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The impact of the COVID-19 pandemic on diet, fitness, and sedentary behaviour of elite para-athletes

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Abstract

Background: With the declaration of the COVID-19 pandemic the 2020 Paralympic Games were postponed, impacting the athletes’ competition schedule for the year. Due to the interrupted competition schedule and potentially decreased motivation, Paralympic athletes may be at risk for a highly disrupted training schedule, impacting their ability to prepare for the 2021 Games.

Objective: Our purpose was to investigate the impact of the COVID-19 pandemic on the training, diet, and fitness of Paralympic cyclists and triathletes.

Methods: Twenty-four paracyclists and one paratriathlete (15 females and 10 males; age 37.6 ± 9.3 years) completed two incremental exercise tests to assess sport-specific fitness and reported their training volume and intensity for a specified week prior to the pandemic (February) and again in March, April, and May (during pandemic). Participants also reported their dietary intake and sedentary screen time prior to and during the pandemic.

Results: The amount of time spent engaging in sedentary screen time increased from 4.5 to 6.1 h (p < .001). No effect of the pandemic was found for training volume (14.2 vs 12.5 h; p = .18), intensity (678 vs 650; p = .36), or dietary intake (p > .05). While fitness test duration was nominally increased for the second test (27.3 vs 27.9 min; p = .02), no difference was seen in fitness (average power output: 201 W vs 204 W; p = .5).

Conclusion: Time spent engaging in sedentary screen time activities increased during the COVID-19 pandemic, but there were no differences in training, fitness, or dietary intake over a short-term (3 months), demonstrating the resilience of these athletes.

Introduction

Originally developed as a way to use sport in the rehabilitation process of individuals who had experienced a spinal cord injury, the Paralympic Games have been the epitome of sporting events for individuals with a physical or visual impairment since 1960. Taking place several weeks following the Olympic Games and using the same venues, the Paralympic Games showcase the highest level of physical performance in those with various impairments. The training schedule of each athlete is crafted carefully for the four years leading up to the competition to ensure that they peak at the exact right moment to have the best chance at achieving a podium performance. However, a mere five months before the Tokyo 2020 Paralympic Games, the International Paralympic Committee announced that due to the COVID-19 global pandemic, the Games would be postponed until August 2021. Such a disruption has the potential to severely impact athletes’ ability to prepare adequately for competitions.

The response to the pandemic declaration from the World Health Organization in March 2020 varied from country to country. Due to the presumed asymptomatic carrier transmission of the virus, methods on containing the virus often included various degrees of “lock-down”. Worldwide, countries opted to close non-essential services and enforce social distancing policies while some countries opted for more rigorous procedures, such as banning outdoor cycling, and limiting outdoor running.

Paralympic athletes may be affected to a greater degree than the...
average adult population due to comorbidities that put them at greater risk if the virus is contracted. Additionally, mobility and sensory limitations of many of the athletes could impact their ability to access the high-quality nutrition required to sustain their vigorous training schedules and maximize both health and performance. With the one year postponement of the 2020 Paralympic Games, the training and dietary habits of these elite athletes are at risk, which could jeopardize their ability to prepare properly for the Games. The purpose of this study was to determine how the COVID-19 global pandemic affected the dietary and training habits of paracyclists and paratriathletes. It was hypothesized that training and dietary habits would be adversely affected during the pandemic, and with the postponement or cancellation of the Paralympics and other racing opportunities. This study is important to inform athletes and coaches regarding the degree of the impact so that possible mitigation strategies can be developed for future waves of the pandemic.

Methods

Participants

Names of national and international paracyclists and paratriathletes were retrieved from results sheets posted online by the international governing bodies of the sports, Union Cycliste Internationale and World Triathlon, respectively. Individuals from English speaking countries identified on these results sheets were recruited via email and social media to take part in the study. Invitation to participate was sent via direct messaging to individuals who participated in an internationally sanctioned event in the 12 months prior. Recruitment occurred from early May to mid-June 2020. Ethical approval was obtained from the University of Saskatchewan Research Ethics Board and all participants provided consent to participate. Participants were eligible if they had competed at the national or international level in the past 12 months or were involved in the development or high-performance national team, as named by their national sport. Individuals who were not currently training for reasons other than the current pandemic or were not proficient in English were excluded.

Study design

To examine typical habits prior to (retrospective) and during (prospective) the COVID-19 pandemic, a questionnaire-based study design was employed. The questionnaire assessed changes in the training and dietary habits of elite paracyclists and paratriathletes due to the pandemic (Fig. 1). Participants used their own bicycle, tricycle, or handcycle (depending on their impairment) as well as their own heart rate monitor, power meter, and indoor trainer for fitness tests to monitor changes in fitness during the pandemic. All data were collected in participants’ own homes with no physical contact from the researchers in order to maintain social distancing. Participants were instructed to perform the fitness tests in similar states (i.e. same level of fatigue, same time of day, same food and water intake prior to the test).

Data collection

Following enrollment, participants received an email with links to two different questionnaires that they completed using the online platform Survey Monkey (San Mateo, USA). The first questionnaire asked them to retrospectively report their training volume (minutes) and intensity, quantified as Training Stress Score (TSS), a measure automatically calculated by their cycling computer based on heart rate or power output and duration (for more information on the calculation of TSS see van Erp et al.) for a specified week in each of February, March, April, and May. They were also asked to report, on average, how much time they spent engaging in sedentary screen time activities (i.e., social media, television, computer) per day, on average, prior to and during the global pandemic.

The second questionnaire was a food frequency questionnaire (FFQ), used to assess dietary intake, adapted for use in the Canadian population. This tool was used, as it has been found to have good reproducibility and can be used to assess changes in nutrient intake as opposed to determining dietary intake over a few days. A variety of foods, beverages, and supplements were presented and participants selected how often they consumed each particular food item (never, once per month, 2–3 times per month, once per week, 2–3 times per week, 4–5 times per week, once per day, 2+ times per day) and subsequently reported how much they consumed each time. Participants were instructed to answer this questionnaire in regard to their typical diet prior to the COVID-19 pandemic (i.e. pre-March 2020). A minimum of one week after they had completed this questionnaire, they were provided with a link of the same dietary questionnaire, which they were instructed to complete regarding their typical diet intake during the pandemic. A one-week separation between pre- and during-COVID questionnaires was utilized to remove “diet recall memory”. That is, to remove any concerns that answers provided on the “during COVID” questionnaire would be impacted by the answers provided on the “pre-COVID” questionnaire. Using the Food Processor Software (ESHA Research, Version 11.1, Salem, Orlando, USA), an estimate of daily energy, micronutrient, and macronutrient intake for each time period (before and during the pandemic) was generated.

Participants also underwent a ‘ramp’ test at the time of enrollment and one month later to assess sport specific fitness. The test began with a 5-min self-selected warm up, after which power output was increased by 20 W every minute starting at 100 W until volitional fatigue or the athlete could no longer meet the power output. The length of the test, maximal heart rate, average heart rate, maximal power output, and average power output were monitored through the use of the participants’ bicycle computer. The participant emailed the file from their bicycle computer (.fit file) to the researcher, who analyzed it using Garmin Connect (Olathe, USA).

Statistics

Data were analyzed using JASP statistical software, version 0.10.2 (2013–2019, University of Amsterdam). Data were assessed for normality prior to assessment through observation of skewness and kurtosis. Fitness variables and sedentary behaviour data were assessed using a dependent samples (paired) t-test. Training volume and training stress score were assessed for differences in each of the months reported as well as sex differences using a factorial repeated-measures analysis of variance. Bonferroni post-hoc tests were used to determine where the differences occurred when appropriate. Training data during the pandemic (i.e. March, April, May) were also combined to assess pre vs during the pandemic using a dependent samples t-test. To determine whether any specific month during the pandemic was different from before the pandemic, training data for each month during the pandemic were also compared to pre-pandemic data using a dependent samples t-test. Dietary data were assessed using a 2 × 2 (sex x time) ANOVA with repeated measures on the “time” factor. Data were deemed significant at p < .05. Data are presented as mean ± standard deviation.
Results

26 paracyclists and 2 paratriathletes (16 females and 12 males; age 37.8 ± 9.3 years) agreed to take part in this study. Twenty-three of these individuals were classified as “elite” (i.e., supported by their national sport organization), while three were sub-elite (i.e., competed at the National level but not supported by national sport organization). Two paracyclists and one paratriathlete (2 males and 1 female) failed to complete the “during COVID” questionnaire, and thus were removed from analysis. Athletes were residents of Canada (n = 8), United Kingdom (n = 2), Australia (n = 7), USA (n = 6), South Africa (n = 1), and Belgium (n = 1). Participant sport class information is shown in Table 1.

Training metrics

Training metric data are shown in Table 2. Volume: No sex × time interaction was observed (p = .86). There was no effect of time on reported training volume at any point (p = .43). The reported training volume reported prior to the COVID-19 pandemic (February) did not differ from values reported in March (p = .21), April (p = .45), or May (p = .18), nor when data from during the pandemic (March, April, and May) were averaged together (p = .18).

Intensity: No sex × time interaction was observed (p = .742) for training stress score. There was no effect of time on reported training intensity, monitored as TSS (p = .36). Values prior to the pandemic (i.e., February) did not differ from those in March (p = .30), April (p = .73), or May (p = .11), nor when values from during the pandemic (March, April, and May) were averaged together (p = .36).

Fitness Tests: Only a small number of participants took part in the fitness tests (n = 5 females; n = 4 males). No differences were observed in the pre vs post fitness tests for peak power, average power, peak heart rate, or average heart rate (p > .05). However, a significant difference was evident for total test duration, with the mean test duration being longer during the post-test (Table 3; p = .02).

Sedentary behaviour: The amount of time engaging in sedentary screen time activities increased from 4.5 ± 1.9 h per day prior to the COVID-19 pandemic to 6.1 ± 1.5 h during the COVID-19 pandemic (p = 0.001). Dietary intake: Macro and micronutrient intake prior to and during the pandemic is shown in Table 4. A main effect of sex was observed for multiple nutrients. Compared to their male counterparts, females had lower intakes of energy carbohydrate, protein, sugar, total fat, saturated fat, monounsaturated fat, polyunsaturated fat, vitamin B₁, vitamin B₃, vitamin B₆, vitamin B₁₂, vitamin D, iron, sodium, potassium, zinc, and folate. No main effects of time nor interactions were found for any nutrient.

Table 1

| Classification | Male (n = 10) | Female (n = 15) | Age (years) |
|----------------|--------------|----------------|-------------|
| H1             | 1            | 0              | 31          |
| H2             | 1            | 0              | 36          |
| H3             | 1            | 0              | 33          |
| T1             | 0            | 1              | 46          |
| T2             | 1            | 2              | 53–60       |
| C2             | 1            | 0              | 35          |
| C3             | 1            | 3              | 21–44       |
| C4             | 0            | 7              | 26–44       |
| C5             | 2            | 1              | 34–38       |
| B              | 2            | 0              | 47, 39      |
| PTS4           | 0            | 1              | 41          |

Table 1. Classification data for athletes. Cyclist classifications: H = handbike; T = tricycle; C = bicycle; B = tandem. Paratriathlon classifications = PTS = ambulatory athletes. Lower numbers (ex., C1) indicate greater impairment; for groups with n ≤ 2, each age is provided, for groups with n ≥ 3, age range is provided. Values are presented as mean ± standard deviation.
Discussion

The findings of the current research suggest that the current pandemic did not impact the training volume or intensity of paracyclists. This is supported by the fitness testing results in a subset of the participants that showed that duration during a ramp exercise test significantly improved during the pandemic. Whilst total test duration should be directly associated with power output, it is possible that the large standard deviation for power output precluded a significant finding.

These results would suggest that neither training nor fitness were compromised. The results differ from those observed in the general population, where there was a decrease in activity levels of individuals considered “inactive”, but an increase in activity levels in those who were already considered “active”, unless the current results do not support an increase nor a decrease in activity. When comparing the results of the current research to those carried out in other populations, the fitness, training, and dietary habits of paracyclists appear to be unaffected by the COVID-19 global pandemic. This suggests that perhaps the amount of time they had to train and infrastructure in which to do so was unaffected, while the general population might have experienced closures of infrastructure or alterations in available time.

Cyclists are a unique group in that they need minimal outside equipment. In areas that do not restrict outdoor physical activity, outdoor training would have been minimally affected. Even in areas with stricter isolation measures, elite cyclists often have access to indoor bicycle trainers, allowing them to continue their training in their home. Similarly, the inclusion of virtual rides and races may have provided additional external motivation for these athletes to continue training at a high level. Even when comparing February and May data (when motivation may be the lowest), no differences were observed.

Sedentary behaviour often is not addressed in an elite or professional athlete population due to their intense training schedules and high volumes of training. While Hu and colleagues have observed cardiometabolic consequences of increased sedentary behaviour in adults who met or exceed the current physical activity guidelines, the authors are unaware if increased levels of sedentary behavior may impact the health of highly active elite athletes. Further, if the increased levels of sedentary activity observed in the current research is short-lived and return to baseline when restrictions are lifted, it is unlikely that such consequences will be a concern in this group. However, such findings are important to be aware of in case of subsequent waves of the virus or for future times of lockdown. In the current study, dietary and training analyses showed no differences in energy intake or training volume or intensity when comparing before the pandemic to during. As such, energy intake and exercise expenditure appear to be similar, while energy expenditure throughout the day might be decreased, resulting in a net imbalance of calories in and calories out relative to prior to the pandemic. However, such a conclusion is purely speculative, as neither body weight nor composition were assessed.

While an increase in sedentary screen time was observed, it is unclear whether this may have negative consequences on the health and wellbeing of this group of athletes. Further, the values observed in the current research are appreciably lower than that observed in other adult populations. Bertrand et al. reported.

Table 3
Power output, test duration, and heart rate during incremental exercise test.

| Test Duration (min) | Average Power (W) | Max Power (W) | Average Heart Rate (bpm) | Max Heart Rate (bpm) |
|---------------------|-------------------|---------------|--------------------------|----------------------|
| Pre                 | Post              | Pre           | Post                     | Pre                  | Post               | Pre               | Post               |
| 27.3 ± 5.8          | 28.0 ± 6.4*       | 219 ± 53      | 224 ± 61                 | 363 ± 77             | 365 ± 91          | 129 ± 24         | 131 ± 25          | 168 ± 28           | 169 ± 29          |

Fitness test completed by n = 5 females; n = 4 males; *Significantly longer than baseline (pre); p < 0.05. Values are presented as mean ± standard deviation.

Table 4
Differences in intake between males and females before and during the pandemic.

| Nutrient            | Pre Pandemic | During Pandemic | (p =) sex | (p =) time |
|---------------------|--------------|-----------------|-----------|-----------|
|                     | Males (n = 10) | Females (n = 15) |           |           |
|                     |              |                 |           |           |
| Energy (kcal)       | 2819 ± 677   | 2034 ± 600      | .001 .526 | .001 .526 |
| Carbohydrates (g)   | 363 ± 99     | 281 ± 97        | .001 .856 | .001 .856 |
| Sugar (g)           | 129 ± 49     | 114 ± 44        | .001 .482 | .001 .482 |
| Protein (g)         | 143 ± 42     | 102 ± 32        | .001 .227 | .001 .227 |
| Total Fat (g)       | 92 ± 26      | 63 ± 19         | .001 .285 | .001 .285 |
| Saturated Fat (g)   | 26 ± 9       | 15 ± 6          | .001 .303 | .001 .303 |
| Monounsaturated Fat (g) | 33 ± 10 | 22 ± 12         | .001 .334 | .001 .334 |
| Polyunsaturated Fat (g) | 24 ± 7   | 18 ± 9          | .001 .650 | .001 .650 |
| Alcohol (g)         | 4 ± 8        | 1 ± 2           | .001 .376 | .001 .376 |
| Caffeine (mg)       | 267 ± 198    | 234 ± 128       | .001 .917 | .001 .917 |
| Calcium (mg)        | 1415 ± 334   | 1315 ± 426      | .001 .420 | .001 .420 |
| Folate (µg)         | 686 ± 209    | 609 ± 253       | .001 .780 | .001 .780 |
| Iron (mg)           | 25 ± 6       | 20 ± 8          | .001 .946 | .001 .946 |
| Potassium (mg)      | 4967 ± 1447  | 4467 ± 1481     | .001 .344 | .001 .344 |
| Sodium (mg)         | 4635 ± 1144  | 3192 ± 1126     | .001 .204 | .001 .204 |
| Total Fibre (g)     | 39 ± 10      | 35 ± 19         | .001 .529 | .001 .529 |
| Vit B1 (mg)         | 3 ± 1        | 2 ± 1           | .001 .988 | .001 .988 |
| Vit B2 (µg)         | 7 ± 2        | 5 ± 4           | .001 .231 | .001 .231 |
| Vit B3 (mg)         | 44 ± 12      | 30 ± 12         | .001 .218 | .001 .218 |
| Vit B6 (mg)         | 4 ± 1        | 3 ± 1           | .001 .212 | .001 .212 |
| Vit C (mg)          | 196 ± 62     | 218 ± 120       | .001 .722 | .001 .722 |
| Vit D (IU)          | 238 ± 1223   | 187 ± 126       | .001 .541 | .001 .541 |
| Vit E (mg)          | 18 ± 2       | 19 ± 7          | .001 .348 | .001 .348 |
| Zinc (mg)           | 18 ± 4       | 13 ± 4          | .001 .463 | .001 .463 |

Values are presented as mean ± standard deviation.
Time, unlike other dietary intake methods which are acute, the month of administration is likely not to have a significant effect, however, this cannot entirely be ruled out. As such, the retrospective nature of the "before-COVID" measure may have impacted the accuracy of the measure, especially with some participants being recruited early May and others mid-June. The recall of training information would not have been as much of a problem for athletes because they had access to a database which contained detailed information on their training history for the past year.

Conclusions

The results of the current research suggest that elite paracyclists and paratriathletes may be affected to a lesser extent during the COVID-19 pandemic than the general population when considering diet and physical activity. Athletes should focus on maintaining their training and dietary practices in order to maximize their fitness so that they perform optimally when competitions resume.

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Author contributions

The study was designed by KAS, PDC LB, and GAZ; the data were collected by KAS; the data were analyzed by KAS, DD and JK; the data interpretation and manuscript preparation were undertaken by KAS, GAZ and PDC. All authors approved the final version of the paper.

Declaration of competing interest

The authors declare no conflict of interest.

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