



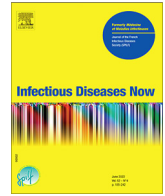
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Short communication

Incidence and characteristics of COVID-19 in French professional football players during the 2020–2021 season

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ABSTRACT

Objectives: To describe the epidemiology of COVID-19 in French professional football players, and to compare the infection incidence with the general population across the first three waves.

Methods: During the 2020–2021 season, all professional football players ($n = 1217$) in the two primary French leagues underwent weekly testing for SARS-CoV-2 infection by nasopharyngeal PCR, in combination with rigorous infection control measures.

Results: Among all players, 572 (47%) tested positive at least once, with no COVID-19-related death or hospital admission. Monthly incidence estimates in players ranged from 1486 to 6731 per 100,000 individuals, i.e. 2–17 times higher than incidence estimates in the general population in France during the study period.

Conclusion: Almost 50% of professional football players developed SARS-CoV-2 infection during the 2020–2021 season in France, with no severe complication.

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1. Introduction

The COVID-19 pandemic has dramatically changed the way society operates, and such impact was also felt in the field of sports. Initially, the risk of SARS-CoV-2 transmission during sports was unknown, and most activities were stopped. The concern was that incidence of COVID-19 amid players would be high, as reported in communities of people with close contacts [1,2]. Afterwards, different risks were identified depending on the sports, and several competitions started again [3]. The COVID-19 outbreak forced professional leagues to apply restrictive measures during the 2020/21 season. Among these leagues, the French Federation of Football (FFF) implemented a protocol including physical distancing, regular handwashing, mandatory masks outside of sports activities, and systematic testing of players and staff by RT-PCR on nasopharyngeal samples before each game, to reduce the risk of

SARS-CoV-2 transmission during training activities, and competitions [4].

Modelling and estimating the incidence of respiratory virus infections in large population is complex [5], and the difficulties had been accentuated for COVID-19 by the consecutive emergence of several highly transmissible variants of concern (VOCs), primarily alpha, then delta, and then omicron [6]. Weekly testing of French professional football players, a well-defined and steady population, represented an opportunity to monitor the incidence of SARS-CoV-2 infection over time, and its determinants. The aim of this study was to describe the epidemiology, the characteristics, and the outcome of SARS-CoV-2 infection in French professional football players during the 2020–2021 season.

2. Methods

The FFF coordinates two professional football championships, i.e. league 1 and league 2, with 20 teams in each league, and respectively 613 and 604 players. The FFF developed a COVID-19 protocol starting in August 2020, by the beginning of the 2020–2021 season. That protocol consisted in mandatory masking outside of sports activities, physical distancing, regular washing with

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alcohol-based hand rub, facility disinfection, closed-door matches (i.e., with no public), and repeated SARS-CoV-2 PCR testing through nasopharyngeal swabs. Every team had a physician in charge of the protocol and its adherence by players and staff members. Symptoms and signs of COVID-19 were identified using a standardized questionnaire. Players and staff members of all teams were tested by nasopharyngeal SARS-CoV-2 RT-PCR one to three days before every game. Tests before games were performed systematically, for each player, whether or not they were symptomatic. When a person tested positive, a quarantine period was started for a minimum of 10 days, and a negative PCR was needed to end the quarantine. Not respecting physical distancing (being at a distance of <1 m) during a period longer than 15 min or exposition to biological fluids of a person with COVID-19 led to an exposure questionnaire, a quarantine and an immediate PCR testing. Serological status of players was assessed using a series of validated tests (ELISA-S and seroneutralization commercial kits), in accredited laboratories.

Results were expressed as *n* (%) for qualitative variables. To estimate the incidence, we divided the number of individuals tested positive for COVID-19 by the total number of days for all football players during each month of the study period. For comparison with SARS-CoV-2 incidence in the general population during the study period, global incidence rates in France were calculated using the French National Authority for Health (*Santé publique France*) published data. Statistical analyses were carried out using Prism 9.3 software (GraphPad Software, San Diego, CA, USA).

3. Results

During the 2020–2021 season, 47% of all professional football players (572/1217) tested positive for SARS-CoV-2 by nasopharyngeal PCR. The proportion of players infected by SARS-CoV-2 was similar in both leagues with 45% (*n* = 276/613) in league 1, and 49% (*n* = 296/604) in league 2. Among all players infected by SARS-CoV-2, most individuals had one single episode, except for 11 players who had documented reinfections (11/572, 1.9% of all SARS-CoV-2 infections). No hospital admission and no death were related to COVID-19 during the study period.

Monthly incidence of SARS-CoV-2 infection ranged from 1486 to 6731 per 100,000 individuals during the study period. The maximum incidence was observed in October 2020, at the start of the second wave in France, whereas the lowest was observed in May 2021, just before the season end.

In France, during the study period, monthly incidences ranged from 206 to 1389 per 100,000 persons in the general population. With the exception of the first month of the 2020–2021 championship, namely August 2020, SARS-CoV-2 infection incidence esti-

mates in football players were 2.3 to 9.3 times higher than in the general population (Fig. 1). The months with the greatest ratios of incidence between football professional players and the French general population were August (17.4), September (9.3), October (8.0) and January (7.7). Other months had lower ratios ranging from 2.3 to 4.1.

Serological assays for SARS-CoV-2 IgG were performed in 57% (697/1,217) of all professional football players. Among them, 35% (248/697) previously had a positive SARS-CoV-2 RT-PCR test, and 55 of these 248 players (22%) were seronegative.

4. Discussion

The primary findings of this study are as follows: (i) COVID-19 was associated with good outcomes with no death and no hospital admission reported in 572 professional football players with SARS-CoV-2 infection, (ii) there was a continuous circulation of SARS-CoV-2 among professional football players during the 2020/21 season; (iii) the incidence estimates were much higher in professional football players than in the general population. We highlighted that an active surveillance with iterative SARS-CoV-2 RT-PCR every week before games in a large population of 1217 professional football players led to incidence estimates much higher than in the general population during the study period (2–17 times higher). As a result, this captive population represents an interesting model of transmission of SARS-CoV-2 in individuals applying preventive measures including physical distancing, handwashing, mandatory masking outside of sport activities, and who underwent repeated COVID-19 tests. In addition, this cohort of football players had the singularity of occurring before the appearance of anti-SARS-CoV-2 vaccination. As a real-life model of transmission, this raises questions about potential underestimations of mathematical predictions, but it also raises concerns about efficacy of personal protective measures to limit transmission despite implemented protocols.

Football being an outdoor sport, given that outdoor transmission is limited for SARS-CoV-2, incidences would probably be even higher in professional teams of indoor sports [7]. Football has been then classified as a moderate-risk activity [3], but the largest prospective cohort of professional football players described so far found a very low risk of transmission during games and training [8]. Because this reinforced surveillance affected a large population (>1000 individuals), these data may be an additional tool to monitor the circulation of SARS-CoV-2 infection. Indeed, the omicron variant dramatically changed the situation by being highly transmissible, and daily contaminations registered since this variant appeared have broken records all around the world [9]. At this point, the reported incidence rates of infection are probably widely underestimated [10]. The use of large cohorts of athletes with reg-

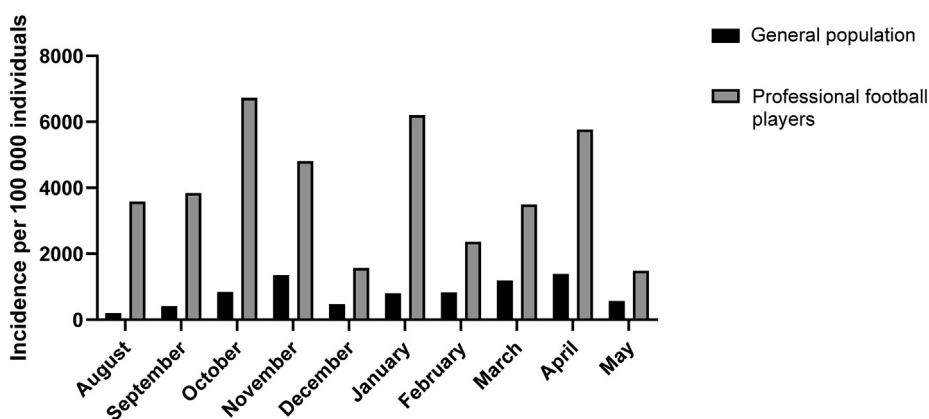


Fig. 1. Monthly incidence of SARS-CoV-2 infection among professional football players and the general population, during the 2020–2021 season in France.

ular testing may represent a more reliable tool to monitor virus circulation.

Here, we reported a proportion of 47% of players infected during the 2020/21 season. These results are consistent but slightly higher than the 20–45% of seroprevalence estimated in individuals aged from 20 to 29 years during the same period in France [11,12].

Surprisingly, among months with the greatest ratios of incidence between professional players and the French general population, two – August 2020 and January 2021 – did not coincide with epidemic waves. To explain these differences with the general population, several hypotheses could be made. August corresponds to the beginning of the season and the start of community life, which could increase viral transmission among players. The high incidence ratio in January may reflect two parameters: (i) early circulation of the alpha variant coming from England after European games between British and French teams; (ii) SARS-CoV-2 acquisition by players when they visited their friends and relatives during the winter break (last week of December).

This work emphasizes that COVID-19 has a limited impact on a healthy sporty population. The study period began before any COVID-19 vaccine was available, and almost half of players were infected by SARS-CoV-2 at least once during the 9-month football season. Knowing that personal protective measures were rigorously applied in this population of professional players, this proportion appears to be high, but it could be counterbalanced by community-life and repeated travels. Additionally, among almost 600 athletes, we would expect some cases of COVID-19-associated cardiac injury, such as inflammatory heart disease [13]. Surprisingly, no long-term consequences were reported and all players were able to return to play in the league [14].

This study has limitations. First, this work focuses on a specific population of athletes and findings may not be generalizable. Indeed, the good clinical outcome that we found in football players could differ in athletes performing other sports, for example those for whom professionals are older, or where athletes have a higher body mass index (which are both major risk factors for COVID-19 severity) [15]. Second, this study was restricted to one season and started before the availability of vaccines against SARS-CoV-2. Other cohorts of athletes with high vaccine coverage conducted over multiple seasons may find results differing from ours. Third, variation of monthly incidence estimates could be a result of the specificity of the football calendar or behavior of players. As mentioned above, August and January were months outside epidemics waves but were associated with high incidence rates, possibly due to intense community life and international games.

5. Conclusions

This active surveillance study found that half of professional football players (572/1217; 47%) were infected by SARS-CoV-2 during the 2020–2021 season in France, with limited consequences (no hospital admission, no death).

Competing interests

The authors have no relevant financial or non-financial interests to disclose.

Data availability

On request.

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Authors' contributions

DLP, EO, CR, and PT participated in study design and wrote the original draft. EO, FM, PK, JFC, and ER contributed to the investigation and data collection. All authors revised and approached the final version of the manuscript.

Ethical statement.

Ethics approval: This study was approved by ethics committee of Rennes University Hospital (approval number 22.38).

Consent to participate: Patients were informed as part of requirements for institutional research.

Consent to publish: Patients were informed as part of requirements for institutional research.

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