours (PR = 0.504; CI 95% = 0.498-0.510; *p*-value < 0.001), 15-17 hours (PR = 0.506; CI 95% = 0.499-0.512; *p*-value < 0.001), 12-14 hours (PR = 0.510; CI 95% = 0.499-0.521; *p*-value < 0.001), 6-8 hours (PR = 0.644; CI 95% = 0.601-0.689; *p*-value < 0.001) or 3-5 hours (PR = 0.499; CI 95% = 0.495-0.504; *p*-value < 0.001) was a protective factor against musculoskeletal injuries. Furthermore, we found that 26.0% (n=245) of the triathletes took time off their training due to injuries once per week, 10.9% (n=103) took time off due to injuries twice per week, 6.5% (n=61) took time off three or more times, and 56.6% (n=533) did not take any time off their training due to injuries. Moreover, 80.4% (n=754) of athletes reported visiting a doctor for a preventive follow-up, while 19.6% (n=188) did not visit any doctor for a preventive follow-up.

Discussion

The present study aimed at evaluating the use of supplements, aerobic fitness, demographic characteristics, sleep patterns, and training volumes of recreational triathletes. Further, this study aimed at assessing the potential associations of these factors with performance as well as the occurrence of musculoskeletal injuries. The main findings of our analyses were that (i) lower sleep quantity, difficulty initiating sleep, female sex, and lower $\dot{V}O_2max$ were the factors associated with perceived performance drops; and (ii) the factors associated with the occurrence of injuries during the last year were higher age, higher body mass index, and a higher training volume.

It is important to note that recreational triathletes have very diverse training volumes. The training volume frequently encountered in our sample was 12-14 hours/week. The results of the present study indicate that certain training volumes are more adequate than others to avoid the perceived performance drops. Sinisgalli et al[4] found that performances in the Ironman distance did not differ between recreational triathletes who trained up to 14 hours/week, those who trained between 15 and 20 hours/week, and those training more than 20 hours/week. However, in the present study, we found that certain training volumes can protect against perceived performance drops. Moreover, we found that low sleep quantity and difficulties initiating sleep can be risk factors for perceived performance drops. While athletes usually prioritize their diet and physical exercise, sleep is also an essential factor to improve physical performance[5]. Moreover, some symptoms found in the present study, such as difficulty initiating sleep and waking up more than 3 times during the night, can indicate disturbed sleeping patterns. In such cases, athletes must seek treatment. An important point is that athletes can suffer from such sleep disturbances without having any knowledge of them. Athletes that sleep more than 8 hours per night usually experience greater performance benefits[4,5]. Moreover, reducing the recommended minimum hours of sleep has been associated with several negative effects on health, such as a sense of fatigue and psychological stress, impaired sports performances, impaired cognitive functions, physical problems and mental problems[4,5].

Furthermore, we found that women have a higher risk of perceived performance drops compared to men while a high $\dot{V}O_2max$ is a protective factor against perceived performance drops for both sexes. A possible explanation for the higher risk of perceived performance drops in women might be that women predominantly reported not feeling rested when waking up during the last week. Our findings are consistent with literature, which generally affirms that sleeping less than the recommended time and having difficulties initiating sleep can be a risk factor for the perceived performance drops. This suggests that sleep should be taken into account by triathletes in addition to exercise and diet.

Our study also investigated the prevalence and factors associated with the occurrence of injuries among recreational triathletes. Previous studies[10,15] investigated the association between training volume and injuries in triathletes and did not find an association between higher distances of swimming, cycling, or running and injuries. However, high training volumes can be less beneficial for recreational triathletes, because, unlike professional athletes, recreational triathletes may have more time restrictions. These restrictions, perhaps due to professional, financial, social, and family commitments, may negatively impact the recovery time[4,6,7]. For example, Clemente-Suárez et al[8] compared the effects of volume *vs.* intensity training in swimming, running, and horizontal jump performance during a period of 4 weeks in recreational triathletes and found that there were no differences between high volume and high-intensity training effects on performance. In addition, Faude et al[16] also showed that there were no advantages of high volume compared to low volume, high-intensity training in competitive swimmers. Therefore, decreasing training volume and increasing training intensity can be a strategy for recreational triathletes to deal with time restrictions. Moreover, preventive medical follow-up visits can help with developing strategies for the prevention of musculoskeletal injuries. In the current study, we found that certain lower training volumes can have a protective effect against musculoskeletal injuries compared to training regimes of more than 20 hours per week. Thus, training volumes should be carefully considered by the trainer because triathletes, compared with cyclists, swimmers, and individual runners, have been found to have higher incidences of musculoskeletal injuries than any athlete from a single sport[17]. As a result of training for three different endurance disciplines (swimming, cycling, and running), triathletes are often plagued by the same injuries and problems that athletes of each of these individual sports experience. In a way, triathlon provides the unique potential to undergo relative rest while, to an extent, still participating in sport-specific training. For instance, if an athlete has iliotibial band syndrome, they can take a break from running and focus on cycling and swimming. If cycling still aggravates the injury, the athlete may simply focus on swimming. This provides tiers of relative rest, especially considering that running is the main area of injury[17]. Since athletes with injuries need to stay away from training to recover, trainers need to be aware of the athlete's self-reporting and need to prescribe a training volume adequate to their routine, time restrictions and adequate recovery time.

We also found that age is a risk factor for musculoskeletal injuries and that a smaller body mass index is a protective factor against musculoskeletal injuries. Schorn et al[18] investigated the risk factors that can lead to acute injuries due to excessive use of the shoulder in recreational triathletes. The authors found, in contrast to our current findings, that age, height, body mass, and body mass index were not associated with injuries. Burns et al[19] did also not find an association between the age and injuries of triathletes. However, the authors found that athletes with excessive use injuries were of a higher age than those without such injuries. Similarly, we also found that injury rates can increase with the age. However, age cannot be taken into consideration as an isolated factor, because a variety of variables may influence musculoskeletal injuries and because age is not a factor that is subject to any kind of intervention.

Limitations

A limitation of the present research is its cross-sectional study design, which did not allow us to draw causal relationships between variables. Moreover, an online questionnaire was used, and caution needs to be exercised when comparing our findings with studies using "paper and pencil" questionnaires. Another limitation is the recall period: as participants were asked to answer according to what they experienced during the previous week, the conclusions that are drawn should be limited to this period. Longitudinal studies are therefore needed to further investigate these variables. Nevertheless, we believe that these limitations did not limit our main conclusions. The strength of this study is its large sample size that allowed detailed analyses of a variety of variables. These findings may have important practical applications considering the increasing number of recreational triathletes that take part in competitions such as the Ironman[20,21].

Conclusions

Recreational triathletes with a low sleep quantity and difficulties initiating sleep frequently experience perceived performance drops. Women are more likely to experience perceived performance drops than men, while a high $\dot{V}O_2$max can be a protective factor against the perceived drops for both sexes. Age is a risk factor for musculoskeletal injuries, while a small body mass index is a protective factor. Moreover, training volumes may influence performance and musculoskeletal injuries as either risk or protective factors. Therefore, trainers must be aware of those risks and monitor their athletes so that actions can be taken to improve their health and performance. These findings can be useful for trainers and recreational triathletes to develop competitive strategies.

Conflicts of Interest

The authors declare no conflicts of interest.

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Ethics Approval

All experimental procedures were approved by the Human Research Ethics Committee of the Federal University of Sao Paulo (approval number: 3,318,080) and conformed to the principles outlined in the Declaration of Helsinki.

Informed Consent

All participants voluntarily gave their informed consent to participate in the study, after having read the purpose of the study in the first section of the electronic survey.

Authors' Contributions

V.N.O. and C.A.B.L.: study concept and design; M.S.A.: data acquisition; V.N.O. and D.A.T.S.: data analysis, interpretation; and article preparation. R.S., M.S.A., R.L.V., G.C.T.C., P.T.N., B.K., K.W., and C.A.B.L.: critical revision of the article. All authors read and approved the final article.

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Data Availability Statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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