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Prevalence of Disordered Eating among Non-elite Multisport Endurance Athletes

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Abstract: The prevalence of concerns about food and body weight among non-elite multisport endurance athletes is unknown. This study aimed to evaluate the prevalence of symptoms and concerns related to disordered eating and their association with performance among 162 non-elite athletes involved in multisport endurance summer and winter events. Self-reported symptoms and concerns related to disordered eating were assessed using the Eating Attitudes Test-26 (EAT-26) questionnaire. The mean EAT-26 score (± SEM) was 6.5 ± 0.5 and only 9 athletes (5.6%) scored 20 arbitrary units or above. In multivariate regression stepwise analyses, the EAT-26 score (β = 0.145, P = 0.0003) significantly predicted percent ranking. These findings suggest that the prevalence of self-reported symptoms of disordered eating is low among non-elite multisport endurance athletes. However, greater concerns regarding food intake and body weight may be associated with poorer performance even among non-elite athletes with normal BMI values and at the lower end of the EAT-26 score.

Key words: Endurance sports nutrition, triathlon, multisport event, disordered eating, eating disorders.

1. Introduction

Multisport endurance events such as triathlons are gaining in popularity among middle-aged non-elite athletes, as more events are being presented each year [1]. Summer triathlons are traditionally composed of swimming, biking and running. The half Ironman (IM 70.3) and the full Ironman (IM) events are particularly gruelling and require a very high level of fitness. The half-ironman (IM 70.3) consists of 1.9 km of swimming, 90m km of cycling and 21.1 km of running, while the IM events double the distance of each discipline. The increased popularity of these multisport endurance events also gave birth to new events such as the ITU S3 Winter Triathlon (5 km snowshoeing, 12 km ice skating and 8 km cross-country skiing for the 2014 edition) and the *Pentathlon des neiges,* which consists of 9-15 km cycling, 3.6-5.5 km of running, 4.9-8 km of cross-country skiing, 5-8.4 km of ice skating and 3.4-5.1 km snowshoeing.

Management of body weight is considered as an important component of performance in endurance events [2]. This drive for performance may result in a disproportionate preoccupation toward food and body weight, leading to various severities of disordered eating (DE). Although difficult to identify and diagnose, DE occurs on a continuum of symptoms and is generally characterized by body dissatisfaction, a drive for thinness and a history of dieting [3]. A study by Sundgot-Borgen & Torstveit [4] showed that 42% of female elite athletes involved in aesthetic sports presented symptoms of subclinical or clinical DE. In comparison, the prevalence of DE among female endurance athletes was 24%. The prevalence of DE among multisport endurance non-elite athletes is essentially unknown, as most of the existing literature on the topic assesses DE and eating disorders (ED) among populations of young female elite athletes. The extent to which a disproportionate concern related to food and body weight is related to performance in multisport events is also unknown.

The purpose of this study was to evaluate the prevalence of DE among non-elite multisport endurance summer and winter athletes. We also

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examined the association between DE and performance in this population. We hypothesized that disproportionate concerns about food and body weight are highly prevalent within multisport endurance environments and that greater preoccupations toward food and body weight is associated with poorer performance even among non-elite endurance athletes.

2. Methods

2.1 Participants

Athletes recruited for this study had to be 18 years and older and had to compete in an age-group category of one of the following multisport endurance events: *Pentathlon des Neiges* 2014 tandem or solo categories (WINTER) (9-15 km of cycling, 3.6-5.5 km of running, 4.9-8 km of cross-country skiing, 5-8.4 km of ice skating and 3.4-5.1 km snowshoeing), *Quebec ITU S3 Winter Triathlon* in 2014 (WINTER) (5 km of snowshoeing, 12 km of ice skating and 8 km of cross-country skiing), *Ironman 70.3* triathlon (IM 70.3), *Ironman 70.3* World Championships (IM 70.3) or in the *Ironman* Triathlon (IM). All the summer triathlons were held in Mont-Tremblant in 2014. Recruitment was made via the events' emailing list, Triathlon Québec (Quebec Federation of Triathlon) members' emailing list and by the presence of one of the investigators on competition sites. A total of 297 athletes were originally recruited and 162 athletes completed the questionnaires necessary for the analyses. All participants provided informed consent either online or in written form. The Clinical Research Ethics Committee of Laval University approved this study protocol (#2013-274).

2.2 Questionnaires

Data was collected through online questionnaires that were available in both French and English. A general information questionnaire was used to obtain socio-demographic information and to assess medical condition, while a validated online food frequency questionnaire (FFQ) was used to assess the previous month's food intake [5]. An in-house questionnaire was developed and used to assess the frequency of use of sports food and supplements in the previous month as well as the quantities of sports food and supplements typically consumed by endurance athletes: sports gels and candies or chews, caffeine pills, sodium tabs, hydration drinks and bars. Average nutritional values were calculated for each type of supplement by using the nutritional facts of different brands of products available in Canada and/or the United States. Total energy and nutrient intakes were obtained by the addition of self-reported dietary intakes obtained by the FFQ and intakes related to the consumption of sports foods and supplements. Data on training habits over the preceding month and training history were also collected through self-report questionnaires. For performance assessment, subjects enrolled in the study provided their full names and identified the sports event they participated in. The performance rank was calculated as a percentile of the participant's rank position in his/her age and gender category using data publicly available on the Sportstats.ca website. A lower percentage rank reflects a better performance. Concerns about food were assessed using the validated EAT-26 questionnaire [6]. The score was calculated using the official scoring sheet according to which a score ≥ 20 is classified as "eating disorder". The questionnaire is subdivided into 3 subscales: dieting, bulimia and food preoccupation and oral control. A higher score in one of these subscales informs on the type of restraint used more commonly by the individual [7].

2.3 Statistical Analysis

Pentathlon des neiges and ITU S3 Winter were combined as WINTER sports for analyses. Both Half-Ironman events were also combined as IM 70.3. To account for potential bias in self-reported energy intakes, values inferior or exceeding the group mean by two SD were considered improbable and subjects with such values were excluded ($N = 6$) in a sensitivity analysis. Under-reporting was also accounted for by further excluding participants with a self-reported energy intake lower than estimated energy requirement based on conservative physical coefficients (PAL) for low active level (Health Canada, 2010) ($N = 47$). The sensitivity analysis was based on a subgroup of 109 participants.

Statistical analyses were performed with SAS (University Edition; SAS Institute Inc., Cary, NC, USA). Mixed models were used to compare means among sports event groups, while t-tests were used to compare means between sexes. Univariate correlation analysis was used to assess relationship between two variables. Stepwise multivariate regression analysis was used to identify predictors of age- and sex-specific performance rank based on the following independent variables: EAT-26 score, energy intake (kcal/kg), carbohydrate intake (g/kg), protein intake (g/kg), training volume (h/week) and BMI (kg/m^2). P-values < 0.05 were considered significant in all analyses.

3. Results

Subjects' characteristics are presented in Table 1. A total of 162 non-elite athletes (114 men and 48 women) aged between 21 and 66 years were included in the main analyses. IM athletes were significantly older than WINTER athletes ($P = 0.01$), while BMI values were significantly lower among IM 70.3 athletes than among WINTER ($P = 0.01$) and IM athletes ($P = 0.04$). WINTER athletes spent significantly less time training than IM 70.3 and IM athletes ($P < 0.0001$). WINTER athletes had significantly lower energy intakes per kg body weight than IM 70.3 and IM athletes ($P < 0.001$). Female athletes compared with males had a lower BMI (21.4 ± 2.2 vs. 23.8 ± 1.7 kg/m^2, $P \leq 0.001$) and reported training more hours weekly (16.2 ± 5.6 vs. 12.7 ± 6.4 h/week, $P \leq 0.001$). Based on age and sex-specific rankings, WINTER athletes performed significantly better than IM 70.3 ($P = 0.0002$) and IM athletes ($P = 0.02$). Sex and age-specific rank ranged from 1 to 100%. Men performed better than women

Table 1 Characteristics of study participants.

	Multisport Event				
	Total	WINTER	IM 70.3	IM	*P*-value[a]
N	162	46	79	37	-
Women, %	29.6	13.0	48.1	10.8	< 0.0001
Age, years	38.0 ± 11.7	34.4 ± 10.1	38.2 ± 12.5	41.9 ± 10.7*	0.01
BMI, kg/m^2	23.1 ± 2.2	23.7 ± 1.4	22.6 ± 2.3*	23.6 ± 2.3**	0.004
Training volume[b], h/week	13.7 ± 6.3	7.6 ± 3.2	15.6 ± 5.4*	17.3 ± 16.0*	< 0.0001
Energy intake[c], kcal	3234 ± 800	3152 ± 712	3170 ± 874	3505 ± 757	0.19
Energy intake[c], kcal/kg	48.4 ± 9.7	43.7 ± 7.7	51.2 ± 10.1*	50.3 ± 9.3*	< 0.001

Values are presented as means ± SD unless stated otherwise.

[a]*P*-values for differences between multisport events groups, as determined by the mixed models for continuous variables and from Chi-Square analysis for proportions. *$P < 0.05$ compared with WINTER, **$P < 0.05$ compared with IM 70.3.

[b]Training time includes all cardiovascular-oriented training (cycling, running, swimming, speed skating, cross-country skiing, snowshoeing, fitness classes, strength training) and team sports (badminton, hockey, soccer) but excludes walking, yoga, rock climbing and alpine skiing time.

[c]Self-reported energy intakes inferior or exceeding the group mean by two SD were excluded ($N = 6$), as well as participants with a self-reported energy intake lower than their estimated energy requirement based on conservative physical coefficients (PAL) for low active level (Health Canada, 2010) ($N = 47$). Analysis is based on $N = 109$.

WINTER: Athletes who competed in the Pentathlon des Neiges or in the ITU Winter Triathlon 2014; IM70.3: Ironman 70.3 in Mont-Tremblant 2014;

IM70.3: Ironman 70.3 World Championship in Mont-Tremblant, 2014;

IM: Ironman in Mont-Tremblant, 2014.

within their age groups (average rank 38.5 ± 3.0% vs. 53.4 ± 4.4%, P = 0.006 not shown).

The overall mean EAT-26 score (± SEM) among all non-elite athletes was 6.5 ± 0.5 on a scale of 0 to 78. Females had higher values than men (9.8 ± 1.1 vs. 5.1 ± 0.5, P = 0.0002, not shown). IM 70.3 athletes had higher mean EAT-26 scores than WINTER and IM athletes (Fig. 1, 9.1 ± 0.8 vs. 2.8 ± 0.7 and 5.5 ± 0.6 respectively, P < 0.01 for both). The EAT-26 *Dieting* subscale scores were higher among IM 70.3 athletes than among WINTER (P < 0.001) and IM (P = 0.01) while the *Bulimia and Food Preoccupation* and *Oral Control* subscale scores were both higher among IM 70.3 athletes than among WINTER athletes (P < 0.01 for both). The prevalence of eating disorder was low, with only 9 non-elite athletes (5.6%) having an EAT-26 score ≥ 20 (Fig. 2). Eight (6 women and 2 men) of these 9 athletes competed in IM 70.3.

As shown in Fig. 3, a higher EAT-26 score was associated with a higher % ranking (r = 0.34, P = 0.0003), and thus with a less favourable performance by age group and gender. This correlation was observed among men (r = 0.35, P = 0.0001) but not among women (r = 0.08, P = 0.58). No significant association was observed between BMI and performance (% rank) among all participants (r = 0.06, P = 0.44). However, BMI correlated positively with performance among men (r = 0.28, P = 0.002), WINTER (r = 0.28, P = 0.06) and IM athletes (r = 0.41, P = 0.01). Finally, weekly training time correlated positively with the EAT-26 score among all athletes (r = 0.13, P = 0.001).

When excluding athletes with suspected under- and over-reporting, total energy intake (kcal/kg body weight) correlated positively with the EAT-26 score (r = 0.32, P = 0.0008). Correlations were particularly strong among men (r = 0.45, P < 0.0001) and WINTER athletes (r = 0.62, P < 0.0001). Carbohydrate intake (g/kg body weight) also correlated positively with the EAT-26 score among all athletes (r = 0.19, P = 0.05), men (r = 0.47, P < 0.0001) and WINTER athletes (r = 0.52, P = 0.0007). Similar associations between protein intake (g/kg body weight) and EAT-26 scores were observed: all athletes (r = 0.33, P = 0.0004), men (r = 0.43, P = 0.0001) and WINTER athletes (r = 0.68, P < 0.0001).

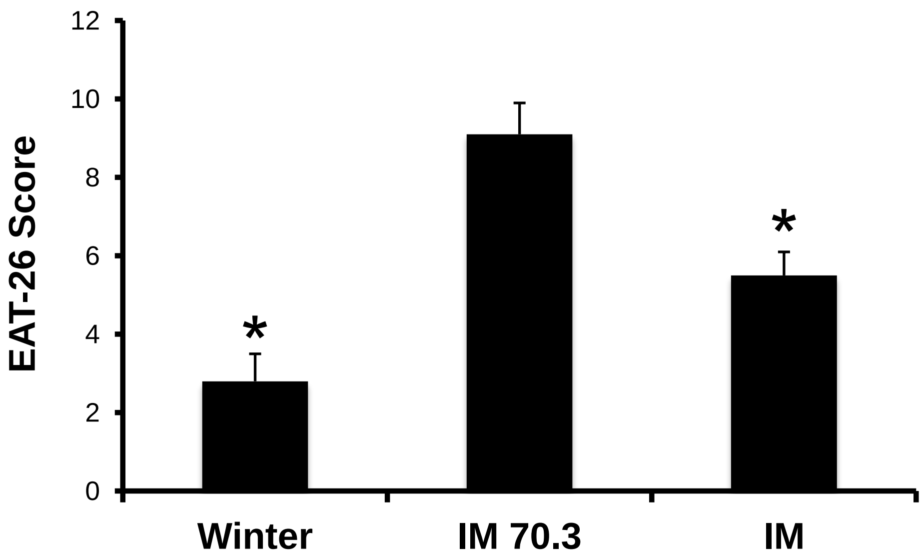

Fig. 1 Mean EAT-26 score (± SEM) among the three groups of multisport endurance non-elite athletes. WINTER: Pentathlon de neige and ITU Winter Triathlon 2014; IM70.3: Ironman 70.3 in Mont-Tremblant 2014 and Ironman 70.3 World Championship in Mont-Tremblant, 2014; IM: Ironman in Mont-Tremblant, 2014. *P < 0.01 vs. IM 70.3.

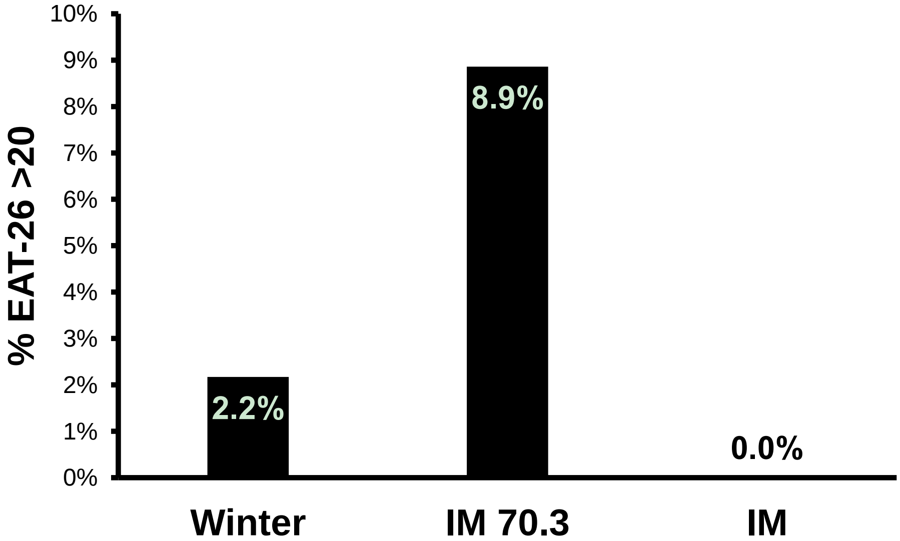

Fig. 2 Prevalence of athletes with an EAT-26 Score > 20 among the three groups of multisport endurance non-elite athletes. WINTER: Pentathlon de neige and ITU Winter Triathlon 2014; IM70.3: Ironman 70.3 in Mont-Tremblant 2014 and Ironman 70.3 World Championship in Mont-Tremblant, 2014; IM: Ironman in Mont-Tremblant, 2014. *P* = 0.07 between groups.

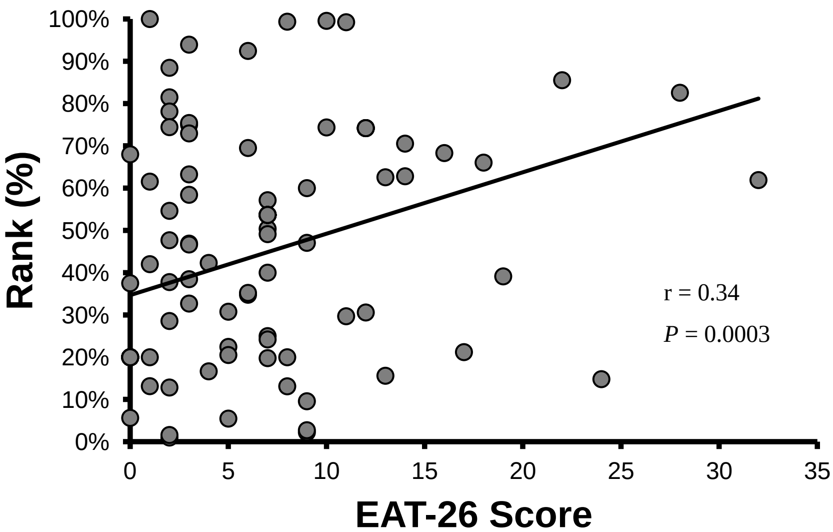

Fig. 3 Scatter plot of the association between EAT-26 score and sex and age-specific rank (%). A lower rank indicates better performance.

In multivariate regression stepwise analyses of data from all athletes, higher EAT-26 scores were significantly associated with higher age- and gender-specific percent rank and thus with poorer performance (β = 1.45, P = 0.0003). Variations in energy intake (kcal/kg), carbohydrate intake (g/kg), protein intake (g/kg), training volume (h/week) and BMI (kg/m^2) showed no significant association with performance in multivariate analyses. Similar results were observed when considering men only (not shown). Among women, higher protein intakes were the only variable associated with a higher % ranking and hence with poorer performance (β = 22.47, P = 0.02, not shown).

4. Discussion

To our knowledge, this is the first study that documents the prevalence of DE and its association with performance among non-elite endurance athletes involved in summer and winter multisport events. The EAT-26 questionnaire identifies individuals presenting symptoms related to DE. Higher scores denote a higher preoccupation toward food and body image, which may translate into unhealthy food behaviours. Individuals presenting a score of 20 or more are at risk of eating disorders and should be referred to a health care professional for further investigation [7]. Indeed, it is important to note that the study did not assess the prevalence of clinically defined ED *per se*. In the present study, only 5.6% of the non-elite multisport athletes had an EAT-26 score above this cut-off. Females and IM 70.3 athletes, which included more women proportionally, were the subgroups with higher EAT-26 scores. Higher EAT-26 scores were significantly associated with poorer performance in multivariate regression stepwise analyses, particularly in men.

This low prevalence of DE among non-elite multisport athletes may be explained, at least partly, by the fact that assessment of this complex trait was based on results from only one questionnaire. Alternatively, it is also possible that among older, non-elite multisport athletes, the reality of managing a busy life schedule deemphasizes the importance of performance, hence resulting in attenuated preoccupation towards body weight management in this population. Nevertheless, these results are consistent with data from the study by Virnig & McLeod [8], in which 4% of Olympic-distance triathletes had EAT-26 score of 20 or more. In our study, 8 of the 9 athletes with EAT-26 scores ≥ 20 participated in the IM 70.3, and 4 of those 8 competed in the highly competitive IM 70.3 World Championship competition (not shown). This event is more competitive than other IM or winter multisport events, with perhaps higher expectations in terms of performance. This may explain, to some extent, the greater preoccupation toward food and body weight in this subgroup [2]. The average EAT-26 score among IM 70.3 athletes was also significantly higher than among other groups, supporting the notion that greater performance expectations may be associated with a greater likelihood of developing significant preoccupations toward food. Unsurprisingly, females had higher EAT-26 scores. Also, most of the participants with a score ≥ 20 were females (6 out of 9), which represents 12.5% of all the females involved in this study. These results are consistent with data from previous studies, where females had a higher prevalence of eating disorders and disordered eating than males [8, 9]. While gender-specific scores in our study are similar to those reported by Virnig & McLeod [8] in a sample of Olympic-distance triathletes, they are notably lower than the ones obtained by [9] in a study including athletes of various levels and from different sports such as boxing, judo, team sports, aquafitness. Athletes involved in aesthetics and weight-category sports are known to express more preoccupations toward food, body image and body weight than triathletes [4, 10]. It is not possible from the present study to ascribe the higher EAT-26 scores among IM 70.3 athletes to the degree of competitiveness or gender, or to a combination of both.

Women in the present study reported training an extra 3.5 hours every week compared with men. Again, this is partly explained by the fact that women are overrepresented in the IM 70.3 events, which included athletes competing in the World Championship competition. Compared with previous studies, training volume reported by non-elite athletes in the present study was more important than what is usually reported by non-elite triathletes [8, 11]. On the other hand, training volume did not correlate with variations in the EAT-26 score among women, suggesting that training volume *per se* may not be an important factor in predicting the risk of experiencing a disproportionate preoccupation toward food and body image.

The significant correlation between performance and EAT-26 scores in univariate and multivariate analyses is consistent with our hypothesis that a disproportionate concern toward food and body image does not favour optimal performance even among non-elite athletes. Interestingly, better age and sex-specific performance was observed among WINTER athletes, who overall had also had the lowest EAT-26 score. Also consistent with this concept, men had lower EAT-26 scores and had better age and sex-specific rankings than women. We stress that this is an observational study and hence, cause-and-effect relationship cannot be inferred from this data.

Interestingly, greater EAT-26 scores correlated positively with energy intake, after excluding potential over and under-reporters from the analyses. This association may be counterintuitive as one would expect a high probability of under-consumption of calories with greater concerns toward food and body image. However, such results must be interpreted in the context of low EAT-26 scores in average among non-elite multisport athletes in this study. Higher scores within the low range of the EAT-26 scale may simply reflect greater consciousness toward food to meet the strenuous energy demands associated with training for a multisport event. Consistent with this hypothesis, correlations between the EAT-26 score and energy intake from carbohydrates and proteins were particularly strong among men and WINTER non-elite athletes, two groups with low EAT-26 scores in average.

5. Strengths and Limitations

To the best of our knowledge, this is the first study documenting the prevalence of DE among non-elite multisport endurance summer and winter athletes. The wide range of performance achieved by the non-elite athletes also adds value to this study by increasing the generalizability of the results. Assessment of DE was based on the EAT-26 questionnaire only. While used widely and validated for the purpose of evaluating eating disorders in broad terms, the EAT-26 questionnaire is not a formal diagnostic tool [7]. The complex nature of DE calls for an extensive evaluation of one's condition and it is recommended to evaluate the extent of DE based on more than one questionnaire for a more in-depth assessment of the problem [12]. All data used in this study are based on self-reported questionnaires among non-elite athletes recruited on site during the weekend events by emphasizing the sports nutrition angle of this research. Although this may have biased the generalizability of the results, the web-based, self-reporting character of the study may also have attenuated potential desirability biases [13].

6. Conclusion

Results from this study suggest that multisport endurance summer and winter non-elite athletes are not particularly at high risk for DE. Nevertheless and as shown before, female non-elite athletes involved in multisport events appear to entertain a less healthy relationship with food and body image than male non-elite athletes. Results also showed that a disproportionate concern toward food, body image and perhaps drive for thinness are associated with poorer performance even among non-elite athletes with relatively normal BMI values and at the lower range of the EAT-26 score. Further research is needed to better understand DE among non-elite summer and winter multisport athletes and the impact of these behaviours on the athletes' mental and physical health as well as on performance.

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