

AGJSR
42,4

1518

Received 10 April 2023
Revised 10 June 2023
25 July 2023
5 October 2023
Accepted 12 November 2023

Elite athletes and sports training during the COVID-19 pandemic: A mini review

Danladi Ibrahim Musa

*Department of Human Kinetics and Health Education, Kogi State University,
Anyigba, Nigeria*

Abel Lamina Toriola

*Department of Sport, Rehabilitation and Dental Sciences,
Tshwane University of Technology, Pretoria, South Africa*

Benson Babatunde Bamidele

*Department of Human Kinetics and Health Education, Kogi State University,
Anyigba, Nigeria*

Badamasi Lawal

*Department of Human Kinetics and Health Education, Bayero University,
Kano, Nigeria*

Abu Sunday

*Department of Human Kinetics and Health Education, Kogi State University,
Anyigba, Nigeria*

Oluwatoyin O. Toriola

Prince Sultan University, Riyadh, Saudi Arabia, and

Jimoh Monay Ahmed and Adams David

*Department of Human Kinetics and Health Education, Kogi State University,
Anyigba, Nigeria*

Abstract

Purpose – The corona virus disease 2019 (COVID-19) pandemic had devastating impact on sporting activities, education and global health. Given the impact of the pandemic-related restrictions and closed fitness centers and other sports facilities, the coping strategies adopted by athletes while training at home to continue their training remain an important question. The purpose of this review is to examine the findings of key studies focusing on the impact of the pandemic on sport training.

Design/methodology/approach – A review was conducted on Google Scholar, Scopus and PubMed to identify articles on physical activity and sport training during the COVID-19 pandemic. Eligibility criteria

© Danladi Ibrahim Musa, Abel Lamina Toriola, Benson Babatunde Bamidele, Badamasi Lawal, Abu Sunday, Oluwatoyin O. Toriola, Jimoh Monay Ahmed and Adams David. Published in *Arab Gulf Journal of Scientific Research*. Published by Emerald Publishing Limited. This article is published under the Creative Commons Attribution (CC BY 4.0) licence. Anyone may reproduce, distribute, translate and create derivative works of this article (for both commercial and non-commercial purposes), subject to full attribution to the original publication and authors. The full terms of this licence may be seen at <http://creativecommons.org/licences/by/4.0/legalcode>

The authors wish to gratefully acknowledge the Registrar, Kogi State University for his kind support towards the preparation of the manuscript and Mohammed-Bello for the word-processing of the manuscript.

Funding support statement: There was no funding.

Conflict of interest: The authors declare no conflict of interest.



Arab Gulf Journal of Scientific
Research
Vol. 42 No. 4, 2024
pp. 1518-1529
Emerald Publishing Limited
e-ISSN: 2536-0051
p-ISSN: 1985-9899
DOI 10.1108/AGJSR-04-2023-0149

included peer-reviewed empirical and quantitative studies. The selected articles were reviewed using contextual analysis.

Findings – The COVID-19 pandemic had devastating impact on sports activities globally. Studies evaluating the influence of the pandemic on sports training have revealed abysmal decline in training volume and general physical fitness, limited access to facilities and equipment and significant reduction in training load. The damage of the pandemic on the sporting world should serve as a guide for proactive steps that should be taken to prevent recurrence of a similar calamity.

Originality/value – This paper highlights important lessons to be learned from the lockdown imposed by the COVID-19 pandemic by stakeholders in sport, including the importance of improvisation of sports facilities by utilizing available spaces at home and neighborhood for physical training.

Keywords Athletes, COVID-19 pandemic, Physical activity, Social distancing, Sport training

Paper type Literature review

1. Introduction

The corona virus disease 2019 (COVID-19) is an infectious disease caused by the SARS-CoV-2 virus and was discovered in late December, 2019 in the City of Wuhan, China. Thereafter, it spread rapidly throughout the world. It was declared an emergency on January 30, 2020 and a global pandemic on 11th March, 2020 by the World Health Organisation (WHO, 2020). The disease affected more than 225 countries and territories as at year 2021 (WHO, 2021). Its high rate of infection and dreadful speed of transmission led to stringent measures by government agencies and health organizations, which included social or physical distancing, declaration of *lockdowns* by countries in order to prevent person-to-person contact or any kind of social gathering or congregation, like sporting events all aimed at minimizing peak infection rate (Gupta *et al.*, 2022).

The lockdowns imposed due to the COVID-19 pandemic had a profound impact on all aspects of human life, including the sporting world, with unprecedented consequences for sports development. Sporting activities across the board were severely affected, resulting in the closure of sports venues and facilities, postponement of sporting events, such as local leagues and international competitions like Union of European Football Associations (UEFA) (March 23, 2020), as well as the rescheduling of the 2020 Tokyo Olympics and Paralympics to July, 2021 (Sayyid, Zainaddin, & Seraj, 2021; Wilshire, Supriya, & Baker, 2021). Many sporting events, including university sports, were outrightly cancelled, and elite athletes, including professionals, Olympic/Paralympic competitors, and Collegiate athletes (Reardon *et al.*, 2019; Urbanski, Szeliga, & Tasiemski, 2021) were all compelled to stay at home (SAH).

The pandemic also had devastating consequences on sport economy, resulting in a significant decrease in revenue (Alam & Abdulraheem, 2023). Professional sports and competitive leagues suffered from low income due to the absence of revenue from gate takings. Other sources of income, such as concessions, merchandise sponsorship and broadcasting, were severely affected (Wiltshire *et al.*, 2021). It was estimated that the sporting leagues in the United States lost approximately USD 13 billion; while some European sporting leagues lost over EUR 1 billion. Additionally, sports events like the annual Wimbledon tennis championships and other Grand Slam tournaments were not spared from the impact of the pandemic (Wiltshire *et al.*, 2021).

With regard to sports performance, the prolonged isolation and quarantine periods prevented athletes from undertaking routine training, culminating in low fitness level and poor mental health (Urbanski *et al.*, 2021; Roche, Sainani, Noordsy, & Fredericson, 2022). Cancellation of institutional campus social activities, including sports, resulted in the isolation of student athletes from team mates during the pandemic (Chandler *et al.*, 2021). It was further observed that the COVID-19 shutdown had a more detrimental impact on sports performance than the traditional off-season period (Grazidi, Lortarco, Baroni, Oliveira, Sagura, & Vanoni, 2020). The pandemic affected virtually all categories of athletes regardless of the level of competition or ranking. Physical activity (PA), training and practice of all sports were compromised. For instance, there was a significant reduction in all aspects of

training including, intensity, frequency, duration and even types of activities undertaken (Washif, Farooq *et al.*, 2022; Urbanski, Rogoza, Brewer, & Tasiemski, 2023).

Uncertainties associated with the pandemic also adversely affected the mental health of athletes (Chandler *et al.*, 2021; Haan *et al.*, 2021). From the foregoing, there is substantial evidence that the COVID-19 home confinement resulted in a decline of all levels of PA, including athletes' routine training which led to reduced fitness and frustration arising from the lack of competitions in sports for all categories of athletes (Machado, Secchi, Camargo, & Mendonca, 2023). The effect of the pandemic on sports activities remains a vibrant topic of research in the days ahead. Although, the imposed worldwide lockdown was aimed at minimizing the rapid spread of the disease, it had severe consequences on athletes' daily routines and general PA (Da Silva *et al.*, 2022; Washif, Farooq *et al.*, 2022; Park, Zhong, Yang, Jeong, & Lee, 2022).

The impact of the pandemic on physical conditioning and coping strategies adopted by athletes to continue their training while at home remains an important question. It is also crucial to understand the lessons learned during the periods of confinement and how to mitigate the impact of future pandemics on sport performance and health of athletes. Furthermore, the question whether the negative impact of the pandemic is similar across sport type and sexes is not well understood. Therefore, it is important to provide information on the state of current knowledge regarding this subject in order to fully appreciate the challenges faced by athletes during the lockdown period. Such information would be useful to athletes, coaches, and sport and health policy makers in containing similar emergencies should they occur in future. The purpose of this review is to summarize the existing literature regarding the effect of COVID-19 lockdown on athletes' training habits and practices, while providing suggestions for physical conditioning during periods of isolation.

After conducting a thorough search of databases, including Google Scholar, Scopus and PubMed, the review highlights the need for athletes to remain active during periods of isolation, and examines the findings of key studies focusing on the impact of the pandemic on sport training and the common home-based activities practiced by athletes during the pandemic. Gaps in the literature that may be critical perspectives for future research are identified. A total of 65 relevant articles were selected while non-relevant papers were expunged. Only peer-reviewed empirical and quantitative articles published in English language between January, 2020 and May 2023 were included in the review. Out of the 65 papers selected, eight that met the inclusion criteria for this review were eventually chosen and evaluated.

2. Need for training during COVID-19 pandemic

The normal training cycle for athletes includes the off-season cycle, during which athletes engage in reduced levels of PA for recovery and health reasons. The pandemic creates a need to train at a level similar to that of the off-season level due to the reasons adduced by Andreato, Coimbra, & Andrade (2020) which are summarized in Table 1.

The need for athletes to remain active during the pandemic arose from the imperatives of boosting immunity, injury prevention, and other health and performance outcomes. High-performance athletes irrespective of sport discipline, who are able to keep fit and active, are more likely to face fewer problems during the return to normal training and competition. Without prejudice to conditioning during periods of restriction, coaches and other professionals should bear in mind that the length of home confinement is important, as longer periods are likely to have relatively more negative effects on athletes.

3. Training habits and practices during the pandemic

Several investigators have documented training habits and practices among elite athletes during the lockdown period (Washif, Farooq *et al.*, 2022; Washif, Sandbaak *et al.*, 2022; Da

Table 1.
Reasons for physical
conditioning during
the pandemic

Parameter	Description
Boosting the body's immunity	In order to reduce the risk of infection, athletes need to engage in PA for boosting and maintaining immunity. All that is needed during this period is to focus on the technical and metabolic characteristics of each sport. There is no single training routine for all sports. However, there is a caveat. The intensity of such activities should be moderate because it has been reported that high-intensity training may lead to post-exercise immunosuppression which could last for about 24 hours after exercise (Yousli, Bragazzi, Briki, Zmijewski, & Chamari, 2020)
Minimizing the effects of detraining	There is also a need to minimize the effects of detraining and facilitate a return to routine activities after confinement. Athletes need to remain physically active during the pandemic in order to maintain physical fitness and physiological adaptations
Injury prevention	Athletes need to prepare for a return to normal sport calendar. They can do this by engaging in exercise routines that prevent injury when they return to normal activities. Such exercises should include mobility, flexibility, core stabilization, balance and weight exercises. These activities require simple equipment. Adoption of FIFA prevention programme adapted for the home environment is a good option (Silvers-Granelli <i>et al.</i> , 2015)
Prevention of excess body mass and fat	Due to detraining resulting from a long period of isolation, athletes need to engage in PA during the pandemic. Accumulation of excess weight and fat has a negative effect on physical performance and health of athletes
Focusing on tactical training	Athletes can improve their tactical knowledge and skills by studying match and performance analyses of their team as well as opponents during the pandemic
Source(s): Authors' own creation	

Silva *et al.*, 2022; Urbanski *et al.*, 2021; Radziminski *et al.*, 2021; Santika, Perdana, & Adiatmika, 2020; Chandler *et al.*, 2021; Jagim *et al.*, 2020). Details of the characteristics and findings of these studies are contained in Table 2.

Information from these studies can guide stakeholders in sport to take proactive measures against future occurrence of similar challenges. Findings from the studies included in this review are contextualized and discussed.

4. Home-based activities during the pandemic

In general, athletes need to maintain a physically active lifestyle but this became a daunting challenge during the pandemic due to the prolonged SAH period. Indeed, the fast-moving world was brought to a standstill. In order to fulfill their health and fitness needs, athletes resorted to home-based exercise during the isolation period. Available evidence shows that aerobic and strength training activities were the major home-based PA performed by athletes world-wide (Kaur, Singh, Arya, & Mittal, 2020; Mutz & Gerke, 2021; Santos *et al.*, 2021).

Many of the world-class athletes trained using available facilities at home, including courtyards, garages, sitting-rooms, corridors and other available spaces within and outside the house. Common activities included body weight exercises using machine or free weights, and muscular strength and endurance activities like push-ups, curl-ups and step-ups. Alternative endurance training modalities included cycle ergometry, aerobic dance, walking and treadmill exercises. Examples of aerobic and strength training can be found online (Insider, 2020) and Figure 1.

Reference	Aim	Sample	Design	Instrument	Results
Washif, Farooq <i>et al.</i> (2022)	Assess knowledge, beliefs and practices of athletes, world-wide	12526 (male = 8265)	CS	Online questionnaire	• Most athletes trained individually, focusing on general health, fitness and well-being, rather than on specific sport due to lack of training resources like space, facilities and equipment • Majority of the athletes reported substantial reduction in key elements of training, including frequency, intensity, duration and type of sport. However, the high-performance athletes were less disadvantaged compared to their amateur and recreational counterparts • Team and contact sports were most disadvantaged during the lock-down as a means of averting the risk of infection, in respect of which social and physical distancing measures were taken to ensure isolation • Only a small proportion of athletes (<40%) were able to maintain sport-specific training during the lock-down; and these athletes were those in individual sports, such as long distance, weight lifting and plyometrics. But these were mainly top-class athletes trained through remote coaching • Most athletes reported low motivation level during this period mainly because of lack of competition
Washif, Sandbaak <i>et al.</i> (2022)	Examine athletes' training practices based on sports and sex, world-wide	12526 (male = 8285)	CS	Online questionnaire	• Most athletes (~50% parasport and ~75% endurance) performed cardiovascular exercise training with no gender difference • Weight-based exercises were commonly practiced by athletes, with males being more involved than females • Combat, parasport and precision athletes (~50%) practiced sport-specific technical skills than athletes in other sports (~35%) • Athletes perceived a decline in training intensity, the largest reduction being in team sports, with no gender difference • Only a small proportion of athletes, mainly in individual sports were able to maintain their training intensity • This study also suffered the same limitations but has similar strengths as the previous one
Da Sila <i>et al.</i> (2022)	Analyze physical activity levels of Brazilian athletes	68 (male = 34)	CS	Online questionnaire	• Majority of participants (95.6%) remained physically active during the isolation period, with 68.9% practicing calisthenics, 1.5% dance, 1.5% stretching and 23.7% practicing sport-specific activities • A substantial proportion (67.7%) of the participants were able to adapt their training to the isolation environment under the guidance of a professional while only 4.4% trained without professional guidance • There was a substantial reduction in all variables of training during the lockdown period. For instance, training duration decreased from three hours to one hour daily, intensity from "high" to "moderate", and frequency, from 6-7 days to 3-5 days per week • Participants engaged in alternative activities such as the use of video games, especially virtual reality and calisthenics to enhance their PA levels • In addition to the negative effect of the confinement on the physical condition of athletes, their mental health was also negatively affected, including depression and anxiety

Table 2.
Characteristics and
results of the studies
included in the review

(continued)

Reference	Aim	Sample	Design	Instrument	Results
Chandler <i>et al.</i> (2021)	Assess the impact of COVID-19 on training, nutrition, and mental health on American elite Collegiate athletes	396 (male = 136)	CS	Online questionnaire	- Cardiovascular exercise was the most reported exercise mode performed 3–5 sessions per week at less than 45 minutes per session. Running was the most common cardiovascular exercise, followed by biking and high-intensity interval training. Other exercise types included rope skipping, circuit training and hiking - Resistance exercise was reported as the second most common exercise mode, with the athletes preponderantly performing between two and four days per week for 30–45 minutes per session. Dumbbells and resistance bands were the most commonly used equipment - Sports-specific drills and yoga/stretching routines were other exercise types performed during the lockdown - Training intensity was determined using the perceived exertion method (Borg's scale). Athletes reported "somewhat hard" or "hard" for cardiovascular and resistance activities, and "easy" or "very easy" for yoga/stretching exercise. There was more variation in intensity reported for sport-specific activities - Most athletes indicated that their training "was less effective" as opposed to "more effective" or "same" during SAH compared to pre-pandemic period - There was no gender difference in cardiovascular exercise participation; but male athletes performed more resistance exercise than their female counterparts
Urbanski <i>et al.</i> (2021)	Evaluate Impact of COVID-19 on training time, satisfaction and access to facilities in Polish paralympic athletes	166 (male = 106)	CS	Online questionnaire	- A significant reduction (9.4 h/w vs 5.5 h/w) in weekly training time due to the pandemic which could affect athletes' preparation for the competition - Majority of the athletes (88.6%) trained at home, 12% suspended training and only 5.4% had some access to sports facilities - A substantial proportion of athletes (74%) were not satisfied with their abilities to train
Radzimiski <i>et al.</i> (2021)	Compare impact of the pandemic on Physical performance, running speed and intensity of German and Polish football leagues	602*	QED	Tracking systems	- For the Bundesliga, no significant differences in total running distance covered, specific distances and total playing time between the periods before and after the shutdown - In the Ekstraklasa, there were significant differences in total distance covered, high-intensity running and number of high-intensity actions. Furthermore, significant difference in effective playing time was documented
Jagim <i>et al.</i> (2020)	Impact of COVID-19 on training habits and health of American athletes	105 (male = 31)	CS	Online questionnaire	- Many athletes trained alone and 84% continued receiving coaching tips remotely from their coaches - There were significant reductions in training frequency and duration; and this was more noticeable among female athletes - Athletes were forced to modify their training habits, thereby making adjustments as much as possible - There was a decline in mental health, especially in individuals' emotional well-being
Santika <i>et al.</i> (2020)	Assess the physical fitness of athletes during COVID-19 pandemic	30	CS	Physical fitness	- Out of the 15 physical fitness parameters including, cardiorespiratory endurance, hand muscle strength, leg muscle strength, leg muscle power, arm muscle endurance, flexibility, agility, reaction time, and others, nine items were scored low, four items moderate and two items good - The fitness condition of the athletes fell below optimal level required for competition

Note(s): *Games; CS = cross-sectional; QED = quasi-experimental design

Source(s): Authors' own creation

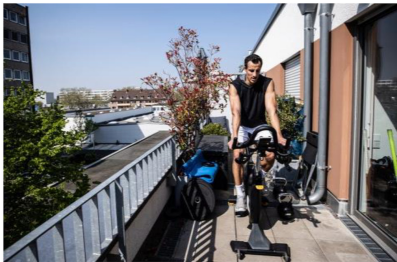
Table 2.



Olympic caliber kayaker training in her garage



Home-based training by remote



National hockey player training at home



World-class footballer training at home



Para-Athlete training at home with available equipment



Athletes stretching on home lawn

Figure 1.
Images of athletes
training at home
during the lockdown,
online at insider
YouTube
account (2020)

Source(s): Insider (2020)

5. Challenges, opportunities and future research directions

The prolonged isolation and quarantine during the pandemic created serious challenges for athletes, coaches and other stakeholders. Planning of training programs is a major mandate for sports managers and coaches, but due to isolation and social distancing, training in many sports were disrupted. Another serious crisis resulting from the shutdown was inadequate or lack of sports facilities and equipment since athletes were compelled to SAH. This situation led to all forms of improvisations (Figure 1). The shutdown also led to a drastic reduction in adherence to training and sport participation especially among young athletes. Many athletes failed to continue participation in training and general PA even after the pandemic receded,

mainly due to negative attitudes, lack of motivation and confidence. Inadequate training resources on the part of parents to aid their wards' participation in sports was another factor associated with low adherence to sport participation (Elliot *et al.*, 2021).

The Covid-19 pandemic is not all bad news after all, as it has its positive sides to athletes and other stakeholders in sports. For instance, the home confinement and other restrictions provided athletes the opportunity of escaping from pressures associated with training in the full glare of the public and cameras. The reduction in training load or break from continuous training and competitions with attendant chronic fatigue, is another positive aspect of the pandemic. It was also reported that the COVID-19 lockdown protected both referees and teams from undue social pressures due to absence of spectators during competitions, that is, "ghost games" in sports like soccer, basketball, darts, and others (Greve, Meurs, & Strauss, 2023; Angells & Reade, 2023; Leitner & Richlan, 2021). Another positive side of the pandemic was that sport organizations had to adapt and find innovative ways to engage their clients in maintaining their PA. This they did through social media and digital communications such as the use of remote and online platforms for sports activities and business (Glebova, Zare, Desbordes, & Greezi, 2022).

The saying that "every crisis is an opportunity in disguise" is relevant to the Covid-19 pandemic as it provided new opportunities in the world of sports and PA like never before. For instance, many online forums emerged as safe ways for interaction between athletes and their coaches. During this period, many events went virtual, for example, conferences and sports events. Furthermore, the pandemic and related restrictions provided opportunities to develop and deploy new digital technologies in sports, including digital sports application such as online training, e-learning platforms and organization of online sports competitions (Glebova *et al.*, 2022).

Among the opportunities created by the pandemic is that of research. It has brought up many research questions that need to be addressed in the near future. Future studies may investigate similar challenges based on gender inequalities in the various sports; the impact of pandemics on sports participation and general PA in the special and vulnerable populations; assessment of physical fitness of athletes before and after the pandemic; preventive strategies, potential treatment options and safety measures during return to active sports participation after infection.

6. Discussion

This review summarizes the impact of COVID-19 pandemic on physical training in high-performance athletes, and as major findings the COVID-19 home confinement had a detrimental effect on athletes in all competitive sports in both able-bodied and those with disabilities worldwide. All elements of training, including intensity, frequency and duration were significantly reduced and majority of athletes engaged mainly in cardiovascular and resistance-type training in contrast to sport-specific training, with athletes in team sports being more affected than those in individual sports. Furthermore, a good proportion of the athletes trained individually, in some cases up to about 84% of athletes (Jagim *et al.*, 2020). This scenario was reported in some of the studies reviewed (Da Silva *et al.*, 2022; Washif, Farooq *et al.*, 2022; Chandler *et al.*, 2021). However, a study reported no changes in training volume, intensity and fitness in paralympic athletes (Shaw, Bertrand, Deprez, Ko, Zello, & Chilibeck, 2021). As the lessons from the shutdown are instructive, coaches, and other professionals should have much to learn from the experience in case of future similar occurrences.

The difficulty in training experienced by athletes during the SAH was mainly due to longer lockdown lengths imposed by different countries (Radziminiski *et al.*, 2021) and lack of access to facilities. These situations forced athletes to improvise sport facilities and equipment in order to get going with their training. For instance, many athletes resorted to

training in garages, sitting-rooms, courtyards, and other available spaces and equipment within and outside their homes (Figure 1). In some cases, these trainings were carried out remotely by coaches or through virtual reality (Urbanski *et al.*, 2021; Da Silva *et al.*, 2022; Jagim *et al.*, 2020).

Except for resistance training, little or no gender differences in the negative effect of home confinement were reported in some studies (Washif, Sandbaak *et al.*, 2022; Chandler *et al.*, 2021). Furthermore, the frustration resulting from lack of adequate training and competitions and the fear of infection affected the mental health of athletes, especially depression and anxiety (Washif, Farooq *et al.*, 2022; Da Silva *et al.*, 2022; Urbanski *et al.*, 2021). In planning for training during periods of emergencies, coaches and other stakeholders in elite sport should make adequate preparation for athletes' mental care. The need to make adequate preparation for training athletes in team sports is critical.

One of the major limitations of most of these studies was the cross-sectional design which is time-dependent, and also precludes inference of cause-effect relationship. With the exception of Radziminski *et al.* (2021) study which used a quasi-experimental design, all other studies adopted a cross-sectional design. The online nature of the instrument also limits participation, especially among the participants with no internet access, and this could have led to potential biases in the sample. Another limitation concerns the small sample sizes in some of the studies (Da Silver *et al.*, 2022; Jagim *et al.*, 2020; Santika *et al.*, 2020). This could have led to the problem of external validity.

The major limitation of this review was the restriction to peer-reviewed quantitative studies. This might have resulted in the exclusion of relevant qualitative studies on the subject-matter. However, the major strength of this paper is the inclusion of some studies with large samples of participants from all the continents, with findings reflecting world-wide perception of athletes concerning sport training during the pandemic. The inclusion of Paralympic athletes is another strength, as this also improved our understanding of the situation in athletes with disability.

7. Conclusions

The COVID-19 pandemic had a negative impact on sports activities globally. The need for athletes to have engaged in PA during the lockdown pertain to boosting immunity, preventing detraining, injury prevention, and getting ready for return to normal sporting activities post-lockdown.

Elite athletes, especially those in team sports, suffered greater decline in training volume and general physical fitness than those in individual sports. Athletes also suffered substantial reduction in physical fitness and all aspects of training, with elite athletes retaining training specificity to a greater extent than athletes of lower classes.

Many athletes experienced difficulty training during the SAH period, mainly due to varying lockdown lengths and restrictions imposed by various countries. Also reported in the studies reviewed were issues related to limited equipment and low motivation among athletes.

Additionally, the pandemic had a negative impact on athletes' training habits, practices and mental health. Gender differences in the influence of pandemic on training were negligible in many sports, except for resistance training in which female athletes were more disadvantaged.

Lessons from the challenges of the pandemic should serve as a guide for stakeholders in the sport industry, while preparing them for similar challenges in the future. Specifically, the following suggestions are proffered.

- (1) Governments and sporting organizations should make provision for the utilization of new technology such as virtual reality and mobile applications to promote remote training, training monitoring and athlete education during future isolation periods.

- (2) Specific policies should be developed based on the lessons from the COVID-19 pandemic to help athletes maintain training and competition comparable to normal levels during future periods of emergencies.
- (3) Where possible, bubble training facilities should be provided as avenues for athletes to maintain training levels similar to normal levels. This approach is however capital-intensive, and prolonged camps may result in psychological challenges, such as mental health abnormalities.
- (4) Future studies should focus on viable home-based PA with the application of all elements of training that will maintain athletes' fitness and skill levels.

References

- Alam, M. M., & Abdullaheem, I. I. (2023). COVID-19 and the financial crisis in the sport sector around the world. *Sport in Society*, 26(1), 154–167.
- Andreato, L. V., Coimbra, D. R., & Andrade, A. (2020). Challenges to athletes during the home confinement caused by the COVID-19 pandemic. *Strength and Conditioning Journal*, 42(3), 1–5.
- Angells, L. D., & Reade, J. J. (2023). Home advantage and mispricing in indoor sports' ghost games: The case of European Basketball. *Annals of Operational Research*, 325, 391–418.
- Chandler, A. J., Arent, M. A., Cintineo, H. P., Torres-McGehee, T. M., Winkelmann, Z. A., & Arent, S. M. (2021). The impacts of COVID-19 on Collegiate student-athlete training, health and well-being. *Translational Journal of the American College of Sports Medicine*, 6(4), 1–11.
- Da Silva, L. F., De Almmeida-Neto, P. F., Bulhoes-Correier, A., De Queiros, V. S., Matos, D. G., Sanas, P. M. S., & Cabral, B. G. D. T. (2022). Impact of social isolation on the impact of physical activity in young Brazilian athletes caused by COVID-19. *The Journal of Sports Medicine and Physical Fitness*, 62(4), 531–537.
- Elliot, S., Drummond, M. J., Prichard, I., Eime, R., Drummond, C., & Mason, R. (2021). Understanding the impact of COVID-19 on youth sport in Australia and consequences for future participation and retention. *BMC Health*, 21, 448. doi: 10.1186/s12889-021-10505-5.
- Glebova, E., Zare, F., Desbordes, M., & Greezi, G. (2022). Covid-19 sport transformation: New challenges and new opportunities. *Physical Culture and Sport Studies and Research*, 95, 54–57.
- Grazidi, R., Lortarco, Baroni, B. M., Oliviera, G. S., Sagura, V., & Vanoni, E. (2020). Corona virus disease quarantine more detrimental than traditional off-season on physical conditioning of professional soccer players. *Journal of Strength Conditioning Research*, 34, 3316–3320.
- Greve, J., Meurs, E. V., & Strauss, B. (2023). Elite dart performance and social influence of real crowds and simulated crowd noise. *Scientific Reports*, 13, 12346. doi: 10.1038/s41598-023-39378-x.
- Gupta, V., Santosh, K. C., Arora, R., Ciano, T., Kalid, K. S., & Mohan, S. (2022). Socioeconomic impact due to COVID-19: An empirical assessment. *Information Processing and Management*, 59, 102810.
- Haan, R., Alblooshi, M. E. A., Syed, D. H., Dougman, K. K., Tunaiji, H. A., Campos, L. A., & Baltatu, O. C. (2021). Health and well-being of athletes during the coronavirus pandemic: A scoping review. *Frontiers in Public Health*, 9, 641392.
- Insider (2020). How athletes are keeping fit during the coronavirus. Available from: <https://insider.com/photos-athletes-keepfit-coronavirus-2020-4>. Accessed on 17/09/2022 (accessed 09 November 2022).
- Jagim, A. R., Luedke, J., Fitzpatric, A., Winkelman, G., Erickson, J. L., Askow, A. T., & Camic, C. L. (2020). The impact of COVID-19 related shutdown measures on training habits and perceptions of athletes in the United States; A brief research report. *Frontiers in Sports and Active Living*, 2, 623068.

- Kaur, H., Singh, T., Arya, Y. K., & Mittal, S. (2020). Physical fitness and exercise during the COVID-19 pandemic: A qualitative enquiry. *Frontier in Psychology*, 11, 590172.
- Leitner, M. C., & Richlan, F. (2021). No fans-No pressure: Referees in professional football during the COVID-19 pandemic. *Frontiers in Sports and Active Living*, 3, 720488. doi: [10.3389/fspor.2021.720488](https://doi.org/10.3389/fspor.2021.720488).
- Machado, E. D., Secchi, L. L. B., Camargo, P. R., & Mendonca, L. D. M. (2023). Influence of quarantine during the corona virus 2019 (COVID-19) on physical and psychosocial aspects: Perceptions of 214 Brazilian athletes. *Global Health Journal*, 7(2023), 49–54.
- Mutz, M., & Gerke, M. (2021). Sports and exercise in times of self-quarantine: How Germans changed their behaviour at the beginning of Covid-19 pandemic. *International Review for Sociology of Sports*, 56(3), 305–316.
- Park, A. H., Zhong, S., Yang, H., Jeong, J., & Lee, C. (2022). Impact of covid-19 on physical activity: A rapid review. *Journal of Global Health*, 12, 05003. doi: [10.7189/jogh.12.05003](https://doi.org/10.7189/jogh.12.05003).
- Radziminski, L., Padron-Cabo, A., Konefal, M., Chmura, P., Szwarc, A., & Jastrzebski, Z. (2021). The influence of COVID-19 pandemic lockdown on the physical performance of professional soccer players: An example of German and Polish leagues. *International Journal of Environmental Research Public Health*, 18, 8796. doi: [10.3390/ijerph18168792](https://doi.org/10.3390/ijerph18168792).
- Reardon, C. I., Haineline, B., Aron, C. M., Baron, D., Baum, A. L., Bindra, A., & Engebretsen, L. (2019). Mental health in athletes: International Olympic Committee consensus statement. *British Journal of Sport Medicine*, 53, 667–699.
- Roche, M., Sainani, K., Noordsy, D., & Fredericson, M. (2022). The impacts of COVID-19 on mental health and training in US professional endurance athletes. *Clinical Journal of Sports Medicine*, 32, 290–296.
- Santika, I. G. P. N. A., Perdana, A. A. O., & Adiatmika, I. P. G. (2020). Analysis of athletes' physical condition during the COVID-19 Pandemic. *Journal of Physical Education, Health and Sport*, 8(2), 39–43.
- Santos, A. M. S., Rossi, F. E., de Mura, H. P. D. N., de Sousa, A. V. M., Machado, D. C. D., Neves, L. M., . . . dos Santos, M. A. P. (2021). COVID-19 pandemic impacts physical activity levels and sedentary times but not sleep quality in young badminton players. *Sport Science for Health*, 17, 969–977.
- Sayyid, S. M., Zainaddin, Z. A. B., & Seraj, P. M. I. (2021). A scientific overview of the impact of COVID-19 pandemic on sports affairs: A systematic review. *Physical Education of Students*, 25(4), 221–229. doi: [10.3389/pub/1.2021/641392](https://doi.org/10.3389/pub/1.2021/641392).
- Shaw, K. A., Bertrand, L., Deprez, D., Ko, J., Zello, G. A., & Chilibeck, P. D. (2021). The impact of Covid-19 pandemic on diet, fitness, and sedentary behaviour of elite para-athletes. *Disability and Health Journal*, 14(3), 101091.
- Silvers-Granelli, H., Mandelbaum, B., Adeniji, O., Insler, S., Bizzini, M., Pohlig, R., . . . Dvorak, J. (2015). Efficacy of the FIFA 11 + injury prevention program in the collegiate male soccer players. *American Journal of Sports Medicine*, 43, 2628–2637.
- Urbanski, P. K., Szeliga, T., & Tasiemski, T. (2021). Impact of COVID-19 pandemic on athletes with disabilities preparing for the paralympic Games in Tokyo. *BMC Research Notes*, 14, 233. doi: [10.1186/s13104-021-05646-0](https://doi.org/10.1186/s13104-021-05646-0).
- Urbanski, P. K., Rogoza, R., Brewer, B., & Tasiemski, T. (2023). Coping with the COVID-19 pandemic by paralympic athletes preparing for elite sport events: A longitudinal study. *Scandinavian Journal of Medicine and Science in Sports*, 33, 512–520.
- Washif, J. A., Farooq, A., Krug, I., Pyne, D. B., Verhagen, G., Taylor, L., & Chamari, K. (2022). Training during the Covid-19 lock down; Knowledge, beliefs and practices of 12,526 athletes from 142 countries and six continents. *Sports Medicine*, 52(4), 933–948. doi: [10.1007/s40279-021-01573-z](https://doi.org/10.1007/s40279-021-01573-z).
- Washif, J. A., Sandbaak, O., Seiler, S., Haugen, T., Farooq, A., Quarrie, K., & Chamari, K. (2022). COVID-19 lockdown: A global study investigation athletes' sport classification and sex on training practices. *International Journal of Sports Physiology and Performance*, 17(8), 1242–1256. doi:[10.1123/ijsp.2021-0543](https://doi.org/10.1123/ijsp.2021-0543).

- Wiltshire, H. D., Supriya, R., & Baker, J. S. (2021). Covid-19 impact on the sport sector economy and athletic performance. *Journal of Risk and Financial Management*, 15, 173. doi: [10.3390/jrfm1540173](https://doi.org/10.3390/jrfm1540173).
- World Health Organization (2020), Timeline. WHO's Covid-19 response. April 10, 2020. Available from: <http://www.who.int/emergencies/diseases/novelcoronavirus-2019/interactivetimeline> (accessed 02 September 2022).
- World Health Organization (2021), *WHO coronavirus disease (Covid-19) dashboard*. Geneva: WHO.
- Yousli, N., Bragazzi, N. L., Briki, W., Zmijewski, P., & Chamari, K. (2020). The COVID-19 pandemic: How to maintain a healthy immune system during the lockdown – a multidisciplinary approach with special focus on athletes. *Biology of Sport*, 3, 211–216.

Corresponding author

Danladi Ibrahim Musa can be contacted at: musa.d@ksu.edu.ng

For instructions on how to order reprints of this article, please visit our website:

www.emeraldgroupublishing.com/licensing/reprints.htm

Or contact us for further details: permissions@emeraldinsight.com