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Household Severe Acute Respiratory Syndrome Coronavirus 2 Transmission and Children: A Network Prospective Study

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(See the Editorial Commentary by Buonsenso and Valentini on pages e1270–2.)

Background. The role of children in household transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) remains unclear. We describe the epidemiological and clinical characteristics of children with coronavirus disease 2019 (COVID-19) in Catalonia, Spain, and investigate the household transmission dynamics.

Methods. A prospective, observational, multicenter study was performed during summer and school periods (1 July 2020–31 October 2020) to analyze epidemiological and clinical features and viral household transmission dynamics in COVID-19 patients aged <16 years. A pediatric index case was established when a child was the first individual infected. Secondary cases were defined when another household member tested positive for SARS-CoV-2 before the child. The secondary attack rate (SAR) was calculated, and logistic regression was used to assess associations between transmission risk factors and SARS-CoV-2 infection.

Results. The study included 1040 COVID-19 patients. Almost half (47.2%) were asymptomatic, 10.8% had comorbidities, and 2.6% required hospitalization. No deaths were reported. Viral transmission was common among household members (62.3%). More than 70% (756/1040) of pediatric cases were secondary to an adult, whereas 7.7% (80/1040) were index cases. The SAR was significantly lower in households with COVID-19 pediatric index cases during the school period relative to summer ($P = .02$) and compared to adults ($P = .006$). No individual or environmental risk factors associated with the SAR.

Conclusions. Children are unlikely to cause household COVID-19 clusters or be major drivers of the pandemic, even if attending school. Interventions aimed at children are expected to have a small impact on reducing SARS-CoV-2 transmission.

Keywords: coronavirus; SARS-CoV-2; child; household; transmission.

The emergence of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has led to a global public health crisis. It is essential to understand the dynamics of SARS-CoV-2 transmission in order to plan effective infection control; spread of the virus within households is known to be high [1–3]. The precise role of children in transmitting this novel coronavirus is uncertain, but it is now evident that strict measures to control the pandemic can be detrimental to a child's health and well-being [4].

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Children seem to be largely spared from the direct health effects of coronavirus disease 2019 (COVID-19). Generally, they have milder disease [5] and may be less susceptible to infection [6, 7]. Data from several countries [5, 8] have shown that children do not amplify transmission within households, schools, or the community [9, 10]. However, these studies were mainly performed during the first wave of the COVID-19 pandemic, when strict lockdown measures including school closure were adopted by most countries; hence, the results could somehow be biased [11–14]. One such example is our retrospective pilot study of all COVID-19 pediatric cases in Catalonia, Spain, that occurred during the first lockdown (10 March 2020–31 May 2020) [15]. We found that children played a small role in viral transmission among household members, but these results should be confirmed in a prospective design.

A much larger percentage of children than adults with COVID-19 are asymptomatic, and this has been proposed as a reason for their minor role in viral shedding. In a study from Wuhan, China, no secondary infections were detected among 1174 close contacts with asymptomatic pediatric cases [16]. Nonetheless, studies based on SARS-CoV-2 viral load in respiratory samples suggest that children could potentially transmit the virus in the same way as adults, even when asymptomatic [17, 18]. Therefore, more data are needed to better define the contribution of children to SARS-CoV-2 transmission so that an appropriate course of action can be designed for this age group.

On 13 March 2020, 5492 Catalonian schools with 1 565 478 students were closed in an effort to contain the spread of COVID-19 [19]. Soon after, the COVID-19 Pediatric Disease in Catalonia (COPEDI-CAT) project was launched to assess the contribution of children to transmitting the virus. In this study, our aim was to describe the epidemiological and clinical characteristics of pediatric COVID-19 cases in Catalonia and investigate the dynamics and potential role of children in household transmission during the summer break and after school initiation.

METHODS

Study Design

This is a prospective, observational, multicenter study. Between 1 July 2020 and 31 October 2020, data were collected from COVID-19 patients aged <16 years. Patients were diagnosed in the participating centers using reverse-transcription polymerase chain reaction (RT-PCR) or rapid antigen testing (PANBIO COVID-19 Ag rapid test device, Abbott). In the primary care setting in Catalonia, children are followed by a pediatrician up to the age of 16 years; hence, this age was set as the upper limit for inclusion. We followed the Strengthening the reporting of observational studies in Epidemiology (STROBE) statement for observational studies [20]. Two study periods were established, summer time (1 July–15 September) and school time (16 September–31 October) based on the markedly different epidemiological background before and after schools reopened. Nonpharmaceutical interventions were applied in all schools, including face masks in classrooms and school buildings for children aged >6 years.

Data Sources and Setting

Catalonia, an autonomous region in northeast Spain with 7.5 million inhabitants (1 581 341 aged <20 years), has a universal, publicly funded health system with 7 subregional departments and more than 400 primary healthcare centers.

Within the COPEDI-CAT project, more than 120 pediatricians from 71 primary health centers and public and private hospitals recorded the demographic, epidemiologic, clinical, and diagnostic data of pediatric COVID-19 cases. Information on the total and positive SARS-CoV-2 RT-PCR results related to eligible participants was delivered by the Catalan Agency for Quality and Health Assessment, which obtained the data from the Catalan Epidemiological Surveillance Network and the referral microbiological laboratories [21].

A questionnaire was designed and distributed to all participating pediatricians to collect clinical and microbiological information related to pediatric COVID-19 cases and their household contacts (Supplemental Material).

Study Definitions

A confirmed COVID-19 case was defined as any individual who tested SARS-CoV-2–positive by real-time RT-PCR or by antigen testing in a respiratory specimen. Viral antigen testing was only available during the last week of the study period (26–31 October 2020). To avoid selection bias in case recruitment, pediatricians recorded all positive cases seen in daily practice. However, during work overload peaks, they only collected data from the first 5 positive cases per day. Contact tracing for each COVID-19 patient aged <16 years was done by the COPEDI-CAT group. Household contacts were defined as all persons living in the same household as the first patient diagnosed, regardless of the duration or proximity of the contact. Follow-up was performed by the patient's pediatrician during a primary care visit or by telephone interview with parents or legal guardians using the dedicated questionnaire. All data were recorded in a web-based platform, Research Electronic Data Capture database.

A pediatric index case was established when a child was the first infected member in the household. The chronology of symptoms and the SARS-CoV-2 RT-PCR test date for contacts were considered surrogates that would reflect transmission dynamics. A secondary case was defined as a symptomatic household contact who tested RT-PCR–positive for SARS-CoV-2 before the child. A primary case was established when no household contacts tested SARS-CoV-2 RT-PCR–positive other than the child or when infection temporality could not be established in positive contacts. In asymptomatic patients, onset was defined as the date of specimen collection for the first positive RT-PCR.

Statistical Analyses

A descriptive analysis was performed in pediatric and adult cases identified during the 2 study periods. Bivariate tests (χ^2 and independent sample *t* tests) were used to assess differences in sociodemographic, household, and clinical characteristics between summer and school periods in index and secondary cases. The secondary attack rate (SAR) was calculated by dividing the total number of household contacts by the number of new SARS-CoV-2 infections among contacts. Univariate and multivariate logistic regression analyses were used to assess associations between transmission risk factors and SARS-CoV-2 infection in pediatric and adult index cases. For the multivariate generalized regression analysis, we selected variables representative of different potential modes of SARS-CoV-2 transmission, those that had a greater effect size on univariate analysis, and those that were significant ($P < .05$). All models were adjusted for sex, age, number of household contacts, and whether or not index cases were symptomatic.

Ethical Considerations

Ethical approval was obtained from the referral Foundation University Institute for Primary Health Care Research Jordi Gol i Gurina (IDIAP-J, Gol) Catalonia, Spain, and the coordinating center of the study, Vall d'Hebron Research Institute, Barcelona, Spain.

RESULTS

During the overall study period, 26 665 of 417 578 (6.4%) SARS-CoV-2 RT-PCRs in individuals aged <16 years tested positive.

We initially recruited 1309 of 26 665 (4.9%) COVID-19 pediatric patients. Ultimately, 1040 patients aged <16 years with complete clinical, epidemiological, and microbiological data were included (Figure 1): 547 during summer (1 July–15 September) and 493 after schools reopened (16 September–31 October). The clinical and epidemiological data (Table 1) showed no significant differences by sex, but both study periods had a higher percentage of patients aged 6–12 years (358 of 1040, 34.4%). The analysis found a median (interquartile range) of 3 (2–4) household contacts, a living area of 90 (70–110) m^2 with 3 (3–4) rooms, and smokers in 20.8% (197 of 947) of households (Table 1).

Nearly half of the pediatric cases (491 of 1040; 47.2%) were asymptomatic, with a higher rate during the school period than the summer period (51.7% vs 43.1%; $P = .006$). Most symptomatic cases (549 of 1040; 52.8%) had mild symptoms (Table 2). Overall, 10.8% (111 of 1028, information missing in 12) had some type of comorbidity, 27 children (2.6%) required hospitalization, there were no deaths, and 6 children had mainly minor sequelae: persistent fever (2), anosmia, ageusia, aphonia, and prolonged positive RT-PCR together with mesenteric lymphadenitis. Pediatric index cases were more commonly symptomatic than secondary cases (83.7% vs 47.1%; $P < .001$) during both periods (Table 3). Differences in median number of household contacts between index and secondary cases were attributable to the different ranges in the 2 groups. Otherwise, no differences regarding sex, age range, living area (m^2), presence of smokers in the household, or hospitalization requirement were found between index and secondary cases. Of note, only 5 children with comorbidities (3 preterm babies, 1 neurological abnormality, and 1 sickle cell disease and cancer) were hospitalized. There were no differences regarding the presence of symptoms or hospitalization requirement between these patients and children without comorbidities.

According to the pediatric COVID-19 case classification used, 72.7% (756 of 1040) of children were cases secondary to an adult case, and 5.0% (52 of 1040) were secondary to another child. Only 7.7% (80 of 1040) of children included were household index cases. The remaining 14.6% (152 of 1040) were primary cases; 109 (71.7%) did not transmit the infection to any of the household contacts, and we were unable to determine the directionality of the transmission in 43 (28.3%) of them. Even when schools were open, pediatric cases were much more likely to be secondary cases from household transmission rather than index cases (Table 3).

In total, 3392 household contacts were linked to the 1040 pediatric cases. Epidemiologic and clinical features are shown in Table 4. Age, family member relationships, and percentage of positive SARS-CoV-2 RT-PCRs per household according to age of the pediatric case differed significantly between summer and school periods. The median (interquartile range) of SARS-CoV-2 infections per household was 62.3% (33.3%–100.0%) with no differences between the periods. The SAR for SARS-CoV-2 infection was significantly lower in households with pediatric index cases than those with adult index cases (59.0% vs 67.6%; $P = .006$; Figure 2 and Table 5). No individual or environmental risk factors for an increased SAR were detected in pediatric index cases. Of note, the SAR was significantly lower during the school period in this group (53.0% vs 64.4%; $P = .02$). When the index case was aged <3 years, the SAR was significantly lower during the school period than in summer time (62.1% vs 33.3%; $P = .02$). We did not find any other significant differences between school and summer time for other

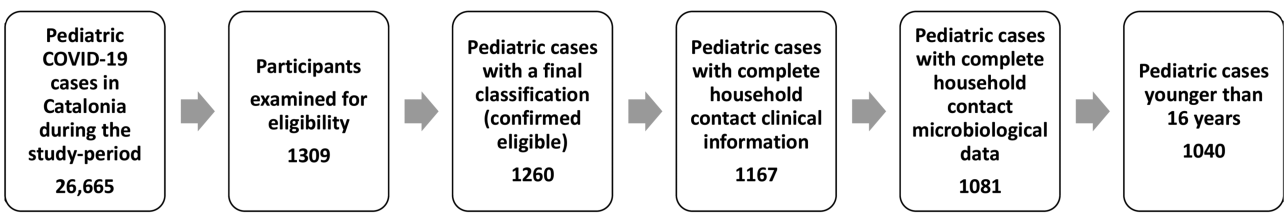

Figure 1. Study inclusions flow chart. Abbreviation: COVID-19, coronavirus disease 2019.

Table 1. Main Clinical and Epidemiological Data for Study Participants by Study Period

	Total, n = 1040		Summer Period, n = 547		School Period, n = 493	
Characteristics	Median, n	IQR, %	Median, n	IQR, %	Median, n	IQR, %
Sex						
Male	529	50.9	278	50.8	251	50.9
Female	511	49.1	269	49.2	242	49.1
Age, years						
0 to < 3	223	21.4	136	24.9	87	17.7
3 to < 6	181	17.4	106	19.4	75	15.2
6 to < 12	358	34.4	174	31.8	184	37.3
12 to < 16	278	26.7	131	23.9	147	29.8
Household contacts	3	2–4	3	2–4	3	2–4
Living area, m^2	90	70–110	90	75–110	90	70–110
Rooms, n	3	3–4	3	3–4	3	3–4
Smokers in household, yes	197	18.9	109	19.9	88	17.8
Symptoms,[a] yes	549	52.8	311	56.9	238	48.3
Admitted to hospital, yes	27	2.6	17	3.1	10	2.0
Final outcome sequelae	6	.6	4	.7	2	.4
Comorbidities, yes	111	10.7	52	9.5	59	12.0
Case classification						
Index	80	7.7	39	7.1	41	8.3
	152	14.6	73	13.3	79	16.0
Secondary to adult	756	72.7	414	75.7	342	69.4
Secondary to another child	52	5.0	21	3.8	31	6.3

Abbreviation: IQR, interquartile range.

[a] *P* value for symptoms was significantly different (.006) between summer and school periods.

age-group index cases. When the index case was an adult, the SAR was significantly higher among female or nonadult household contacts and when family size was ≤4 members (Table 5). In households with an adult index, the SAR was almost identical in the summer and school periods, (67.7% vs 67.5%, respectively).

Among the 80 pediatric index cases, 14 of them did not transmit the infection to any of the household contacts. On the contrary, among adult index cases, all of them infected at least someone else at home.

DISCUSSION

The contribution of children to spreading SARS-CoV-2 has been debated since the early days of the pandemic. In this study, we assessed the clinical and epidemiological characteristics,

Table 2. Clinical Features of Patients by Study Period

Signs and Symptoms in Children With Coronavirus Disease 2019: 1 July 2020 to 31 October 2020

	Total N = 1040	Summer Period N = 547	School Period N = 493	*P* Value
	N (%)	**N (%)**	**N (%)**	
Asymptomatic	491 (47.2)	236 (43.1)	255 (51.7)	**.006**
Symptomatic	549 (52.8)	311 (56.9)	238 (48.3)	
Fever	395 (71.9)	236 (75.6)	159 (66.5)	.017
Cough	206 (37.4)	91 (29.2)	115 (48.1)	< .001
Headache	130 (23.6)	64 (20.5)	66 (27.6)	.073
Fatigue	128 (23.2)	60 (19.2)	68 (28.4)	.018
Diarrhea	91 (16.5)	56 (18.0)	35 (14.6)	.233
Abdominal pain	72 (13.1)	44 (14.1)	28 (5.7)	.277
Vomiting	53 (9.6)	29 (9.3)	24 (11.7)	.048
Ageusia/Anosmia	45 (8.2)	28 (9.0)	17 (7.1)	.524
Skin lesions	27 (4.9)	19 (6.1)	8 (3.3)	.999
Dyspnea	26 (4.7)	9 (2.9)	17 (7.1)	.036
Others	135 (24.5)	86 (27.6)	49 (20.5)	.071

Table 3. Epidemiologic Characteristics of Pediatric Index and Secondary Cases During the 2 Study Periods

	Total		Summer Period		School Period	
Characteristics	Index Cases (n = 80) (n/%)	Secondary Cases (n = 756) (n/%)	Index Cases (n = 39) (n/%)	Secondary Cases (n = 414) (n/%)	Index Cases (n = 41) (n/%)	Secondary Cases (n = 342) (n/%)
Sex						
Male	36/45.0	385/50.9	19	205	17	180
Female	44/55.0	371/49.1	20	209	24	162
Age, years						
0 to < 3	15/18.7	155/20.5	11/28.2	95/23.0	4/9.7	60/17.5
3 to < 6	14/17.5	136/18.0	7/17.9	85/20.5	7/17.1	51/14.9
6 to < 12	27/33.8	261/34.5	12/30.8	132/31.9	15/36.6	129/37.7
12 to < 16	24/30.0	204/27.0	9/23.1	102/24.6	15/36.6	102/29.8
Household contacts, median/IQR	3/2–4	3/2–4	3/3–4.5	3/2–4	3/2–4	3/2–4
Living area, median/IQR, m^2	80/70–100	90/70–110	79/65.3–97.5	90/75–110	87.5/75–100	87/70–110
Rooms, median/IQR, n	3/3–4	3/3–4	3/3–3	3/3–4	3/3–4	3/3–4
Smokers in household, yes	20/25.0	139/18.4	13/33.3	76/18.4	7/17.1	63/18.4
Symptoms, yes	67/83.7	356/47.1	36/92.3	204/49.3	31/75.6	152/44.4
Hospital admission, yes	4/5.0	15/2.0	4/10.3	8/1.9	0/0.0	7/2.0
Final outcome sequelae	3/3.8	3/0.4	1/2.6	3/0.7	2/4.9	0/0.0
Comorbidities, yes	12/15.0	71/9.4	5/12.8	37/8.9	7/17.1	34/9.9

Abbreviation: IQR, interquartile range.

and determined viral transmission dynamics of 1040 pediatric COVID-19 cases linked to 3392 household contacts.

Most children aged <16 years had mild disease; nearly half were asymptomatic (47.2%) and very few needed hospital admission (2.6%). Children were tested as a part of the contact tracing studies within the household but also due to mass screening studies performed in the schools. In fact, asymptomatic cases were higher when the schools were open (51.7%) than in summer time (43.1%; $P = .006$), likely as a result of these mass screening studies (Table 2). Within their households, most pediatric COVID-19 cases were secondary to an adult case (72.7%). Most importantly, only 7.7% of children were

Table 4. Baseline Characteristics of Household Contacts of Children With Coronavirus Disease 2019

	Total (n = 3392)		Summer Period (n = 1766)		School Period (n = 1626)	
Characteristics	N	%	n	%	n	%
Sex						
Male	1641	48.4	840	47.6	801	49.3
Female	1750	51.6	925	52.4	825	50.7
Age, median/IQR, years	34	13–43	34	14–43	35	13–44
Family relationship						
Father	837	24.7	427	24.2	410	25.2
Mother	961	28.3	495	28.0	466	28.7
Sister/brother	1139	33.6	549	31.1	590	36.3
Grandparents	158	4.6	102	5.8	56	3.4
Others	288	8.5	188	10.6	100	6.2
Missing	9	0.3	5	0.3	4	0.2
Symptoms, yes	1386	40.9	773	43.8	613	37.7
Total positive PCRs among household contacts	2091	61.6	1100	62.3	991	60.9
Positive PCRs by household, median (IQR)	62.3	(33.3–100.0)	63.5	(33.3–100.0)	60.9	(33.3–100.0)
Positive PCRs by household and age of pediatric case, years						
0 to < 3	449	21.5	269	24.4	180	18.2
3 to < 6	395	18.9	240	21.8	155	15.6
6 to < 12	720	34.4	355	32.3	365	36.8
12 to < 16	527	25.2	236	21.5	291	29.4
Hospital admission, yes	80	2.4	48	2.7	32	2.0
Intensive care unit admission among hospitalizations, yes	3	3.7	1	2.1	2	6.2

Abbreviation: IQR, interquartile range; PCR, polymerase chain reaction.

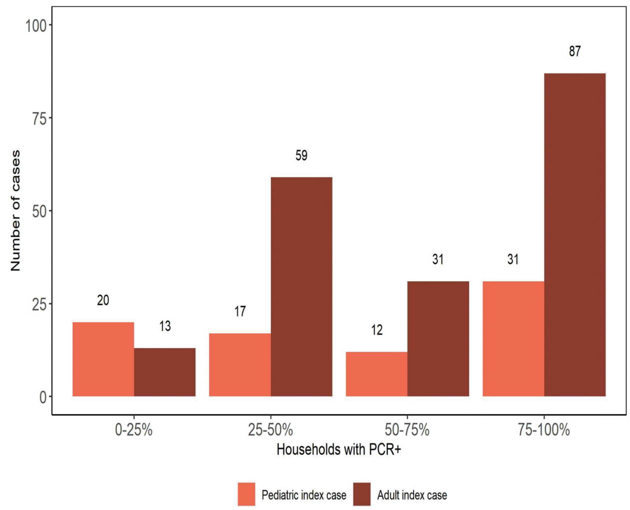

Figure 2. Percentage of positive severe acute respiratory syndrome coronavirus 2 reverse-transcription PCRs in households by age (pediatric vs adult) of the index cases. Abbreviation: PCR, polymerase chain reaction.

drivers of SARS-CoV-2 infection. COVID-19 disease spreads easily among household members; 6 of every 10 contacts tested RT-PCR–positive, but very few (2.4%) required hospitalization. The SAR was significantly lower in households where children rather than adults had transmitted SARS-CoV-2 ($P = .006$), and it was even lower during the school period, when children were expected to be more contagious because of social interaction with classmates.

The household SAR we found (62.3%) is significantly higher than values reported in studies from China (11.2%) [22], Korea (11.8%) [2], and the United States (29.0%) [23] but it is within the range found in 2 meta-analyses (4.6%–90%) [24, 25]. On stratification by age in available household studies, children were seldom the index case (4%–8%) [11, 26], a finding similar to our results (7.7%), but higher than a recent published study performed in the first wave [27]. These differences may be due to different epidemiological scenarios, with very limited childhood interactions in stronger lockdowns.

A recent systematic review concluded that children and adolescents are less susceptible to SARS-CoV-2 infection than adults, with the lowest risk in the 10- to 14-year-old group [6]. However, in the present study, the SAR was significantly higher in transmission from adult index cases to child household contacts than from adults to adult contacts ($P < .001$). This discordant finding may be attributable to the study focus on pediatric cases, with possible underestimation of the adulthood SAR.

In contrast to previous assumptions that asymptomatic COVID-19 in children is associated with silent transmission [17] or that asymptomatic index cases are associated with a lower SAR [1, 16], we found no differences in the SAR between symptomatic and asymptomatic index cases either in children or adults, even though nearly half the children included were asymptomatic. Asymptomatic pediatric cases were significantly higher during the school period than the summer period, likely because of generalized screening performed in schools ($P = .006$).

Regarding the clinical features of COVID-19, the most common symptoms described in European adults have been headache (70.3%), loss of smell (70.2%), and nasal obstruction (67.8%) [28], which contrasts with the fever (58.3%), cough (47.3%), and sore throat (18.3%) in children [29] (similar to our data). As reported, few affected children have an underlying pathology (14%–25%, mainly chronic lung disease and cardiovascular disease) [15, 29, 30], and only 2.5%–4.1% require hospitalization [30]. Again, our data support these findings. Few children had comorbidities and there were no differences regarding symptoms and hospitalization rates between those with and without comorbidities. These data reinforce the idea that no special SARS-CoV-2 preventive measures are needed for children with underlying diseases.

Overcrowding appears to be determinant in SARS-CoV-2 dissemination [31], but the risk of secondary cases was not higher in households with a larger number of members or smaller living areas. We did not record socioeconomic status; further research is needed to address the effect of poverty on pediatric SARS-CoV-2 transmission.

In Catalonia, schools were closed on 13 March2020, 2 days after the pandemic was officially declared, in order to decrease SARS-CoV-2 community transmission [19]. Most schools did not reopen until September 2020. During the summer, some sectors of our society discussed whether closing schools was the right decision, as data were emerging of low transmissibility in children [32, 33]. Some countries such as Taiwan were able to minimize SARS-CoV-2 spread without complete school closure [34]. COVID-19 modeling studies have predicted that school closure alone would prevent 2%–4% of deaths, a rate far from that achieved with other social distancing interventions [35]. Nonetheless, other studies that investigated nonpharmaceutical interventions to reduce COVID-19 highlight school closure as a major option to consider [36, 37]. However, this radical measure can have adverse consequences [38]. Closing schools interrupts learning and can lead to poor nutrition, stress, and social isolation in children [36]. Disruption of education has a significant negative impact on society as a whole and on children's health and well-being, potentially leading to inequity issues and a loss of years of life [4].

Official data from the 3 months after school reopening in Catalonia are reassuring, as viral transmission was low in schoolmates and teachers [39]. Our data confirm a milder disease course in children and show that their contribution to transmission is low during the school period, even in the high-risk household environment where (in contrast to the norm in schools) no preventive measures are adopted. These findings

Table 5. Secondary Attack Rates and Household Risk Factors for Severe Acute Respiratory Syndrome Coronavirus 2 Infection Between Pediatric and Adult Index Cases

Pediatric Index Case	Infected Cases, N	Total Contacts, N	Secondary Attack Rates, %	Odds Ratio (95% Confidence Interval)	*P* Value
General transmission rate[a]	167	283	**59.0**		
Contact sex					
Female	94	150	62.7	1.71 (.81–3.59)	.16
Male	73	133	54.9	Ref.	
Contact age, years					
<18	60	100	60.0	Ref.	
≥18	107	183	58.5	0.56 (.21–1.49)	.246
18 to 39	49	84	58.3		
40 to 65	56	97	57.7		
≥65	2	2	100		
Index case sex					
Female	89	155	57.4	0.77 (.39–1.49)	.432
Male	78	128	60.9	Ref.	
Pediatric index case age, years					
0 to <3	39	53	73.6	2.27 (.62–8.35)	.216
3 to <6	24	47	51.1	0.88 (.39–1.98)	.75
6 to <12	59	101	58.4	1.18 (.53–2.65)	.687
12 to <16	45	82	54.9	Ref.	
Index case symptoms					
Yes	150	247	60.7	1.72 (.65–4.52)	.276
No	17	36	47.2	Ref.	
Family size					
4 or fewer	67	116	57.8	0.89 (.45–1.77)	.739
More than 4	100	167	59.9	Ref.	
Relationship					
Mother	48	76	63.2	Ref.	
Father	38	65	58.5	1.44 (.6–3.47)	
Sister/brother	62	108	57.4	0.58 (.2–1.63)	.298
Grandparents	2	5	40.0	0.34 (.06–2.03)	
Other	17	29	58.6	0.88(.33–2.40)	.809
Adult Index Case	Infected Cases, N	Total Contacts, N	Secondary Attack Rates, %	Odds Ratio (95% Confidence Interval)	P Value
General transmission rate[a]	393	581	**67.6**		
Contact sex					
Female	219	304	72	**1.71 (1.13–2.57)**	**.01**
Male	174	277	62.8	Ref.	
Contact age, years					
<18	271	340	79.7	Ref.	
≥18	122	241	50.6	**0.24 (.17–0.35)**	**<.001**
18 to 39	65	121	53.7		
40 to 65	49	103	47.6		
≥65	8	17	47.1		
Index case sex					
Female	192	299	64.2	0.81 (.51–1.29)	.374
Male	201	282	71.3	Ref.	
Case age, years					
18 to 39	207	304	68.1	Ref.	
40 to 65	183	272	67.3	0.89 (.56–1.42)	.629
≥65	3	5	60	1.44 (.85–2.43)	.177
Index case symptoms					
Yes	382	565	67.6	0.75 (.14–4.07)	.738
No	11	16	68.8	Ref.	
Family size					
4 or less	218	296	73.6	**1.59 (1.02–2.49)**	**.04**
More than 4	175	285	61.4	Ref.	
Relationship					
Partner	88	164	53.7	Ref.	
Children	270	343	78.7	0.81 (.34–1.96)	
Parents/parents-in-law	14	26	53.8	1.76 (.36–8.72)	
Other	21	48	43.8	0.44 (.19–1.04)	.061

[a] *P* value = .006 in the comparison of secondary attack rate between pediatric and adult index cases. Values in bold are those statistically significant.

support the safety of keeping schools open, as proposed by the European Centre for Disease Prevention and Control [40] and the American Academy of Pediatrics in its last interim report on 5 January 2021 [41].

The prospective design, large sample, and collaborative network of pediatricians from primary health centers and hospitals add value to this study. These physicians, who recorded household cases and contact data, knew all the families included; hence, the final case classification is likely more accurate than if it had been done by external researchers.

Nonetheless, the study has limitations. First, numerous pediatricians within COPEDI-CAT registered the data simultaneously, and even with standardized recording, data entry errors can occur. We addressed this issue by ongoing double-checking and deep review of all data before analysis. Second, information on older children was limited, as primary care pediatricians only attend children aged <16 years. Adolescents aged 16–18 years who may have a major role in viral transmission were not included. Third, the index case in each cluster was defined as the person in the household who first developed symptoms or first tested RT-PCR SARS-CoV-2–positive. Therefore, the contribution of asymptomatic individuals to transmission may have been underestimated. Finally, these findings are specific to the variant distribution at the time of the study and could be different if the new SARS-CoV-2 variants shift their distribution in the future.

CONCLUSIONS

SARS-CoV-2 transmission is high among household members, but most children and young adolescents are mildly affected. Our results show that children, whether symptomatic or not, do not greatly contribute to household clusters of infection and are unlikely to be major drivers of the pandemic, even when schools are open. Interventions aimed at children are expected to have a small impact on reducing COVID-19 and should be optimized to exclude overly stringent measures that can profoundly affect the well-being of this population.

Supplementary Data

Supplementary materials are available at *Clinical Infectious Diseases* online. Consisting of data provided by the authors to benefit the reader, the posted materials are not copyedited and are the sole responsibility of the authors, so questions or comments should be addressed to the corresponding author.

Notes

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