Reply to: The role of pets in SARS-CoV-2 transmission: an exploratory analysis

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To the Editor,

We have read with great interest the work published by Teixeira and colleagues [1]. In this case–control study with a test-negative design in outpatients with flu-like symptoms, people with positive SARS-CoV-2 RT-qPCR reported more frequent exposure to cats or dogs in the residence than negative controls, with an odds ratio of 1.29 (95% confidence interval 1.08–1.54). This raises the question of how pets such as cats and dogs can contribute to transmission of SARS-CoV-2 in households. Indeed, while human-to-cat transmission was already documented early in the pandemic [2], as well as between-cats (but not between-dogs) [3], recent work has also shown possibility of pet-to-human transmission: a case study reporting positive testing in a veterinarian following examination of a cat infected by household members, with genetic findings supporting cat-to-human transmission [4], and an outbreak investigation in a pet shop identifying numerous linked infections in Syrian hamsters and humans [5]. Together with those findings, the study by Teixeira and colleagues suggests that cats and dogs contribute to SARS-CoV-2 transmission in households. Here, we report results from a case–control study conducted in France on the risk of SARS-CoV-2 infection associated with living with cats or dogs.

We have been conducting an ongoing nationwide case–control study (ComCor study) on COVID-19 in France since October 2020. Cases are invited to participate by email by the national health insurance system (Caisse Nationale d’Assurance Maladie) following their positive test (rapid antigen test or RT-PCR). Ipsos, an opinion and market research company, enrolls controls matched on age (three age categories), gender, region of residence, population density and calendar week of exposure, using a frequency-matching procedure. Cases and controls respond to an online auto-questionnaire on exposures (sociodemographic data, household characteristics, locations visited, etc.) in the 10 days preceding symptom onset for cases (or testing in case of asymptomatic infection), or questionnaire completion for controls. Since the beginning of 2022, that period was reduced to 7 days following emergence of the Omicron variant which has a shorter incubation period. We studied factors associated with the risk of SARS-CoV-2 infection in a multivariable logistic regression adjusting for matching factors, COVID-19 vaccine status (including time elapsed since last injection), as well as a series of at-risk exposures which we have previously documented as associated with the risk of SARS-CoV-2 infection: working habits (including working from home), number of people in the household, including children attending school (daycare center, kindergarten, primary school, middle school, high school, or university), housing type (apartment, individual house, or shelter), use of public transport or carpooling, long-distance travel including use of airplane or train, indoor sports activities, work as a healthcare worker, attendance of bars, restaurants, parties, underlying conditions (diabetes mellitus, chronic respiratory disease, and hypertension), and body mass index [6]. To investigate evolution of risk throughout the study, we divided the study in eight distinct periods based on incidence changes and epidemic control measures (lockdown, curfew, health pass, mask requirements). We conducted statistical analyses with STATA/SE 16.0 (College Station, Texas, USA).

In an analysis including 540,201 cases and 44,416 controls enrolled between 27 October 2020 and 19 May 2022, 192,230 (35.6%) cases and 16,729 (37.7%) controls...
reported living with a cat, and 122,027 (22.6%) cases and 11,166 (25.1%) controls reported living with a dog. We found no increased odds of SARS-CoV-2 infection in univariable analysis for people living with pets: odds ratio 0.91 (95% CI 0.90–0.93) for living with a cat, OR 0.87 (95% CI 0.85–0.89) for living with a dog. These results were consistent in multivariable analysis after adjustment on matching factors and a series of exposures associated with the risk of SARS-CoV-2 infection: OR 0.85 (95% CI 0.83–0.87) for living with a cat, OR 0.83 (95% CI 0.81–0.86) for living with a dog. Associations were steady throughout the study period (see Table 1). Findings were similar in multivariable subgroup analysis by type of housing: OR 0.90 (95% CI 0.87–0.92) for living with a cat and OR 0.89 (95% CI 0.87–0.92) for living with a dog, for the 330,727 cases (61.2%) and 26,979 controls (60.7%) living in individual houses; OR 0.75 (95% CI 0.72–0.79) for living with a cat and OR 0.69 (95% CI 0.65–0.72) for living with a dog, for the 207,084 cases (38.3%) and 17,288 controls (38.9%) living in apartments.

In this case–control study, we found that living with a cat or a dog was not associated with an increased risk of SARS-CoV-2 infection. Strengths of our study include nationwide coverage throughout emergences of consecutive variants, a large sample size, and extensive adjustment for confounding. Restricting our study population to participants living in individual houses or to those living in apartments, where interactions with pets may differ, did not change the findings. It is difficult to point out on reasons why our results differed from those of Teixeira et al. It could be that the nature and level of interactions among owners and pets differ in Brazil compared to France, or differing participants enrollment processes. Differences in housing and urbanization conditions between Brazil and France may have also played a role. Another reason may be the absence of control for confounding in Texeira’s study; however, the lack of changes in effect size between uni- and multi-variable analyses in our study goes against an important role for confounding in the causal interpretation of these associations. Both our results and those provided by Teixeira and colleagues should

| Study period       | Second wave (D614G) | Curfew and third wave (Alpha) | Third lockdown | Fourth wave (Delta) | Health pass | Fifth wave (Delta) | Fifth wave (BA.1) | Sixth wave (BA.2) |
|--------------------|---------------------|--------------------------------|----------------|---------------------|-------------|-------------------|-------------------|-------------------|
| Onset and end dates of study period | 27/10/2020 03/12/2020 | 04/12/2020 08/04/2021 | 09/04/2021 13/06/2021 | 14/06/2021 13/08/2021 | 14/08/2021 01/10/2021 | 02/10/2021 19/12/2021 | 20/12/2021 17/03/2022 | 18/03/2022 19/05/2022 |
| Cases (no)            | 22938               | 103479                         | 29420          | 16352               | 10789       | 62820             | 202666           | 91737             |
| Controls (no)          | 1847                | 5725                           | 3262           | 4727                | 2196        | 4002              | 12145            | 10512             |
| Living with a cat   | Univariable analysis OR (95% CI) | 0.90 (0.82–1.00) | 0.95 (0.90–1.01) | 0.88 (0.81–0.95) | 0.81 (0.76–0.86) | 0.78 (0.71–0.86) | 0.87 (0.81–0.92) | 0.97 (0.94–1.01) | 0.91 (0.86–0.94) |
| Living with a dog   | Univariable analysis OR (95% CI) | 0.77 (0.69–0.87) | 0.88 (0.83–0.94) | 0.80 (0.74–0.87) | 0.80 (0.74–0.86) | 0.76 (0.68–0.85) | 0.82 (0.76–0.89) | 0.87 (0.83–0.91) | 0.88 (0.84–0.92) |

Multivariable logistic regression models adjusting on age, gender, region, population density, vaccine status, body-mass index, smoking status, immunosuppressive therapy, diabetes mellitus, hypertension, chronic respiratory disease, working habits, housing type, number of people in the household, children in the household attending schools, attending of meetings, use of public transport, traveling, indoor sports, healthcare worker status, attendance of bars, restaurants or parties.

*OR* odds ratio

b95% CI 95% confidence interval

*aOR* adjusted odds ratio

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be interpreted with caution, given inherent limitations to the case–control study design, including recall or selection biases. Further epidemiological studies, such as cohort studies, could help provide more robust evidence.

In the absence of clear evidence on this topic, we believe it is important to gather more information from international studies, and would like to add evidence from ours, which suggests that cat-to-human or dog-to-human transmission did not contribute significantly to the circulation of SARS-CoV-2 in France.

**Author contributions** All authors designed the investigation and developed the study questionnaire. TC managed the data collection and maintained the database. SG, TC and AF performed the statistical analyses and drafted the first versions of the manuscript. All authors critically reviewed and approved the final version of the manuscript.

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**Declarations**

**Conflict of interest** The authors declare they have no conflict of interest.

**Ethical approval** This study received ethical approval by the Comité de Protection des Personnes Sud-Ouest et Outre-Mer I on 21 September 2020. The data protection authority Commission Nationale de l’Informatique et des Libertés (CNIL) authorized the processing of data on 21 October 2020. Restrictions apply to the accessibility of these data. Access to these data would require prior authorization by the CNIL. Informed consent was obtained from all participants. The study is registered with ClinicalTrials.gov under the identifier NCT04607941.

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