

BMJ Open

BMJ Open is committed to open peer review. As part of this commitment we make the peer review history of every article we publish publicly available.

When an article is published we post the peer reviewers' comments and the authors' responses online. We also post the versions of the paper that were used during peer review. These are the versions that the peer review comments apply to.

The versions of the paper that follow are the versions that were submitted during the peer review process. They are not the versions of record or the final published versions. They should not be cited or distributed as the published version of this manuscript.

BMJ Open is an open access journal and the full, final, typeset and author-corrected version of record of the manuscript is available on our site with no access controls, subscription charges or pay-per-view fees (<http://bmjopen.bmj.com>).

If you have any questions on BMJ Open's open peer review process please email info.bmjopen@bmj.com

BMJ Open

Research protocol for Sentinel Schools study: Monitoring and evaluation of SARS-CoV-2 epidemic in Catalan educational settings.

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2021-055649
Article Type:	Protocol
Date Submitted by the Author:	20-Jul-2021
Complete List of Authors:	<p>Bordas, Anna; Centre for Epidemiological Studies on STD/HIV/SIDA of Catalonia</p> <p>Soriano-Arandes, Antoni; Hospital Vall d'Hebron, Pediatric Infectious Diseases and Immunodeficiencies Unit Vall d'Hebron Institut de Recerca, Universitat Autònoma de Barcelona</p> <p>Subirana, Maria; ISGlobal; Universitat Pompeu Fabra</p> <p>Malagrida, Rosina; IrsiCaixa AIDS Research Institute, Living lab for Health</p> <p>Reyes-Urueña, Juliana; Centre for Epidemiological Studies on STD/HIV/SIDA of Catalonia; CIBERESP</p> <p>Folch, C; Centre for Epidemiological Studies on STD/HIV/SIDA of Catalonia; CIBERESP</p> <p>Soler-Palacin, Pere; Hospital Vall d'Hebron, Pediatric Infectious Diseases and Immunodeficiencies Unit, Vall d'Hebron Institut de Recerca, Universitat Autònoma de Barcelona</p> <p>Gascón, Mireia; ISGlobal, Centre for International Health Research (CRESIB); Universitat Pompeu Fabra</p> <p>Sunyer, Jordi; ISGlobal, IMIM-Parc Salut Mar; Universitat Pompeu Fabra</p> <p>Anton, Andres; Institut Català de la Salut, Microbiology Department, Hospital Universitari Vall d'Hebron, Universitat Autònoma de Barcelona</p> <p>Blanco, Ignacio; Institut Català de la Salut, Microbiology Department, Laboratori Clínic Metropolitana Nord, Hospital Universitari Germans Trias i Pujol, Institut D'Investigació en Ciències de La Salut Germans Trias i Pujol (IGTP)</p> <p>Fernández-Morales, Jessica; IrsiCaixa AIDS Research Institute, Living lab for Health</p> <p>Colom-Cadena, Andreu; Centre for Epidemiological Studies on STD/HIV/SIDA of Catalonia</p> <p>Sentís, Alexis; Centre for Epidemiological Studies on STD/HIV/SIDA of Catalonia; Epiconcept SAS</p> <p>Pumarola, Tomas; Institut Català de la Salut, Microbiology Department, Hospital Universitari Vall d'Hebron, Universitat Autònoma de Barcelona</p> <p>Basora, Josep; IDIAP Jordi Gol, Direction</p> <p>Casabona, Jordi; Centre for Epidemiological Studies on STD/HIV/SIDA of Catalonia; CIBERESP</p>
Keywords:	COVID-19, Community child health < PAEDIATRICS, PUBLIC HEALTH, Epidemiology < INFECTIOUS DISEASES

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60



SCHOLARONE™
Manuscripts

1 **Research protocol for Sentinel Schools study: Monitoring and evaluation of SARS-CoV-** 2 **2 epidemic in Catalan educational settings.**

3 Anna Bordas^{1*}, Antoni Soriano-Arandes^{2*}, Maria Subirana^{3,4*}, Rosina Malagrida^{5*}, Juliana Reyes-Urueña^{1,6},
4 Cinta Folch^{1,6}, Pere Soler-Palacín², Mireia Gascón^{3,4}, Jordi Sunyer^{3,4}, Andrés Anton⁷, Ignacio Blanco⁸, Jessica
5 Fernández-Morales⁵, Andreu Colom-Cadena¹, Alexis Sentís^{1,9}, Tomàs Pumarola⁷, Josep Basora¹⁰ and Jordi
6 Casabona^{1,6}, for the Sentinel School Network Study Group of Catalonia*

7
8 ¹ Centre of epidemiological studies on sexually transmitted infections and AIDS of Catalonia (CEEISCAT). Ministry of
9 Health. Government of Catalonia. Badalona. Spain.

10 ² Pediatric Infectious Diseases and Immunodeficiencies Unit, Hospital Universitari Vall d'Hebron, Vall d'Hebron Institut
11 de Recerca, Universitat Autònoma de Barcelona, Barcelona, Spain

12 ³ Barcelona Institut for Global Health, IMIM-Parc Salut Mar, Barcelona. Spain.

13 ⁴ Universitat Pompeu Fabra (UPF), Barcelona, Spain

14 ⁵ IrsiCaixa Living Lab for Health, Badalona, Spain.

15 ⁶ Spanish Consortium for Research on Epidemiology and Public Health (CIBERESP), Instituto de Salud Carlos III, Madrid,
16 Spain.

17 ⁷ Microbiology Department, Hospital Universitari Vall d'Hebron, Institut Català de la Salut, Universitat Autònoma de
18 Barcelona, Barcelona, Spain

19 ⁸ Microbiology Department, Laboratori Clínic Metropolitana Nord, Hospital Universitari Germans Trias i Pujol, Institut
20 Català de la Salut, Institut D'Investigació en Ciències de La Salut Germans Trias i Pujol (IGTP), Badalona, Spain.

21 ⁹ Epiconcept, Epidemiology Department, Paris, France.

22 ¹⁰ Foundation University Institute for Research in Primary Health Care Jordi Gol i Gurina (IDIAP Jordi Gol), Barcelona,
23 Spain.

24
25 *Co-first authors, these authors contributed equally to this work

26 27 **Sentinel School Network Study Group of Catalonia***

28 **Principal investigators:** Jordi Casabona [Centre d'Estudis Epidemiològics sobre les Infeccions de Transmissió Sexual i
29 Sida de Catalunya (CEEISCAT)-CIBERESP], Josep Basora (Institut Universitari d'Investigació en Atenció Primària (IDIAP
30 Jordi Gol).

31 **Project manager:** Anna Bordas (CEEISCAT).

32 **Technical committee:** Jordi Casabona (CEEISCAT), Jordi Sunyer (ISGlobal), Pere Soler-Palacín (Hospital Universitari
33 Vall d'Hebron), Rosina Malagrida (Living lab for Health, IRSiCaixa) as *Work Package coordinators*. Juliana Reyes-
34 Urueña, Cinta Folch, Pol Romano, Esteve Muntada, Anna Bordas, Andreu Colom-Cadena i Jordi Casabona (CEEISCAT),
35 Mireia Gascón, Maria Subirana, Jordi Sunyer (ISGlobal), Rosina Malagrida, Jessica Fernández (Living lab for Health),
36 Antonio Soriano (Hospital Universitari Vall d'Hebron), Josep Vidal (Gerència Territorial de la Catalunya Central,
37 Institut Català de la Salut).

38 **Microbiology laboratories:** Tomàs Pumarola, Andrés Antón, Cristina Andrés, Juliana Esperalba, Albert Blanco (Hospital
39 Universitari Vall d'Hebron), Ignacio Blanco, Pere-Joan Cardona, Maria Victoria González, Gema Fernández, Cristina
40 Esteban (Hospital Universitari Germans Trias i Pujol)

41 **Data Management and statistical analysis:** Yesika Díaz, Lucia Alonso, Jordi Aceiton, Marcos Montoro (CEEISCAT).

42 **Data Protection Officer and Technical Support:** Esteve Muntada (CEEISCAT).

43 **Communication manager:** Pol Romano (CEEISCAT).

44 **Field team:** Maria Subirana (ISGlobal), Jessica Fernández (Living Lab for Health, IRSiCaixa), Andreu Colom-Cadena,
45 Isabel Martínez, Marina Herrero, Alba García, Juan Rus (CEEISCAT).

46 **Community Paediatricians:** Esperança Macià i Silvia Burgaya (CAP Manlleu), M^a Teresa Riera-Bosch, Elisabet Sola (EAP
47 Vic Nord), Lidia Aulet, Maria Mendoza, Lidia Busquets (EAP Vic Sud), Xavier Perramon, Júlia Sebastià (EAP Eixample
48 Dret), Ana Moreno (Cap Ripollet), Xavier Duran, Belen Pérez (EAP Can Gibert del Pla), Anna Gatell (Equip Territorial
49 de Pediatria Alt Penedès), Maria Coma (Hospital Universitari Joan XXIII).

1
2
3 50 **Department of Health:** Ariadna Mas (Direcció Assistencial Atenció Primària, Institut Català de la Salut), Maria Antònia
4 51 Llopis (Coordinació dels laboratoris de l'Institut Català de la Salut), Sandra Pequeño and Jacobo Mendioroz
5 52 (Subdirecció general de Vigilància i Resposta a Emergències de l'Agència de Salut Pública de Catalunya, Departament
6 53 de Salut), Carmen Cabezas (Agència de Salut Pública de Catalunya, Departament de Salut).

7
8 54

9 55 **Corresponding author:** Anna Bordas, e-mail address: abordas@igtp.cat, address: Institut de
10 56 Recerca Germans Trias i Pujol (IGTP), Edifici Muntanya, Carretera de Can Ruti, Camí de les
11 57 Escoles s/n, 08916 Badalona (Spain).

12
13 58

14
15 59 **Key words:** COVID-19, severe acute respiratory syndrome coronavirus 2, School Settings,
16 60 Sentinel Surveillance

17 18 61 **ABSTRACT**

19 20 62 **Introduction**

21 63 Since the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) became of concern in
22 64 January 2020 many preventive measures have been adopted in educational settings to ensure
23 65 the control of coronavirus disease 2019 (COVID-19) pandemic among children and staff in
24 66 schools. This study aims to set up a school sentinel surveillance network with the purpose of
25 67 monitoring SARS-CoV-2 infection, seroprevalence as well as to analyse the impact of preventive
26 68 interventions of SARS-CoV-2 in school settings. Additionally, we will assess diverse screening
27 69 strategies in a cohort of students and school staff to monitor the screening acceptance and its
28 70 potential impact. Altogether, we hope this study will enable the design of more effective
29 71 strategies for the prevention of COVID-19 spread.

30 31 72 **Methods and analysis**

32 73 The sentinel schools' study is a cross-sectional, school-based project including twenty-six
33 74 participating sentinel schools in Catalonia (Spain). Children, adolescents and staff at the schools
34 75 will be invited to participate. This project will be carried out from January, 2021 until June, 2022
35 76 as follows: i) Twice yearly serological testing and molecular SARS-CoV-2 detection and
36 77 questionnaires covering SARS-CoV-2 symptoms, tests, health, knowledge, attitudes and
37 78 behaviours; ii) An environmental evaluation carried out in different classrooms; iii) SARS-CoV-2
38 79 transmission dynamics and the impact of different variants among confirmed cases and
39 80 classmates; iv) A participatory process by which the participants are invited to act as co-
40 81 investigators to evaluate prevention strategies and provide recommendations to improve
41 82 COVID-19 prevention in schools. Descriptive analysis will be performed for the main variables
42 83 collected. The incidence and seroprevalence will be calculated and the association with socio-
43 84 demographic factors and school characteristics will be determined using multivariate logistic
44 85 regression.

45 46 86 **Ethics and dissemination**

47 87 Ethical approval was obtained from the IDIAPJGol and the Hospital Universitari Vall d'Hebron
48 88 ethics committees. A report will be generated quarterly. Findings will be disseminated at
49 89 national and international conferences and published in peer-reviewed journals.

50 51 90 **STRENGTHS AND LIMITATIONS OF THIS STUDY**

52 53 91 **Strengths**

- 54
55 92 - A multicentre study combining cross-sectional and longitudinal studies, collecting data from
56 93 sentinel schools throughout Catalonia.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

- 94 - Planned to consolidate the sentinel school surveillance network to monitor and evaluate the
- 95 epidemiology of SARS-CoV-2 in school settings and assess the effectiveness of future
- 96 preventive and control measures, new diagnostic tests or vaccination.
- 97 - Transdisciplinary and participatory research, carried out in collaboration with the education
- 98 community to ensure that the prevention and control strategy for SARS-CoV-2 fits with the
- 99 needs and expectations of schools.

100 Limitations

- 101 - The participating school-population might not be representative of the entire Catalan school
- 102 population distributed across all the territory.
- 103 - Participation in periodic screenings could be low due to fear of testing the younger children
- 104 or because of pandemic fatigue due to the large number of tests being performed.

For peer review only

112 INTRODUCTION

113 Coronavirus disease 2019 (COVID-19), first reported from Wuhan city, China in December 2019¹,
114 was declared a Public Health Emergency of International Concern by the World Health
115 Organization (WHO) on 30 January 2020 and defined as a pandemic on 11 March 2020. Although
116 children were recognized as contributing to only a small proportion of laboratory-confirmed
117 COVID-19 cases and rarely developing severe or fatal disease^{2, 3}, their role in asymptomatic
118 infection and transmission, which is well-described for other respiratory viral infections such as
119 influenza, was uncertain at the point of these restrictions and is still under discussion.

120 On the declaration of the global COVID pandemic most countries closed their schools as part of
121 their national lockdown measures^{4, 5}, with more than 1 billion children and young people
122 affected so far⁶. The closure of schools reduced the number of contacts within the population
123 and, therefore, the subsequent transmission⁵. However, this measure can also cause
124 considerable damage to children and their families with significant social and economic impacts,
125 mainly on physical and mental health. On the other hand, most evidence from countries that
126 have reopened schools or never closed them, suggests that schools have not been associated
127 with significant increases in community transmission⁷⁻¹⁰. Thus, the transmission of SARS-CoV-2
128 from paediatric patients both at home and in schools has been an intensely topic since the
129 beginning of the COVID-19 pandemic, also regarding the emergency of new variant scenarios¹¹⁻
130 ¹⁴.

131 Since Catalan schools reopened in September 2020 after 6-months of closure, there have been
132 83,911 accumulated positive COVID-19 cases, of which 74,246 were students (5.16%) and 8,996
133 school staff (5.49%)¹⁵. Likewise, a recent study that analysed the incidence dynamics of SARS-
134 CoV-2 infection in children in the first term of the school reopening shows that the infection rate
135 among children remained lower compared with the general population for pre-school (3-6
136 years) and primary pupils (6-12 years) but was equal to it or higher in secondary students (12-
137 18 years)¹⁶. Moreover, several studies have shown that in this pandemic very few cases infect
138 many contacts (super-spreaders) while most cases either infect nobody or very few people and
139 this includes paediatric index cases¹⁷⁻²¹. Defining host-related, viral and environmental patterns
140 that determine these super-spreading situations is relevant to the tailoring of measures to
141 minimize the transmission of SARS-CoV-2 in schools²².

142 Preventive interventions play an important role in working together to gain control of the
143 COVID-19 pandemic, also in schools. In this sense, the social and behavioural sciences can
144 provide valuable insights into managing the pandemic and its impacts²³. Non-pharmacological
145 preventive interventions in schools such as physical distancing, hygiene, use of masks, restricting
146 interactions to clusters of students in bubble-groups, massive microbiological testing and other
147 safety measures are essential to prevent transmission. These measures should be adapted to
148 the setting and age group and prevent transmission while providing children with an optimal
149 learning and social environment⁴. Furthermore, as it is known that SARS-CoV-2 transmission is
150 via aerosols and virus-laden aerosols may easily accumulate in indoor environments, a proper
151 ventilation of indoor spaces can be a great preventive measure. Additionally, the first set of
152 COVID-19 vaccines provided a pharmacological intervention in the last quarter of 2020 when
153 they received the authorization for emergency use by the European Medicines Agency (EMA)
154 and the Food and Drug Agency in the United States²⁴. So far, teaching and non-teaching staff
155 and population over 16 years are being vaccinated as defined in the Spanish vaccination strategy
156 raising hopes for a better control of the epidemic inside school settings. In this context, there is
157 a need to understand the epidemiology of SARS-CoV-2 in children once the adult population has
158 been vaccinated. The pandemic is moving very fast, and behaviours and attitudes may change
159 in response to the COVID-19 pandemic. Understanding the drivers of vaccine acceptance will be
160 crucial to the success of COVID-19 mass vaccination campaigns.

1
2
3 161 Therefore, the use of periodical cross-sectional surveys on the knowledge, attitude and practice
4 162 (KAP) associated with COVID-19 will allow rapid and adaptive monitoring of demographics,
5 163 preventive behaviours, knowledge, and perceptions over time, among others, and can be useful
6 164 in order to identify misinformation as they emerge.

7
8 165 This article reports the design and protocol of a school-based study in several sentinel schools
9 166 in Catalonia. The study is part of the COVID-19 monitoring and evaluation plan from the Ministry
10 167 of Health of the Government of Catalonia, and it is conceived as a participatory and
11 168 transdisciplinary research process where the students and school staff will be invited to
12 169 participate. The monitoring and evaluation provide practical information for making timely
13 170 decisions, addressing community needs, and identifying more effective strategies for the
14 171 prevention of COVID-19 spread and future infectious threats. In addition, the protocol could be
15 172 highly useful for adaption into other educational settings for the monitoring of the COVID-19
16 173 pandemic.

17
18
19 174

20 175 **GENERAL OBJECTIVES**

- 21
22
23 176 1. To describe over time the knowledge, attitudes and behaviours (KAB) of students and school
24 177 staff (teaching and non-teaching staff) towards SARS-CoV-2 infection and its prevention, as
25 178 well as its impact in school settings.
26 179 2. To assess over time the prevalence of SARS-CoV-2 infection and seroprevalence of
27 180 antibodies against SARS-CoV-2 and to identify associated sociodemographic, biological,
28 181 behavioural and environmental factors among both children and staff.
29 182 3. To identify and describe multi-level determinants, barriers and needs of SARS-CoV-2
30 183 prevention related measures in school settings over time.
31 184 4. To assess the secondary attack rate of SARS-CoV-2 children index cases and its multilevel
32 185 determinants and factors, both in school and family settings.
33 186 5. To analyse the impact of preventive and control measures on the occurrence of SARS-CoV-
34 187 2 in school settings.
35 188 6. To pilot alternative testing and screening technologies and strategies, to assess their
36 189 acceptability, feasibility and performance and the occurrence of SARS-CoV-2 infection
37 190 among students over 12 years old and school staff.
38 191 7. To analyse the impact of different SARS-CoV-2 variants' transmission in school settings.
39 192 8. To facilitate a participatory process where the education community will act as co-
40 193 researchers elaborating recommendations to improve the prevention and control measures
41 194 in the school environment.
42 195 9. To evaluate the impact on students' learning, attitudes and motivations of their
43 196 participation in the research process and the teacher's perspectives on this impact.
44 197

45 198 **METHODS AND ANALYSIS**

46 199 **Study design and Setting**

47
48
49 200 The population of Catalonia was 7,619,494 in 2019. The Catalan school system includes
50 201 1,582,466 students, 117,398 teaching staff and 5,492 school centres²⁵.

51
52
53 202 This project is based on sentinel schools defined as a network of schools representing the
54 203 diversity of schools and the scholar population in Catalonia, and chosen using the following
55 204 criteria:

- 56 205 • Volunteering/commitment of both the school management team and the teaching staff
57 206 as well as the children's parents to participate in the project

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

- 207 • Representation of schools located in the different Basic Health Areas (BHA) and
- 208 territorial areas will be ensured taking into account tertiles of SARS-CoV-2 accumulated
- 209 incidence and tertiles of socio-economic deprivation index²⁶
- 210 • Representation of schools with different characteristics:
 - 211 ○ Sociodemographic indicators. At least two-to-five high complexity schools
 - 212 characterized by low socioeconomic level and specific educational needs
 - 213 ○ Some schools located in rural areas²⁷
 - 214 ○ Schools with all levels of education, small school size and school centres with
 - 215 professional training courses
 - 216 ○ Public, charter and private schools

217 The sentinel surveillance is carried out by means of serial cross-sectional and longitudinal school-
 218 based studies, direct observation, index case study and participatory research approach in
 219 children, adolescent and school staff from the selected sentinel schools. In a subset of schools
 220 (n=5), a cohort of students from first grade of secondary school to high school (12->18 years)
 221 and school staff has been established in order to monitor the COVID-19 incidence and the
 222 feasibility and acceptability of different periodical screening practices for COVID-19
 223 confirmation. All the study interventions will be carried out in two academic years starting from
 224 January 2021 to June 2022.

225 **Study population (Inclusion criteria)**

- 226 • Students attending sentinel schools will be eligible for the study, from preschool (3-
 227 years-old) to high school (approximately 18-years-old)
- 228 • School staff of the sentinel schools, including teachers, administrators, canteen and
 229 cleaning staff, and other adults working in the educational settings such as
 230 extracurricular education instructors

231 **Informed consent**

232 Informed consent will be obtained from school staff, parents of children under 16 and pupils of
 233 16 years-old or older. Participants will be free to decline/withdraw consent at any time without
 234 providing a reason and without being subject to any resulting detriment.

235 **Study procedures**

236 Summary information of questionnaires, biological samples and other information to be
 237 collected is provided in Table 1.

238 Knowledge, attitudes and behaviours regarding COVID-19 (KAB) questionnaires and impact of 239 preventive and control measures

240 Each headteacher will send the study information pack (a study leaflet and the information
 241 sheet) and the link to the online informed consent and the baseline questionnaires by e-mail to
 242 the parents/guardians, school staff and older students (when necessary, on paper). We will send
 243 follow-up questionnaires twice a year. Three different questionnaire models will be designed:
 244 for teachers and other school staff (Questionnaire A); for students under 16, which will be
 245 answered by parents/guardian (Questionnaire B), and for students over 16 (Questionnaire C).
 246 The variables included in the KAB survey will be mainly based on the WHO recommendations,
 247 as described in WHO/Europe (2020)²⁸.

248 Prevalence of SARS-CoV-2 active infection and seroprevalence of antibodies against SARS-CoV- 249 2

250 *Cross-sectional study:* A field team (FT) made up of three nurses and a field coordinator will visit
 251 each school equipped with personal protective equipment to collect the samples for testing.

252 They will schedule the number of intervention days with each participating school depending on
 253 school size. The following samples in the baseline and the following cross sectionals (twice
 254 yearly) will be collected from all participants: i) Nasal swabs to perform a transcription-mediated
 255 amplification assay (TMA) for detection of SARS-CoV-2; ii) Finger prick blood sample to assess
 256 with a quick anti SARS-CoV-2 IgM/IgG antibody test.

257 *Longitudinal study:* Follow-up interventions will be scheduled twice yearly during the school year
 258 as an alternative testing strategy. In each intervention, the FT will collect saliva and nasal
 259 specimens for the detection of SARS-CoV-2 by molecular or antigenic tests, respectively. The
 260 cohort participants will fill in an additional online epidemiological survey with information
 261 related to SARS-CoV-2 infection, their symptomatology, exposure and vaccine status.

262 Secondary attack rate and SARS-CoV-2 variants

263 This part of the study will be carried by the Paediatric Infectious Diseases and
 264 Immunodeficiencies Unit at Hospital Universitari Vall d'Hebron (HUVH). Data on COVID-19 index
 265 cases will be collected with appropriate social and geographical distribution. These cases will be
 266 detected by the routine data provided by the Catalan Public Health Department or detected
 267 during the study interventions and analysed in depth from then on. Data on demographic, social
 268 and clinical features, vaccination status, comorbidities and clinical outcome will be collected.
 269 School and household contacts will also be studied in depth to detect secondary cases. Samples
 270 from the index case and all COVID-19 confirmed contacts will be sequenced using whole genome
 271 sequencing (WGS) following the ARTIC Network protocol²⁹ for the characterization of SARS-CoV-
 272 2 (lineage and mutations), molecular tracing of sequences, and measurement of the viral load
 273 in these respiratory samples to assess its role in the transmission dynamics.

274 Environmental determinants and barriers

275 The environmental evaluation will be carried out by the ISGlobal team to obtain information on
 276 the structural characteristics of each participating sentinel school, ventilation practices and
 277 other environmental prevention measures using the KKmoon carbon dioxide detector device.
 278 This intervention will include: i) A structural evaluation by a field technician in at least one
 279 classroom for each grade; ii) Online twice yearly surveys addressed to teachers and
 280 headteachers regarding ventilation and other prevention practices; iii) Twice yearly 15-day
 281 assessment of CO₂, temperature and humidity – seven days assessed by the field technician and
 282 the remainder as an experimenting tool for students – in 5 to 8 previously chosen classrooms.

283 Participatory research

284 The project is conceived as a collaborative and transdisciplinary research project where the
 285 education community and families participate in different phases of the research process. They
 286 will act as co-researchers evaluating the prevention and control measure implementation of
 287 SARS-CoV-2 infection in the school environment with a systemic perspective, as well as
 288 elaborating their recommendations to improve the prevention and control strategy. This
 289 approach will be implemented in collaboration with the EC funded project CONNECT, which aims
 290 to improve science learning and increase students' motivation towards science careers by
 291 engaging schools, scientists and families to solve local challenges.

292 Participation will entail discussion groups: i) Online focus groups with teachers. Preliminary
 293 results of the bio-behavioural surveys will be shared and, based on these, they will be invited to
 294 analyse problems, opportunities and needs, and to develop proposals for improvement of
 295 prevention measures following a protocol; ii) Teachers conducting focus groups with their class-
 296 group students and then families, reproducing a similar protocol; iii) The edited list of
 297 recommendations will be presented by students to scientists and policy makers in an online
 298 conference; iv) Elaboration of the final list of recommendations; v) Capital science survey: a pre-

1
2
3 299 and post-intervention survey addressed to pupils regarding the science learning and students'
4 300 attitudes and motivation, and a pre- and post-intervention survey addressed to teachers
5 301 regarding the education process.

6
7 302

8
9 303 Sample management, microbiological analysis and test result communication

10 304 As described above, diverse biological samples will be collected during the study.

11
12 305 The finger prick blood collected at the baseline and the follow-up will be processed at the time
13 306 of collection to perform a quick SARS-CoV-2 serological test (COVID-19 IgG/IgM Rapid Test Kit,
14 307 Lambra, Spain) with sensitivities of 97,2% (IgG) and 87,9% (IgM), and specificities of 100% for
15 308 both immunoglobulins as the manufacturers describe. This approach will be used to assess the
16 309 exposure to SARS-CoV-2 infection or vaccination by the presence of antibodies. In addition, the
17 310 nasal swab sample collected in the longitudinal study will be processed at the time of collection
18 311 for detection of SARS-CoV-2 antigen using the Panbio COVID-19 Ag Rapid Test (Abbot, USA) with
19 312 a sensitivity of 93.3% (95% CI: 83.8-98.2%) and specificity of 99.4% (95% CI: 97.0-100%) as the
20 313 manufacturers describe. The nursing team will upload the rapid test results on an online
21 314 research database using electronic tablets. These results will be introduced afterwards to the
22 315 electronic health record of all participants, who will be able to consult them in the online patient
23 316 health portal (La Meva Salut app). In case of Ag positive with IgG negative, the COVID-school
24 317 manager, a new sanitary staff role acting as a liaison between the primary care team and the
25 318 school centres, will activate the public health protocol established by the Catalan Ministry of
26 319 Health³⁰.

27
28
29
30 320 Nasal swabs and saliva samples will be maintained at 4°C during sampling procedures and
31 321 transport to laboratory facilities. A molecular assay based on the transcription mediated
32 322 amplification assay (Procleix SARS-CoV-2, Grifols) will be conducted in HUVH for detection of
33 323 SARS-CoV-2 in nasal swabs, and RT-PCR assay (Allplex SARS-CoV-2/FluA/FluB/RSV, Werfen) will
34 324 be conducted at the Hospital Universitari Germans Trias i Pujol (HUGTiP) laboratories to
35 325 determine SARS-CoV-2 infection in saliva specimens. If the TMA assay (HUVH) or RT-PCR assay
36 326 (HUGTiP) is positive, an active infection will be confirmed. Once the nasal samples have been
37 327 tested, all positive specimens will be stored in sample collection C.0001145 on the *Instituto de*
38 328 *Salud Carlos III* register. On the other hand, saliva samples with positive SARS-CoV-2 results will
39 329 be frozen and stored at the IGTP-HUGTiP Biobank and conserved for two years. TMA/PCR results
40 330 will be uploaded by the microbiology laboratories to the electronic health record, and the
41 331 participants and their general practitioners or paediatricians will be able to check them.

42
43
44 332 Regarding the transmissibility study, nasopharyngeal or nasal swab samples from index cases
45 333 and positive secondary cases will be sent to the HUVH laboratory for genetic SARS-CoV-2
46 334 characterisation, to measure the viral load and to detect other respiratory viruses. The genetic
47 335 characterisation of SARS-CoV-2 will be performed through WGS according to the ARTIC Network
48 336 protocol²⁹ by using MiSeq and NextSeq 2000 platforms (Illumina, CA, USA). Other respiratory
49 337 viruses will be detected by a real-time multiplex RT-PCR assay (Allplex Respiratory Panel Assay,
50 338 Seegene); total nucleic acids will be extracted using NucliSENS EasyMAG (bioMérieux, Marcy
51 339 l'Etoile, France) or Microlab STARlet System (Hamilton, CA, USA) according to the
52 340 manufacturer's instructions. Additionally, to measure the SARS-CoV-2 viral load, an in-house
53 341 quantitative RT-PCR assay using the primer/probe set targeting the nucleocapsid protein (N1)
54 342 and the human RNase P (housekeeping gene) from the CDC 2019-nCoV Real-Time RT-PCR
55 343 Diagnostic Panel will be carried out. The Ct values of the viral target will be normalized to a
56 344 housekeeping gene based on the Δ Ct method (Ct_{sample} - Ct_{housekeeping gene}) in order to
57 345 minimize the variations due to the non-standardized collection of a heterogenous specimens.

346 **Data management, data protection and patient confidentiality**

347 Informed consents and the different surveys will be designed and published by means of the
348 EUSurvey management system, an official online survey management tool of the European
349 Commission. For those participants for whom online access is not possible, printed surveys will
350 be distributed by the field team and afterwards digitalized. The periodical surveys from the
351 cohort study will be published by means of the OpenTIC software.

352 After giving their consent to participate (or allow their child to participate), each participant will
353 be allocated a unique participant ID number on enrolment to the study. This unique identifier
354 will serve as a link to all the data needed for the study (questioners, biological samples). The file
355 that relates the identifier or pseudonym to the personally identifiable data will be encrypted
356 and the access to this file will be restricted to a very small number of authorized persons (EM,
357 YD, JA, LA). The process will comply with the General Data Protection Regulation (GDPR)
358 requirements.

359 **Study definitions:**

360 Given that all the participants attending the school should be asymptomatic, a confirmed COVID-
361 19 case will be defined as any individual testing SARS-CoV-2 positive by molecular assays (PCR
362 or TMA-based) or COVID-19 Ag Rapid Test (RAT) in a respiratory or saliva specimen³¹.

363 A paediatric index case will be established when the child is the first confirmed COVID-19 case
364 in the classroom noticed by health authorities or the research team²¹. A secondary case will be
365 defined as a classmate or household contact subsequently testing positive for SARS-CoV-2 by
366 molecular assay or RAT. Close contacts will be defined as all people who have shared space with
367 a positive COVID-19 less than 2 metres away, for more than 15 minutes, without protection and
368 from the 48 hours prior to the onset of symptoms. If the positive person has not had symptoms,
369 onset will be defined as the date of performing the diagnostic test.

370 **Variables collected**

- 371 i) Individual data
- 372 • Sociodemographic and socioeconomic indicators: age, gender, ethnic origin,
373 household and career, economic status, job situation of their parents in the case of
374 pupils
 - 375 • Clinical data and infection by SARS-CoV-2: symptoms, hospitalization, exposure,
376 contact with positive cases
 - 377 • Attitude, behaviour and knowledge regarding COVID-19 and preventive measures
 - 378 • Pandemic impact indicators such as changes on mental and physic health and the
379 purchasing power of parents and school staff
 - 380 • Vaccination data: manufacturer, number of doses, date of doses, refusal to
381 vaccinate (date and reason)
 - 382 • Attitude and usability of focus groups regarding scientific contribution
- 383 ii) Collective data
- 384 Number of classrooms, number of tables/classroom, number of pupils/m², school
385 surface, schoolyard surface, concentration of CO₂, temperature and humidity in the
386 classrooms.
- 387 iii) Ecological data
- 388 These data will be collected and provided by the Primary Care Services Information
389 System (SISAP) and the Data analytics program for health research and innovation
390 (PADRIS) and will include data from different data sources in order to obtain the
391 information mentioned below:

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

- 392 • Number of new COVID-19 confirmed cases or tested positive for SARS-CoV-2 by
393 TMA/PCR or RAT /total of residents.
- 394 • Number of new COVID-19 confirmed cases or tested positive for SARS-CoV-2 by
395 TMA/PCR or RAT/total of tested people.
- 396 • Number of new COVID-19 confirmed cases or tested positive for SARS-CoV-2 by
397 TMA/PCR or RAT/total of suspected cases.
- 398 • Number of confined classrooms/total number of classrooms.

399 **Data analysis plan and sample size**

400 We estimate a 70% participation among the total of 11,000 individuals who are on the census
401 at the 26 sentinel schools. A descriptive analysis will be performed for all the main
402 aforementioned variables collected: participant's sociodemographic characteristics, SARS-CoV-
403 2 infection characterization, its associated factors, behaviour information and other outcomes
404 of interest. For quantitative variables, we will use measures of central tendency and dispersion
405 (mean, standard deviation, median, interquartile range, 95% confidence interval). For
406 qualitative variables, we will calculate absolute frequencies and percentages. To estimate the
407 statistical significance of time trends in SARS-CoV-2 laboratory confirmed cases we will use
408 multivariate logistic regression analysis with robust standard errors clustered at the individual-
409 level and school-level, adjusting for sociodemographic, environmental and school structural
410 variables.

411 In order to address the fourth objective related to the transmissibility study, a descriptive
412 analysis will be performed for all cases and contacts identified in school clusters. Analyses will
413 include chi-square and independent sample t-test procedures to assess differences between
414 super-spreaders and non-spreaders for index cases and secondary cases using socio-
415 demographics, number of classmates and household contacts, clinical and environmental
416 variables. Finally, we will use univariate and multivariate logistic regression models to assess the
417 association between transmission risk factors and SARS-CoV-2 infection among index cases and
418 close contacts. All models will be adjusted for gender, age, vaccination status, number of
419 classmates, and household contacts and whether or not the index cases are symptomatic.

420 Global data on the COVID-19 epidemic in Catalonia and the school basic health area (BHA) will
421 be collected to contextualize the current epidemic situation. Data will be provided globally and
422 stratified by age groups and collectives. This data will be provided by the Catalan Agency for
423 Quality and Health Assessment (AQuAS) and SISAP. Analysis of the interrupted time series of
424 SARS-CoV-2 seroprevalence and COVID-19 confirmed cases will be performed to assess the
425 public health implemented measures including vaccination programmes. The confirmed cases
426 will be modelled as ARIMA processes to estimate the expected numbers to be compared to
427 those observed and estimate the impact of the different analysed measures, to do this we will
428 calculate absolute and relative changes between expected-observed confirmed cases in each
429 time point of the implemented measures. Analysis will be conducted in R (R Core Team, 2014).

430

431 **ETHICS AND DISSEMINATION**

432 The ethical aspects of the present study include:

- 433 • Recruitment of participants with informed consent
- 434 • Collection and storage of biological samples
- 435 • Questionnaires with non-anonymized data
- 436 • Collection and storage of personal data

437 The confidentiality of data and other ethical considerations will be managed in accordance with
438 the recommendations of the Spanish Law 14/2007 of 3 July, on Biomedical Research and the

1
2
3 439 Spanish Royal Decree RD 1716/2011 of 18 November, which lays down the basic requirements
4 440 for the authorisation and operation of biobanks for purposes of Biomedical Research and the
5 441 treatment of biological samples of human origin. Informed consent is required for this project
6 442 as is established in article 59 of the law.

8 443 The necessary measures will be taken to ensure the protection of personal data and their
9 444 confidentiality, in accordance with EU Regulation 2016/679 of the European Parliament and of
10 445 the Council of 27 April 2016 on the protection of natural persons with regard to the processing
11 446 of personal data and on the free movement of such data (RGPD), and in the Spanish Organic Law
12 447 3/2018 of 5 December, for the protection of personal data and Guarantee of digital rights (LOPD-
13 448 GDD).

15 449 The data protection office of the Ministry of Health of the Government of Catalonia has reached
16 450 an agreement signed by all the organizations in the research team to align with all the ethical
17 451 considerations mentioned above and recommended by the same office.

19 452 The data and results provided by this project will be valuable in the current context of the public
20 453 health emergency of international concern declared by the WHO for the COVID-19 pandemic
21 454 and taking into account the urgent need for information coming from COVID-19 studies.

23 455 The CEEISCAT research team will generate a quarterly report with qualitative and quantitative
24 456 data to give feedback to the stakeholders. Findings from this study will be disseminated at
25 457 national and international conferences, reported on the public webpage of the project and
26 458 published in peer-reviewed journals.

28
29 459

30 460 **Study registration**

32 461 Ethical approval was obtained from the Foundation University Institute for Research in Primary
33 462 Health Care Jordi Gol i Gurina (IDIAPJGol) ethics committee with code 20/192-PCV on 17
34 463 December 2020 and the Hospital Universitari Vall d'Hebron ethics committee with code
35 464 PR(AMI)668/2020.

37 465

39 466 **AUTHORS' CONTRIBUTIONS**

41 467 All authors have read, reviewed and agreed to the finalized submitted version of the manuscript.
42 468 Conceptualisation: JC. Design study: JC, CF, AS, AB, JR, JS, PS, AS and MG. Operational procedures: JC, JR,
43 469 AB, CF, AC, JS, MG, AA, TP, IB, JF, RM, PS, AS, and JB. Resources: RF, JM, JMA, CC and JB. Writing and draft
44 470 preparation: AB, CF, AC. Writing, review and edition; all authors.

45
46 471

47 472 **FUNDING STATEMENT**

49 473 This work will be supported by Ministry of Health from Government of Catalonia with no grant
50 474 number. This funding source had no role in the design of this study and will not have any role
51 475 during its execution, analyses, interpretation of the data or decision to submit result.

53 476

55 477 **COMPETING INTEREST STATEMENT**

57 478 All of the authors declare that they have no conflicts of interest.

59 479
60

1
2
3 480 **PATIENT AND PUBLIC INVOLVEMENT**

4
5 481 No patient involved

6
7 482

8 483 **REFERENCES**

9
10
11 484 1 Emergencies preparedness, response. Novel Coronavirus – Republic of Korea (ex-China).
12 485 Available at: [https://www.who.int/csr/don/21-january-2020-novel-coronavirus-republic-of-](https://www.who.int/csr/don/21-january-2020-novel-coronavirus-republic-of-korea-ex-china/en/)
13 486 [korea-ex-china/en/](https://www.who.int/csr/don/21-january-2020-novel-coronavirus-republic-of-korea-ex-china/en/). Accessed December/17, 2020.

14
15 487 2 Pollán M, Pérez-Gómez B, Pastor-Barriuso R, et al. Prevalence of SARS-CoV-2 in Spain (ENE-
16 488 COVID): a nationwide, population-based seroepidemiological study. *Lancet* 2020;396:535-44
17 489 doi:S0140-6736(20)31483-5 [pii].

18
19
20 490 3 Hildenwall H, Luthander J, Rhedin S, et al. Paediatric COVID-19 admissions in a region with
21 491 open schools during the two first months of the pandemic. *Acta Paediatr* 2020;109:2152-4
22 492 doi:10.1111/apa.15432 [doi].

23
24 493 4 COVID-19 in children and the role of school settings in COVID-19 transmission, 6 August
25 494 2020. Stockholm: ECDC, 2020.

26
27
28 495 5 Viner RM, Russell SJ, Croker H, et al. School closure and management practices during
29 496 coronavirus outbreaks including COVID-19: a rapid systematic review. *Lancet Child Adolesc*
30 497 *Health* 2020;4:397-404 doi:S2352-4642(20)30095-X [pii].

31
32 498 6 United Nations Educational, Scientific and Cultural Organization (UNESCO). Education: From
33 499 disruption to recovery. Available at: <https://en.unesco.org/covid19/educationresponse>.
34 500 Accessed January 3, 2020.

35
36
37 501 7 Organization WH. Considerations for school-related public health measures in the context of
38 502 COVID-19: annex to considerations in adjusting public health and social measures in the
39 503 context of COVID-19, 10 May 2020 2020:6 p.

40
41 504 8 Macartney K, Quinn HE, Pillsbury AJ, et al. Transmission of SARS-CoV-2 in Australian
42 505 educational settings: a prospective cohort study. *Lancet Child Adolesc Health* 2020;4:807-16
43 506 doi:S2352-4642(20)30251-0 [pii].

44
45
46 507 9 Brandal LT, Ofitserova TS, Meijerink H, et al. Minimal transmission of SARS-CoV-2 from
47 508 paediatric COVID-19 cases in primary schools, Norway, August to November 2020. *Euro Surveill*
48 509 2021;26:2002011. doi: 10.2807/1560,7917.ES.2020.26.1.2002011 doi:10.2807/1560-
49 510 7917.ES.2020.26.1.2002011 [doi].

50
51 511 10 Zimmerman KO, Akinboyo IC, Brookhart MA, et al. Incidence and Secondary Transmission of
52 512 SARS-CoV-2 Infections in Schools. *Pediatrics* 2021;147:e2020048090. doi: 10.1542/peds.2020-
53 513 048090 doi:10.1542/peds.2020-048090 [doi].

54
55
56 514 11 Esposito S, Principi N. School Closure During the Coronavirus Disease 2019 (COVID-19)
57 515 Pandemic: An Effective Intervention at the Global Level?. *JAMA Pediatr* 2020;174:921-2
58 516 doi:10.1001/jamapediatrics.2020.1892 [doi].

- 1
2
3 517 12 Posfay-Barbe KM, Wagner N, Gauthey M, et al. COVID-19 in Children and the Dynamics of
4 518 Infection in Families. *Pediatrics* 2020;146:e20201576. doi: 10.1542/peds.2020,1576. Epub
5 519 2020 May 26 doi:e20201576 [pii].
6
7 520 13 Lee B, Raszka WV, Jr. COVID-19 Transmission and Children: The Child Is Not to Blame.
8 521 *Pediatrics* 2020;146:e2020004879. doi: 10.1542/peds.2020,004879. Epub 2020 May 26
9 522 doi:e2020004879 [pii].
10
11
12 523 14 Somekh E, Gleyzer A, Heller E, et al. The Role of Children in the Dynamics of Intra Family
13 524 Coronavirus 2019 Spread in Densely Populated Area. *Pediatr Infect Dis J* 2020;39:e202-4
14 525 doi:10.1097/INF.0000000000002783 [doi].
15
16 526 15 Dades sobre la covid-19 als centres educatius. Traçacovid. Available at:
17 527 <http://educacio.gencat.cat/ca/actualitat/escolasegura/tracacovid/dades-covid19-centres/#/>.
18
19
20 528 16 Perramon A, Soriano-Arandes A, Pino D, et al. Epidemiological dynamics of the incidence of
21 529 COVID-19 in children and the relationship with the opening of schools in Catalonia (Spain).
22 530 *medRxiv* 2021 doi:10.1101/2021.02.15.21251781.
23
24 531 17 Zhang J, Litvinova M, Liang Y, et al. Changes in contact patterns shape the dynamics of the
25 532 COVID-19 outbreak in China. *Science* 2020;368:1481-6 doi:10.1126/science.abb8001 [doi].
26
27
28 533 18 Mizumoto K, Omori R, Nishiura H. Age specificity of cases and attack rate of novel
29 534 coronavirus disease (COVID-19). *medRxiv* 2020 doi:10.1101/2020.03.09.20033142.
30
31 535 19 Bi Q, Wu Y, Mei S, et al. Epidemiology and transmission of COVID-19 in 391 cases and 1286
32 536 of their close contacts in Shenzhen, China: a retrospective cohort study. *Lancet Infect Dis*
33 537 2020;20:911-9 doi:S1473-3099(20)30287-5 [pii].
34
35
36 538 20 Heavey L, Casey G, Kelly C, et al. No evidence of secondary transmission of COVID-19 from
37 539 children attending school in Ireland, 2020. *Euro Surveill* 2020;25:2000903. doi: 10.2807/1560
38 540 doi:10.2807/1560-7917.ES.2020.25.21.2000903 [doi].
39
40 541 21 Soriano-Arandes A, Gatell A, Serrano P, et al. Household SARS-CoV-2 transmission and
41 542 children: a network prospective study. *Clin Infect Dis* 2021 doi:10.1093/cid/ciab228 [doi].
42
43 543 22 COVID-19. IFRC, UNICEF and WHO issue guidance to protect children and support safe
44 544 school operations. Geneva: World Health Organization. Available at:
45 545 [https://www.unicef.org/press-releases/covid-19-ifrc-unicef-and-who-issue-guidance-protect-](https://www.unicef.org/press-releases/covid-19-ifrc-unicef-and-who-issue-guidance-protect-children-and-support-safe-school)
46 546 [children-and-support-safe-school](https://www.unicef.org/press-releases/covid-19-ifrc-unicef-and-who-issue-guidance-protect-children-and-support-safe-school). Accessed May 26, 2020.
47
48
49 547 23 Bavel JJV, Baicker K, Boggio PS, et al. Using social and behavioural science to support
50 548 COVID-19 pandemic response. *Nat Hum Behav* 2020;4:460-71 doi:10.1038/s41562-020-0884-z
51 549 [doi].
52
53 550 24 COVID-19 vaccines. Available at: [https://www.ema.europa.eu/en/human-](https://www.ema.europa.eu/en/human-regulatory/overview/public-health-threats/coronavirus-disease-covid-19/treatments-vaccines/vaccines-covid-19/)
54 551 [regulatory/overview/public-health-threats/coronavirus-disease-covid-19/treatments-](https://www.ema.europa.eu/en/human-regulatory/overview/public-health-threats/coronavirus-disease-covid-19/treatments-vaccines/vaccines-covid-19/)
55 552 [vaccines/vaccines-covid-19/](https://www.ema.europa.eu/en/human-regulatory/overview/public-health-threats/coronavirus-disease-covid-19/treatments-vaccines/vaccines-covid-19/). Accessed April 14, 2021.
56
57
58 553 25 Alumnes i professors. Per nivells educatius. Available at:
59 554 <https://www.idescat.cat/pub/?id=aec&n=734>. Accessed March 1, 2021.

- 1
2
3 555 26 Colls C, Mias M, García-Altés A. Un índice de privación para reformar el modelo de
4 556 financiación de la atención primaria en Cataluña. *Gaceta Sanitaria* 2020;34:44-50
5 557 doi:<https://doi.org/10.1016/j.gaceta.2018.07.015>.
6
7
8 558 27 Domínguez i Amorós M, Monllor i Rico, N and Simó i Solsona, M. Món rural i joves. Realitat
9 559 juvenil i polítiques de joventut als municipis rurals de Catalunya 2010.
10
11 560 28 World Health Organization Europe. Monitoring knowledge, risk perceptions, preventive
12 561 behaviours and trust to inform pandemic outbreak response 2020.
13
14 562 29 ARTIC Network Protocol. Available at: [https://www.protocols.io/view/ncov-2019-](https://www.protocols.io/view/ncov-2019-sequencing-protocol-v3-locost-bh42j8ye)
15 563 [sequencing-protocol-v3-locost-bh42j8ye](https://www.protocols.io/view/ncov-2019-sequencing-protocol-v3-locost-bh42j8ye).
16
17
18 564 30 Gestió de casos de COVID-19 als centres educatius. Available at:
19 565 [https://canalsalut.gencat.cat/web/shared/continguts_per_compartir/ENS/salut-](https://canalsalut.gencat.cat/web/shared/continguts_per_compartir/ENS/salut-escola/documentacio/escoles/gestio-casos-centres-educatius.pdf)
20 566 [escola/documentacio/escoles/gestio-casos-centres-educatius.pdf](https://canalsalut.gencat.cat/web/shared/continguts_per_compartir/ENS/salut-escola/documentacio/escoles/gestio-casos-centres-educatius.pdf).
21
22 567 31 Case definition. Available at: [https://www.ecdc.europa.eu/en/covid-19/surveillance/case-](https://www.ecdc.europa.eu/en/covid-19/surveillance/case-definition)
23 568 [definition](https://www.ecdc.europa.eu/en/covid-19/surveillance/case-definition). Accessed 05/01, 2021.
24
25
26 569

27 570 **ACKNOWLEDGMENTS**

29 571 The authors thank the Ministries of Health and Education, Government of Catalonia (Spain), the
30 572 Direcció General de Recerca i Innovació en Salut (DGRIS), Sub direction of Public Health and
31 573 Institut Català de la Salut (ICS), Josep G. Cambray, Head of Education Department and all the
32 574 health care professionals acting as a COVID-19 pandemic health taskforce in Catalonia for
33 575 making this project possible.
34

35 576
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

577 **Table 1. Summary information of study procedures.**

Type of intervention	Determination	Type of Test	Coordination	Frequency
Bio-behavioural questionnaires			CEEISCAT	
- Questionnaire A (teaching and non-teaching staff) - Questionnaire B (parents or foster parents of students under 16 years old) - Questionnaire C (16-years-old or older students)				Once during 2020-2021 school year and twice during 2021-2022 school year
Biological sampling			CEEISCAT	
Baseline - Blood from finger prick - Nasal swab sample	Ab anti-SARS-CoV-2 Viral RNA (SARS-CoV-2)	LFA TMA		Once during 2020-2021 school year and twice during 2021-2022 school year
Longitudinal study (> 1st grade of middle school and school staff) - Saliva sample - Nasal swab sample	Viral RNA (SARS-CoV-2) SARS-CoV-2 Ag rapid test	RT-PCR LFA		Bi-monthly
Environmental and structural evaluation in each sentinel school			ISGlobal	
- Environmental questionnaires (Directors and teachers) - Structural and environmental evaluation by a field technician - CO ₂ , humidity and temperature measurements	Prevention measures (e.g. ventilation practices)			Once during 2020-2021 school year and twice during 2021-2022 school year
Transmissibility study			HUVH	
- COVID-19 index cases - Household and classmate contacts evaluation - Secondary attack rate	Viral coinfections Viral RNA (SARS-CoV-2) SARS-CoV-2 characterisations Viral load measurement	RT-PCR TMA/PCR Whole genome sequencing Quantitative PCR assay		
Participatory research			Living lab (IRSIcaixa)	
- Scientific capital surveys - Focus groups - List of recommendations - Annual school conference				Once during 2020-2021 school year and twice during 2021-2022 school year

578 Ab: antibodies; Ag: antigens; LFA: Lateral flow assay; TMA: Transcription mediated amplification assay

579

580

581

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1-2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	6-7
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	9-10
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-8
Bias	9	Describe any efforts to address potential sources of bias	NA
Study size	10	Explain how the study size was arrived at	5-6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	10
		(b) Describe any methods used to examine subgroups and interactions	10
		(c) Explain how missing data were addressed	NA
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	10
		(e) Describe any sensitivity analyses	NA

Continued on next page

Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	NA
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	NA
		(b) Indicate number of participants with missing data for each variable of interest	NA
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	NA
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	NA
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	NA
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	NA
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	NA
		(b) Report category boundaries when continuous variables were categorized	NA
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	NA
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	NA
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	NA
Generalisability	21	Discuss the generalisability (external validity) of the study results	NA
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	14

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Study protocol for monitoring SARS-CoV-2 infection and its determinants in Catalonia (Spain): an observational and participatory research approach in a Sentinel Network of Schools.

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2021-055649.R1
Article Type:	Protocol
Date Submitted by the Author:	30-Nov-2021
Complete List of Authors:	<p>Bordas, Anna; Centre for Epidemiological Studies on STD/HIV/SIDA of Catalonia</p> <p>Soriano-Arandes, Antoni; Hospital Vall d'Hebron, Pediatric Infectious Diseases and Immunodeficiencies Unit Vall d'Hebron Institut de Recerca, Universitat Autònoma de Barcelona</p> <p>Subirana, Maria; ISGlobal; Universitat Pompeu Fabra</p> <p>Malagrida, Rosina; IrsiCaixa AIDS Research Institute, Living lab for Health</p> <p>Reyes-Urueña, Juliana; Centre for Epidemiological Studies on STD/HIV/SIDA of Catalonia; CIBERESP</p> <p>Folch, C; Centre for Epidemiological Studies on STD/HIV/SIDA of Catalonia; CIBERESP</p> <p>Soler-Palacin, Pere; Hospital Vall d'Hebron, Pediatric Infectious Diseases and Immunodeficiencies Unit, Vall d'Hebron Institut de Recerca, Universitat Autònoma de Barcelona</p> <p>Gascón, Mireia; ISGlobal, Centre for International Health Research (CRESIB); Universitat Pompeu Fabra</p> <p>Sunyer, Jordi; ISGlobal, IMIM-Parc Salut Mar; Universitat Pompeu Fabra</p> <p>Anton, Andres; Institut Català de la Salut, Microbiology Department, Hospital Universitari Vall d'Hebron, Universitat Autònoma de Barcelona</p> <p>Blanco, Ignacio; Institut Català de la Salut, Microbiology Department, Laboratori Clínic Metropolitana Nord, Hospital Universitari Germans Trias i Pujol, Institut D'Investigació en Ciències de La Salut Germans Trias i Pujol (IGTP)</p> <p>Fernández-Morales, Jessica; IrsiCaixa AIDS Research Institute, Living lab for Health</p> <p>Colom-Cadena, Andreu; Centre for Epidemiological Studies on STD/HIV/SIDA of Catalonia</p> <p>Sentís, Alexis; Centre for Epidemiological Studies on STD/HIV/SIDA of Catalonia; Epiconcept SAS</p> <p>Pumarola, Tomas; Institut Català de la Salut, Microbiology Department, Hospital Universitari Vall d'Hebron, Universitat Autònoma de Barcelona</p> <p>Basora, Josep; IDIAP Jordi Gol, Direction</p> <p>Casabona, Jordi; Centre for Epidemiological Studies on STD/HIV/SIDA of Catalonia; CIBERESP</p>
Primary Subject Heading:	Public health

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Secondary Subject Heading:	Epidemiology, Paediatrics
Keywords:	COVID-19, Community child health < PAEDIATRICS, PUBLIC HEALTH, Epidemiology < INFECTIOUS DISEASES



1 Study protocol for monitoring SARS-CoV-2 infection and its determinants in Catalonia 2 (Spain): an observational and participatory research approach in a Sentinel Network 3 of Schools.

4 Anna Bordas^{1*}, Antoni Soriano-Arandes^{2*}, Maria Subirana^{3,4*}, Rosina Malagrida^{5*}, Juliana Reyes-Urueña^{1,6},
5 Cinta Folch^{1,6}, Pere Soler-Palacín², Mireia Gascón^{3,4}, Jordi Sunyer^{3,4}, Andrés Anton⁷, Ignacio Blanco⁸, Jessica
6 Fernández-Morales⁵, Andreu Colom-Cadena¹, Alexis Sentís^{1,9}, Tomàs Pumarola⁷, Josep Basora¹⁰ and Jordi
7 Casabona^{1,6}, for the Sentinel School Network Study Group of Catalonia*

8
9 ¹ Centre of epidemiological studies on sexually transmitted infections and AIDS of Catalonia (CEEISCAT). Ministry of
10 Health. Government of Catalonia. Badalona. Spain.

11 ² Pediatric Infectious Diseases and Immunodeficiencies Unit, Hospital Universitari Vall d'Hebron, Vall d'Hebron Institut
12 de Recerca, Universitat Autònoma de Barcelona, Barcelona, Spain

13 ³ Barcelona Institut for Global Health, IMIM-Parc Salut Mar, Barcelona. Spain.

14 ⁴ Universitat Pompeu Fabra (UPF), Barcelona, Spain

15 ⁵ IrsiCaixa Living Lab for Health, Badalona, Spain.

16 ⁶ Spanish Consortium for Research on Epidemiology and Public Health (CIBERESP), Instituto de Salud Carlos III, Madrid,
17 Spain.

18 ⁷ Microbiology Department, Hospital Universitari Vall d'Hebron, Institut Català de la Salut, Universitat Autònoma de
19 Barcelona, Barcelona, Spain

20 ⁸ Microbiology Department, Laboratori Clínic Metropolitana Nord, Hospital Universitari Germans Trias i Pujol, Institut
21 Català de la Salut, Institut D'Investigació en Ciències de La Salut Germans Trias I Pujol (IGTP), Badalona, Spain.

22 ⁹ Epiconcept, Epidemiology Department, Paris, France.

23 ¹⁰ Foundation University Institute for Research in Primary Health Care Jordi Gol i Gurina (IDIAP Jordi Gol), Barcelona,
24 Spain.

25
26 *Co-first authors, these authors contributed equally to this work

27 28 Sentinel School Network Study Group of Catalonia*

29 **Principal investigators:** Jordi Casabona [Centre d'Estudis Epidemiològics sobre les Infeccions de Transmissió Sexual i
30 Sida de Catalunya (CEEISCAT)-CIBERESP], Josep Basora (Institut Universitari d'Investigació en Atenció Primària (IDIAP
31 Jordi Gol).

32 **Project manager:** Anna Bordas (CEEISCAT).

33 **Technical committee:** Jordi Casabona (CEEISCAT), Jordi Sunyer (ISGlobal), Pere Soler-Palacín (Hospital Universitari
34 Vall d'Hebron), Rosina Malagrida (Living lab for Health, IRSiCaixa) as *Work Package coordinators*. Juliana Reyes-
35 Urueña, Cinta Folch, Pol Romano, Esteve Muntada, Anna Bordas, Andreu Colom-Cadena i Jordi Casabona (CEEISCAT),
36 Mireia Gascón, Maria Subirana, Jordi Sunyer (ISGlobal), Rosina Malagrida, Jessica Fernández (Living lab for Health),
37 Antonio Soriano (Hospital Universitari Vall d'Hebron) , Josep Vidal (Gerència Territorial de la Catalunya Central,
38 Institut Català de la Salut).

39 **Microbiology laboratories:** Tomàs Pumarola, Andrés Antón, Cristina Andrés, Juliana Esperalba, Albert Blanco (Hospital
40 Universitari Vall d'Hebron), Ignacio Blanco, Pere-Joan Cardona, Maria Victoria González, Gema Fernández, Cristina
41 Esteban (Hospital Universitari Germans Trias i Pujol)

42 **Data Management and statistical analysis:** Yesika Díaz, Lucia Alonso, Jordi Aceiton, Marcos Montoro (CEEISCAT).

43 **Data Protection Officer and Technical Support:** Esteve Muntada (CEEISCAT).

44 **Communication manager:** Pol Romano (CEEISCAT).

45 **Field team:** Maria Subirana (ISGlobal), Jessica Fernández (Living Lab for Health, IRSiCaixa), Andreu Colom-Cadena,
46 Isabel Martínez, Marina Herrero, Alba García, Juan Rus (CEEISCAT).

47 **Community Paediatricians:** Esperança Macià i Silvia Burgaya (CAP Manlleu), M^a Teresa Riera-Bosch, Elisabet Sola (EAP
48 Vic Nord), Lidia Aulet, Maria Mendoza, Lidia Busquets (EAP Vic Sud), Xavier Perramon, Júlia Sebastià (EAP Eixample

1
2
3 49 Dret), Ana Moreno (Cap Ripollet), Xavier Duran, Belen Pérez (EAP Can Gibert del Pla), Anna Gatell (Equip Territorial
4 50 de Pediatria Alt Penedès), Maria Coma (Hospital Universitari Joan XXIII).

5 51 **Department of Health:** Ariadna Mas (Direcció Assistencial Atenció Primària, Institut Català de la Salut), Maria Antònia
6 52 Llopis (Coordinació dels laboratoris de l'Institut Català de la Salut), Sandra Pequeño and Jacobo Mendioroz
7 53 (Subdirecció general de Vigilància i Resposta a Emergències de l'Agència de Salut Pública de Catalunya, Departament
8 54 de Salut), Carmen Cabezas (Agència de Salut Pública de Catalunya, Departament de Salut).

9
10 55

11
12 56 **Corresponding author:** Anna Bordas, e-mail address: abordas@igtp.cat, address: Institut de
13 57 Recerca Germans Trias i Pujol (IGTP), Edifici Muntanya, Carretera de Can Ruti, Camí de les
14 58 Escoles s/n, 08916 Badalona (Spain).

15
16 59

17
18 60 **Key words:** COVID-19, severe acute respiratory syndrome coronavirus 2, School Settings,
19 61 Sentinel Surveillance

20 62 **ABSTRACT**

21 63 **Introduction**

22
23
24 64 Since the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) became of concern in
25 65 January 2020 many preventive measures have been adopted in educational settings to ensure
26 66 the control of coronavirus disease 2019 (COVID-19) pandemic among children and staff in
27 67 schools. This study aims to set up a school sentinel surveillance network with the purpose of
28 68 monitoring SARS-CoV-2 infection, seroprevalence as well as to analyse the impact of preventive
29 69 interventions of SARS-CoV-2 in school settings. Additionally, we will assess diverse screening
30 70 strategies in a cohort of students and school staff to monitor the screening acceptance and its
31 71 potential impact. Altogether, we hope this study will enable the design of more effective
32 72 strategies for the prevention of COVID-19 spread.

33 73 **Methods and analysis**

34
35
36 74 The sentinel schools' study is a cross-sectional, school-based project including twenty-six
37 75 participating sentinel schools in Catalonia (Spain). Children, adolescents and staff at the schools
38 76 will be invited to participate. This project will be carried out from January, 2021 until June, 2022
39 77 as follows: i) Twice yearly serological testing and molecular SARS-CoV-2 detection and
40 78 questionnaires covering SARS-CoV-2 symptoms, tests, health, knowledge, attitudes and
41 79 behaviours; ii) An environmental evaluation carried out in different classrooms; iii) SARS-CoV-2
42 80 transmission dynamics and the impact of different variants among confirmed cases and
43 81 classmates; iv) A participatory process by which the participants are invited to act as co-
44 82 investigators to evaluate prevention strategies and provide recommendations to improve
45 83 COVID-19 prevention in schools. Descriptive analysis will be performed for the main variables
46 84 collected. The incidence and seroprevalence will be calculated and the association with socio-
47 85 demographic factors and school characteristics will be determined using multivariate logistic
48 86 regression.

49 87 **Ethics and dissemination**

50
51
52 88 Ethical approval was obtained from the IDIAPJGol and the Hospital Universitari Vall d'Hebron
53 89 ethics committees. A report will be generated quarterly. Findings will be disseminated at
54 90 national and international conferences and published in peer-reviewed journals.

55
56
57 91

58 92 **STRENGTHS AND LIMITATIONS OF THIS STUDY**

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

93 Strengths

- 94 - A multicentre study combining cross-sectional and longitudinal studies, collecting data from
- 95 sentinel schools throughout Catalonia.
- 96 - Planned to consolidate the sentinel school surveillance network to monitor and evaluate the
- 97 epidemiology of SARS-CoV-2 in school settings and assess the effectiveness of future
- 98 preventive and control measures, new diagnostic tests or vaccination.
- 99 - Transdisciplinary and participatory research, carried out in collaboration with the education
- 100 community to ensure that the prevention and control strategy for SARS-CoV-2 fits with the
- 101 needs and expectations of schools.

102 Limitations

- 103 - The participating school-population might not be representative of the entire Catalan school
- 104 population distributed across all the territory.
- 105 - Participation in periodic screenings could be low due to fear of testing the younger children
- 106 or because of pandemic fatigue due to the large number of tests being performed.

107

108 INTRODUCTION

109 Coronavirus disease 2019 (COVID-19), first reported from Wuhan city, China in December 2019¹,
110 was declared a Public Health Emergency of International Concern by the World Health
111 Organization (WHO) on 30 January 2020 and defined as a pandemic on 11 March 2020. Although
112 children were recognized as contributing to only a small proportion of laboratory-confirmed
113 COVID-19 cases and rarely developing severe or fatal disease^{2, 3}, their role in asymptomatic
114 infection and transmission, which is well-described for other respiratory viral infections such as
115 influenza, was uncertain at the point of these restrictions and is still under discussion.

116 On the declaration of the global COVID-19 pandemic most countries closed their schools as part
117 of their national lockdown measures^{4, 5}, with more than 1 billion children and young people
118 affected so far⁶. The closure of schools reduced the number of contacts within the population
119 and, therefore, the subsequent transmission⁵. However, this measure can also cause
120 considerable damage to children and their families with significant social and economic impacts,
121 mainly on physical and mental health⁷⁻¹¹. On the other hand, most evidence from countries that
122 have reopened schools or never closed them, suggests that schools have not been associated
123 with significant increases in community transmission¹²⁻¹⁵. Thus, the transmission of SARS-CoV-2
124 from paediatric patients both at home and in schools has been an intensely topic since the
125 beginning of the COVID-19 pandemic, also regarding the emergency of new variant scenarios¹⁶⁻
126 ¹⁹.

127 Since Catalan schools reopened in September 2020 after 6-months of closure, there have been
128 83,911 accumulated positive COVID-19 cases, of which 74,246 were students (5.16%) and 8,996
129 school staff (5.49%)²⁰. Likewise, a recent study that analysed the incidence dynamics of SARS-
130 CoV-2 infection in children in the first term of the school reopening shows that the infection rate
131 among children remained lower compared with the general population for pre-school (3-6
132 years) and primary pupils (6-12 years) but was equal to it or higher in secondary students (12-
133 18 years)²¹. Moreover, several studies have shown that in this pandemic very few cases infect
134 many contacts (super-spreaders) while most cases either infect nobody or very few people and
135 this includes paediatric index cases²²⁻²⁶. Defining host-related, viral and environmental patterns
136 that determine these super-spreading situations is relevant to the tailoring of measures to
137 minimize the transmission of SARS-CoV-2 in schools²⁷.

138 Preventive interventions play an important role in working together to gain control of the
139 COVID-19 pandemic, also in schools. In this sense, the social and behavioural sciences can
140 provide valuable insights into managing the pandemic and its impacts²⁸. Non-pharmacological
141 preventive interventions in schools such as physical distancing, hygiene, use of masks, restricting
142 interactions to clusters of students in bubble-groups, massive microbiological testing and other
143 safety measures are essential to prevent transmission²⁹. These measures should be adapted to
144 the setting and age group and prevent transmission while providing children with an optimal
145 learning and social environment⁴. Furthermore, as it is known that SARS-CoV-2 transmission is
146 via aerosols and virus-laden aerosols may easily accumulate in indoor environments, a proper
147 ventilation of indoor spaces can be a great preventive measure²⁹. Additionally, the first set of
148 COVID-19 vaccines provided a pharmacological intervention in the last quarter of 2020 when
149 they received the authorization for emergency use by the European Medicines Agency (EMA)
150 and the Food and Drug Agency in the United States³⁰. So far, teaching and non-teaching staff
151 and population over 12 years are being vaccinated as defined in the Spanish vaccination strategy
152 raising hopes for a better control of the epidemic inside school settings. In this context, there is
153 a need to understand the epidemiology of SARS-CoV-2 in children once the adult population has
154 been vaccinated. The pandemic is moving very fast, and behaviours and attitudes may change
155 in response to the COVID-19 pandemic. Understanding the drivers of vaccine acceptance will be
156 crucial to the success of COVID-19 mass vaccination campaigns.

1
2
3 157 Therefore, the use of periodical cross-sectional surveys on the knowledge, attitude and practice
4 158 (KAP) associated with COVID-19 will allow rapid and adaptive monitoring of demographics,
5 159 preventive behaviours, knowledge, and perceptions over time, among others, and can be useful
6 160 in order to identify misinformation as they emerge.

7
8 161 This article reports the design and protocol of a school-based study in several sentinel schools
9 162 in Catalonia. The study is part of the COVID-19 monitoring and evaluation plan from the Ministry
10 163 of Health of the Government of Catalonia, and it is conceived as a participatory and
11 164 transdisciplinary research process where the students and school staff will be invited to
12 165 participate. The monitoring and evaluation provide practical information for making timely
13 166 decisions, addressing community needs, and identifying more effective strategies for the
14 167 prevention of COVID-19 spread and future infectious threats. In addition, the protocol could be
15 168 highly useful for adaption into other educational settings for the monitoring of the COVID-19
16 169 pandemic.

17
18
19 170

20 171 **GENERAL OBJECTIVES**

- 21
22
23 172 1. To describe over time the knowledge, attitudes and behaviours (KAB) of students and school
24 173 staff (teaching and non-teaching staff) towards SARS-CoV-2 infection and its prevention, as
25 174 well as its impact in school settings.
26 175 2. To assess over time the prevalence of SARS-CoV-2 infection and seroprevalence of
27 176 antibodies against SARS-CoV-2 and to identify associated sociodemographic, biological,
28 177 behavioural and environmental factors among both children and staff.
29 178 3. To identify and describe multi-level determinants, barriers and needs of SARS-CoV-2
30 179 prevention related measures in school settings over time.
31 180 4. To assess the secondary attack rate of SARS-CoV-2 children index cases and its multilevel
32 181 determinants and factors, both in school and family settings.
33 182 5. To analyse the impact of preventive and control measures on the occurrence of SARS-CoV-
34 183 2 in school settings.
35 184 6. To pilot alternative testing and screening technologies and strategies, to assess their
36 185 acceptability, feasibility and performance and the occurrence of SARS-CoV-2 infection
37 186 among students and school staff.
38 187 7. To analyse the impact of different SARS-CoV-2 variants' transmission in school settings.
39 188 8. To facilitate a participatory process where the education community will act as co-
40 189 researchers elaborating recommendations to improve the prevention and control measures
41 190 in the school environment.
42 191 9. To evaluate the impact on students' learning, attitudes and motivations of their
43 192 participation in the research process and the teacher's perspectives on this impact.
44 193

45 194 **METHODS AND ANALYSIS**

46 195 **Study design and Setting**

47
48 196 The population of Catalonia was 7,619,494 in 2019. The Catalan school system includes
49 197 1,582,466 students, 117,398 teaching staff and 5,492 school centres³¹.

50 198 This project is based on sentinel schools defined as a network of schools representing the
51 199 diversity of schools and the scholar population in Catalonia, and chosen using the following
52 200 criteria:

- 53
54
55 201 • Volunteering/commitment of both the school management team and the teaching staff
56 202 as well as the children's parents to participate in the project

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

- 203 • Representation of schools located in the different Basic Health Areas (BHA) and territorial areas will be ensured taking into account tertiles of SARS-CoV-2 accumulated incidence and tertiles of socio-economic deprivation index³²
- 206 • Representation of schools with different characteristics:
 - 207 ○ Sociodemographic indicators. At least two-to-five high complexity schools characterized by low socioeconomic level and specific educational needs
 - 208 ○ Some schools located in rural areas³³
 - 209 ○ Schools with all levels of education, small school size and school centres with professional training courses
 - 210 ○ Public, charter and private schools
 - 211
 - 212

213 The sentinel surveillance is carried out by means of serial cross-sectional and longitudinal school-based studies, direct observation, index case study and participatory research approach in children, adolescent and school staff from the selected sentinel schools. In a subset of schools (n=5), a cohort of students from first grade of secondary school to high school (12->18 years) and school staff has been established in order to monitor the COVID-19 incidence and the feasibility and acceptability of different periodical screening practices for COVID-19 confirmation. All the study interventions will be carried out in two academic years starting from January 2021 to June 2022 and the analysis will take place from June 2022 until the end of 2022.

221 **Study population (Inclusion criteria)**

- 222 • Students attending sentinel schools will be eligible for the study, from preschool (3-years-old) to high school (approximately 18-years-old)
- 223
- 224 • School staff of the sentinel schools, including teachers, administrators, canteen and cleaning staff, and other adults working in the educational settings such as
- 225 extracurricular education instructors
- 226

227 **Informed consent**

228 Informed consent will be obtained from school staff, parents of children under 16 and pupils of 16 years-old or older. Participants will be free to decline/withdraw consent at any time without providing a reason and without being subject to any resulting detriment.

231 **Study procedures**

232 Summary information of questionnaires, biological samples and other information to be collected is provided in Table 1.

234 Knowledge, attitudes and behaviours regarding COVID-19 (KAB) questionnaires and impact of preventive and control measures

236 Each headteacher will send the study information pack (a study leaflet and the information sheet) and the link to the online informed consent and the baseline questionnaires by e-mail to the parents/guardians, school staff and older students (when necessary, on paper). We will send follow-up questionnaires twice a year. Three different questionnaire models will be designed: for teachers and other school staff (Questionnaire A); for students under 16, which will be answered by parents/guardian (Questionnaire B), and for students over 16 (Questionnaire C). The variables included in the KAB survey will be mainly based on the WHO recommendations, as described in WHO/Europe (2020)³⁴.

244 Prevalence of SARS-CoV-2 active infection and seroprevalence of antibodies against SARS-CoV-2

246 *Cross-sectional study:* A field team (FT) made up of three nurses and a field coordinator will visit each school equipped with personal protective equipment to collect the samples for testing.

1
2
3 248 They will schedule the number of intervention days with each participating school depending on
4 249 school size. The following samples in the baseline and the following cross sectionals (twice
5 250 yearly) will be collected from all participants: i) Nasal swabs to perform a transcription-mediated
6 251 amplification assay (TMA) for detection of SARS-CoV-2; ii) Finger prick blood sample to assess
7 252 with a quick anti SARS-CoV-2 IgM/IgG antibody test.

9 253 *Longitudinal study:* Follow-up interventions will be scheduled twice monthly during the school
10 254 year as an alternative testing strategy. In each intervention, the FT will collect saliva and nasal
11 255 specimens for the detection of SARS-CoV-2 by molecular or antigenic tests, respectively. The
12 256 cohort participants will fill in an additional online epidemiological survey with information
13 257 related to SARS-CoV-2 infection, their symptomatology, exposure and vaccine status.

15 258 Secondary attack rate and SARS-CoV-2 variants

17 259 This part of the study will be carried by the Paediatric Infectious Diseases and
18 260 Immunodeficiencies Unit at Hospital Universitari Vall d'Hebron (HUVH). Data on COVID-19 index
19 261 cases will be collected with appropriate social and geographical distribution. These cases will be
20 262 detected by the routine data provided by the Catalan Public Health Department or detected
21 263 during the study interventions and analysed in depth from then on. Data on demographic, social
22 264 and clinical features, vaccination status, comorbidities and clinical outcome will be collected.
23 265 School and household contacts will also be studied in depth to detect secondary cases. Samples
24 266 from the index case and all COVID-19 confirmed contacts will be sequenced using whole genome
25 267 sequencing (WGS) following the ARTIC Network protocol³⁵ for the characterization of SARS-CoV-
26 268 2 (lineage and mutations), molecular tracing of sequences, and measurement of the viral load
27 269 in these respiratory samples to assess its role in the transmission dynamics.

30 270 Environmental determinants and barriers

32 271 The environmental evaluation will be carried out by the ISGlobal team to obtain information on
33 272 the structural characteristics of each participating sentinel school, ventilation practices and
34 273 other environmental prevention measures using the KKmoon carbon dioxide detector device.
35 274 This intervention will include: i) A structural evaluation by a field technician in at least one
36 275 classroom for each grade; ii) Online twice yearly surveys addressed to teachers and
37 276 headteachers regarding ventilation and other prevention practices; iii) Twice yearly 15-day
38 277 assessment of CO₂, temperature and humidity – seven days assessed by the field technician and
39 278 the remainder as an experimenting tool for students – in 5 to 8 previously chosen classrooms.

41 279 Participatory research

43 280 The project is conceived as a collaborative and transdisciplinary research project where the
44 281 education community and families participate in different phases of the research process. They
45 282 will act as co-researchers evaluating the prevention and control measure implementation of
46 283 SARS-CoV-2 infection in the school environment with a systemic perspective, as well as
47 284 elaborating their recommendations to improve the prevention and control strategy. This
48 285 approach will be implemented in collaboration with the EC funded project CONNECT, which aims
49 286 to improve science learning and increase students' motivation towards science careers by
50 287 engaging schools, scientists and families to solve local challenges.

53 288 Participation will entail discussion groups: i) Online focus groups with teachers. Preliminary
54 289 results of the bio-behavioural surveys will be shared and, based on these, they will be invited to
55 290 analyse problems, opportunities and needs, and to develop proposals for improvement of
56 291 prevention measures following a protocol; ii) Teachers conducting focus groups with their class-
57 292 group students and then families, reproducing a similar protocol; iii) The edited list of
58 293 recommendations will be presented by students to scientists and policy makers in an online
59 294 conference; iv) Elaboration of the final list of recommendations; v) Capital science survey: a pre-

1
2
3 295 and post-intervention survey addressed to pupils regarding the science learning and students'
4 296 attitudes and motivation, and a pre- and post-intervention survey addressed to teachers
5 297 regarding the education process.

6
7 298

8
9 299 Sample management, microbiological analysis and test result communication

10 300 As described above, diverse biological samples will be collected during the study.

11
12 301 The finger prick blood collected at the baseline and the follow-up will be processed at the time
13 302 of collection to perform a quick SARS-CoV-2 serological test (COVID-19 IgG/IgM Rapid Test Kit,
14 303 Lambra, Spain) with sensitivities of 97,2% (IgG) and 87,9% (IgM), and specificities of 100% for
15 304 both immunoglobulins as the manufacturers describe. This approach will be used to assess the
16 305 exposure to SARS-CoV-2 infection or vaccination by the presence of antibodies. In addition, the
17 306 nasal swab sample collected in the longitudinal study will be processed at the time of collection
18 307 for detection of SARS-CoV-2 antigen using the Panbio COVID-19 Ag Rapid Test (Abbot, USA) with
19 308 a sensitivity of 93.3% (95% CI: 83.8-98.2%) and specificity of 99.4% (95% CI: 97.0-100%) as the
20 309 manufacturers describe. The nursing team will upload the rapid test results on an online
21 310 research database using electronic tablets. These results will be introduced afterwards to the
22 311 electronic health record of all participants, who will be able to consult them in the online patient
23 312 health portal (La Meva Salut app). In case of Ag positive with IgG negative, the COVID-school
24 313 manager, a new sanitary staff role acting as a liaison between the primary care team and the
25 314 school centres, will activate the public health protocol established by the Catalan Ministry of
26 315 Health³⁶.

27
28
29
30 316 Nasal swabs and saliva samples will be maintained at 4°C during sampling procedures and
31 317 transport to laboratory facilities. A molecular assay based on the transcription mediated
32 318 amplification assay (Procleix SARS-CoV-2, Grifols) will be conducted in HUVH for detection of
33 319 SARS-CoV-2 in nasal swabs, and RT-PCR assay (Allplex SARS-CoV-2/FluA/FluB/RSV, Werfen) will
34 320 be conducted at the Hospital Universitari Germans Trias i Pujol (HUGTiP) laboratories to
35 321 determine SARS-CoV-2 infection in saliva specimens. If the TMA assay (HUVH) or RT-PCR assay
36 322 (HUGTiP) is positive, an active infection will be confirmed. Once the nasal samples have been
37 323 tested, all positive specimens will be stored in sample collection C.0001145 on the *Instituto de*
38 324 *Salud Carlos III* register. On the other hand, saliva samples with positive SARS-CoV-2 results will
39 325 be frozen and stored at the IGTP-HUGTiP Biobank and conserved for two years. TMA/PCR results
40 326 will be uploaded by the microbiology laboratories to the electronic health record, and the
41 327 participants and their general practitioners or paediatricians will be able to check them.

42
43
44 328 Regarding the transmissibility study, nasopharyngeal or nasal swab samples from index cases
45 329 and positive secondary cases will be sent to the HUVH laboratory for genetic SARS-CoV-2
46 330 characterisation, to measure the viral load and to detect other respiratory viruses. The genetic
47 331 characterisation of SARS-CoV-2 will be performed through WGS according to the ARTIC Network
48 332 protocol³⁵ by using MiSeq and NextSeq 2000 platforms (Illumina, CA, USA). Other respiratory
49 333 viruses will be detected by a real-time multiplex RT-PCR assay (Allplex Respiratory Panel Assay,
50 334 Seegene); total nucleic acids will be extracted using NucliSENS EasyMAG (bioMérieux, Marcy
51 335 l'Etoile, France) or Microlab STARlet System (Hamilton, CA, USA) according to the
52 336 manufacturer's instructions. Additionally, to measure the SARS-CoV-2 viral load, an in-house
53 337 quantitative RT-PCR assay using the primer/probe set targeting the nucleocapsid protein (N1)
54 338 and the human RNase P (housekeeping gene) from the CDC 2019-nCoV Real-Time RT-PCR
55 339 Diagnostic Panel will be carried out. The Ct values of the viral target will be normalized to a
56 340 housekeeping gene based on the Δ Ct method (Ct_{sample} - Ct_{housekeeping gene}) in order to
57 341 minimize the variations due to the non-standardized collection of a heterogenous specimens.

342 **Data management, data protection and patient confidentiality**

343 Informed consents and the different surveys will be designed and published by means of the
 344 EUSurvey management system, an official online survey management tool of the European
 345 Commission. For those participants for whom online access is not possible, printed surveys will
 346 be distributed by the field team and afterwards digitalized. The periodical surveys from the
 347 cohort study will be published by means of the OpenTIC software.

348 After giving their consent to participate (or allow their child to participate), each participant will
 349 be allocated a unique participant ID number on enrolment to the study. This unique identifier
 350 will serve as a link to all the data needed for the study (questioners, biological samples). The file
 351 that relates the identifier or pseudonym to the personally identifiable data will be encrypted
 352 and the access to this file will be restricted to a very small number of authorized persons (EM,
 353 YD, JA, LA). The process will comply with the General Data Protection Regulation (GDPR)
 354 requirements.

355 **Study definitions:**

356 Given that all the participants attending the school should be asymptomatic, a confirmed COVID-
 357 19 case will be defined as any individual testing SARS-CoV-2 positive by molecular assays (PCR
 358 or TMA-based) or COVID-19 Ag Rapid Test (RAT) in a respiratory or saliva specimen³⁷.

359 A paediatric index case will be established when the child is the first confirmed COVID-19 case
 360 in the classroom noticed by health authorities or the research team²⁶. A secondary case will be
 361 defined as a classmate or household contact subsequently testing positive for SARS-CoV-2 by
 362 molecular assay or RAT. Close contacts will be defined as all people who have shared space with
 363 a positive COVID-19 less than 2 metres away, for more than 15 minutes, without protection and
 364 from the 48 hours prior to the onset of symptoms. If the positive person has not had symptoms,
 365 onset will be defined as the date of performing the diagnostic test.

366 **Variables collected**

- 367 i) Individual data
- 368 • Sociodemographic and socioeconomic indicators: age, gender, ethnic origin,
 369 household and career, economic status, job situation of their parents in the case of
 370 pupils
 - 371 • Clinical data and infection by SARS-CoV-2: symptoms, COVID-19 chronic symptoms,
 372 the duration of symptoms, reinfection of COVID-19, hospitalization, exposure,
 373 contact with positive cases
 - 374 • Attitude, behaviour and knowledge regarding COVID-19 and preventive measures
 - 375 • Pandemic impact indicators such as changes on mental and physic health and the
 376 purchasing power of parents and school staff
 - 377 • Vaccination data: manufacturer, number of doses, date of doses, side effects of
 378 COVID-19 vaccine, refusal to vaccinate (date and reason)
 - 379 • Attitude and usability of focus groups regarding scientific contribution
- 380 ii) Collective data
- 381 Number of classrooms, number of tables/classroom, number of pupils/m², school
 382 surface, schoolyard surface, concentration of CO₂, temperature and humidity in the
 383 classrooms.
- 384 iii) Ecological data
- 385 These data will be collected and provided by the Primary Care Services Information
 386 System (SISAP) and the Data analytics program for health research and innovation
 387 (PADRIS) and will include data from different data sources in order to obtain the
 388 information mentioned below:

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

- 389 • Number of new COVID-19 confirmed cases or tested positive for SARS-CoV-2 by
390 TMA/PCR or RAT /total of residents.
- 391 • Number of new COVID-19 confirmed cases or tested positive for SARS-CoV-2 by
392 TMA/PCR or RAT/total of tested people.
- 393 • Number of new COVID-19 confirmed cases or tested positive for SARS-CoV-2 by
394 TMA/PCR or RAT/total of suspected cases.
- 395 • Number of confined classrooms/total number of classrooms.

396 **Data analysis plan and sample size**

397 We estimate a participation of 50-70% among the total of 11,000 individuals who are on the
398 census at the 26 sentinel schools since not all potential participants are aware of the public
399 health concern and due to other barriers. A descriptive analysis will be performed for all the
400 main aforementioned variables collected: participant's sociodemographic characteristics, SARS-
401 CoV-2 infection characterization, its associated factors, behaviour information and other
402 outcomes of interest. For quantitative variables, we will use measures of central tendency and
403 dispersion (mean, standard deviation, median, interquartile range, 95% confidence interval). For
404 qualitative variables, we will calculate absolute frequencies and percentages. To estimate the
405 statistical significance of time trends in SARS-CoV-2 laboratory confirmed cases we will use
406 multivariate logistic regression analysis with robust standard errors clustered at the individual-
407 level and school-level, adjusting for sociodemographic, environmental and school structural
408 variables.

409 In order to address the fourth objective related to the transmissibility study, a descriptive
410 analysis will be performed for all cases and contacts identified in school clusters. Analyses will
411 include chi-square and independent sample t-test procedures to assess differences between
412 super-spreaders and non-spreaders for index cases and secondary cases using socio-
413 demographics, number of classmates and household contacts, clinical and environmental
414 variables. Finally, we will use univariate and multivariate logistic regression models to assess the
415 association between transmission risk factors and SARS-CoV-2 infection among index cases and
416 close contacts. All models will be adjusted for gender, age, vaccination status, number of
417 classmates, and household contacts and whether or not the index cases are symptomatic.

418 Global data on the COVID-19 epidemic in Catalonia and the school basic health area (BHA) will
419 be collected to contextualize the current epidemic situation. Data will be provided globally and
420 stratified by age groups and collectives. This data will be provided by the Catalan Agency for
421 Quality and Health Assessment (AQuAS) and SISAP. Analysis of the interrupted time series of
422 SARS-CoV-2 seroprevalence and COVID-19 confirmed cases will be performed to assess the
423 public health implemented measures including vaccination programmes. The confirmed cases
424 will be modelled as ARIMA processes to estimate the expected numbers to be compared to
425 those observed and estimate the impact of the different analysed measures, to do this we will
426 calculate absolute and relative changes between expected-observed confirmed cases in each
427 time point of the implemented measures. Analysis will be conducted in R (R Core Team, 2014).

428

429 **PATIENT AND PUBLIC INVOLVEMENT (PPI)**

430 We will convene a virtual PPI panel, who will contribute to the dissemination of findings.

431

432 **ETHICS AND DISSEMINATION**

433 The ethical aspects of the present study include:

- 434 • Recruitment of participants with informed consent
- 435 • Collection and storage of biological samples
- 436 • Questionnaires with non-anonymized data
- 437 • Collection and storage of personal data

438 The confidentiality of data and other ethical considerations will be managed in accordance with
439 the recommendations of the Spanish Law 14/2007 of 3 July, on Biomedical Research and the
440 Spanish Royal Decree RD 1716/2011 of 18 November, which lays down the basic requirements
441 for the authorisation and operation of biobanks for purposes of Biomedical Research and the
442 treatment of biological samples of human origin. Informed consent is required for this project
443 as is established in article 59 of the law.

444 The necessary measures will be taken to ensure the protection of personal data and their
445 confidentiality, in accordance with EU Regulation 2016/679 of the European Parliament and of
446 the Council of 27 April 2016 on the protection of natural persons with regard to the processing
447 of personal data and on the free movement of such data (RGPD), and in the Spanish Organic Law
448 3/2018 of 5 December, for the protection of personal data and Guarantee of digital rights (LOPD-
449 GDD).

450 The data protection office of the Ministry of Health of the Government of Catalonia has reached
451 an agreement signed by all the organizations in the research team to align with all the ethical
452 considerations mentioned above and recommended by the same office.

453 The data and results provided by this project will be valuable in the current context of the public
454 health emergency of international concern declared by the WHO for the COVID-19 pandemic
455 and taking into account the urgent need for information coming from COVID-19 studies.

456 The CEEISCAT research team will generate a quarterly report with qualitative and quantitative
457 data to give feedback to the stakeholders. Findings from this study will be disseminated at
458 national and international conferences, reported on the public webpage of the project and
459 published in peer-reviewed journals.

460

461 **Study registration**

462 Ethical approval was obtained from the Foundation University Institute for Research in Primary
463 Health Care Jordi Gol i Gurina (IDIAPJGol) ethics committee with code 20/192-PCV on 17
464 December 2020 and the Hospital Universitari Vall d'Hebron ethics committee with code
465 PR(AMI)668/2020.

466

467 **AUTHORS' CONTRIBUTIONS**

468 All authors have read, reviewed and agreed to the finalized submitted version of the manuscript.
469 Conceptualisation: JC. Design study: JC, CF, AS, AB, JR, JS, PS, AS and MG. Operational procedures: JC, JR,
470 AB, CF, AC, JS, MG, AA, TP, IB, JF, RM, PS, AS, MS and JB. Resources: RF, JM, JMA, CC and JB. Writing and
471 draft preparation: AB, CF, AC, AS, MS and RM. Writing, review and edition; all authors.

472

473 **FUNDING STATEMENT**

474 This work will be supported by Ministry of Health from Government of Catalonia with no grant
475 number. This funding source had no role in the design of this study and will not have any role
476 during its execution, analyses, interpretation of the data or decision to submit result.

477

478 **COMPETING INTEREST STATEMENT**

479 All of the authors declare that they have no conflicts of interest.

480

481 **REFERENCES**

482 1 Emergencies preparedness, response. Novel Coronavirus – Republic of Korea (ex-China).
483 Available at: [https://www.who.int/csr/don/21-january-2020-novel-coronavirus-republic-of-](https://www.who.int/csr/don/21-january-2020-novel-coronavirus-republic-of-korea-ex-china/en/)
484 [korea-ex-china/en/](https://www.who.int/csr/don/21-january-2020-novel-coronavirus-republic-of-korea-ex-china/en/). Accessed December/17, 2020.

485 2 Pollán M, Pérez-Gómez B, Pastor-Barriuso R, et al. Prevalence of SARS-CoV-2 in Spain (ENE-
486 COVID): a nationwide, population-based seroepidemiological study. *Lancet* 2020;396:535-44
487 doi:S0140-6736(20)31483-5 [pii].

488 3 Hildenwall H, Luthander J, Rhedin S, et al. Paediatric COVID-19 admissions in a region with
489 open schools during the two first months of the pandemic. *Acta Paediatr* 2020;109:2152-4
490 doi:10.1111/apa.15432 [doi].

491 4 COVID-19 in children and the role of school settings in COVID-19 transmission, 6 August
492 2020. Stockholm: ECDC, 2020.

493 5 Viner RM, Russell SJ, Croker H, et al. School closure and management practices during
494 coronavirus outbreaks including COVID-19: a rapid systematic review. *Lancet Child Adolesc*
495 *Health* 2020;4:397-404 doi:S2352-4642(20)30095-X [pii].

496 6 United Nations Educational, Scientific and Cultural Organization (UNESCO). Education: From
497 disruption to recovery. Available at: <https://en.unesco.org/covid19/educationresponse>.
498 Accessed January 3, 2020.

499 7 López-Bueno R, López-Sánchez GF, Casajús JA, et al. Health-Related Behaviors Among School-
500 Aged Children and Adolescents During the Spanish Covid-19 Confinement. *Front Pediatr*
501 2020;8:573 doi:10.3389/fped.2020.00573 [doi].

502 8 López-Bueno R, Calatayud J, Ezzatvar Y, et al. Association Between Current Physical Activity
503 and Current Perceived Anxiety and Mood in the Initial Phase of COVID-19 Confinement. *Front*
504 *Psychiatry* 2020;11:729 doi:10.3389/fpsy.2020.00729 [doi].

505 9 Wilson OWA, Holland KE, Elliott LD, et al. The Impact of the COVID-19 Pandemic on US
506 College Students' Physical Activity and Mental Health. *J Phys Act Health* 2021;18:272-8
507 doi:jpah.2020-0325 [pii].

508 10 Cohen ZP, Cosgrove KT, DeVille DC, et al. The Impact of COVID-19 on Adolescent Mental
509 Health: Preliminary Findings From a Longitudinal Sample of Healthy and At-Risk Adolescents.
510 *Front Pediatr* 2021;9:622608 doi:10.3389/fped.2021.622608 [doi].

511 11 Lee J, Solomon M, Stead T, et al. Impact of COVID-19 on the mental health of US college
512 students. *BMC Psychol* 2021;9:95,021-00598-3 doi:10.1186/s40359-021-00598-3 [doi].

- 1
2
3 513 12 Organization WHO. Considerations for school-related public health measures in the context
4 514 of COVID-19: annex to considerations in adjusting public health and social measures in the
5 515 context of COVID-19, 10 May 2020 2020:6 p.
- 6
7
8 516 13 Macartney K, Quinn HE, Pillsbury AJ, et al. Transmission of SARS-CoV-2 in Australian
9 517 educational settings: a prospective cohort study. *Lancet Child Adolesc Health* 2020;4:807-16
10 518 doi:S2352-4642(20)30251-0 [pii].
- 11
12 519 14 Brandal LT, Ofitserova TS, Meijerink H, et al. Minimal transmission of SARS-CoV-2 from
13 520 paediatric COVID-19 cases in primary schools, Norway, August to November 2020. *Euro Surveill*
14 521 2021;26:2002011. doi: 10.2807/1560,7917.ES.2020.26.1.2002011 doi:10.2807/1560-
15 522 7917.ES.2020.26.1.2002011 [doi].
- 16
17
18 523 15 Zimmerman KO, Akinboyo IC, Brookhart MA, et al. Incidence and Secondary Transmission of
19 524 SARS-CoV-2 Infections in Schools. *Pediatrics* 2021;147:e2020048090. doi: 10.1542/peds.2020-
20 525 048090 doi:10.1542/peds.2020-048090 [doi].
- 21
22 526 16 Esposito S, Principi N. School Closure During the Coronavirus Disease 2019 (COVID-19)
23 527 Pandemic: An Effective Intervention at the Global Level?. *JAMA Pediatr* 2020;174:921-2
24 528 doi:10.1001/jamapediatrics.2020.1892 [doi].
- 25
26
27 529 17 Posfay-Barbe KM, Wagner N, Gauthey M, et al. COVID-19 in Children and the Dynamics of
28 530 Infection in Families. *Pediatrics* 2020;146:e20201576. doi: 10.1542/peds.2020,1576. Epub
29 531 2020 May 26 doi:e20201576 [pii].
- 30
31 532 18 Lee B, Raszka WV, Jr. COVID-19 Transmission and Children: The Child Is Not to Blame.
32 533 *Pediatrics* 2020;146:e2020004879. doi: 10.1542/peds.2020,004879. Epub 2020 May 26
33 534 doi:e2020004879 [pii].
- 34
35
36 535 19 Somekh E, Gleyzer A, Heller E, et al. The Role of Children in the Dynamics of Intra Family
37 536 Coronavirus 2019 Spread in Densely Populated Area. *Pediatr Infect Dis J* 2020;39:e202-4
38 537 doi:10.1097/INF.0000000000002783 [doi].
- 39
40 538 20 Dades sobre la covid-19 als centres educatius. Traçacovid. Available at:
41 539 <http://educacio.gencat.cat/ca/actualitat/escolasegura/tracacovid/dades-covid19-centres/#/>.
- 42
43
44 540 21 Perramon A, Soriano-Arandes A, Pino D, et al. Schools as a Framework for COVID-19
45 541 Epidemiological Surveillance of Children in Catalonia, Spain: A Population-Based Study. *Front*
46 542 *Pediatr*. 2021 Sep 8;9:754744. doi: 10.3389/fped.2021.754744.
- 47
48 543 22 Zhang J, Litvinova M, Liang Y, et al. Changes in contact patterns shape the dynamics of the
49 544 COVID-19 outbreak in China. *Science* 2020;368:1481-6 doi:10.1126/science.abb8001 [doi].
- 50
51 545 23 Mizumoto K, Omori R, Nishiura H. Age specificity of cases and attack rate of novel
52 546 coronavirus disease (COVID-19). *medRxiv* 2020 doi:10.1101/2020.03.09.20033142.
- 53
54
55 547 24 Bi Q, Wu Y, Mei S, et al. Epidemiology and transmission of COVID-19 in 391 cases and 1286
56 548 of their close contacts in Shenzhen, China: a retrospective cohort study. *Lancet Infect Dis*
57 549 2020;20:911-9 doi:S1473-3099(20)30287-5 [pii].
- 58
59
60

- 1
2
3 550 25 Heavey L, Casey G, Kelly C, et al. No evidence of secondary transmission of COVID-19 from
4 551 children attending school in Ireland, 2020. *Euro Surveill* 2020;25:2000903. doi: 10.2807/1560
5 552 doi:10.2807/1560-7917.ES.2020.25.21.2000903 [doi].
6
7 553 26 Soriano-Arandes A, Gatell A, Serrano P, et al. Household Severe Acute Respiratory
8 554 Syndrome Coronavirus 2 Transmission and Children: A Network Prospective Study. *Clin Infect*
9 555 *Dis.* 2021 Sep 15;73(6):e1261-e1269. doi: 10.1093/cid/ciab228
10
11
12 556 27 COVID-19. IFRC, UNICEF and WHO issue guidance to protect children and support safe
13 557 school operations. Geneva: World Health Organization. Available at:
14 558 [https://www.unicef.org/press-releases/covid-19-ifrc-unicef-and-who-issue-guidance-protect-](https://www.unicef.org/press-releases/covid-19-ifrc-unicef-and-who-issue-guidance-protect-children-and-support-safe-school)
15 559 [children-and-support-safe-school](https://www.unicef.org/press-releases/covid-19-ifrc-unicef-and-who-issue-guidance-protect-children-and-support-safe-school). Accessed May 26, 2020.
16
17
18 560 28 Bavel JJV, Baicker K, Boggio PS, et al. Using social and behavioural science to support
19 561 COVID-19 pandemic response. *Nat Hum Behav* 2020;4:460-71 doi:10.1038/s41562-020-0884-z
20 562 [doi].
21
22 563 29 Kuehn BM. Fewer COVID-19 Cases in Schools With Masks and Improved Ventilation. *JAMA*
23 564 2021;326:125 doi:10.1001/jama.2021.10044 [doi].
24
25
26 565 30 COVID-19 vaccines. Available at: [https://www.ema.europa.eu/en/human-](https://www.ema.europa.eu/en/human-regulatory/overview/public-health-threats/coronavirus-disease-covid-19/treatments-vaccines/vaccines-covid-19/)
27 566 [regulatory/overview/public-health-threats/coronavirus-disease-covid-19/treatments-](https://www.ema.europa.eu/en/human-regulatory/overview/public-health-threats/coronavirus-disease-covid-19/treatments-vaccines/vaccines-covid-19/)
28 567 [vaccines/vaccines-covid-19/](https://www.ema.europa.eu/en/human-regulatory/overview/public-health-threats/coronavirus-disease-covid-19/treatments-vaccines/vaccines-covid-19/). Accessed April 14, 2021.
29
30
31 568 31 Alumnes i professors. Per nivells educatius. Available at:
32 569 <https://www.idescat.cat/pub/?id=aec&n=734>. Accessed March 1, 2021.
33
34 570 32 Colls C, Mias M, García-Altés A. Un índice de privación para reformar el modelo de
35 571 financiación de la atención primaria en Cataluña. *Gaceta Sanitaria* 2020;34:44-50
36 572 doi:<https://doi.org/10.1016/j.gaceta.2018.07.015>.
37
38 573 33 Domínguez i Amorós M, Monllor i Rico, N and Simó i Solsona, M. Món rural i joves. Realitat
39 574 juvenil i polítiques de joventut als municipis rurals de Catalunya 2010.
40
41
42 575 34 World Health Organization Europe. Monitoring knowledge, risk perceptions, preventive
43 576 behaviours and trust to inform pandemic outbreak response 2020.
44
45 577 35 ARTIC Network Protocol. Available at: [https://www.protocols.io/view/ncov-2019-](https://www.protocols.io/view/ncov-2019-sequencing-protocol-v3-locost-bh42j8ye)
46 578 [sequencing-protocol-v3-locost-bh42j8ye](https://www.protocols.io/view/ncov-2019-sequencing-protocol-v3-locost-bh42j8ye).
47
48
49 579 36 Gestió de casos de COVID-19 als centres educatius. Available at:
50 580 [https://canalsalut.gencat.cat/web/shared/continguts_per_compartir/ENS/salut-](https://canalsalut.gencat.cat/web/shared/continguts_per_compartir/ENS/salut-escola/documentacio/escoles/gestio-casos-centres-educatius.pdf)
51 581 [escola/documentacio/escoles/gestio-casos-centres-educatius.pdf](https://canalsalut.gencat.cat/web/shared/continguts_per_compartir/ENS/salut-escola/documentacio/escoles/gestio-casos-centres-educatius.pdf).
52
53 582 37 Case definition. Available at: [https://www.ecdc.europa.eu/en/covid-19/surveillance/case-](https://www.ecdc.europa.eu/en/covid-19/surveillance/case-definition)
54 583 [definition](https://www.ecdc.europa.eu/en/covid-19/surveillance/case-definition). Accessed 05/01, 2021.
55
56 584

58 585 **ACKNOWLEDGMENTS**

1
2
3 586 The authors thank the Ministries of Health and Education, Government of Catalonia (Spain), the
4 587 Direcció General de Recerca i Innovació en Salut (DGRIS), Sub direction of Public Health and
5 588 Institut Català de la Salut (ICS), Josep G. Cambray, Head of Education Department and all the
6 589 health care professionals acting as a COVID-19 pandemic health taskforce in Catalonia for
7 590 making this project possible.
8

9 591
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

For peer review only

592 **Table 1. Summary information of study procedures.**

Type of intervention	Determination	Type of Test	Coordination	Frequency
Bio-behavioural questionnaires			CEEISCAT	
- Questionnaire A (teaching and non-teaching staff) - Questionnaire B (parents or foster parents of students under 16 years old) - Questionnaire C (16-years-old or older students)				Once during 2020-2021 school year and twice during 2021-2022 school year
Biological sampling			CEEISCAT	
Baseline - Blood from finger prick - Nasal swab sample	Ab anti-SARS-CoV-2 Viral RNA (SARS-CoV-2)	LFA TMA		Once during 2020-2021 school year and twice during 2021-2022 school year
Longitudinal study (> 1st grade of middle school and school staff) - Saliva sample - Nasal swab sample	Viral RNA (SARS-CoV-2) SARS-CoV-2 Ag rapid test	RT-PCR LFA		Bi-monthly
Environmental and structural evaluation in each sentinel school			ISGlobal	
- Environmental questionnaires (Directors and teachers) - Structural and environmental evaluation by a field technician - CO ₂ , humidity and temperature measurements	Prevention measures (e.g. ventilation practices)			Once during 2020-2021 school year and twice during 2021-2022 school year
Transmissibility study			HUVH	
- COVID-19 index cases - Household and classmate contacts evaluation - Secondary attack rate	Viral coinfections Viral RNA (SARS-CoV-2) SARS-CoV-2 characterisations Viral load measurement	RT-PCR TMA/PCR Whole genome sequencing Quantitative PCR assay		
Participatory research			Living lab (IRSIcaixa)	
- Scientific capital surveys - Focus groups - List of recommendations - Annual school conference				Once during 2020-2021 school year and twice during 2021-2022 school year

593 Ab: antibodies; Ag: antigens; LFA: Lateral flow assay; TMA: Transcription mediated amplification assay

594

595

596

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1-2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	6-7
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	9-10
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-8
Bias	9	Describe any efforts to address potential sources of bias	NA
Study size	10	Explain how the study size was arrived at	5-6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	10
		(b) Describe any methods used to examine subgroups and interactions	10
		(c) Explain how missing data were addressed	NA
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	10
		(e) Describe any sensitivity analyses	NA

Continued on next page

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60**Results**

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	NA
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	NA
		(b) Indicate number of participants with missing data for each variable of interest	NA
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	NA
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	NA
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	NA
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	NA
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	NA
		(b) Report category boundaries when continuous variables were categorized	NA
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA

Discussion

Key results	18	Summarise key results with reference to study objectives	NA
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	NA
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	NA
Generalisability	21	Discuss the generalisability (external validity) of the study results	NA

Other information

Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	14
---------	----	---	----

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.