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**Effects of the COVID-19 pandemic on professional tennis players' match statistics:
A large-scale population-based study**

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ABSTRACT

Not required.

The COVID-19 pandemic caused the postponement of important sporting events like the Tokyo 2020 Olympics and Paralympics and has thus impacted professional sports considerably. In the case of professional tennis circuits, the Women's Tennis Association (WTA) and the Association of Tennis Professionals (ATP) suspended their tours from April to July 2020. Owing to restrictions on population movement to prevent the spread of COVID-19, some players could not have sufficient access to facilities and equipment for training and practice. Indeed, a survey of 3,289 athletes demonstrated that 56% of them found it difficult to train effectively,¹ and that training intensity, frequency, and duration were decreased in athletes during the COVID-19 lockdown.² Such restrictions could decrease physical and athletic performance in athletes. The previous research demonstrated that home confinement due to the COVID-19 pandemic decreased muscle strength in football players even though they had been training at home.³ However, there is no evidence that the COVID-19 pandemic has affected the performance of professional tennis players thus far. Here, we examined the effects of the COVID-19 pandemic on the performance of professional tennis players by analysing their match statistics using a large-scale population-based approach.

This study utilised data from a database (<https://github.com/JeffSackmann>). The data included statistics from 21,499 matches of 1,785 professional tennis players from 2019 to 2021. Matches played from April to July were excluded in all years as the suspended period in 2020. The percentages of service games, points won, percentages of 1st service in, service aces, double faults, break points faced per service game, and break points saved per face were used as outcomes. To test the impacts of the COVID-19 pandemic on the match statistics, linear mixed models were performed using the following formula: Outcome ~ tournament category (WTA tour, ATP tour, and ATP challenger) + year (2019, 2020, and 2021)*time (pre- and post-suspension) + (1 | player ID). Then, multiple comparison tests were performed using Bonferroni methods.

The percentages of service games won, total, 1st, and 2nd service points won, and service aces decreased, while breakpoints increased after the tours suspension period due to COVID-19 in 2020 (Figure 1). Such differences were not observed in 2019, suggesting that the differences in match statistics were

due to the COVID-19 pandemic rather than intra-season variability. There had been a slight recovery from the impact of COVID-19 on match statistics from 2020 to 2021; however, it did not fully recover in 2021 (Figure 1). There were no clear effects of the COVID-19 pandemic on the number of double faults and breakpoints saved. The negative effects of the COVID-19 pandemic on the match statistics were consistently observed across the sub-groups, while they could be more substantial in males, players who have lost, and lower-rank players compared to females, winners, and high-ranked players, as supported by the significant year*time*sub-group interactions (data not shown).

The results of this study indicate that strategies aimed at restoring service performance in professional tennis players during and after the COVID-19 pandemic are urgently required, especially in male and lower-ranked players. The training strategies for improving service performance that have less pandemic-related restrictions may be useful for players and their team, for example, mental training programs,⁴ including video modelling training,⁵ perceptual-cognitive skills training,⁶ imagery training,⁷ and deepening the understanding of useful strategies for improving service performance during the match, such as pacing strategies.⁸ The present study is the first to use large-scale population data to examine the impact of temporary tours withdrawal on the performance of professional tennis players. Regardless of sex or ranking, it may be useful to focus on enhancing service performance when returning to the tours after a temporary period of absence.

CONFLICT OF INTEREST

The authors declare that they have no competing interests.

AUTHOR CONTRIBUTIONS

T.I. conceptualised, designed, and developed the theory of the manuscript, performed data extraction, and wrote the manuscript. N.R., T.N., M.M., and M.C. revised the manuscript, provided critical feedback and direction, helped plan the manuscript, and made critical contributions. All authors have read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

DATA AVAILABILITY

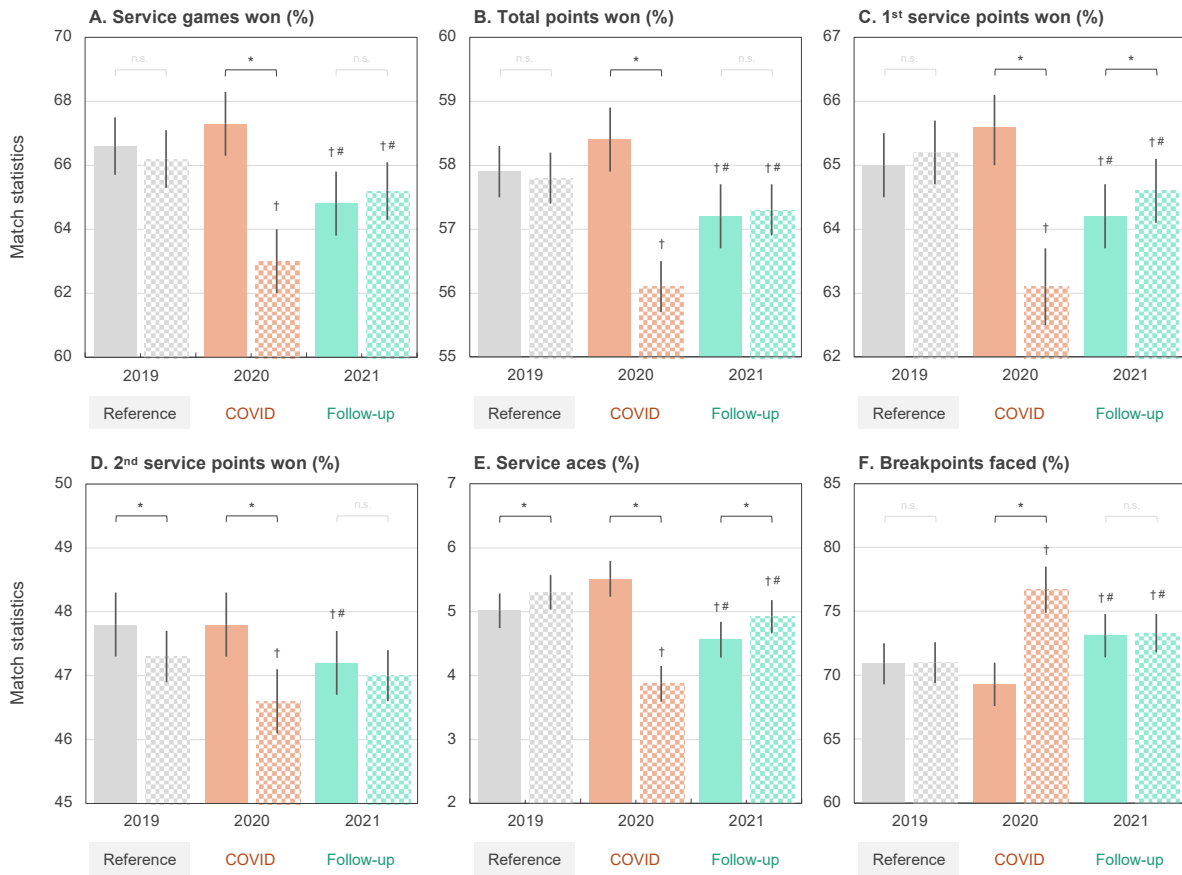
All the data used in this study are available at <https://github.com/JeffSackmann>.

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Figure Captions

Figure 1. The results of the main analysis. A. Service games won, B. Total points won, C. 1st service points won, D. 2nd service points won, E. Service aces per service points, and F. Breakpoints faced per service games. Values are presented as mean \pm 95% confidence interval. * denotes significant difference between pre-and post-suspension period ($p < .05$). † and # denote significant difference between 2019 and 2020 in the same period (Bonferroni adjusted $p < .05$, unadjusted $p < .017$), respectively.



Pre-suspension (January to March) * Pre- vs post-suspension ($p < .05$)
 Post-suspension (August to November) † vs 2019 in same period (adjusted $p < .05$)
 Follow-up # vs 2020 in same period (adjusted $p < .05$)