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Nowhere to hide: The significant impact of coronavirus disease 2019 (COVID-19) measures on elite and semi-elite South African athletes☆

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ABSTRACT

Objectives: To describe the perceptions of South African elite and semi-elite athletes on return to sport (RTS); maintenance of physical conditioning and other activities; sleep; nutrition; mental health; healthcare access; and knowledge of coronavirus disease 2019 (COVID-19).
Design: Cross- sectional study.
Methods: A Google Forms survey was distributed to athletes from 15 sports in the final phase (last week of April 2020) of the level 5 lockdown period. Descriptive statistics were used to describe player demographic data. Chi-squared tests investigated significance ($p < 0.05$) between observed and expected values and explored sex differences. Post hoc tests with a Bonferroni adjustment were included where applicable.
Results: 67% of the 692 respondents were males. The majority (56%) expected RTS after 1–6 months. Most athletes trained alone (61%; $p < 0.0001$), daily (61%; $p < 0.0001$) at moderate intensity (58%; $p < 0.0001$) and for 30–60 min (72%). During leisure time athletes preferred sedentary above active behaviour ($p < 0.0001$). Sleep patterns changed significantly (79%; $p < 0.0001$). A significant number of athletes consumed excessive amounts of carbohydrates (76%; $p < 0.0001$; males 73%; females 80%). Many athletes felt depressed (52%), and required motivation to keep active (55%). Most had access to healthcare during lockdown (80%) and knew proceedings when suspecting COVID-19 (92%).
Conclusions: COVID-19 had physical, nutritional and psychological consequences that may impact on the safe RTS and general health of athletes. Lost opportunities and uncertain financial and sporting futures may have significant effects on athletes and the sports industry. Government and sporting federations must support athletes and develop and implement guidelines to reduce the risk in a COVID-19 environment.

Practical implications

1. Implement a culture of education for athletes and support staff regarding hygiene, wearing masks, social distancing measures and self-isolation to improve health literacy and promote required behaviours.
2. Consider health, nutritional and psychological support and education during the remainder of the lockdown period.
3. Reduce the injury risk by implementing a progressive training load and allowing for maximum adaptation before competition is re-introduced.
4. Sleep hygiene and its effects on performance should become an imperative part of athletic education.
5. Athletes returning to sport should require thorough medical assessment including nutrition assessment prior to resumption of high intensity sporting activity.
6. Mental health aspects form an important part of athlete performance and should be recognised and acted on timeously through life/performance coaches or psychologists.
7. Stimulate athletes to become saving and investment-wise, and plan their future in time for a career/business/life after sport.

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1. Introduction

The coronavirus disease 2019 (COVID-19) caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) resulted in a global pandemic with unprecedented consequences. Many scientific articles (peer-reviewed and non-peer reviewed) have been published regarding epidemiology,[1] pathogenesis,[2] complications[3] and treatment.[4] The COVID-19 pandemic forced governments to implement unparalleled measures to curb the rapid spread of the disease including strict lockdown, banning of all organised and social gatherings (including sports events) and restricting non-essential travel, with a significant effect on the sports industry and athletes. In South Africa, level 5 lockdown measures were enforced from 26 March to 30 April (5 weeks). Only essential services, travel and shopping were allowed and exercise outside individual property boundaries was not allowed,[5] likely having a psychological impact on all, including athletes.[6] Our current understanding of these lockdown measures on training, nutrition and mental health of athletes are limited. This study aims to investigate the perceptions of South African elite and semi-elite athletes on (1) return to sport (RTS); (2) maintenance of physical conditioning and other activities; (3) sleep; (4) nutrition; (5) mental health; (6) healthcare access; and (7) knowledge of the COVID-19 disease.

2. Methods

A cross-sectional study was designed, based on input from researchers and clinicians looking after athletes, regarding the challenges they experienced during the lockdown period. Survey questions were adapted from validated questionnaires on maintenance of activity,[7] nutrition[8] and mental state.[9] The survey was piloted by 20 healthcare workers including sports physicians, physiotherapists and biokineticists. Following ethics approval from the Ethical Committee of the University of Pretoria (REC 274/2020), a link to the online Google Form survey was distributed to a convenience sample of athletes via WhatsApp. Athletes were asked to read the description and need for the study and click on the link to proceed after giving consent. Participants from 15 sports (soccer, hockey, rugby, cricket, athletics, netball, basketball, endurance running, cycling, track and field, swimming, squash, golf, tennis, karate) were recruited through the databases of the researchers, sports medicine healthcare professionals and administrators affiliated with the research team. The inclusion criteria was (1) elite and semi-elite athletes based in South Africa, (2) >18 years of age. Recreational athletes were excluded. The survey was live for 72 h during the level 5 lockdown period, from 28 April to 30 April 2020 and took 10–15 min to complete. Data were collected from Google Forms and exported to a csv file for data analysis. The data consisted of categorical feedback, hence the descriptive statistics consisted of frequencies and percentages which described the feedback received. We used the Chi-square goodness of fit test to investigate if a significant difference, tested at a 5% level of significance, existed between the observed and expected values. The Chi-square test of independence was used to explore sex specific associations. Post hoc analyses were included with a Bonferroni adjustment where applicable. As questions were single or multiple choice options. It should be noted that proportions do not add up to 100% for the questions with multiple responses. Multiple choice options on risk reduction behaviour were listed as per the World Health Organization (WHO)[10] and National Institute for Communicable Diseases (NICD)[11] documents regarding the most important aspects.

3. Results

From a total of 1080 distributed surveys, 692 athletes responded. The response rate was 64% and respondents consisted of 67% males (Table 1). Some (presumably university level semi-elite athletes, $n = 55$; 8%) reported participation in two or more sports. Four respondents preferred not to reveal their sex.

Most respondents were from soccer (26%), followed by hockey (16%) and rugby (13%). Most males participated in soccer (37%), while most females played netball (31%).

Regarding return to competitive sport, 35% athletes expected to RTS within 1–3 months whilst 31% felt unsure, and no sex difference was observed ($p = 0.0740$). Only 50% athletes were comfortable with RTS when allowed by authorities, and results are comparable between males and females ($p = 0.6901$). The athletes are willing to compete behind closed doors ($p < 0.0001$), while male athletes are more willing than females ($p < 0.0001$) (Table 2).

For exercise maintenance and other activities, more athletes trained alone ($p < 0.0001$), compared to those training alone but digitally directed by a trainer, or a medical person or using technology like Zoom together with other athletes. More males used Zoom to train with other athletes than females ($p < 0.0001$). Most athletes trained daily vs alternative days or $\leq 3\times$ a week ($p = 0.0001$). More males trained daily compared to females ($p = 0.0059$). Sessions consisted mainly of own body weight (males 73%) and cardio exercises (females 70%). Athletes could train outside without breaking the law ($p < 0.0001$) (male vs female $p = 0.3779$), at a reduced training intensity ($p < 0.0001$) (male vs female $p = 0.6972$) and sessions lasted mostly 30–60 min (males vs females $p = 0.6351$). Sports specific equipment is used significantly more ($p < 0.0001$) than treadmills, steppers, stationary bikes, swimming. Males and females had comparable results ($p = 0.0899$). Sedentary behaviour above active behaviour was preferred during leisure time ($p < 0.0001$). Sedentary behaviour largely favoured watching television, and males significantly favoured electronic gaming compared to females ($p < 0.0001$) (Table 3).

More athletes reported changes in sleep-wake times during the lockdown period ($p < 0.0001$), but they still experienced restful sleep ($p < 0.0001$) and did not experience constant fatigue ($p < 0.0001$). There were no sex differences in sleep-wake times ($p = 0.6045$) and restful sleep ($p = 0.2455$), however, a significantly larger proportion of females felt more fatigued than males ($p = 0.0213$) (Table 4).

Even though not statistically significant, more than half of the athletes admitted to the worsening of their *diet* ($p = 0.1486$), with females significantly more than males ($p < 0.0001$). Excessive carbohydrate consumption was significantly more ($p < 0.0001$) than excessive fizzy drinks, poor hydration during and after exercise, processed foods, and red meat (Table 4).

Observing mental state, 52% of the athletes felt depressed at some time ($p = 0.3230$), and females reported a significantly ($p < 0.0001$) higher rate. While 54% of all athletes did not report energy loss, and 55% struggled to keep motivated; female athletes reported higher energy loss ($p = 0.0084$) and lack of motivation ($p = 0.0358$) compared to males. Most felt they adapted to the new routine (males vs females $p = 0.0765$). Libido stayed the same for most respondents, but significantly more males reported increased libido compared to females ($p < 0.0001$). Many athletes were not aware of online psychological and mental health programmes, however, females are significantly more mindful ($p = 0.0020$) (Table 4).

A significant number of athletes had access to healthcare ($p < 0.0001$; males vs females $p = 0.5934$). Both males and females accessed telehealth opposed to physical consultations ($p < 0.0001$), via WhatsApp (65% males vs 52% females) or telephone (60% males vs 56% female). More athletes had access to general practition-

Table 1
Athlete demographics: sex and sport involvement.

Type of sport involvement	Total surveys distributed $n = 1080$	Female $n = 225$ (33%)	Male $n = 463$ (67%)	Responses $n = 769$ (Respondents $n = 692$)	Response rate within each sport
	n	%	%	%	%
Soccer	250	5	37	26	72
Hockey	150	19	14	16	74
Rugby	130	4	17	13	69
Cricket	110	4	16	12	77
Athletics	100	15	8	10	72
Netball	80	31	–	10	86
Basketball	80	17	6	9	81
Endurance running	50	10	4	6	78
Cycling	20	4	2	3	90
Track and field	30	3	1	2	43
Swimming	30	3	1	2	37
Squash	15	0	1	1	40
Golf	15	0	1	1	33
Tennis	10	1	–	0.5	30
Karate	10	1	–	0.3	20

Respondents $n = 692$: completed responses received back.
Responses $n = 769$: athletes reported participation in two or more sports.

ers and physiotherapists for medical assistance compared to other healthcare professionals ($p < 0.0001$). Males and females differed significantly towards choice of health access ($p < 0.0001$) (Table 5).

Television news, news websites, social media and government sites were the sources of knowledge on COVID-19 used as opposed to radio, friends, doctors, community forums, physiotherapists and bankers ($p < 0.0001$) and no sex difference was observed. Handwashing with soap and water and hand sanitising with >70% alcohol content were rated as the most important ($p < 0.0001$; males vs females $p = 0.8127$). Most athletes were aware that shortness of breath, fever, dry cough and sore throat were the main symptoms of COVID-19 ($p < 0.0001$; males vs females $p = 0.8402$). Shortness of breath was identified by 85% male vs 78% female athletes as the main symptom of COVID-19. Most athletes knew how to proceed on symptom development ($p < 0.0001$; males vs females $p = 1.000$). On suspicion of COVID-19 symptoms, a significant difference existed in accessing healthcare via contacting their doctors, or opting for contacting the National Institute of Communicable Diseases (NICD) hotline, as opposed to going to a laboratory for testing, searching the web or social media or going to the doctor's rooms ($p < 0.0001$). Both males and females knew proceedings ($p = 1.000$), and would contact a doctor (Table 5).

4. Discussion

The COVID-19 pandemic lockdown measures significantly impacted elite and semi-elite athletes in South Africa. One of our key findings is that despite high levels of uncertainty regarding RTS guidelines, most athletes are continuing to train daily. Two out of three athletes trained alone with only a minority of athletes using digital guidance by a professional. There are certain risks to unsupervised training,[12] including an inadvertent lapse into poor technique and posture, which may predispose athletes to injuries.[13] Solo training and a lack of sport- specific training may also be challenging for athletes who participate in team and very technical (e.g. pole vault) sports. More than half of the athletes were training at a moderate exercise intensity for 30–60 min per day, at a lower training load than normal. Moderate training loads allow for recovery[14] and this is important during the COVID-19 pandemic to avoid blunting of the immune system.[15–17] Even though the additional recovery time came at an opportune time (e.g. Olympics was 4 months away), deconditioning is bound to occur, posing challenges in reconditioning and safe RTS.[12] The majority of athletes engaged in own bodyweight strength training, cardio workouts, and functional sport-specific training, resembling appropriate active rest phase modalities.[18] Only a small number of athletes included proprioception in their programmes. Good proprioception plays an important role in accurate movement patterns and can prevent injuries and recurrence of injuries.[19] Such exercises are easy to do indoors and even in confined spaces, and should be recommended. Athletes had considerable access to equipment, including sports specific equipment, treadmills, steppers, free weights, swimming pools and stationary bikes, providing good opportunities for cross-training, which we also recommend to assist with whole-body maintenance and to add variety.[20]

Leisure time activities with possible lifestyle changes during lockdown were of concern. The majority chose sedentary behaviour, especially watching television. Males engaged more in electronic and cell-phone gaming, possibly contributing to sleep alteration and feelings of fatigue. Few partook in alcohol-related activities during this period. The detrimental effects of sedentary behaviour on both physical and mental health is beyond dispute.[21,22] Realistic changes to decrease sedentary behaviour during the lockdown needs to be advocated by health care professionals. Athletes are also exposed to the negative psychological consequences of COVID-19 like anxiety and stress reported across the wider society, where people are overwhelmed by the constantly changing alerts and media reports about the virus spread. Home confinement not only affect the physiological status of athletes,[23,24] but the inability to compete may also influence athlete mental health.[25] We found that one in two athletes was depressed, with energy loss and lack of motivation to train. Females are more affected in all these spheres, with potentially profound adverse effects on their mental health.[26,27] A recent consensus document on athlete mental health stressed the importance of mental well-being for optimal performance.[25] Access to psychological support to maintain their mental health during and after lockdown is paramount. A significant proportion of athletes reported a change in sleep routine, even though still restful. Nevertheless, almost half of the respondents reported feeling chronically fatigued. Quality and quantity of sleep have a significant impact on injury incidence and recovery post-exercise.[28] Sleep allows for the immune system to regenerate and recuperate.[29] Compromised immunity increases the risk of viral illness (including COVID-19), this is particularly important given the imminent winter of the southern hemisphere. Social isolation, exercise reduction, sedentary behaviour, and changes in nutrition have a psychological consequence and can impact sleep and fatigue. Athletes need to be

Table 2
Athlete responses to return to competitive sport during the lockdown period.

Return to competitive sport during lockdown					
When do you think you will be competing again?	**Female *n* = 225**	**Male *n* = 463**	**PNTS *n* = 4**	**Total *n* = 692**	***p*- value**
	%	%	%	%	
1 month[a]	8	11	–	10	<0.0001*
1–3 months[b]	30	38	–	35	
3–6 months[c]	24	19	50	21	
>6 months[d]	4	3	–	3	
Unsure[b]		34	29	50	31
As you are aware, the SARS-CoV-2 virus will not simply "disappear" and maybe around for some time. Should regulations and authorities allow return to sport, would you be comfortable to return to your sport?	**Female *n* = 225**	**Male *n* = 463**	**PNTS *n* = 4**	**Total *n* = 692**	***p*- value**
Yes[a]	48	51	25	50	<0.0001*
No[b]	16	14	50	15	
Maybe[c]	36	35	25	35	
If you answered "No" or "Maybe", please say what would make you comfortable to return to sport					
Maybe	**Female *n* = 82**	**Male *n* = 160**	**PNTS *n* = 1**	**Total *n* = 430 (% of 243)**	***p*- value**
I am assured that protocols have been put in place to significantly reduce my chances at contracting the virus	59	53	–	54	<0.0001*
Risks must be reduced by 100%	40	39	100	40	
My sporting federation and government must be happy with guidelines to protect athletes	44	36	–	38	
The international sporting world must be moving in the same direction	24	32	–	29	
I am enabled financially or equipment-wise by my federation to take the precautionary measures implemented	9	13	–	12	
No	**Female *n* = 35**	**Male *n* = 65**	**PNTS *n* = 2**	**Total *n* = 174(% of 102)**	***p*- value**
Risks must be reduced 100%	54	62	100	60	<0.0001*
I am enabled financially or equipment-wise by my federation to take the precautionary measures implemented	11	9	–	43	
The international sporting world must be moving in the same direction	17	34	–	27	
My sporting federation and government must be happy with guidelines to protect athletes	23	29	–	26	
I am assured that protocols have been put in place to significantly reduce my chances at contracting the virus	49	40	50	10	
Would you compete behind closed doors but televised?	**Female *n* = 225**	**Male *n* = 463**	**PNTS *n* = 4**	**Total *n* = 692**	***p*- value**
Yes	72	86	50	82	<0.0001*
No	28	14	50	18	

PNTS: Prefer not to say.
[ab] When significance tests indicated that differences existed between the counts within each question, the superscripts indicate which options reported similar results. These represent the post hoc results.
* Significant difference $p < 0.05$.

educated regarding the psychological impact on sleep and fatigue[20] and re-adjust their sleeping patterns on RTS.

More than half of the athletes reported deterioration in eating habits, especially a significant increase in carbohydrate ingestion. Impaired nutrition may result in a myriad of issues upon RTS including deteriorated performance, lifestyle-related concerns and affecting weight category sport.[30] Athletes are generally believed to consume substantial amounts of supplements,[31] but a large percentage of athletes in our study did not consume supplements. Only one in three athletes used a combination of vitamin C, multivitamins, zinc, vitamin B, protein and other unclassifiable supplements. During the COVID-19 pandemic some authors have advised taking supplements including vitamin C, zinc and vitamin D for immune enhancement.[4,20] Most athletes can train outside without breaking regulations, exposing them to natural light to allow vitamin D synthesis.[32] Given the significant inadequacies in nutrition during the lockdown, it seems appropriate to implement nutritional guidance by a sports nutritionist, both during the lockdown and afterward.

The majority of athletes had access to healthcare professionals, mostly through telehealth. With the implementation of the lockdown and dangers of COVID-19, the Health Professionals Council of South Africa relaxed its regulations on the use of telehealth, making it more accessible.[33] Only one in four had access to a sports physician, perhaps due to financial or travelling constraints. The athletes accessed traditional and social media to gain knowledge on COVID-19 demonstrating the ability of these platforms to reach wide audiences to deliver key public health messages. It appears that doctors or other evidence-based platforms were poorly utilised for this purpose possibly because healthcare professionals did not reach out to the athlete population. Nevertheless, athletes had good knowledge about COVID-19 preventative measures and presenting symptoms. They identified handwashing with soap and water or the use of alcohol-based hand sanitisers as a priority in reduc-

Table 3
Athlete responses to exercise maintenance and other activities during the lockdown period.

Exercise maintenance during lockdown					
How are you maintaining activity during lockdown?[#]	**Female *n* = 225**	**Male *n* = 463**	**PNTS *n* = 4**	**Total *n* = 897 (% of 692)**	***p*- value**
	%	%	%	%	
Alone[a]	57	63	75	61	<0.0001[*]
Directed digitally by a Fitness or Personal trainer[b]	31	23	25	25	
Directed digitally by a medical person (Physiotherapist/Biokineticist/Sports Scientist)[b]	30	20	25	24	
Using technology like Zoom etc. with other athletes[b]	10	24	–	20	
How often do you train in a week?	**Female *n* = 225**	**Male *n* = 463**	**PNTS *n* = 4**	**Total *n* = 692**	***p*- value**
Daily[a]	53	65	75	61	<0.0001[*]
Every alternate day[b]	27	23	25	24	
3× or less a week[c]	20	12	–	15	
What do your sessions consist of? [#]	**% of Female**	**% of Male**	**% of PNTS**	**Total *n* = 2031(% of 692)**	***p*- value**
Own body weight strength[a]	66	73	50	71	<0.0001[*]
Cardio (running/stepper/cycle/treadmill) [a]	70	65	25	67	
Sport specific exercises that are functional[b]	62	48	50	52	
Resisted strength work (use of elastics and/or weights)[b]	43	52	25	49	
Flexibility[c]	31	30	25	31	
Proprioception (balance)[c]	24	24	25	24	
Are you able to exercise outside without breaking the law? (e.g. in your backyard)	**Female *n* = 225**	**Male *n* = 463**	**PNTS *n* = 4**	**Total *n* = 692**	***p*- value**
Yes	85	82	25	83	<0.0001[*]
No	15	18	75	17	
Have you reduced your training load and intensity during this lockdown period?	**Female *n* = 225**	**Male *n* = 463**	**PNTS *n* = 4**	**Total *n* = 692**	***p*- value**
Yes	76	74	75	75	<0.0001[*]
No	24	26	25	25	
At what intensity do you exercise?	**Female *n* = 225**	**Male *n* = 463**	**PNTS *n* = 4**	**Total *n* = 692**	***p*- value**
High[a]	36	36	25	36	<0.0001[*]
Moderate[b]	57	58	75	57	
Low[c]	7	6	–	7	
When you do exercise, how long are your sessions?	**Female *n* = 225**	**Male *n* = 463**	**PNTS *n* = 4**	**Total *n* = 692**	***p*- value**
<30 min[a]	11	12	50	11	<0.0001[*]
30–45 min[b]	35	31	25	33	
45–60 min[b]	40	39	–	39	
>60 min[c]	14	18	25	17	
Do you have any of the following equipment you use at home to assist you with exercise?[#]	**% of Female**	**% of Male**	**% of PNTS**	**Total *n* = 1609(% of 692)**	***p*- value**
Sports specific equipment (soccer ball/rugby ball/tennis ball, etc.)[a]	56	67	75	63	<0.0001[*]
Resistance bands[ab]	53	52	75	52	
Free weights[b]	41	48	50	46	
Swimming pool[c]	31	28	–	29	
Stationary bike (or any equipment to allow for indoor cycling)[c]	28	20	–	23	
Stepper[d]	8	11	25	10	
Treadmill[d]	10	9	–	10	
Other activities during lockdown					
Aside from exercise, what else do you do to keep busy during the lockdown?[#]	**% of Female**	**% of Male**	**% of PNTS**	**Total *n* = 2693(% of 692)**	***p*- value**
Active					<0.0001[*]
Fix things at home or spring clean[a]	58	49	50	52	
Games outdoors (playing with kids, etc.) [b]	21	28	25	25	
Sedentary					
Watch television[a]	72	71	75	72	
Social media[a]	61	57	75	58	
Read a book[bc]	50	41	75	44	
Electronic gaming (play station etc.) [bcde]	11	51	75	38	
Cell phone gaming[cde]	29	40	25	36	
Work remotely on your other business ventures[de]	37	27	–	30	
Board games[e]	24	31	–	29	
Drink alcohol[f]	3	5	–	4	

PNTS: Prefer not to say.
[ab] When significance tests indicated that differences existed between the counts within each question, the superscripts indicate which options reported similar results. These represent the post hoc results.
[#] Questions were open to select more than one option i.e. percentages may add up to >100.
[*] Significant difference $p < 0.05$.

Table 4
Athlete responses to sleep, nutrition and mental state during the lockdown period.

Sleep during lockdown					
Have you been sleeping and waking up at your normal times as before the lockdown?	**Female *n* = 225**	**Male *n* = 463**	**PNTS *n* = 4**	**Total *n* = 692**	***p*- value**
	%	%	%	%	
Yes	20	22	–	21	<0.0001*
No	80	78	100	79	
Is your sleep restful?	**Female *n* = 225**	**Male *n* = 463**	**PNTS *n* = 4**	**Total *n* = 692**	***p*- value**
Yes	70	75	25	73	<0.0001*
No	30	25	75	27	
Are you feeling constantly fatigued during the lockdown?	**Female *n* = 225**	**Male *n* = 463**	**PNTS *n* = 4**	**Total *n* = 692**	***p*- value**
Yes	48	38	100	42	<0.0001*
No	52	62	–	58	
Nutrition during lockdown					
Has your diet worsened or improved during the lockdown?	**Female *n* = 225**	**Male *n* = 463**	**PNTS *n* = 4**	**Total *n* = 692**	***p*- value**
Improved	36	53	25	47	0.1486
Worsened	64	47	75	53	
If your diet has worsened, in what way?#	**Female *n* = 143**	**Male *n* = 219**	**PNTS *n* = 3**	**Total *n* = 686 (% of 365)**	***p*- value**
Excessive carbohydrates (includes sweets/chocolates/rice/bread etc.)[a]	80	73	100	76	<0.0001*
Fizzy drinks[b]	24	41	67	34	
Poor hydration during exercise and after exercise[b]	34	33	67	34	
Excessive processed foods[c]	16	22	33	20	
Excessive red meat[cd]	10	17	67	15	
Alcohol[d]	12	8	33	10	
Are you using any supplements to assist in boosting your immune system?	**Female *n* = 225**	**Male *n* = 463**	**PNTS *n* = 4**	**Total *n* = 692**	***p*- value**
Yes	36	30	–	32	<0.0001*
No	64	70	100	68	
If yes to the above question, what supplements?#	**Female *n* = 82**	**Male *n* = 173**	**PNTS *n* = 0**	**Total *n* = 219**	***p*- value**
Multivitamin[a]	39	27	–	36	<0.0001*
Vitamin C[b]	46	23	–	36	
Other[ab]	24	17	–	23	
Protein[b]	10	14	–	15	
No information supplied[c]	1	6	–	5	
Zinc[c]	5	2	–	4	
Mental state during lockdown					
Do you feel depressed?	**Female *n* = 225**	**Male *n* = 463**	**PNTS *n* = 4**	**Total *n* = 692**	***p*- value**
Yes	60	48	75	52	0.3230
Yes, all of the time	4	2	–	3	
Yes, on very few occasions	29	27	–	27	
Yes, sometimes	27	19	75	22	
No	40	52	25	48	
No	40	52	25	48	
Do you feel you have a loss of "energy" daily?	**Female *n* = 225**	**Male *n* = 463**	**PNTS *n* = 4**	**Total *n* = 692**	***p*- value**
Yes	53	42	100	46	0.0275*
No	47	58	–	54	
Do you struggle to keep yourself motivated to exercise?	**Female *n* = 225**	**Male *n* = 463**	**PNTS *n* = 4**	**Total *n* = 692**	***p*- value**
Yes	60	52	75	55	0.0150*
No	40	48	25	45	
Have you re-adapted to developing a new routine daily with lockdown?	**Female *n* = 225**	**Male *n* = 463**	**PNTS *n* = 4**	**Total *n* = 692**	***p*- value**
Yes	62	69	50	66	<0.0001*
No	38	31	50	34	
Has your libido (sexual appetite)...during lockdown	**Female *n* = 225**	**Male *n* = 463**	**PNTS *n* = 4**	**Total *n* = 692**	***p*- value**
Decreased[a]	14	13	25	13	<0.0001*
Increased[b]	13	38	25	30	
Stay the same[c]	73	49	50	57	
Are you aware of several psychological and mental health programmes available online and via skype should you need it?	**Female *n* = 225**	**Male *n* = 463**	**PNTS *n* = 4**	**Total *n* = 692**	***p*- value**

Table 4 (*Continued*)

Yes	60	47	50	51	0.6483
No	40	53	50	49	
Have you been sleeping and waking up at your normal times as before the lockdown?	**Female *n* = 225**	**Male *n* = 463**	**PNTS *n* = 4**	**Total *n* = 692**	***p*- value**
	%	%	%	%	
Yes	20	22	–	21	<0.0001*
No	80	78	100.00	79	
Is your sleep restful?	**Female *n* = 225**	**Male *n* = 463**	**PNTS *n* = 4**	**Total**	***p*- value**
Yes	70	75	25	73	<0.0001*
No	30	25	75	27	
Are you feeling constantly fatigued during the lockdown?	**Female *n* = 225**	**Male *n* = 463**	**PNTS *n* = 4**	**Total**	***p*- value**
Yes	48	38	100	42	<0.0001*
No	52	62	–	58	

PNTS: Prefer not to say.

[ab] When significance tests indicated that differences existed between the counts within each question, the superscripts indicate which options reported similar results. These represent the post hoc results.

[#] Questions were open to select more than one option i.e. percentages may add up to >100.

[*] Significant difference $p < 0.05$.

ing their risk of contracting the virus. Applying respiratory hygiene was rated high while only one in two athletes recognised social distancing of >2 m as important. Even though athletes were aware of how to mitigate the risk, they lacked awareness of the priorities of risk modification.[10] The timing of the survey may have contributed to athletes favouring the use of surgical and FFP1/FFP2/N95 masks (which should be reserved for healthcare professionals), instead of a cloth mask. Cloth masks have shown some potential to reduce the risk of viral transmission.[34] This information was shared by the government shortly before the start of the survey, which may have biased the responses.[35] The athletes also correctly recognised the most significant symptoms of COVID-19 as communicated by the World Health Organisation,[10] NICD[11] and National Department of Health,[36] being shortness of breath, fever, dry cough and a sore throat. Almost all athletes knew how to proceed if they suspected having contracted the SARS-CoV-2 virus. Three out of four athletes know they should either contact their doctors, or the NICD toll- free number for guidance. These findings underline the vital role and efficacy of high quality messaging in traditional and social media in a pandemic.

Athletes are keen to RTS, and the majority of athletes are even prepared to do so behind closed doors.[37] However, one in three athletes were unsure when to RTS, possibly owing to global uncertainty about the pandemic, lack of communication by national and international federations and sport governing bodies. One out of two athletes were comfortable to RTS when advised, the other half was unsure or would not return. Established protocols, risk mitigation strategies, guidance from sports federations and government following international trends, and financial support from federations and/or provision of protective equipment were some of the requirements identified by the athletes. Continuous athlete education to promote required behaviours, preparing the environment and health screening to evaluate COVID-19 status prior to RTS is needed.[38] Physiological readiness to RTS should include re-evaluating weight, blood pressure, liver function, glucose, glycated haemoglobin and lipid profiles.[39] Then a stepwise and sport-specific return to training, synchronised with the expected gradual lifting of restrictions of movement and social distancing is advised.[38]

High load, training load fluctuations that negatively impact acute:chronic load ratios are known injury risk factors.[13,14] Accelerated RTS after the lockdown of NFL athletes in 2011, subsequently lead to high injury rates.[12] Ongoing monitoring of training loads, injury and illness upon RTS and addressing any deficits regarding the level of conditioning, strength, proprioception, neuromuscular activation and sport-specific conditioning following this period of lockdown, is recommended.[40–42] Further, nutrition, sleep, mental and general health issues related to restriction of movement should be addressed[40–42] and supported through the RTS process.[43] It is also important to control the possible spreading of the virus during RTS, as well as managing the progress of the pandemic by early detection and management of new cases in the sports community to mitigate a second wave.[23,38]

The majority of our study participants were males, with the sex distribution of our participants being representative of the current South African athlete population.[44] Convenience sampling was used and team sports were overrepresented, thus the findings may not be generalisable to individual sports. We did not require athletes to report pre-lockdown sleep patterns, mental status or supplement use thus findings cannot be comparable to pre-lockdown habits. We did not specifically differentiate between guided or unguided training programmes, even though there was an option to indicate guidance by professionals. The study was open for only 72 h and may have limited the response rate. This short access period was necessary to allow timely data analyses and planning of implementation measures and advice before RTS. Additionally owing to availability of resources, we were unable to verify the level of evidence of websites, social media platforms or other sources of information used by athletes. We also did not specifically ask why athletes opted for advice from non-medical experts or how finances were affected.

5. Conclusion

COVID-19 has significant physical and mental effects on athletes including physical deconditioning, altered sleep patterns, worsening nutrition, uncertainty on RTS and feelings of depression. Athletes are well informed on the COVID-19 disease, however, the need remains to provide them with easy access to reliable evidence-based resources. Closer medical, nutritional and psychological support during and after the lockdown is recommended. Further, lost opportunities and uncertain financial and sporting futures may have long-lasting effects on both athletes and the sports industry. Re-adjustment to normal life and RTS will undoubtedly be challenging. Even though the international focus seems to be on RTS, this study shows that there are many other lifestyle challenges needing to be overcome prior to returning to a pre-COVID-19 normality. Governments and sporting federations should develop and implement regional and sport-specific

Table 5
Athlete responses to healthcare and knowledge on COVID-19 during lockdown.

Questions on healthcare during lockdown					
Do you have easy access to your healthcare professionals?	**Female *n* = 225**	**Male *n* = 463**	**PNTS *n* = 4**	**Total *n* = 692**	***p*- value**
	%	%	%	%	
Yes	81.33	79.27	75.00	79.91	<0.0001*
No	18.67	20.73	25.00	20.09	
Is your access via#	**% of Female**	**% of Male**	**% of PNTS**	**Total *n* = 1246(% of 692)**	***p*- value**
Telehealth					<0.0001*
Whatsapp[a]	52	65	50	61	
Telephone[a]	56	60	25	59	
Social media[b]	15	19	–	17	
Other electronic means[b]	13	13	25	13	
Physical					
Physical consultations	40	25	25	30	
Which professionals do you have access to?#	**% of Female**	**% of Male**	**% of PNTS**	**Total *n* = 1168(% of 692)**	***p*- value**
General Practitioner[a]	52	44	50	47	<0.0001*
Physiotherapist[a]	30	46	25	41	
Other[b]	39	23	–	28	
Biokineticist[b]	27	28	50	28	
Sports Physician[b]	16	30	–	26	
Knowledge on COVID-19 during lockdown					
Where do you gain your knowledge from regard COVID-19?#	**% of Female**	**% of Male**	**% of PNTS**	**Total *n* = 2265(% of 692)**	***p*- value**
Television news[b]	73	74	25	73	<0.0001*
News websites[ab]	72	68	100	70	
Social media[bc]	59	58	25	58	
Official government websites and social media sites[c]	60	48	75	52	
Radio[d]	27	24	–	25	
A friend[efg]	15	14	25	15	
My doctor[efg]	9	16	–	14	
Community forums[fg]	13	9	25	10	
My physio[g]	2	12	–	9	
My banker[b]	1	2	–	2	
What are the most important aspects in reducing risk at contracting the coronavirus?#	**% of Female**	**% of Male**	**% of PNTS**	**Total *n* = 4181(% of 692)**	***p*- value**
Social distancing of 2 m[d]	61	57	50	58	<0.0001*
Handwashing with soap and water[a]	89	83	100	85	
Coughing/sneezing into a flexed elbow[cd]	72	70	100	71	
Not rubbing eyes/nose/mouth[bc]	80	75	100	77	
Cloth masks[ij]	20	25	–	23	
Hand sanitising with alcohol content 70[ab]	84	84	100	84	
Sneezing/coughing into a handkerchief[efh]	38	40	50	40	
Wearing gloves[efg]	43	43	50	43	
Social distancing of 1 m[fgh]	33	41	50	39	
Surgical masks[fgh]	38	39	–	39	
FFP1/FFP2/N95 masks[ghi]	31	30	50	31	
Disposing of clothes when returning from shops etc.[j]	17	15	25	16	
What are the main symptoms of the coronavirus that should prompt you to get a medical opinion?#	**% of Female**	**% of Male**	**% of PNTS**	**Total *n* = 1980(% of 692)**	***p*- value**
Fever[a]	79	79	100	79	<0.0001*
Dry Cough[b]	61	65	100	64	
Shortness of breath[c]	78	85	100	83	
Sore throat[b]	56	63	75	61	
Should you think you have coronavirus symptoms do you know how to proceed?	**Female *n* = 225**	**Male *n* = 463**	**PNTS *n* = 4**	**Total *n* = 692**	***p*- value**
Yes	92	92	100	92	
No	8	8	–	8	
If your answer is yes to the above question how would you proceed?#	**% of Female**	**% of Male**	**% of PNTS**	**Total *n* = 1190(% of 692)**	***p*- value**
Contact a doctor[a]	71	74	75	73	<0.0001*
Phone the toll-free NICD number[b]	52	50	50	51	
Go to a lab and ask them for testing for COVID-19[c]	24	24	–	24	
Search on google or social media[d]	7	10	–	9	
Just arrive at a doctors rooms for a consultation[e]	1	2	–	2	
Speak to your pharmacist[e]	0	2	–	2	
Do you have easy access to your healthcare professionals?	**Female *n* = 225**	**Male *n* = 463**	**PNTS *n* = 4**	**Total *n* = 692**	***p*- value**
Yes	81.33	79.27	75.00	79.91	<0.0001*

Table 5 (*Continued*)

No	18.67	20.73	25.00	20.09	
Is your access via[#]	**% of Female**	**% of Male**	**% of PNTS**	**Total *n* = 1246(% of 692)**	***p*- value**
Telehealth					<0.0001[*]
Whatsapp[a]	52	65	50	61	
Telephone[a]	56	60	25	59	
Social media[b]	15	19	–	17	
Other electronic means[b]	13	13	25	13	
Physical					
Physical consultations	40	25	25	30	
Which professionals do you have access to?[#]	**% of Female**	**% of Male**	**% of PNTS**	**Total *n* = 1168(% of 692)**	***p*- value**
General Practitioner[a]	52	44	50	47	<0.0001[*]
Physiotherapist[a]	30	46	25	41	
Other[b]	39	23	–	28	
Biokineticist[b]	27	28	50	28	
Sports Physician[b]	16	30	–	26	

PNTS: Prefer not to say.
[ab] When significance tests indicated that differences existed between the counts within each question, the superscripts indicate which options reported similar results. These represent the post hoc results.
[#] Questions were open to select more than one option i.e. percentages may add up to >100.
[*] Significant difference $p < 0.05$.

evidence-based guidelines for safe RTS in a COVID-19 environment to minimise risk of community transmission and preserve public health.

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Authors' contribution

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Conflict of interest

The authors report no conflict of interest pertaining to this manuscript.

Data sharing statement

No additional data are available.

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