

Potential role of children in the household transmission of SARS-CoV-2 infection in Catalonia (Spain)

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Abstract: We analyzed the characteristics of the Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) infected children during lock-down period in Catalonia (Spain), and their transmission role within the households. Among 295 traced household contacts of 89 pediatric patients, children were classified as final index cases in only 3.4% of the traced homes.

Keywords: SARS-CoV-2; COVID-19; children; household; contact tracing

1. Introduction

Household clusters of coronavirus disease 2019 (COVID-19) may play an essential role in the community transmission of Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) infections, and consequently a risk for spreading the disease to the community [1]. Therefore, household contact tracing studies can be highly effective for COVID-19 prevention [2]. In South Korea, two similar studies demonstrated dissenting transmission rates within households from SARS-CoV-2 infected children [1, 3]. In Europe (French Alps), a study of a cluster with twelve secondary cases included a symptomatic child who attended three schools without transmitting the virus to any of his contacts [4]. Also, in the Netherlands periodic reports from the National Institute of Public Health showed that patients under 20 years play a smaller role in the spread of the infection than adults [5]. However, studies exclusively based on SARS-CoV-2 viral load in respiratory samples suggest a possible role of children in SARS-CoV-2 transmission, even when asymptomatic [6, 7].

On March 13th, as a first measure within a global lockdown, 5,492 Catalanian schools with a total of 1,565,478 students were closed in an effort to contain the spread of COVID-19 [8].

2. Materials and Methods

Catalonia, a northeastern region of Spain with 7.5 million inhabitants -1,581,341 below 20 years of age- with a regional-level governance public health system comprises 7 health sub-regional departments, and more than 400 Primary health-care centers.

The objectives of this project named "COVID-19 pediatric disease in Catalonia" (COPEDI-CAT) were: 1) to describe the epidemiological and clinical characteristics of all the pediatric COVID-19 cases diagnosed in Catalonia (Spain); and 2) to describe the dynamics of the SARS-CoV-2 infection within the household and 3) to assess the children's potential role in its transmission.

This is a retrospective cross-sectional study, including the lock-down period, between 10th March and 31st May 2020 (study-period), to collect data from all pediatric (below 18 years of age) COVID-19 patients who were diagnosed by reverse transcription polymerase-chain-reaction (RT-PCR).

We obtained demographic, epidemiological, and diagnostic data of the pediatric cases through the Catalanian Health Quality and Assessment Agency from five different sources: primary health-care centers, hospitals, emergency departments, the Catalanian Epidemiological Surveillance Network, and the referral laboratories. Thereafter, a telephone survey was applied by expert healthcare workers to the parents or legal guardians of each confirmed SARS-CoV-2 pediatric case to obtain clinical and microbiological information from their household contacts. Finally, SARS-CoV-2 serological investigation was performed to household contacts of all the pediatric cases included in the study to better assess exposure to SARS-CoV-2. All data were registered in a web-based software platform Research Electronic Data Capture (REDCap®) database.

Index case was defined when the child was the first infected within the household considering the chronology of the symptoms and the serology results performed to the contacts as surrogates that reflects the temporality of the infection. Secondary cases were defined when another symptomatic household contact tested positive for SARS-CoV-2 RT-PCR or serology before the child. In co-primary cases we did not find any household contact other than the child testing positive for SARS-CoV-2 RT-PCR or serology, or we were unable to establish temporality within contacts testing positive for SARS-CoV-2 RT-PCR or serology.

As a project under the supervision of the Catalanian Public Health Agency to support health-policy recommendations on easing the current COVID-19 partial lockdown measures and allowing children back to school safely, ethics approval was not requested initially. However, to perform the microbiological studies to the household contacts, we finally obtained an ethical approval for this purpose and for all the study (PR (AG) 475/2020).

3. Results

3.1. Characteristics of the cases and their household contacts

3.1.1. Characteristics of the cases

The first pediatric case of COVID-19 was identified on March 10th, 2020; by May 31st, 158 cases of children under 18 years had been reported, with a median [IQR] age of 12 [4-16] years (table 1). Temporal distribution showed two different time-peaks, the first in the second half of March likely secondary to infections acquired before lock-down measures, and the second through the second half of April 2020 till the end of May likely due to the increased number of RT-PCR performed between March (n=987) and May (n=8,073) (figure 1 and figure 2). Nearly 20% (31/158) needed hospital admission (5 in the pediatric intensive care unit), with a higher non-significant percentage in the under 3 years age-group (35.7%; 10/28), and in female (24.4%; 21/86).

Complete clinical and household contacts data were actively obtained from 56.3% (89/158) of the patients (table 1); 43.7% (69/158) were excluded for the contact-tracing analysis because different reasons (figure 3). The median [IQR] time between the diagnosis date of the case and the information collected from household contacts was 121 [92-138] days.

Fever (59.6%; 50/89) and cough (49.4%; 44/89) were the most frequent symptoms while 21.3% (19/89) were asymptomatic (table 1). One death was reported (0.6%), and six patients had some, mostly minor, sequelae.

3.1.2. Characteristics of the household contacts

A total of 295 household contacts were linked to these 89 pediatric cases. After completing the contact-tracing study, children were defined as index cases in at 3.4%; the rest of children were classified as co-primary (40.4%) or were secondary cases to adults (56.2%) (table 2).

3.2. Figures, Tables and Schemes

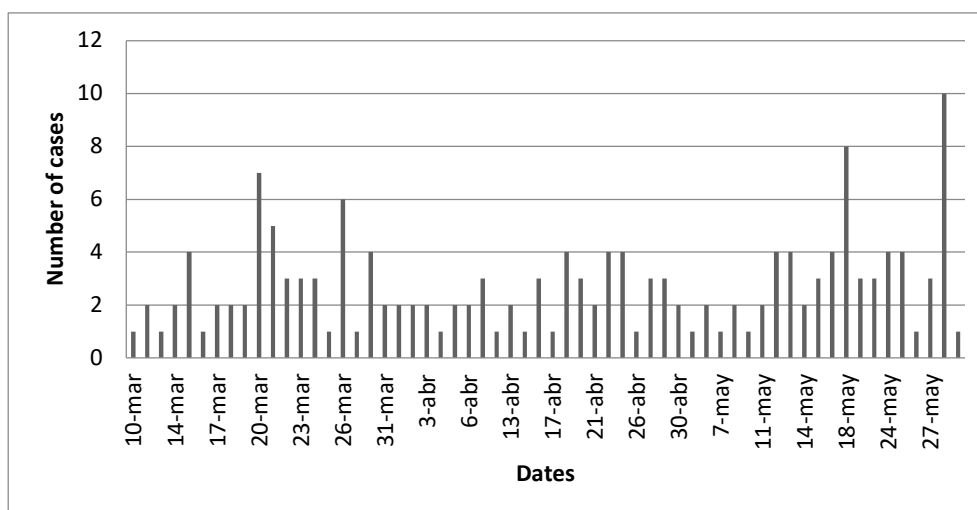


Figure 1. Temporal distribution of SARS-CoV-2 pediatric cases between March and May 2020

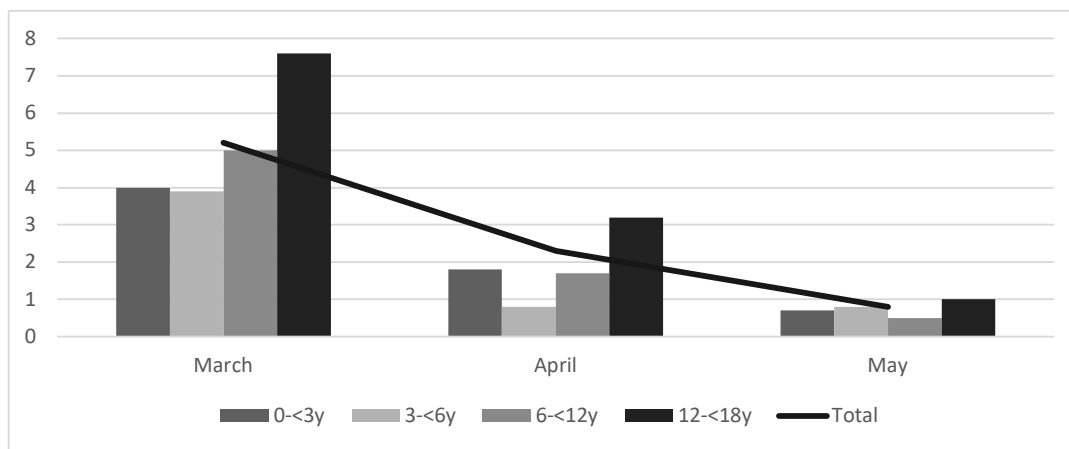


Figure 2. Distribution of the percentage of positive SARS-CoV-2 RT-PCR tests by month and by age- groups

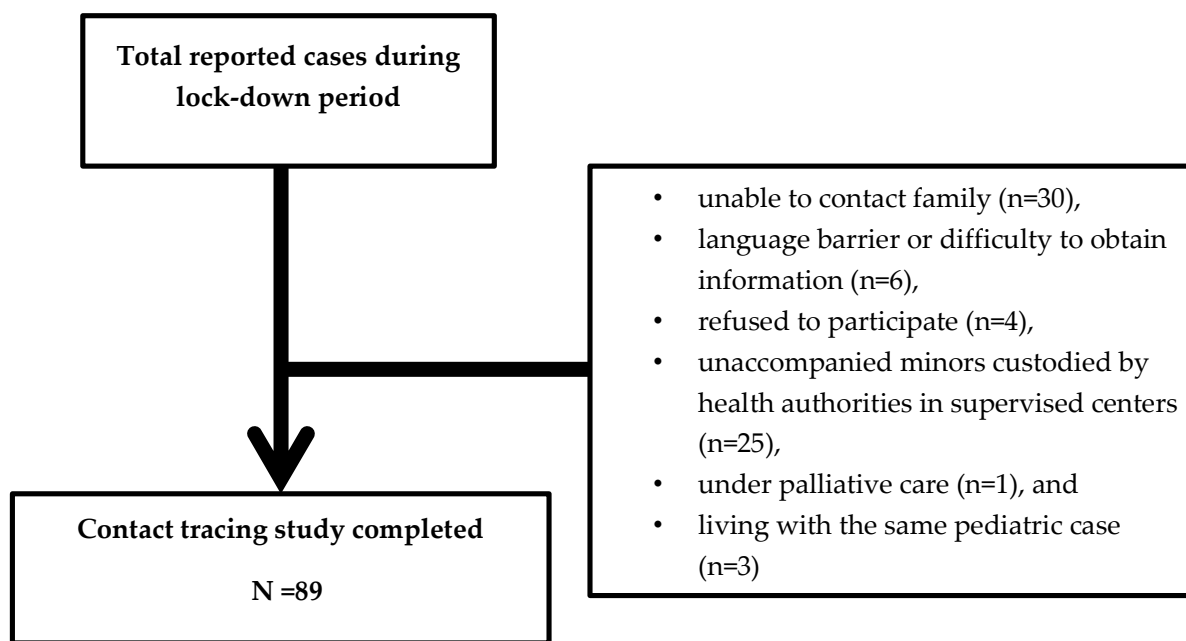


Figure 3. Flow-chart of the study analysis

Table 1. Epidemiological and clinical characteristics of included patients.

| Characteristics | Number of cases | % |
|--|-----------------|---------|
| Sex (n=158) | | |
| Male | 72 | 46.0 |
| Female | 86 | 54.0 |
| School age-group (n=158) | | |
| 0 to <3 y-old | 28 | 17.7 |
| 3 to <6y-old | 18 | 11.4 |
| 6 to <12y-old | 30 | 19.0 |
| 12 to <16y-old | 40 | 25.3 |
| 16 to <18y-old | 42 | 26.6 |
| Admission to hospital (yes) (n=158) | | |
| 0 to <3 y-old | 10 | 35.7 |
| 3 to <6y-old | 3 | 16.7 |
| 6 to <12y-old | 3 | 10.0 |
| 12 to <16y-old | 7 | 17.5 |
| 16 to <18y-old | 8 | 19.0 |
| Days of hospital stay (n=89) (median/IQR) | 5.5 | 3-12.25 |
| Admission to PICU (yes) | 5 | 5.6 |
| Symptoms (n=89) | | |
| Asymptomatic | 19 | 21.3 |
| Fever (>37.5°C) | 53 | 59.6 |
| Cough | 44 | 49.4 |
| Fatigue | 36 | 40.5 |
| Dyspnea | 28 | 31.5 |
| Diarrhea | 20 | 22.5 |
| Abdominal pain | 17 | 19.1 |
| Vomiting | 13 | 14.6 |
| Exanthema | 13 | 14.6 |
| Taste or smell alteration | 12 | 13.5 |
| Headache | 9 | 10.1 |
| Other | 11 | 12.4 |
| Comorbidities (n=89) (yes)# | 23 | 25.8 |
| Final outcome | | |
| Recovered | 83 | 93.3 |
| Sequelae* | 6 | 6.7 |

#Comorbidities associated with hospitalization: severe congenital heart disease, and chronic lung disease (not including asthma)

*Sequelae: chronic inflammatory syndrome, failure to thrive, post-COVID-19 persistent fever, dilated cardiomyopathy, persistent anosmia and dysgeusia, weight loss and anorexia

Table 2. Epidemiological and clinical characteristics of included patients.

| Variable | Median | IQR |
|---|--------|---------------------|
| Household contacts (n) | 3 | 3-4 |
| Age of the contacts (years) | 35 | 14-46 |
| | N | % |
| Sex (female) | 152 | 51.5 |
| Familiar relationship | | |
| Father | 75 | 25.4 |
| Mother | 88 | 29.8 |
| Siblings | 109 | 37.0 |
| Grandparents | 11 | 3.7 |
| Others | 12 | 4.1 |
| Symptoms (yes) | 153 | 51.9 |
| SARS-CoV-2 Serology result | | |
| Positive | 78 | 26.4 |
| Negative | 81 | 27.5 |
| Not performed | 136 | 46.1 |
| Hospitalized | 17 | 5.8 |
| Admitted to the ICU | 4 | 1.4 |
| Household contacts with a clinically or microbiologically confirmed COVID-19 diagnosis | N | % |
| Yes | 178 | 60.3 |
| No | 47 | 15.9 |
| Unknown | 70 | 23.7 |
| Case classification | N | % (CI 95%) |
| Final index case | 3* | 3.4 (0.0-7.1) |
| Co-primary case | 36 | 40.4 (30.3-50.6) |
| None of household contacts with clinical or laboratory confirmed diagnosis | 5/36 | 13.9 |
| One household contact with clinical or laboratory confirmed diagnosis | 7/36 | 19.4 |
| Two household contacts with clinical or laboratory confirmed diagnosis | 5/36 | 13.9 |
| Three household contacts with clinical or laboratory confirmed diagnosis | 5/36 | 13.9 |
| Secondary cases | 50 | 56.2 (45.9-66.5) |

*Three final index cases were: one 17-year-old boy, one 17-year-old girl, and a 5-year-old girl.

4. Discussion

The clinical impact of COVID-19 on pediatric patients in Catalonia (Spain) during confinement was low compared to adults, and most presented as mild cases. The median age of the cases was 12 years, however a third of younger children were admitted to the hospital due to a possible bias for considering them at higher risk for COVID-19 complications at the beginning of the epidemic.

Pediatric patients were classified as final index cases, and responsible for household SARS-CoV-2 transmission, in only 3.4% of the contact-traced homes which is much lower than other studies [1, 9]. In contrast, in nearly 60% of the cases the final index case was an adult. To note, about 6 out of 10 household contacts were clinically and/or microbiologically diagnosed with COVID-19, most of them with mild symptoms without hospitalization, demonstrating a high transmission rate among household contacts (data not shown).

The study has some limitations, firstly because SARS-CoV-2 RT-PCR was mostly performed only to the clinically significant cases during the study-period. Secondly, the number of cases is small diminishing the ability to detect differences when comparing transmission between index and secondary children cases. Also, there is a potential memory bias regarding symptoms and the dynamics of the transmissibility of the infection. The rate of infected contacts may have been underestimated, as not all contacts were tested for RT-PCR and some serological results from them have been unable to perform. The prospective study currently ongoing will probably overcome most of these limitations, adding information in a different epidemiological context.

With the results of our study, and as other authors reported previously, children do not appear to be the responsible for household clusters of infection and are unlikely to be the main drivers of the pandemic [10-12]. Interventions aimed at children might have a small impact on reducing SARS-CoV-2 transmission, particularly if the transmissibility of subclinical infections is low [11]. Moreover, most children with comorbidities should be allowed to go back to school, as showed in our study where only severe cardiopathies or chronic lung diseases (excluding asthma) were associated to hospitalizations. Recent results demonstrated that child-to-child transmission in schools and childcare facilities is uncommon and not the primary cause of SARS-CoV-2 infection [13, 14]. School closure seems to be an inefficient measure to contain COVID-19 disease [15]. Active surveillance is needed to confirm the safety of this approach.

Author Contributions: Conceptualization, A.S-A., and P.S-P.; methodology, A.S-A., M.C., J.R-U., U.L., E.M-C., Y.D., and P.S-P.; software, U.L., E.M-C., J.R-U., and Y.D.; validation, A.S-A., J.R-U., U.L., E.M-C., Y.D., and P.S-P.; formal analysis, J.R-U., and Y.D.; investigation, A.S-A., B.F., M.C., J.E., J.R-U., U.L., A.G., P.S., X.B., R.C., M.E., A.A., J.G-P., G.R., A.F., N.R., M.F., N.L., A.S., M.P., A.F., G.G., T.R., E.M-C., Y.D., V.P., and P.S-P.; resources, A.S-A., M.C., J.E., J.R-U., U.L., A.A., E.M-C., Y.D., V.P., and P.S-P.; data curation, A.S-A., B.F., U.L., and E.M-C.; writing—original draft preparation, A.S-A., B.F., M.C., and P.S-P.; writing—review and editing, A.S-A., B.F., M.C., J.E., J.R-U., U.L., A.G., P.S., X.B., R.C., M.E., A.A., J.G-P., G.R., A.F., N.R., M.F., N.L., A.S., M.P., A.F., G.G., T.R., E.M-C., Y.D., V.P., and P.S-P.; visualization, A.S-A., B.F., M.C., J.E., J.R-U., U.L., A.G., P.S., X.B., R.C., M.E., A.A., J.G-P., G.R., A.F., N.R., M.F., N.L., A.S., M.P., A.F., G.G., T.R., E.M-C., Y.D., V.P., and P.S-P.; supervision, A.S-A., M.C., J.R-U., and P.S-P.; project administration, A.S-A., M.C., J.E., J.R-U., U.L., E.M-C., Y.D., V.P., and P.S-P.; all authors: A.S-A., B.F., M.C., J.E., J.R-U., U.L., A.G., P.S., X.B., R.C., M.E., A.A., J.G-P., G.R., A.F., N.R., M.F., N.L., A.S., M.P., A.F., G.G., T.R., E.M-C., Y.D., V.P., and P.S-P. have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Acknowledgments: Centre Estudis Epidemiològics sobre les Infeccions de Transmissió Sexual i Sida de Catalunya: Anna Bordas, Alexis Sentis, Jordi Aceiton, Jordi Casabona; Agència de Qualitat i Avaluació Sanitàries: Lluís Martínez-López; Hospital Comarcal de l'Alt Penedès: Lluís Delgado; Consorci Sanitari Alt Penedès-Garraf: Ernesto Mónaco; Hospital de Barcelona: Carlos Herrero; Hospital CIMA de Barcelona: Isabel Casas Hospital Universitari General de Catalunya: Pere Sala, Vanessa Laveglia; Hospital Universitari Dexeus: Grisel Vilagrassa, Cristina Bonjoch; Hospital Universitari Germans Trias i Pujol: María Méndez; Hospital Universitari Josep Trueta i Hospital de Santa Caterina de Girona: Francesc Ripoll, Borja Guarch; Hospital General de Granollers: Pilar Llobet, Berta Pujol; Hospital de Igualada i Atenció Primària de l'Anoia: Isabel Zambudio; Hospital Universitari Arnau de Vilanova, Lleida: Laura Minguell, Nuria Visa Reñe, Fernando Paredes Carmona; Hospital Althaia Manresa: Zulema Lobato; Consorci Sanitari del Maresme, Hospital de Mataró: Anna Vidal, Rosario Diez; Fundació Hospital Sant Joan de Déu de Martorell: Ana Moreira, Evelyn Berbel Palau; Hospital de Nens de Barcelona: Álvaro Díaz-Conradi; Hospital d'Olot i Equip Pediàtric Territorial Garrotxa i Ripollès (EPTGiR): Ferran Campillo, Stephan Schneider; Hospital de Palamós, Serveis de Salut Integrats del Baix Empordà: Joan Manuel Torres; Hospital Sagrat Cor i Hospital Quirón Salud del Vallès: María

Milà; Hospital Clinic Maresme-Grup Creu Grogà: Víctor Sanmartín; Consorci Sanitari de Terrassa: Abel Martínez, Iris González; Hospital Mútua de Terrassa: Emiliano Mora, Tomàs Pérez-Porcuna, Roger Garcia-Puig; Consorci Corporació Sanitària Parc Taulí de Sabadell: Romina Conti; Hospital Universitari de la Santa Creu i Sant Pau: José María Valle T-Figueras; CM Teknon: Olga Martínez; Hospital Universitari Joan XXIII de Tarragona: Blanca Rosich, Arantxa Gómez; Hospital Vall D'Aran: Imma Caubet; Pius Hospital de Valls: Clara Calbet; Hospital General de Vic: Montse Ruiz García; Hospital Universitari Vall d'Hebron de Barcelona: Raisa Morales, Pepe Santos; EAP Ripollet: Ana M Moreno, Imma Bayona; Hospital de Mollet: Pilar Gussinyé; CAP Poblenou: Carlos Losana; Gran Sol Barcelona: Teresa Fenollosa; Equip Territorial de Pediatria del Garraf: Coral Moreno, Joan Azemar; SAP Osona: Silvia Burgaya; Atenció Primària Girona: Xavi Durán; Hospital de Figueres (Alt Empordà): Pili Villalobos; EAP El Carmel: Mònica Vila; ABS Eixample, Lleida: Daniel Gros Esteban, Silvia Prado Muñoz; ABS Balàfia-Pardinyes, Lleida: Gemma Terrer Manrique; ABS Pla d'Urgell (Mollerussa), Lleida: Neus Piqué Palacín, Mireia Carulla Bonjoch; CAP Montblanc: Àngels Naranjo; CAP Llibertat Reus: Olga Salvado; CAP Cambrils: Lorena Braviz; CAP Almacelles: Maria Chiné Segura; ABS Les Borges Blanques: Mireia Biosca Pàmies; ABS Cappellet Lleida: Evaristo Galdeano Borra; CAP Onze de Setembre. Lleida: Mercé Escuer Morell; ABS Rural Sud-Granadella: Raquel Plasencia Atienza; ABS Bordeta-Magraners (Lleida): Mercé Giribet Folch; CAP Sort/Hospital Pallars: Rebecca Oglesby; Hospital Quirón-Salud Barcelona: Isa Vives; Equip Territorial de Pediatria de l'Alt Penedès: Silvia Sabate Alborna, Vanesa Fernandez Diaz, Cintia Ago; CAP Can Serra Hospitalet de Llobregat: Anna M^a Ristol; CAP el Clot: Laura Dominguez; ABS Bellpuig, Lleida: Anna Castan Campanera; Corporació del Maresme i la Selva: Javier Cantero; Equip Territorial de Pediatria del Garraf: Cinta Valldepérez; Hospital Universitari San Joan de Reus: Marc García Lorenzo; EAP Salt: Laia Solé; CAP El Serral (Sant Vicenç dels Horts): Josep de la Flor.

We also want to thank the study collaborators: research technicians Ms. Ingrid Carbones, Ms. Eva del Amo; and research nurses Ms. Saida Ridaó, Ms. Montserrat García, Ms. Jenifer Davila and Ms. Cristina Montiel for their collaboration in blood extraction, samples processing and telephone interviews, and all the patients and their families for their participation in this study.

This study was carried out using anonymized data provided by the Catalan Agency for Quality and Health Assessment (AQuAS), within the framework of the PADRIS Program.

Conflicts of Interest: The authors declare no conflict of interest.

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