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Training Modifications in Endurance Athletes Due to COVID-19 Restrictions

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Abstract: The aim of this study was to determine which characteristics of recreational, collegiate, and professional endurance athletes were associated with training changes due to COVID-19 safety restrictions. A Qualtrics survey was distributed to endurance athletes around the world from June 2020 to February 2021. Significant differences between athlete characteristics and changes in training status were determined using a Chi-squared test (significance $p < 0.05$). Approximately 66% of the 331 endurance athletes changed their training due to restrictions. Significant group differences were found for age, sex, prior coaching status, prior use of a training program, and athlete primary sport compared to the whole sample. Understanding these factors may allow athletes/coaches to approach training in a different way to help minimize or prevent the effects of detraining for a greater portion of athletes should a COVID-19 variant or any other pandemic emerge in the future.

Keywords: COVID-19; behavior change; training adaptation; athletes; sport

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1. Introduction

The coronavirus disease 2019 (COVID-19) abruptly altered daily life by rapidly spreading worldwide and was declared a pandemic on 11 March 2020 [1]. As of 7 March 2023, nearly 760 million individuals have been infected worldwide [2]. This virus, transmitted primarily through respiratory droplets spread via close contact with other individuals, quickly became known by its characteristic symptoms of dry cough, shortness of breath, and fever [3]. Due to its high transmission rate and risk for severe illness, hospitalization, and mortality, as well as the novel nature of the disease, nationwide guidelines and restrictions were put in place to decrease spread of the virus. Precautionary measures such as social distancing, mask-requirements, mandatory lockdowns, isolation, and quarantines became the new norm, causing a sudden disruption in nearly every individual's daily life [4].

Due to widespread safety measures, people involved in physical activity and sport no longer had access to the same equipment or facilities. Local sport and physical activity organizations ceased practice and competition. National-level sport organizations such as the National Basketball Association (NBA) and National Football League (NFL) restricted their events. Even international-level competitions such as the Tokyo 2020 Olympics were suspended. While robust literature related to the effect of COVID-19 on athletes' practice habits is limited, multiple studies have reported results related to the COVID-19 restrictions on athletes' daily routines and training regimens. The findings among these studies indicate that while athletes were able to continue training in some form, training was often completed at lower intensities, less frequently, and with a shorter duration per session, and focused more on non-sport-specific movements [5–8]. These studies, however, examine both endurance and non-endurance athletes [6–8] or a single sport [6], which limits our understanding of the impacts on endurance athletes alone. A smaller study conducted by Leo et al. with 12 elite U23 cyclists (under 23 years of age) demonstrated that these athletes

were able to maintain their physical fitness measures (maximal oxygen uptake, sprint, and graded exercise peak power) and training characteristics despite the lockdowns [9]. Finally, a study examining mental health in professional US endurance athletes noted an increase in exercise duration despite a higher prevalence of depression and anxiety during lockdown during COVID-19 restrictions [10]. Understanding how training routines have changed is important, as reports in the literature demonstrate the detrimental impacts a sudden change in training can have on an athlete's preparation for competition and risk for injury during the return-to-play period. For example, in the 2011 NFL lockout, Achilles' tendon injury incidence surpassed any previous annual total, with 12 cases occurring within a 33-day window (17 days of preseason conditioning, and 2 weeks of preseason competition) [11]. A similar trend of increased injury rate was reported in German soccer players in the Bundesliga league after returning from the 2020 COVID-19 lockdowns [12]. When controlling for the number of games played after return from lockdown protocols, injury rate was 3.12 times higher compared to injury occurrences before lockdown. Major League Baseball players saw a two-fold increase in injury rate compared to the injury rate seen during the two seasons prior to COVID-19 lockdowns [13]. It was also reported that COVID-19-related changes in training behavior increased injury risk in distance runners 1.4 times [14]. These four studies note a decrease in either the intensity, volume, frequency, or total duration of training, or a combination of these factors. This led to inadequate preparation during the return-to-play phase, highlighting the importance of understanding those at risk for potentially career-altering or career-ending injuries due to similar training changes. While the above examples are sport-specific, it is clear that increased injury rates following changes in training are not isolated occurrences.

While it is clear that injury risk is greater following periods of decreased training, evidence has emerged that while the COVID-19 pandemic did lead to detraining in some individuals, others were able to maintain or even increase their exercise frequency during the pandemic lockdown [15]. In a worldwide study of athletes from different disciplines, it was determined that only 39% of endurance athletes were able to maintain sport-specific training [8]. It is unclear why there was such a varied response in physical activity and training behavior during the COVID-19 lockdown; however, it has been reported that motives to maintain sport and exercise performance differ based on variables such as age, sex, and type of sport [16]. Therefore, it is important to understand whether there are variables associated with training maintenance that may inform athletes and coaches on how to approach training should there be a large-scale lockdown in the future. The purpose of this study was to determine the association between the demographic and descriptive characteristics of endurance athletes and changes in training during the COVID-19 pandemic. Since no literature concerning the effects of COVID-19 safety measures on training patterns in endurance athletes had been published prior to the distribution of our questionnaire, no formal hypothesis was crafted for this study. This analysis was descriptive and exploratory in nature and may inform athletes, coaches, and other sports practitioners regarding the factors associated with different training behavior changes.

2. Materials and Methods

2.1. Experimental Design

An electronic questionnaire (Qualtrics, Provo, UT, USA) was distributed to endurance athletes from June 2020 to March 2021 to determine whether or not their training had changed due to the COVID-19 pandemic. This study was part of a larger questionnaire that also analyzed the recovery, sleep, nutrition, supplement use, and training habits of endurance athletes. The questionnaire was distributed using social media, email, and word of mouth. A contact list of groups/teams associated with national endurance sports organizations (e.g., USA Triathlon, USA Cycling, etc.) was compiled from publicly available information online. Participants were recruited from both within and outside the United States. The Texas Christian University Institutional Review Board (IRB) approved this study, and all participants signed their informed consent prior to answering the questionnaire.

2.2. Participants

Individuals who completed the questionnaire were included in the analysis if they were at least 18 years old and self-identified as an endurance athlete. Endurance sport was defined as an activity that involves prolonged rhythmic exercise mainly powered by oxidative phosphorylation [17]. Individuals were excluded if they self-reported they were <18 years of age and participated in a non-endurance activity, or if they failed to complete the demographic sections in the questionnaire.

2.3. Questionnaire

This study used participant responses for age, sex (male, female, non-binary, or other), highest education level (some high school, high school diploma, vocational training, some college, Bachelor's degree, or Graduate degree), annual household income (<USD 20,000, USD 20,000–34,999, USD 35,000–49,999, USD 50,000–74,999, USD 75,000–99,999, >USD 100,000, or prefer not to answer) to analyze demographic variables associated with training changes. Information regarding participants' sporting backgrounds used for the analysis included primary sport of choice (cycling, Nordic skiing, para-cycling, running, race walking, rowing, speed skating, swimming, triathlon, wheelchair racing, or other), current classification (professional, current collegiate, former collegiate, or recreational), overall race placement in the past year, race placement in their age group/division in the past year, experience working under a coach (current and former), and experience following a training program (current and former). There were 3 questions about COVID-related changes in training. If a participant indicated that 'yes,' training had changed due to COVID-19, follow-up questions were asked to determine the directionality of the change (training less/more than before, at higher/lower intensities than before, longer/shorter duration per session). A free-text cell was also included to allow individuals to provide nuance in how and why training changes occurred. A list of these questions can be found in Appendix A.

2.4. Statistical Analysis

All statistical analyses were performed in SPSS version 26 (software, IBM, Armonk, NY, USA). Pearson Chi-Square (χ^2) tests were conducted to determine whether training changes due to COVID-19 were associated with sex, age, household income, education, athlete classification, current or former training program use, current or former training with a coach, or race placement in the past year. The alpha level for the χ^2 analysis was set to 0.05. If a significant association between training changes due to COVID-19 and a demographic or training characteristic was found, the standardized adjusted residuals were examined to identify the category with the largest differences in the observed and expected values. A significant standardized adjusted residual was set at ≥ 1.96 or ≤ -1.96.

3. Results

A total of 331 endurance athletes responded to the question of whether training had changed due to COVID-19. Out of this group, 219 (66%) reported that their training had changed due to the COVID-19 pandemic, and the other 112 (34%) reported no changes in their training (Table 1). The majority of athletes who responded were female (53%, $n = 158$), and in the younger age groups (18–30 years (35%) and 31–40 years (23%)). Significant associations, assessed using the standardized adjusted residuals for significant χ^2 analyses, are reported compared to this proportion when all participant responses were valid for that variable (when $n = 331$). Those that are not compared to this proportion had to invalid or missing responses to the demographic or training question (when $n < 331$).

3.1. Chi-Squared Analyses

Recoding and data cleaning were conducted to ensure that the Chi-Square assumption of the expected value of the cells being 5 or greater in at least 80% of cells was met. Such recoding and cleaning yielded a smaller sample size for certain Chi-square tests. Age was

grouped by decade up to 71–80 years. Participants aged 18, 19, or 20 years were grouped into the 21–30 years category. The statistical analysis for sport of choice was modified by grouping paracycling (n = 1), Nordic skiing (n = 1), race walking (n = 1), and wheelchair racing (n = 1) into the "other" category (n = 7), as these groups were not large enough (n < 8) for χ^2 analysis. The responses for sex were modified in a similar manner; the participants (n = 31) who selected "other" for sex typed their name when prompted to specify, and the participant (n = 1) who selected "non-binary" was excluded from the sex and training change χ^2 analyses due to an invalid response and an inadequate group size, respectively.

Table 1. Training changes by participant characteristics.

Age	**Yes *n* = 217 (66%)**	**No *n* = 112 (34%)**	**Total *n* = 329**	***p*-Value**
	%	%	% (total)	
18–30	75	25	35	$p = 0.033$
31–40	56	44	23	
41–50	71	29	22	
51–60	58	42	12	
61–70	62	38	8	
71–80	25	75	1	
Sex	**Yes *n* = 199 (67%)**	**No *n* = 99 (33%)**	**Total *n* = 298**	
Female	73	27	53	$p = 0.019$
Male	60	40	47	
Education	**Yes *n* = 218 (66%)**	**No *n* = 112 (34%)**	**Total *n* = 330**	
Some high school	100	0	0	$p = 0.278$
High school diploma (9–12 years)	75	25	2	
Vocational training (after high school)	20	80	2	
Some college (less than 4 years)	64	36	17	
Bachelor's degree	64	36	33	
Graduate degree	69	31	46	
Annual Income	**Yes *n* = 219 (66%)**	**No *n* = 112 (34%)**	**Total *n* = 331**	
Less than USD 20,000	55	45	7	$p = 0.424$
USD 20,000–34,999	69	31	5	
USD 35,000–49,999	54	46	4	
USD 50,000–74,999	67	33	11	
USD 75,000–99,999	81	19	10	
Over USD 100,000	65	35	53	
Prefer not to say	70	30	11	
Primary Sport	**Yes *n* = 219 (66%)**	**No *n* = 112(34%)**	**Total *n* = 331**	
Cycling	57	43	21	$p < 0.001$
Running	55	45	37	
Rowing	85	15	4	
Swimming	75	25	2	
Triathlon	82	18	32	
Other	67	33	4	
Athlete Classification	**Yes *n* = 219 (66%)**	**No *n* = 112 (34%)**	**Total *n* = 331**	
Current pro	81	19	13	$p = 0.135$
Current collegiate	67	33	16	
Former collegiate	72	28	5	
Recreational	63	37	67	

3.1.1. Age

The proportion of athletes who reported changes in training due to COVID differed significantly by age (Pearson $\chi^2_{5,329} = 12.1$, $p = 0.033$) (Table 1). Based on the standardized adjusted residual analysis, those aged 18–30 years (n = 114) reported that their training had changed at a higher proportion (75%) compared to the proportion of training changes reported by those with a valid response (66%). Those in the 31–40-year category (n = 75) reported that their training had not changed at a higher proportion (44%). Two responses were considered invalid: an age of 226 years and a non-number response. Of those in the 18–30-year range who reported how and/or why training changed, the majority selected

responses indicative of a decrease in training (less training, lower intensity, shorter sessions) (Table 2). The two most common responses as to why training changed were, "I cannot access facilities I normally use for training" and "Group training sessions are no longer an option" (Table 2).

Table 2. Frequency of responses as to how and why training changed in groups that reported significant changes.

How Has your Training Changed due to the COVID-19 Pandemic?	Total	Aged 18–30	Sex—Female	Triathletes	Pre-Pandemic Coach	Pre-Pandemic Training Program
I train less than before	89	27	43	29	16	26
I train more than before	55	11	23	10	14	8
I train at lower intensities than before	73	20	40	20	19	19
I train at higher intensities than before	14	4	5	3	2	1
Individual sessions are shorter than before	41	12	22	14	9	11
Individual sessions are longer than before	23	5	11	1	5	6
Other	39	8	16	8	9	6
Why has your training changed due to the COVID-19 pandemic?						
I cannot access facilities I normally use for training	136	42	62	42	30	30
Group training sessions are no longer an option	93	29	45	22	22	22
My work situation has changed and I have less time	33	13	16	12	6	10
My work situation has changed and I have more time	38	8	17	10	10	8
My work situation has changed and my hours are less flexible	21	9	11	7	2	3
My work situation has changed and my hours are more flexible	63	16	26	16	17	12
Other	32	8	25	11	8	11

These questions were only asked as a follow-up to those who responded "Yes" to the initial question of whether or not training had changed.

3.1.2. Sex

The comparison of changes in training due to COVID differed significantly by sex (Pearson $\chi^2_{1,298} = 5.469$, $p = 0.019$) (Table 1). Standardized adjusted residual analysis indicated that female athletes reported that their training had changed at a significantly higher proportion (73%) compared to training changes reported by those with a valid response (67%). A significantly larger proportion of male athletes reported no changes in their training (40%) compared to the whole cohort with a valid response. Of the females who reported how and/or why training changed, the majority selected responses indicative of a decrease in training (less training, lower intensity, shorter sessions) (Table 2). The two most common responses as to why training changed were, "I cannot access facilities I normally use for training" and "Group training sessions are no longer an option" (Table 2).

3.1.3. Education Level

No significant association was noted following χ^2 analysis between training changes and education level ($\chi^2_{5,330} = 6.307$, $p = 0.278$) (Table 1).

3.1.4. Socioeconomic Status

No significant association was noted following χ^2 analysis between training changes and annual household income ($\chi^2_{6,331} = 5.989$, $p = 0.424$) (Table 1).

3.1.5. Primary Endurance Sport

A significant association was found between training changes and primary endurance sport ($\chi^2_{5,331} = 23.613$, $p < 0.001$) (Table 1). Standardized adjusted residual analysis showed that significantly more athletes who trained for a triathlon experienced changes in their training (82%) compared to training changes noted by all participants (66%). A significantly higher proportion of runners reported no training changes (45%). Cycling trended toward significance (standardized residual of 1.9), with a higher proportion of athletes reporting no changes in training (45%). Of the triathletes who reported how and/or why their training changed, the majority selected responses indicative of a decrease in training (less training, lower intensity, shorter sessions) (Table 2). The two most common responses as to why training changed were, "I cannot access facilities I normally use for training" and "Group training sessions are no longer an option" (Table 2).

3.1.6. Athlete Classification

No significant association was noted following χ^2 analysis between training changes and athlete classification ($\chi^2_{5,331} = 5.564$, $p = 0.135$) (Table 3).

Table 3. Participant training characteristics.

Do you currently have a coach?	**Yes *n* = 219 (66%)**	**No *n* = 112 (34%)**	**Total *n* = 331**	
Yes	72	28	38	$p = 0.095$
No	63	37	63	
Have you ever had a coach?	**Yes *n* = 129 (63%)**	**No *n* = 77 (37%)**	**Total *n* = 206**	
Yes	71	29	29	$p = 0.023$
No	55	45	33	
Do you currently follow a training program?	**Yes *n* = 219 (66%)**	**No *n* = 112 (34%)**	**Total *n* = 331**	
Yes	67	33	59	$p = 0.758$
No	65	35	42	
Have you ever followed a training program?	**Yes *n* = 86 (64%)**	**No *n* = 48 (36%)**	**Total *n* = 134**	
Yes	72	28	30	$p < 0.001$
No	42	58	11	
Have you placed in the top 3 overall in any races in the past year?	**Yes *n* = 219 (66%)**	**No *n* = 111 (34%)**	**Total *n* = 330**	
Yes	68	32	21	$p = 0.729$
No	66	34	79	
Have you placed in the Top 3 in your age group or division in any race in the past year?	**Yes *n* = 219 (66%)**	**No *n* = 112 (34%)**	**Total *n* = 331**	
Yes	66	34	43	$p = 0.883$
No	66	34	58	

3.1.7. Coaching Status

No significant association was noted following χ^2 analysis between training changes and those who are currently training with a coach ($\chi^2_{1,331} = 2.788$, $p = 0.095$) (Table 3). However, a significant association was found between training changes and whether or not athletes had worked with a coach in the past ($\chi^2_{1,206} = 5.180$, $p = 0.023$). Those who reported that they had worked with a coach in the past reported that their training had changed at a higher proportion (71%) compared to the proportion seen in all individuals who reported whether they had worked with a coach in the past (63%). A smaller proportion of athletes who reported that they had not worked with a coach in the past experienced changes in their training due to the pandemic (45%) compared to the proportion seen in all individuals who reported whether they had worked with a coach in the past (37%). Of those who had a coach before the pandemic and who reported how and/or why training changed, the majority selected responses indicative of a decrease in training (less training, lower intensity, shorter sessions) (Table 2). The two most common responses as to why training changed were, "I cannot access facilities I normally use for training" and "Group training sessions are no longer an option" (Table 2).

3.1.8. Program Participation

No significant association was noted following χ^2 analysis between training changes and those who are currently following a training program ($\chi^2_{1,331} = 0.095$, $p = 0.758$) (Table 3). A significant association was found between training changes and whether or not an athlete had followed a training program in the past ($\chi^2_{1,134} = 10.852$, $p < 0.001$). Those who reported that they had followed a training program reported at a higher proportion that training had changed due to the pandemic (72%) compared to training changes seen in all individuals who had followed a training program (64%). Significantly more athletes who had not followed a program in the past reported no changes in their training (58%) compared to training changes reported by the sub-cohort with valid responses (36%). Of those who had followed a training program before the pandemic and who reported how and/or why training changed, the majority selected responses indicative of a decrease in training (less training, lower intensity, shorter sessions) (Table 2). The two most common responses as to why training changed were, "I cannot access facilities I normally use for training" and "Group training sessions are no longer an option" (Table 2).

3.1.9. Prior Race Success

No significant association was noted following χ^2 analysis between training changes and whether or not athletes had placed in the top three overall in any race in the past year, $\chi^2_{1,330} = 0.120$, $p = 0.729$. Additionally, no significant association was found following χ^2 analysis between training changes and whether or not athletes had placed in the top three in their age group/division in the past year ($\chi^2_{1,331} = 0.022$, $p = 0.883$).

3.2. Free-Text Responses on How and Why Training Changed

In addition to the responses reported in Table 2, free-text responses provided insight into how ($n = 39$) and why ($n = 32$) training changed. Common themes for how training changed include more solo training ($n = 7$) and decreased access to the usual training facilities ($n = 12$). Athletes who reported that they increased the frequency of solo training voiced that they trained less with their teams/partners due to new conflicting schedules or concerns about social distancing. Athletes also reported that access to training facilities or equipment had changed. Particularly noticeable was that athletes who selected swimming and triathlon as their primary endurance sport of choice voiced that they swam less or stopped swimming altogether ($n = 9$). This was due to either a lack of access to indoor pools or concerns about training in crowds in outside pools. Similarly, cyclists and runners commonly reported modifying their routes to avoid contact with other people. Some cyclists reported that they increased the frequency of indoor training using a virtual cycling trainer to avoid contact with people on outside routes ($n = 2$). Athletes also reported that

they modified their supplementary strength training due to gym closures to either more accessible home training or increased training for their primary endurance sport (n = 3).

Common reasons for why training changed due to the COVID-19 pandemic included decreased motivation (n = 4), less race-oriented training (n = 13), safety concerns about COVID-19 (e.g., mask wearing, social distancing; n = 6), and changes in responsibilities outside of training (n = 5). With the pandemic, athletes reported they had no races to train for, and as a result, they decreased their training intensity or had less motivation to keep up with training. With less group training and more solo training, athletes also voiced less motivation to train. And finally, with changes in athletes' work, school, or home responsibilities, or those of the athletes' families, athletes reported having less overall time for training (n = 4). Of note, some athletes did report an increase in training (n = 3), saying they were just getting back into training (n = 1), returning from an injury (n = 1), or they now had increased availability due to decreased responsibilities for work (n = 1).

4. Discussion

The primary purpose of this study was to determine the demographic and training characteristics of endurance athletes associated with changes in training due to the COVID-19 pandemic. Our analysis of these questionnaire data indicated that athletes' age, sex, primary endurance sport, and prior coaching or prior use of a training program were significantly associated with changes in training. Factors that did not show significance included athletes' education level, annual household income, classification, current coaching status or current use of a training program, or success in a race in the past year. It is important to take these factors into consideration when designing training programs in a lockdown situation, or developing proper return-to-play strategies to ensure a safe transition back to normal training.

Significantly more of the youngest group (18–30 years) reported a change in training compared to the other five age groups. More than double the participants spent less time in training compared to those who spent more time in training during the lockdown. Significantly more of the second youngest age group (31–40 years) reported being able to maintain their normal training (i.e., no change) compared to the other five groups. These two age groups are of particular interest in ensuring training maintenance, as this is when endurance athletes are likely to be in their prime (20–40 years old) [18–20]. The larger change in the 18–30-year-old group compared to the 31–40-year-old group may be explained by the difference in reliance on access to training facilities. While 42 of the 18–30-year-old participants reported a loss of facility access as a reason for training behavior change, only 19 (not reported in the Results section) of the 31–40-year-old group reported the same reasoning.

Sex differences were noted, with more males reporting that training was unchanged due to the pandemic and more females reporting that training had changed. Among the males who did report a change in training, there was roughly an even split between increasing and decreasing training behaviors. A significantly greater portion of female athletes reported a change in training, with nearly twice as many spending less time training compared to those who spent more time training. The reasoning behind this may be similar to that of the difference in age groups, as 50% more females than males reported not having access to facilities as a reason for a training level decrease. These sex differences should be considered in conjunction with results from other studies when designing return-to-play strategies. For example, Pillay et al. and Romdhani et al. also noted sex differences, with females experiencing more adverse effects on mental health and a higher proportion of anxiety and depression symptoms compared to males during the COVID-19 lockdowns [7,21].

When evaluating training responses based on each athlete's primary sport, a significantly greater number of triathletes reported training changes compared to all other athletes. Though not statistically significant, both runners and cyclists had the lowest amount of change in training during the pandemic. Based on the free-text responses, running and

cycling athletes who experienced training changes reported more solo training and changes in training routes to avoid crowded areas, suggesting that training was continued. This may indicate the maintenance of normal training regimens, but conclusions on the impact of lockdowns and COVID-19 safety precautions on training intensity, frequency, volume, and other training metrics are better determined using more objective metrics, such as GPS training trackers. Triathletes who reported changing their training due to COVID-19 overwhelmingly suggested in their open-ended responses that closures of indoor pools and the inaccessibility of outdoor bodies of water greatly limited their ability to train in the swimming discipline. These athletes also reported that this increased their focus on the running and cycling disciplines. Thus, as access to pools and other bodies of waters increases, training should be adequately progressed to minimize injury risk. Of note, this change in training focus for triathletes further indicates that those engaged in cycling and running were able to maintain their training routines.

Finally, athletes who had undertaken prior coaching and prior use of a training program were noted to have a higher proportion of change in training compared to their counterparts. The conclusions from this analysis are limited, as the wording of the question did not clarify whether or not athletes discontinued their training with a coach or a program due to the pandemic or the two factors were mutually exclusive. Nonetheless, utilizing a training program and/or receiving training from a coach can help athletes progress and stay on track with training and may help maximize progress in their sport [22,23].

4.1. Practical Applications

For the training and return-to-play safety of endurance athletes, the results of the current study provide valuable insight to be considered by athletes and coaches should there be a lockdown situation in which training facilities are closed down and/or social distancing becomes required. Given that young adult (18–30 years) and female endurance athletes are more likely to decrease their training under such conditions, they should consider self-management and self-efficacy practices that will increase the probability of training adherence. Some of these techniques may include: planning and preparation, goal setting, or reporting to an accountability partner (coach, family, friend, etc.) or mobile application. The selection of motivation techniques should be approached with intent, as age, sex, and primary sport may have different motivators [16,24]. Athletes and coaches may want to consider existing tools such as the Bernese Motive and Goal Inventory to determine how to best approach each individual situation [25]. For athletes who have a coach and/or a regimented training program, they should keep their coaches and/or training programs to increase their likelihood of maintaining training behavior.

4.2. Strengths and Limitations

This study did have a large sample size of 331 participants who responded to the question of whether or not their training changed due to the pandemic. Having a larger sample size, the results may have been less skewed in terms of athlete classification, annual household income, and highest completed education level. Making direct comparisons of the current study to other relatively similar studies should be carried out with cautions, as professional athletes in other sports may have had access to training "bubble" camps, allowing athletes access to regular training facilities and professional support staff [26]. However, the response rate was not determined, as recruitment through large organizations, social media, and word of mouth did not allow for tracking of the total number of individuals contacted. The results of the 331 participants should also be interpreted with caution, as there may have been an undeterminable response/non-response bias.

While this study was able to determine whether or not these endurance athletes experienced changes in their training due to the COVID-19 pandemic, the directionality of the changes athletes experienced was not readily available from this questionnaire. Follow-up questions were asked; however, these questions were prompted as optional questions rather than required questions to move forward with the survey. Even though nearly every

participant responded with at least one reason as to why their training had changed, an alternate method of questioning the athletes would allow us to determine the directionality of these changes. Another alternate method that would provide more objective data is using fitness tracking data, such as Strava or Garmin, to compare training data pre-, intra-, and post-lockdown.

Additionally, this study was part of a larger survey study, examining the sleep, recovery, nutrition, and supplement habits of endurance athletes. This overall survey included in-depth analyses of these three factors associated with training, taking about 1 h to complete. The length of the survey may have deterred responses from this subsection related to training changes due to COVID-19. Finally, free-text responses were only obtained from those who reported that "yes", their training did change due to the COVID-19 pandemic, to better understand how and why training changed. No follow-up questions were asked of the group that said "no", training did not change, which may have provided insight into factors that allowed this group to maintain their training as a comparison.

5. Conclusions

In conclusion, this study demonstrates that age, sex, and primary endurance sport were significant determining characteristics of endurance athletes associated with training changes during the COVID-19 pandemic. Coaches and athletes alike should consider using additional tools or motivational techniques with athletes who are more likely to enter into patterns of detraining. By maintaining training levels, even during a pandemic or lockdown scenario, athletes may reduce their risk of injury when returning to play.

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Appendix A

Below is a list of questions from the larger Endurance Athlete Survey that were analyzed for the current study:

- How old are you?
- What is your sex?
    - ○ Female
    - ○ Male
    - ○ Non-Binary
    - ○ Other (please specify)
    - ○ Prefer not to Answer

- What is your highest level of education? Select one.
  - ○ Some High School
  - ○ High School Diploma (9–12 years)
  - ○ Vocational Training (after high school)
  - ○ Some College (less than 4 years)
  - ○ Bachelor's Degree
  - ○ Graduate Degree
- What is your house hold income? Select one.
  - ○ Less than $20,000
  - ○ $20,000 to $34,999
  - ○ $35,000 to $49,999
  - ○ $50,000 to $74,999
  - ○ $75,000 to $99,999
  - ○ Over $100,000
  - ○ Prefer not to answer
- Are you a professional athlete?
  - ○ Yes
  - ○ No
- Are you a current collegiate athlete?
  - ○ Yes
  - ○ No
- (If no is selected to the previous question) Are you a former collegiate athlete?
  - ○ Yes
  - ○ No
- What is your primary endurance sport? Select one.
  - ○ Cycling
  - ○ Nordic skiing
  - ○ Para-cycling
  - ○ Running
  - ○ Race Walking
  - ○ Rowing
  - ○ Speed skating
  - ○ Swimming
  - ○ Triathlon
  - ○ Wheelchair racing
  - ○ Other (please specify)
- Have you placed in the top 3 overall in any races in the past year?
  - ○ Yes
  - ○ No
- Have you placed in the Top 3 in your age group or division in any races in the past year?
  - ○ Yes
  - ○ No
- Do you currently have a coach?
  - ○ Yes
  - ○ No
- (If no is selected to the previous question) Have you ever had a coach?
  - ○ Yes
  - ○ No
- Do you currently follow a training program?

- ○ Yes
- ○ No

- (If no is selected to the previous question) Have you ever followed a training program?
  - ○ Yes
  - ○ No
- Has your training changed due to the COVID-19 Pandemic?
  - ○ Yes
  - ○ No
- (If yes is selected to the previous question)
  - ○ How has your training changed due to the COVID-19 pandemic? Select all that apply.
    - ▪ I train less than before
    - ▪ I train more than before
    - ▪ I train at lower intensities than before
    - ▪ I train at higher intensities than before
    - ▪ Individual sessions are shorter than before
    - ▪ Individual sessions are longer than before
    - ▪ Other (please specify)
  - ○ Why has your training changed due to the COVID-19 pandemic? Select all that apply.
    - ▪ I cannot access facilities I normally use for training
    - ▪ Group training sessions are no longer an option
    - ▪ My work situation has changed and I have less time
    - ▪ My work situation has changed and I have more time
    - ▪ My work situation has changed and my hours are less flexible
    - ▪ My work situation has changed and my hours are more flexible
    - ▪ Other (please specify)

References

1. Centers for Disease Control and Prevention. CDC Museum COVID-19 Timeline. 15 March 2023. Available online: https://www.cdc.gov/museum/timeline/covid19.html#:~:text=March%2011%2C%202020,declares%20COVID%2D19%20a%20pandemic (accessed on 8 April 2023).
2. World Health Organization. Who Coronavirus (COVID-19) Dashboard. Available online: https://covid19.who.int/ (accessed on 14 March 2023).
3. Wiersinga, W.J.; Rhodes, A.; Cheng, A.C.; Peacock, S.J.; Prescott, H.C. Pathophysiology, Transmission, Diagnosis, and Treatment of Coronavirus Disease 2019 (COVID-19): A Review. *JAMA* **2020**, *324*, 782. [CrossRef] [PubMed]
4. World Health Organization. COVID-19 Strategy Update. 2020. Available online: https://www.who.int/docs/default-source/coronaviruse/covid-strategy-update-14april2020.pdf?sfvrsn=29da3ba0_19 (accessed on 10 March 2023).
5. Facer-Childs, E.R.; Hoffman, D.; Tran, J.N.; Drummond, S.P.A.; Rajaratnam, S.M.W. Sleep and mental health in athletes during COVID-19 lockdown. *Sleep* **2021**, *44*, zsaa261. [CrossRef] [PubMed]
6. Fikenzer, S.; Fikenzer, K.; Laufs, U.; Falz, R.; Pietrek, H.; Hepp, P. Impact of COVID-19 lockdown on endurance capacity of elite handball players. *J. Sports Med. Phys. Fit.* **2021**, *61*, 977–982. [CrossRef]
7. Romdhani, M.; Rae, D.E.; Nédélec, M.; Ammar, A.; Chtourou, H.; Al Horani, R.; Ben Saad, H.; Bragazzi, N.; Dönmez, G.; Driss, T.; et al. COVID-19 Lockdowns: A Worldwide Survey of Circadian Rhythms and Sleep Quality in 3911 Athletes from 49 Countries, with Data-Driven Recommendations. *Sports Med.* **2022**, *52*, 1433–1448. [CrossRef]
8. Washif, J.A.; Farooq, A.; Krug, I.; Pyne, D.B.; Verhagen, E.; Taylor, L.; Wong, D.P.; Mujika, I.; Cortis, C.; Haddad, M.; et al. Training During the COVID-19 Lockdown: Knowledge, Beliefs, and Practices of 12,526 Athletes from 142 Countries and Six Continents. *Sports Med.* **2022**, *52*, 933–948. [CrossRef] [PubMed]
9. Leo, P.; Mujika, I.; Lawley, J. Influence of COVID-19 Restrictions on Training and Physiological Characteristics in U23 Elite Cyclists. *J. Funct. Morphol. Kinesiol.* **2021**, *7*, 1. [CrossRef] [PubMed]
10. Roche, M.; Sainani, K.; Noordsy, D.; Fredericson, M. Impacts of COVID-19 on Mental Health and Training in US Professional Endurance Athletes. *Clin. J. Sport Med. Off. J. Can. Acad. Sport Med.* **2022**, *32*, 290–296. [CrossRef]
11. Myer, G.D.; Faigenbaum, A.D.; Cherny, C.E.; Heidt, R.S.; Hewett, T.E. Did the NFL Lockout expose the Achilles heel of competitive sports? *J. Orthop. Sports Phys. Ther.* **2011**, *41*, 702–705. [CrossRef]

12. Seshadri, D.R.; Thom, M.L.; Harlow, E.R.; Drummond, C.K.; Voos, J.E. Case Report: Return to Sport Following the COVID-19 Lockdown and Its Impact on Injury Rates in the German Soccer League. *Front. Sports Act. Living* **2021**, *3*, 604226. [CrossRef]
13. Platt, B.N.; Uhl, T.L.; Sciascia, A.D.; Zacharias, A.J.; Lemaster, N.G.; Stone, A.V. Injury Rates in Major League Baseball During the 2020 COVID-19 Season. *Orthop. J. Sports Med.* **2021**, *9*, 2325967121999646. [CrossRef]
14. DeJong, A.F.; Fish, P.N.; Hertel, J. Running behaviors, motivations, and injury risk during the COVID-19 pandemic: A survey of 1147 runners. *PLoS ONE* **2021**, *16*, e0246300. [CrossRef] [PubMed]
15. Brand, R.; Timme, S.; Nosrat, S. When pandemic hits: Exercise frequency and subjective well-being during COVID-19 pandemic. *Front. Psychol.* **2020**, *11*, 2391. [CrossRef]
16. Ley, C. Participation motives of sport and exercise maintainers: Influences of age and gender. *Int. J. Environ. Res. Public Health* **2020**, *17*, 7830. [CrossRef] [PubMed]
17. Booth, F.W.; Ruegsegger, G.N.; Toedebusch, R.G.; Yan, Z. Endurance Exercise and the Regulation of Skeletal Muscle Metabolism. In *Progress in Molecular Biology and Translational Science*; Elsevier: Amsterdam, The Netherlands, 2015; Volume 135, pp. 129–151. [CrossRef]
18. Allen, S.V.; Hopkins, W.G. Age of Peak Competitive Performance of Elite Athletes: A Systematic Review. *Sports Med.* **2015**, *45*, 1431–1441. [CrossRef] [PubMed]
19. Rüst, C.A.; Knechtle, B.; Knechtle, P.; Rosemann, T.; Lepers, R. Age of peak performance in elite male and female Ironman triathletes competing in Ironman Switzerland, a qualifier for the Ironman world championship, Ironman Hawaii, from 1995 to 2011. *Open Access J. Sports Med.* **2012**, *3*, 175–182. [CrossRef]
20. Tanaka, H.; Seals, D.R. Endurance exercise performance in Masters athletes: Age-associated changes and underlying physiological mechanisms. *J. Physiol.* **2008**, *586*, 55–63. [CrossRef] [PubMed]
21. Pillay, L.; Janse van Rensburg, D.C.C.; Jansen van Rensburg, A.; Ramagole, D.A.; Holtzhausen, L.; Dijkstra, H.P.; Cronje, T. Nowhere to hide: The significant impact of coronavirus disease 2019 (COVID-19) measures on elite and semi-elite South African athletes. *J. Sci. Med. Sport* **2020**, *23*, 670–679. [CrossRef] [PubMed]
22. Losch, S.; Traut-Mattausch, E.; Mühlberger, M.D.; Jonas, E. Comparing the Effectiveness of Individual Coaching, Self-Coaching, and Group Training: How Leadership Makes the Difference. *Front. Psychol.* **2016**, *7*, 629. [CrossRef]
23. McClaran, S.R. The effectiveness of personal training on changing attitudes towards physical activity. *J. Sports Sci. Med.* **2003**, *2*, 10–14. [CrossRef]
24. Molanorouzi, K.; Khoo, S.; Morris, T. Motives for adult participation in physical activity: Type of activity, age, and gender. *BMC Public Health* **2015**, *15*, 66. [CrossRef]
25. Schmid, J.; Gut, V.; Conzelmann, A.; Sudeck, G. Bernese motive and goal inventory in exercise and sport: Validation of an updated version of the questionnaire. *PLoS ONE* **2018**, *13*, e0193214. [CrossRef]
26. Washif, J.A.; Mohd Kassim, S.F.A.; Lew, P.C.F.; Chong, C.S.M.; James, C. Athlete's Perceptions of a "Quarantine" Training Camp During the COVID-19 Lockdown. *Front. Sports Act. Living* **2021**, *2*, 622858. [CrossRef]