Scientific evidence on the risks associated with schools during the second wave of Sars-Cov2 in Italy

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Background

Biological background on risk and prognostic factors related to Covid19 in children:

-Children express significantly fewer ACE2 receptors – the entry point of SARS-CoV-2 into human cells – compared to adults;

-They are commonly exposed to other seasonal coronaviruses and develop both humoral and cellular cross-immunity.

Children appear therefore less susceptible to the infection and when infected have an arsenal of neutralizing cross reactive antibodies that might reduce the likelihood of transmitting the virus and improve covid19 prognosis.

Bunyavanich S, Do A, Vicencio A. Nasal Gene Expression of Angiotensin-Converting Enzyme 2 in Children and Adults. JAMA 2020
Ng KW, Faulkner N, Cornish GH, et al. Preexisting and de novo humoral immunity to SARS-CoV-2 in humans. Science 2020

Rational

School openings have been considered an issue due to conflicting studies:
-Modeling studies and epidemiological studies show conflicting results

-In children<5y Sars-CoV-2 genetic material was > children 6-17 and adults (Heald-Sargent T et al. JAMA Pediatrics 2020).

-In a Covid19 outbreak at a summer camp in Georgia (USA), children were found to be highly susceptible to infection (Szablewski CM et al. SARS-CoV-2 MMWR Morb Mortal Wkly Rep).

-In Israel, ten days after schools fully reopened, a major outbreak occurred in schools (Stein-Zamir C et al. Eurosurveillance 2020)

-Temporal correlations between school openings and the second wave was interpreted as a causal link.

In Italy schools remained closed nationwide from March until September. High schools were closed in November. In some regions all schools remained closed except for few weeks.

Aims of the study

-to investigate the overall incidence of SARS-CoV-2 infection among students and teachers in schools compared to general population;

-to study the association between the increase in reproduction number Rt and dates of school openings and closing in different Italian regions;

-to investigate the increase in time of incidence of SARS-CoV-2 by age during the second wave;

-to calculate the rate of secondary infections per n. of tests and frequency of clusters identified in schools during contact tracing activity;

-to investigate infections within schools by type of index-case (students vs teachers).

Study designs and sources of data

Cross-sectional and prospective cohort study:

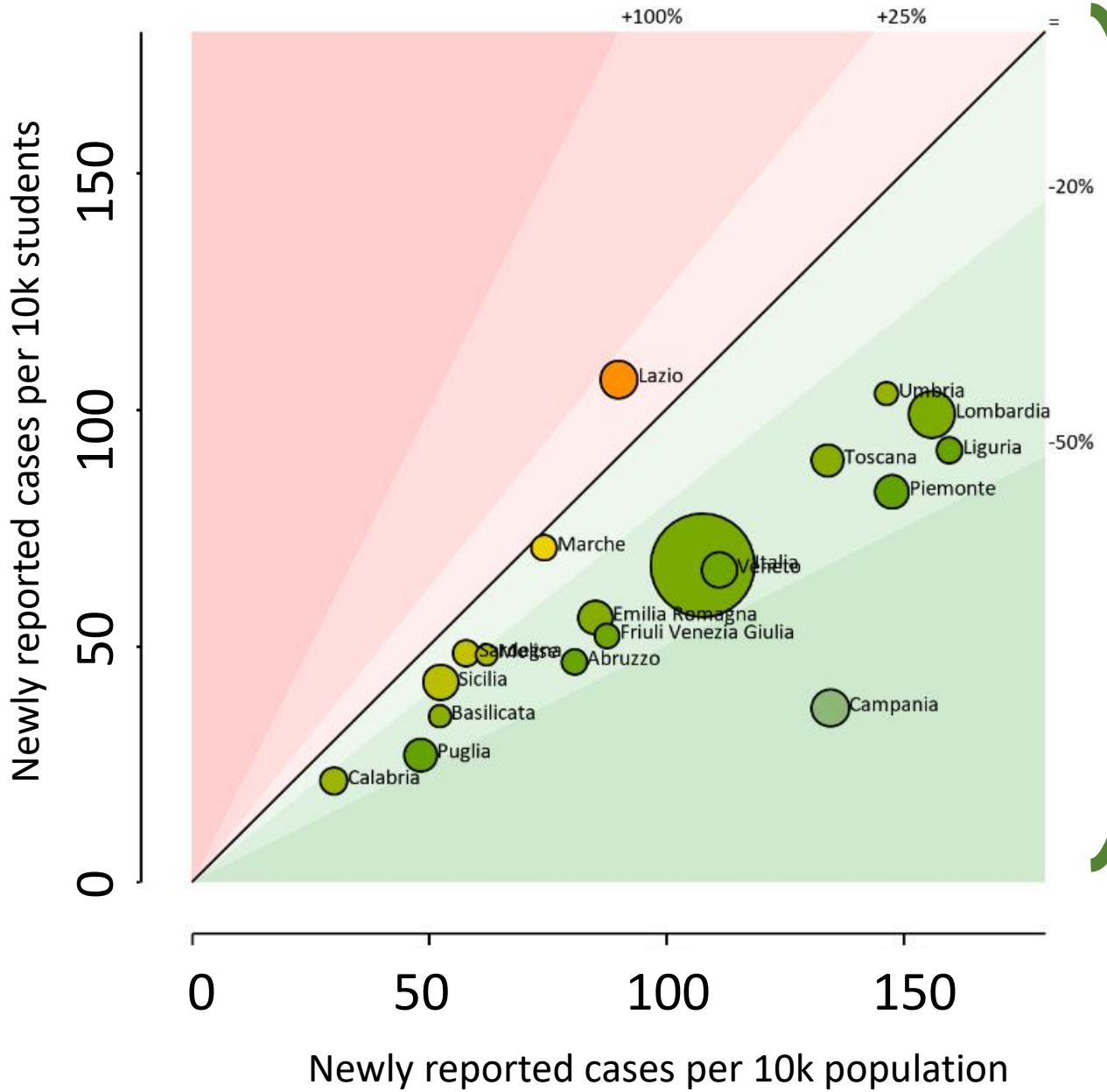
- From 14th September to 7th November 2020 data on Sars-Cov-2 incidence in schools: 7 million students and 700,000 teachers and non-teaching staff: 97% of Italian schools
- The end of November and beginning December data on swabs tests and secondary infections: 45%-56% Italian institutes
- In December data on secondary infections by type of index case in schools of Veneto region

Databases:
School Principals every week for each comprehensive institute.
Department of Prevention of the local unit (AULSS) of the National Health System responsible for tracing.
Italian civil protection and Office for National Statistics

No evidence of association between schools and SARS-CoV-2 second wave in Italy. Gandini S. et al https://www.medrxiv.org/content/10.1101/2020.12.16.20248134v1

Incidence of Sars-cov-2 in schools
In students, teachers and other staff

Incidence in elementary and middle school students

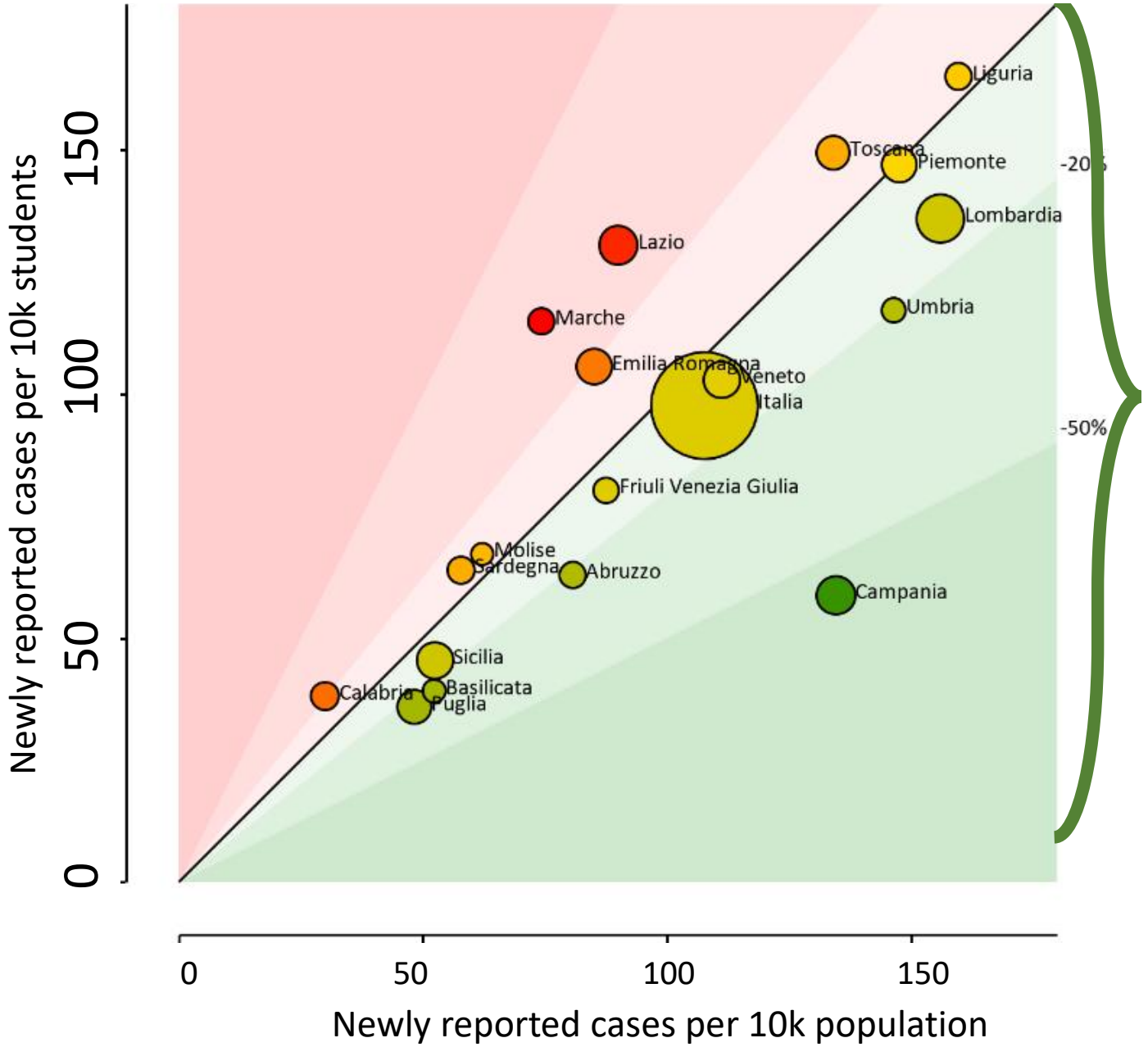


Regions with a lower incidence than the general population

Incidence in the population: 108/10,000,
elementary and middle schools: 66/10,000

On average 39% lower than
in the general population

Incidence in high schools students



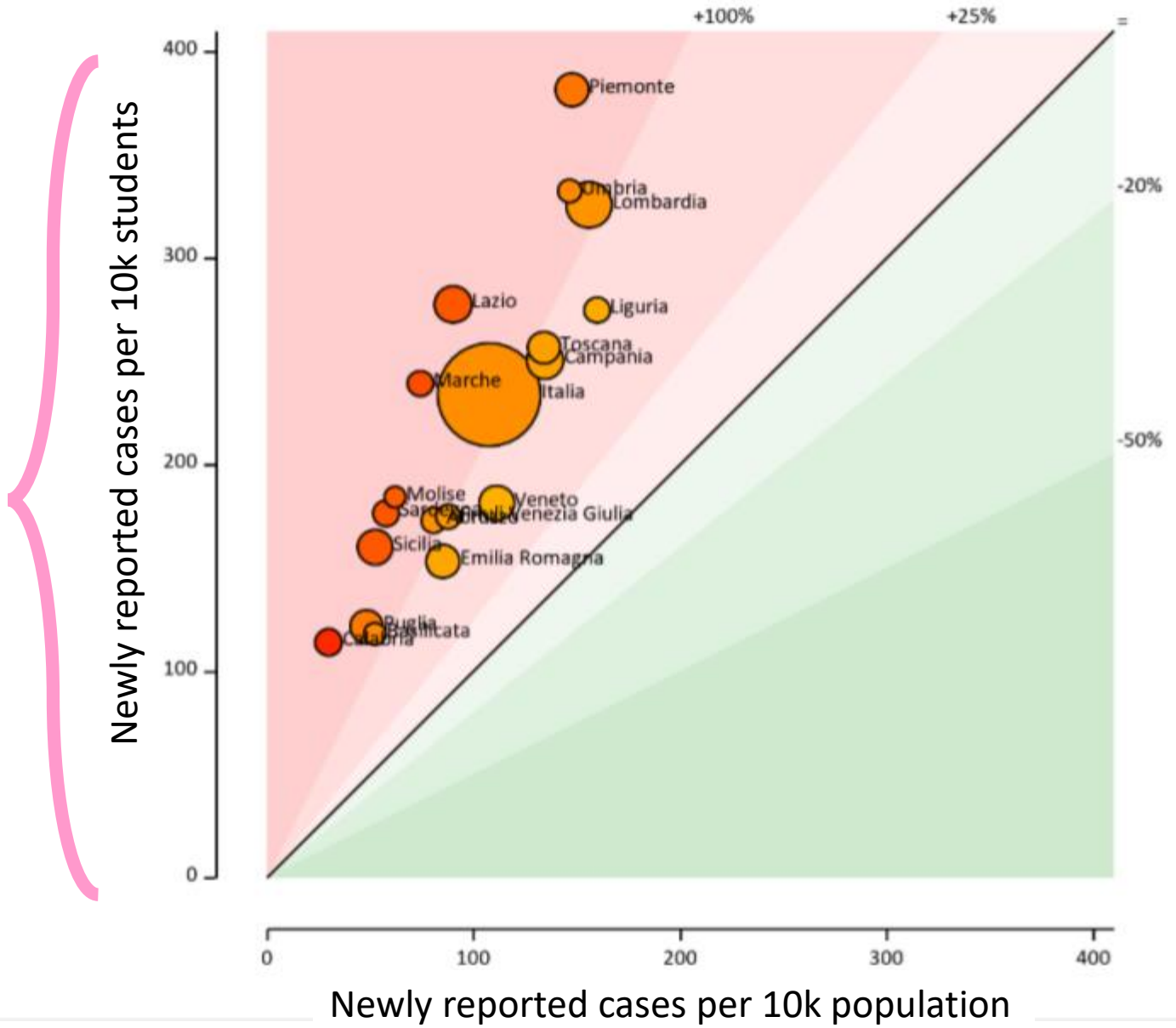
Regions with a lower incidence than the general population

In high schools students incidence was: 98/10,000. In average 9% lower to that of the general population.

Incidence in teachers and non-teaching staff

Regions with a higher incidence than the general population

Among teachers and non-teaching staff incidence was 2-fold higher than in the general population approx. 220/10,000



Incidence in students, teachers, and other school personnel by region, from kindergarten to middle school in the period 23-28 November

REGION	New positive cases among students	% of positive students	New positive cases among teachers	% of positive teachers	New positive cases among other school personnel	% of positive people among other school personnel
Abruzzo	413	0.32%	680	1.35%	224	1.81%
Apulia	778	0.17%	817	1.13%	35	1.17%
Basilicata	267	0.46%	657	1.68%	394	2.25%
Calabria	252	0.12%	209	0.80%	72	0.95%
Campania	1,004	0.16%	212	1.05%	20	0.98%
Emilia Romagna	1,990	0.47%	2,004	2.03%	594	2.53%
Friuli Venezia Giulia	381	0.38%	749	1.53%	24	2.09%
Lazio	1,579	0.31%	832	1.29%	258	1.58%
Liguria	430	0.32%	201	1.36%	78	1.84%
Lombardy	3,791	0.40%	243	1.57%	196	2.16%
Marche	509	0.30%	246	1.27%	171	1.48%
Molise	157	0.49%	1,195	2.61%	335	2.78%
Piedmont	1,215	0.30%	752	1.28%	79	1.52%
Sardinia	429	0.28%	143	1.24%	52	1.38%
Sicily	1,887	0.35%	625	1.47%	258	2.06%
Tuscany	1,117	0.32%	59	1.43%	261	2.05%
Umbria	286	0.28%	89	1.22%	72	1.36%
Veneto	2,068	0.44%	182	1.67%	68	2.19%
TOTAL	**18,553**	**0.32%**	**9,895**	**1.52%**	**3,191**	**1.96%**

Quarantines in students, teachers and other personnel by region, from kindergarten to middle school in the period 23-28 November.

REGION	Cases of quarantine among students	% of quarantine among students	Cases of quarantine among teachers	% of quarantine among teachers	Cases of quarantine among other personnel	% of quarantine among other personnel
Abruzzo	2,532	1.95%	308	2.68%	55	2.71%
Apulia	7,574	1.64%	816	1.92%	521	2.22%
Basilicata	455	0.79%	107	1.47%	164	2.17%
Calabria	1,556	0.74%	374	1.43%	64	1.70%
Campania	1,099	0.18%	620	0.86%	80	1.54%
Emilia Romagna	9,969	2.36%	1,231	2.69%	247	2.72%
Friuli Venezia Giulia	2,421	2.41%	1,140	2.91%	330	2.73%
Lazio	13,268	2.57%	1,742	2.96%	87	2.80%
Liguria	3,886	2.88%	407	3.73%	34	2.97%
Lombardy	23,599	2.51%	434	2.94%	347	2.77%
Marche	5,273	3.09%	771	3.83%	388	3.14%
Molise	571	1.77%	1,077	2.20%	430	2.46%
Piedmont	7,545	1.89%	107	2.59%	430	2.63%
Sardinia	4,221	2.78%	489	3.16%	338	2.92%
Sicily	8,280	1.54%	1,197	1.86%	66	2.21%
Tuscany	9,187	2.65%	1,510	3.01%	359	2.81%
Umbria	1,728	1.70%	395	2.05%	100	2.36%
Veneto	8,598	1.84%	2,247	2.28%	131	2.48%
TOTALE	**111,762**	**1.92%**	**14,972**	**2.30%**	**4,171**	**2.56%**

Incidence rates of secondary infections identified during activity of contact tracing in Italian Schools

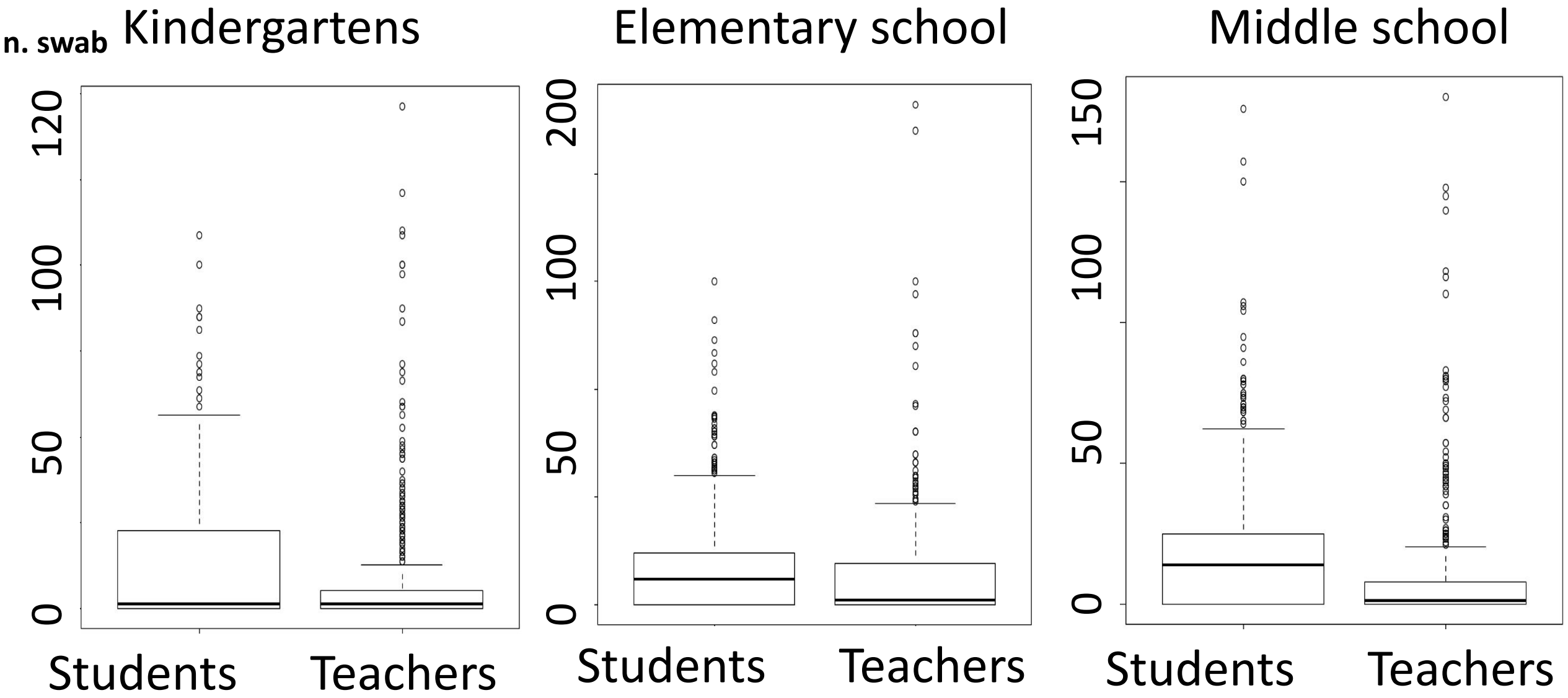
	Student as index case LSmeans 95%CI	Teacher as index case LSmeans 95%CI	P-test
Kindergarten	0.78% (0.45%, 1.20%)	0.71% (0.33%, 1.22%)	0.81
Elementary school	0.68% (0.48%, 0.91%)	0.98% (0.64%, 1.39%)	0.22
Middle school	0.74% (0.53%, 0.97%)	0.90% (0.51%, 1.40%)	0.50

Data from 23 of November to 5 of December 2020.

Incidence rates of secondary infections are defined as number of cases/number of swab tests occurring the same week after a SARS-COV-2 positive student or teacher was found.

LSmeans, 95%CI and P-values are estimated with multivariable generalized linear regression model, adjusted for week of test and density of the region, weighted for the number of tests released in each institute to trace close contacts.

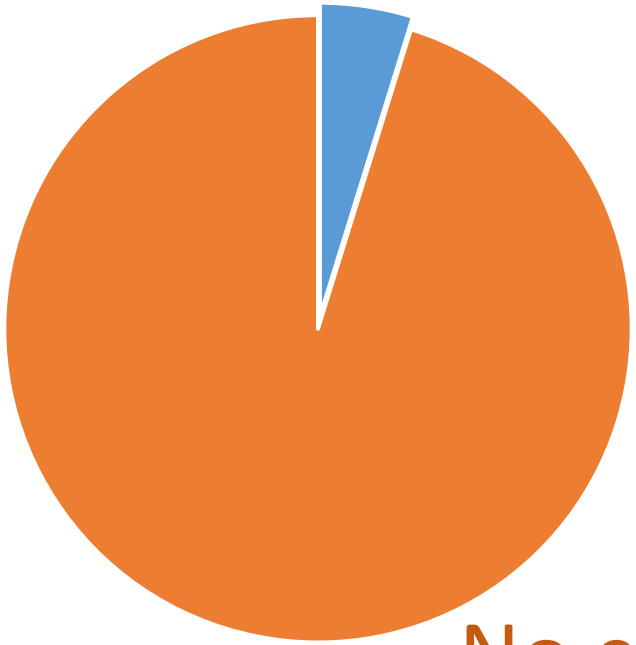
Number of swabs for screening per week during contact tracing after an index case found in schools



Frequencies of clusters within schools in two weeks

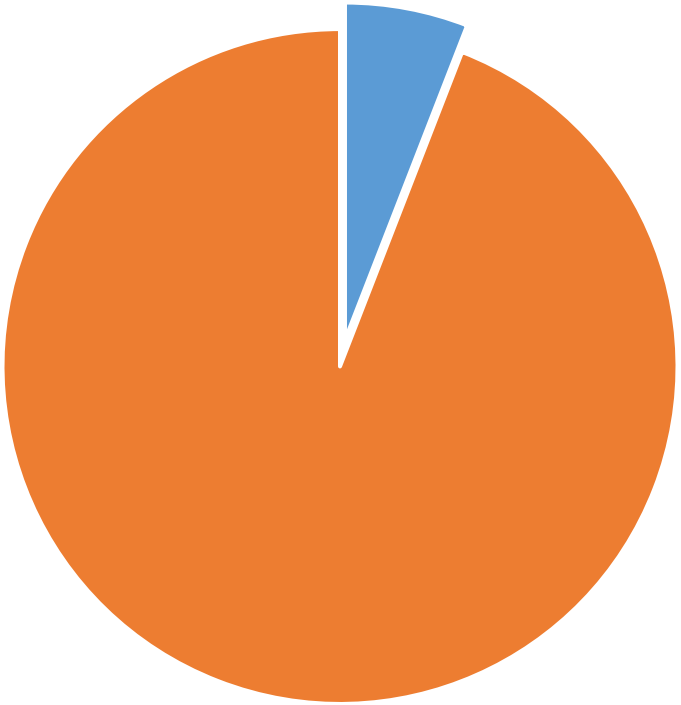
End of November-Begging of December 2020

Kindergarten

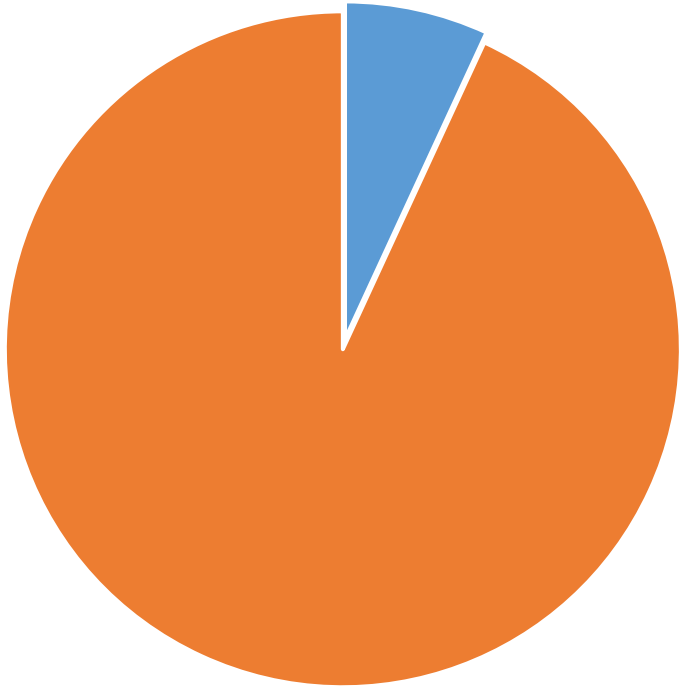


5%-7%

Middle schools



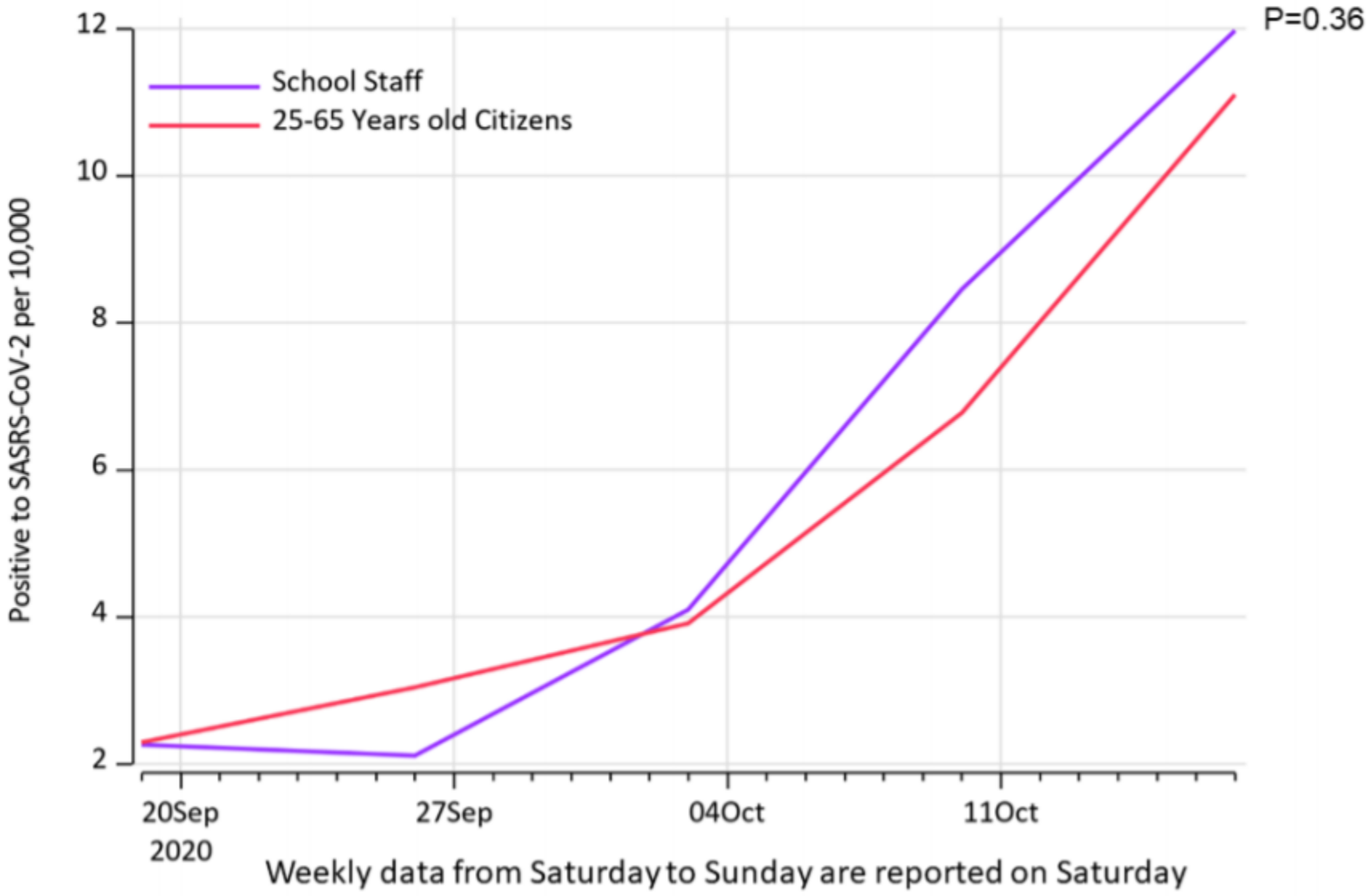
Elementary schools



No cluster

Investigation of Incidence of Sars-covd-2 in teachers/staff
Data from Veneto

Incidence of SARS-cov-2 among teachers and the general population at working age interval 25-65 in Veneto

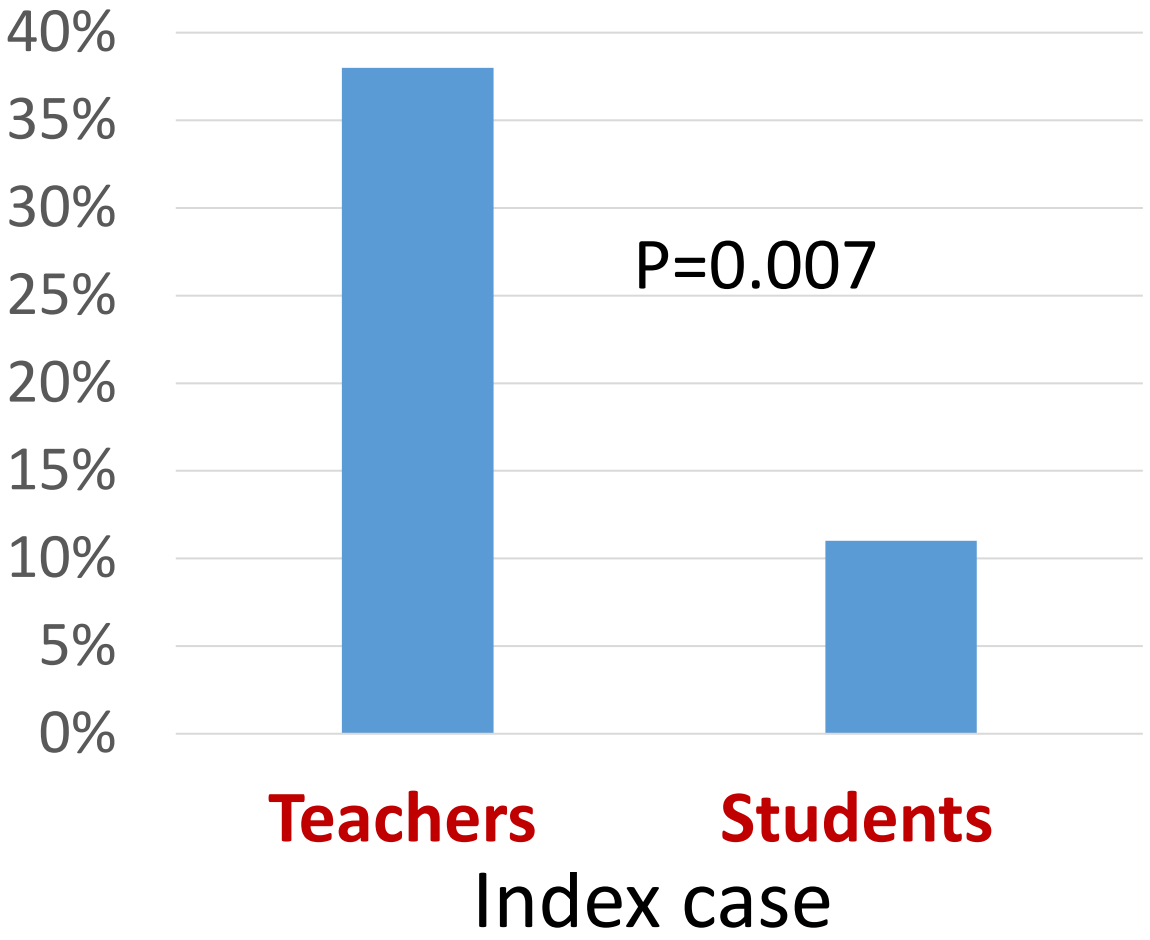


The frequency of secondary cases in teachers at school by type of index case

Index cases		Secondary cases			
		Total	Students	Teachers	Staff
Students	355	60 (100%)	54 (90%)	6 (10%)	0 (0%)
Students age <13		38 (100%)	33 (87%)	5 (13%)	0 (0%)
Students age 13-18		22 (100%)	21 (95%)	1 (5%)	0 (0%)
Teachers	112	16 (100%)	10 (63%)	6 (37%)	0 (0%)
Staff	25	5 (100%)	0 (0%	0 (0%)	5 (100%)
Total	492	81	64	12	5

Index and secondary cases in 339 schools of the Province of Verona

25th of November to 21st of December 2020

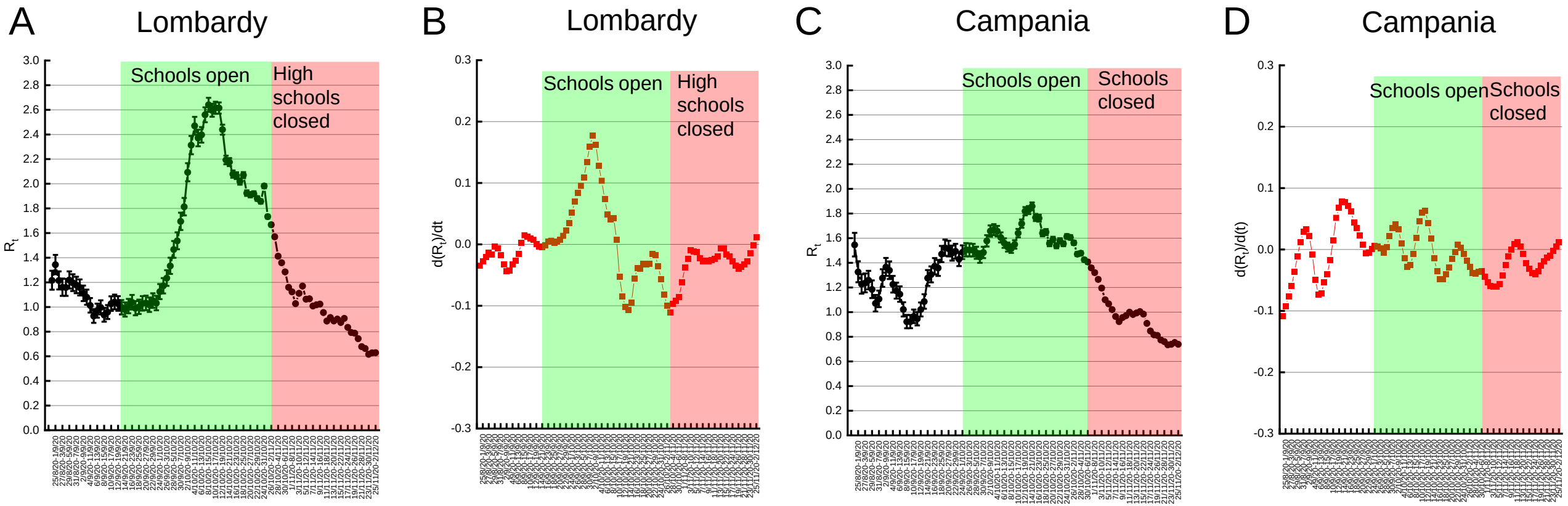


Similar results were found recently in a study conducted in Georgia

Clusters of SARS-CoV-2 Infection Among Elementary School Educators and Students in One School District — Georgia, December 2020–January 2021. Jeremy A. W. Gold, M

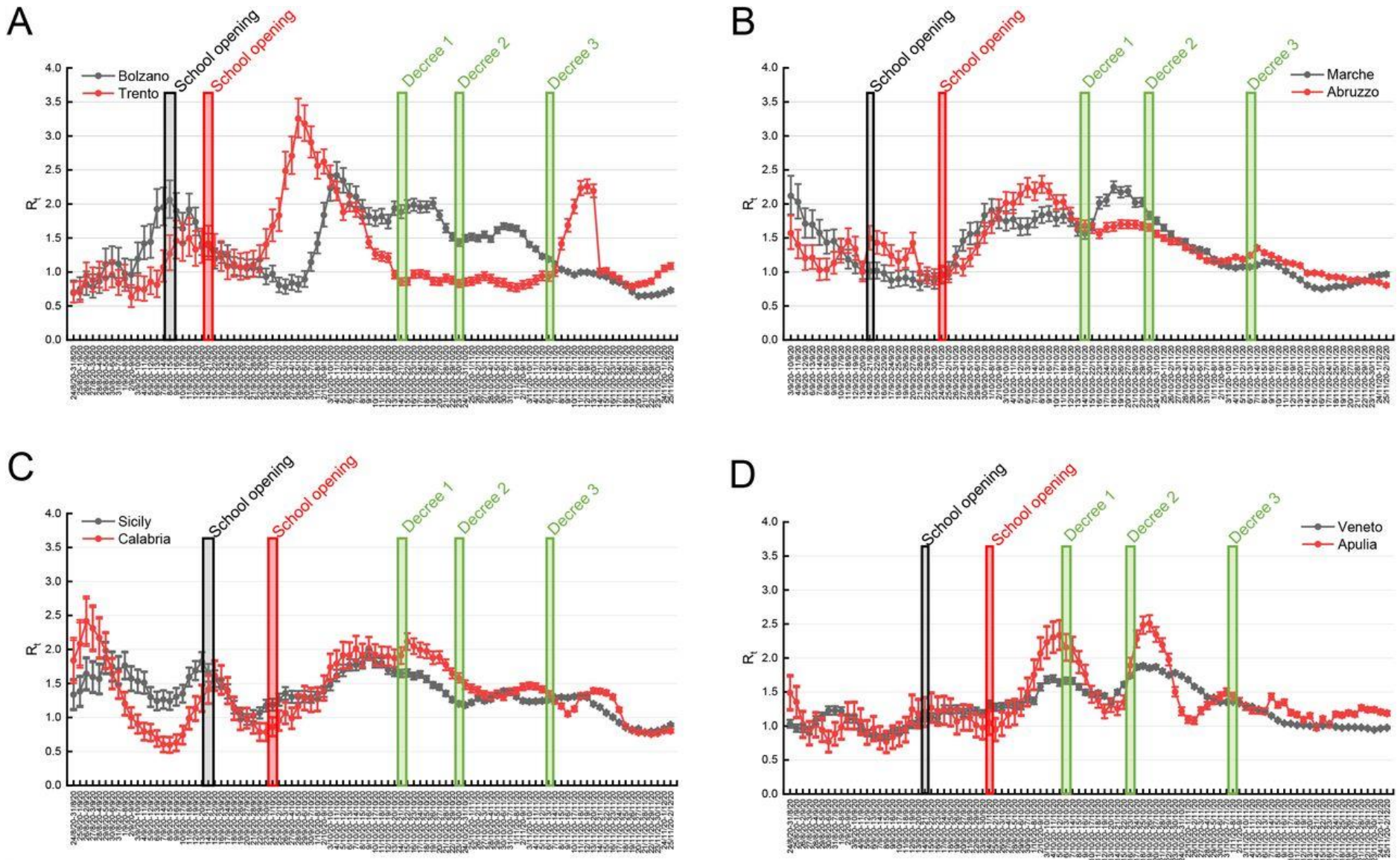
Investigation of changes in time of Sars-cov-2 in association with opening and closing of schools

Opening and closure of schools do not modify Rt



Rt was computed from the positives after referral to swab by a physician (diagnostic suspicion).
In all graphs, R_t values are reported as median values with 95% confidence interval over a 7-day period.
First order derivative of R_t in Lombardy (B) and Campania (D). Days of school opening and closure are indicated.

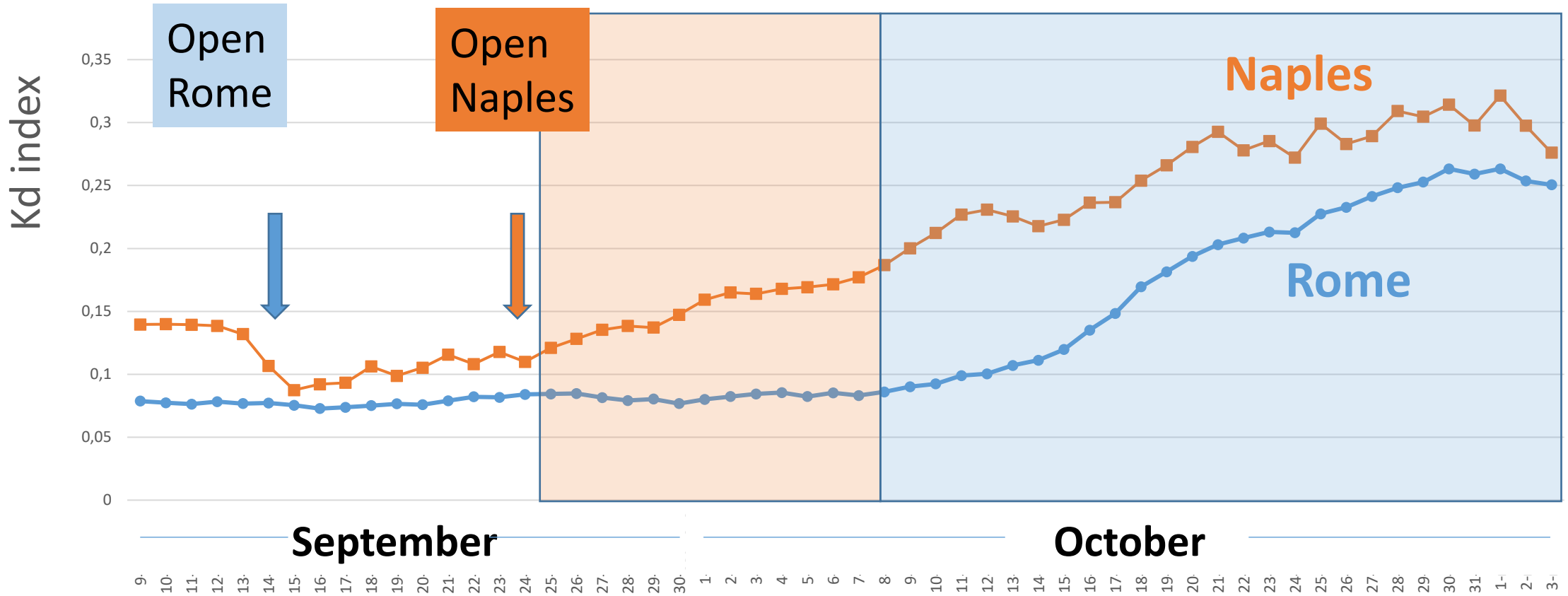
Increases in R_t are not univocally correlated with school opening times



Pairwise comparison of median R_t in the indicated 7 days periods (95% Confidence intervals) in the provinces of Bolzano and Trento (A) and in the indicated regions (B-D). The green bars indicate the day of the entry into force of the Presidential decrees

In Rome schools opened 10 days before Naples, but the positive numbers began to rise 12 days after Naples

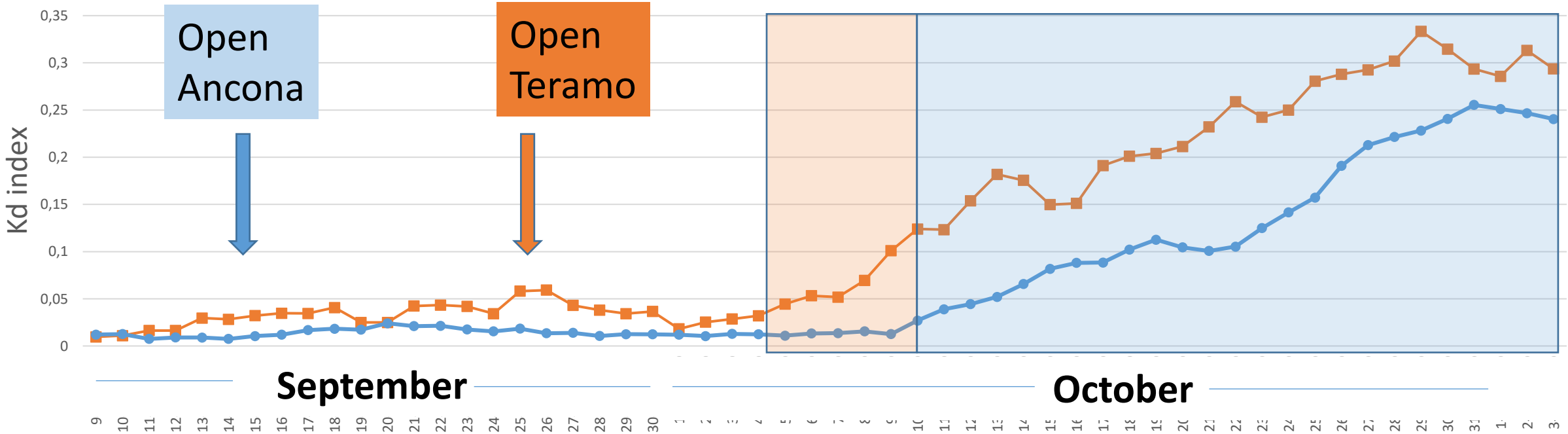
Kd: indicator adopted by the Japanese COVID-19 committee to control changes in the epidemic curve



Kd is a backward difference approximation of the logarithmic derivative of the cumulative n. of cases with a time interval of 7 days; the ratio of the n. of newly confirmed cases in a week to the total number of cases.

Nakano T, Ikeda Y. Novel Indicator to Ascertain the Status and Trend of COVID-19 Spread: Modeling Study. J Med Internet Res. 2020 Nov 30

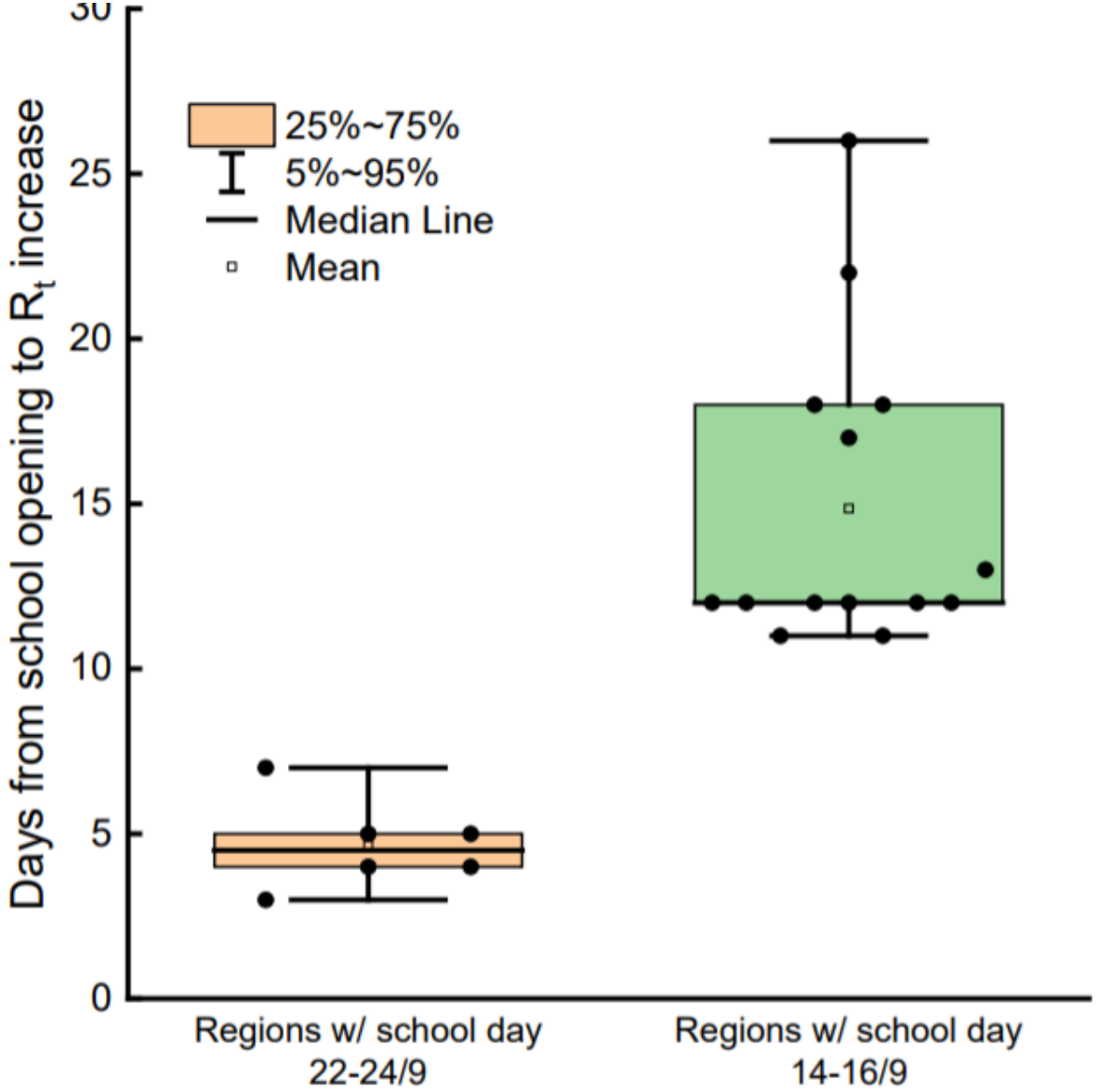
In Ancona schools opened 10 days earlier than in Teramo, but the positive numbers increased 10 days later



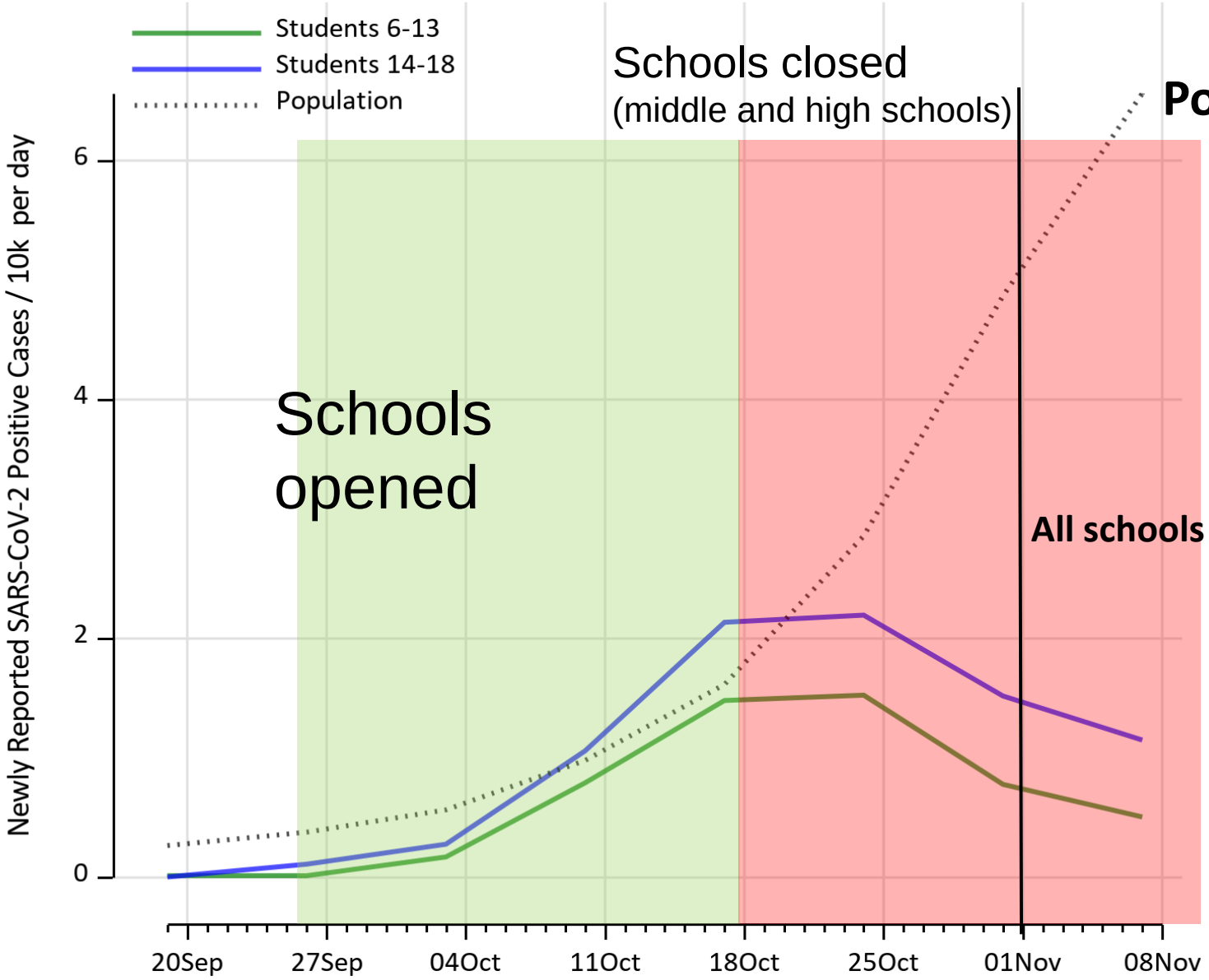
Same trend comparing with L'Aquila

K: indicator adopted by the Japanese COVID-19 committee to control changes in the epidemic curve

Days of delay between school opening and the increase in the Rt infection rate



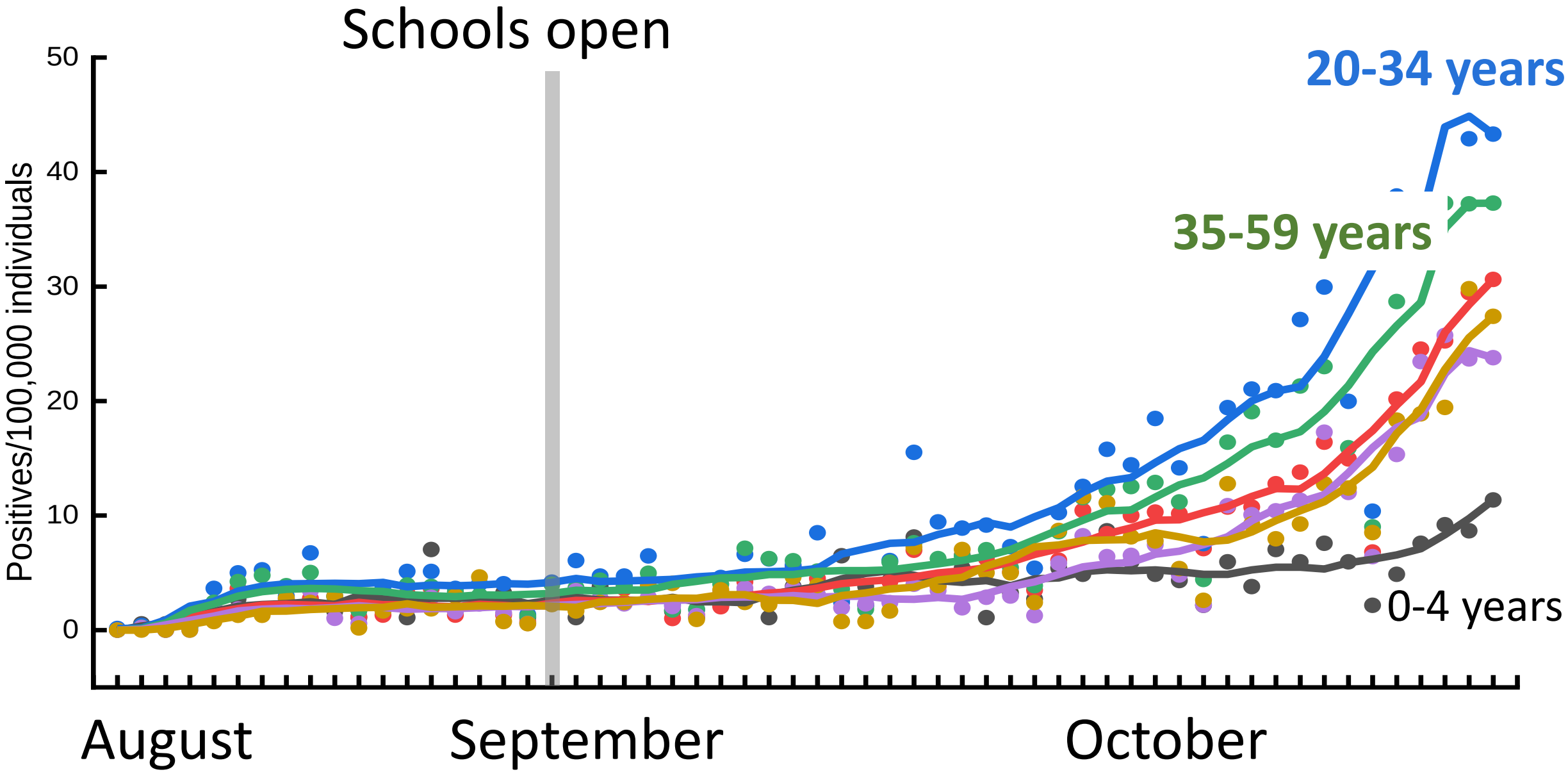
In Campania even when schools are closed the curve of sars-cov-2 cases continues to increase as before



Positive students: high schools

Positive students elementary and middle schools

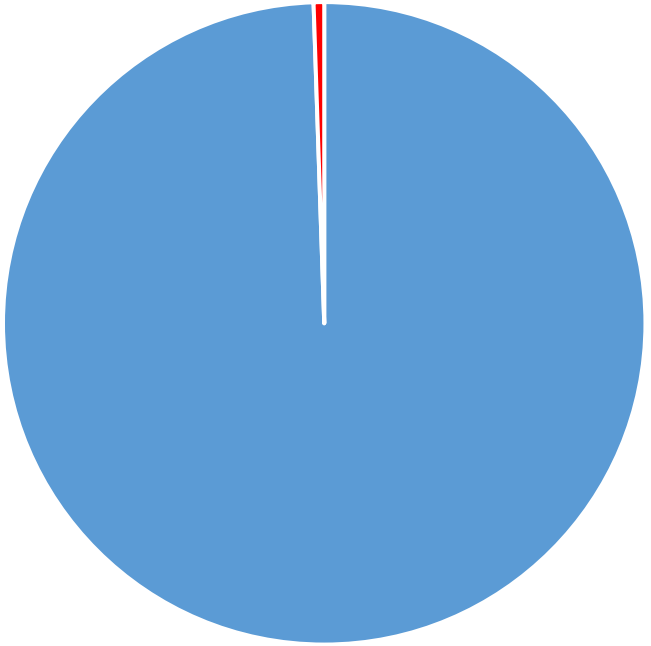
Cases increased primarily for the 20-59 age groups



Other studies

Incidence of sars-cov-2 during a screening test in all schools of Sicily

Kindergarten	0.12%
Elementary	0.35%
Middle schools	0.56%
High schools	0.92%
Total	**0.53%**



Over 312000 students in November

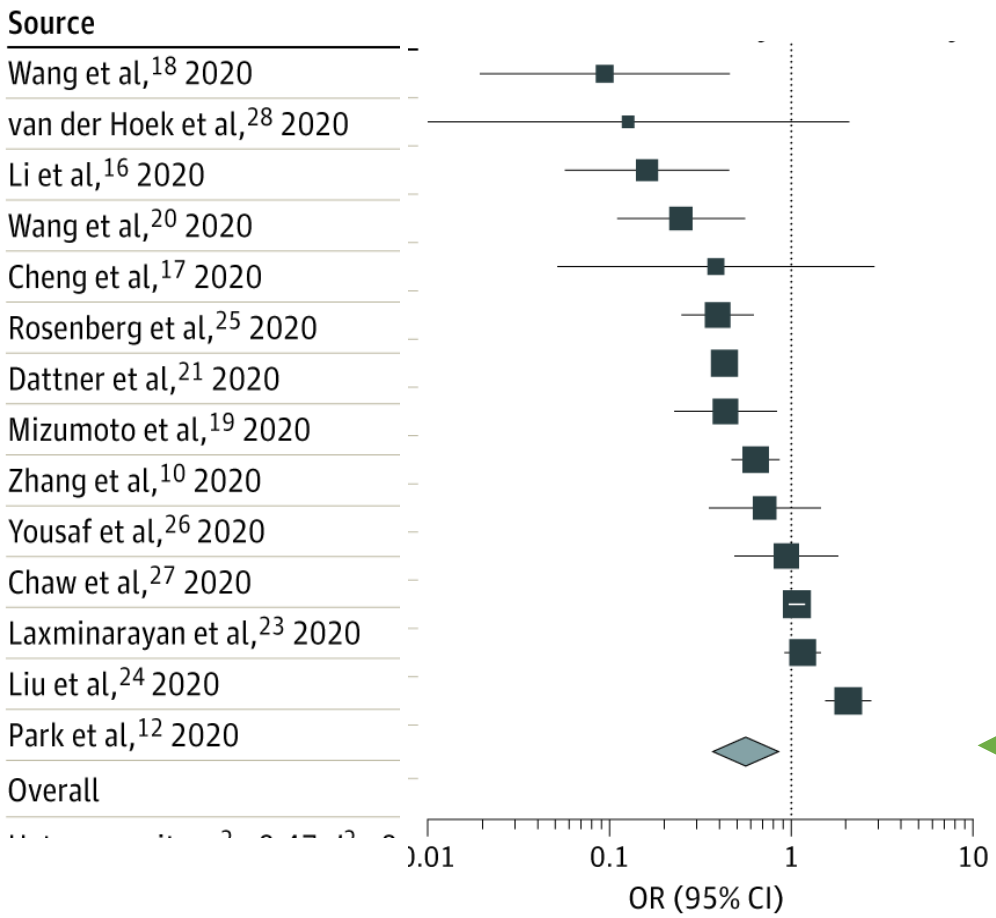
Florence:

January 2021 third evaluation: 7 positive out of over 12 000 in elementary and middle schools.

Data from Minister of Education

Studio finanziato da Palazzo Vecchio e Fondazione Cr Firenze

Children and adolescents have a lower susceptibility to SARS-CoV-2 infection than adults: meta-analysis

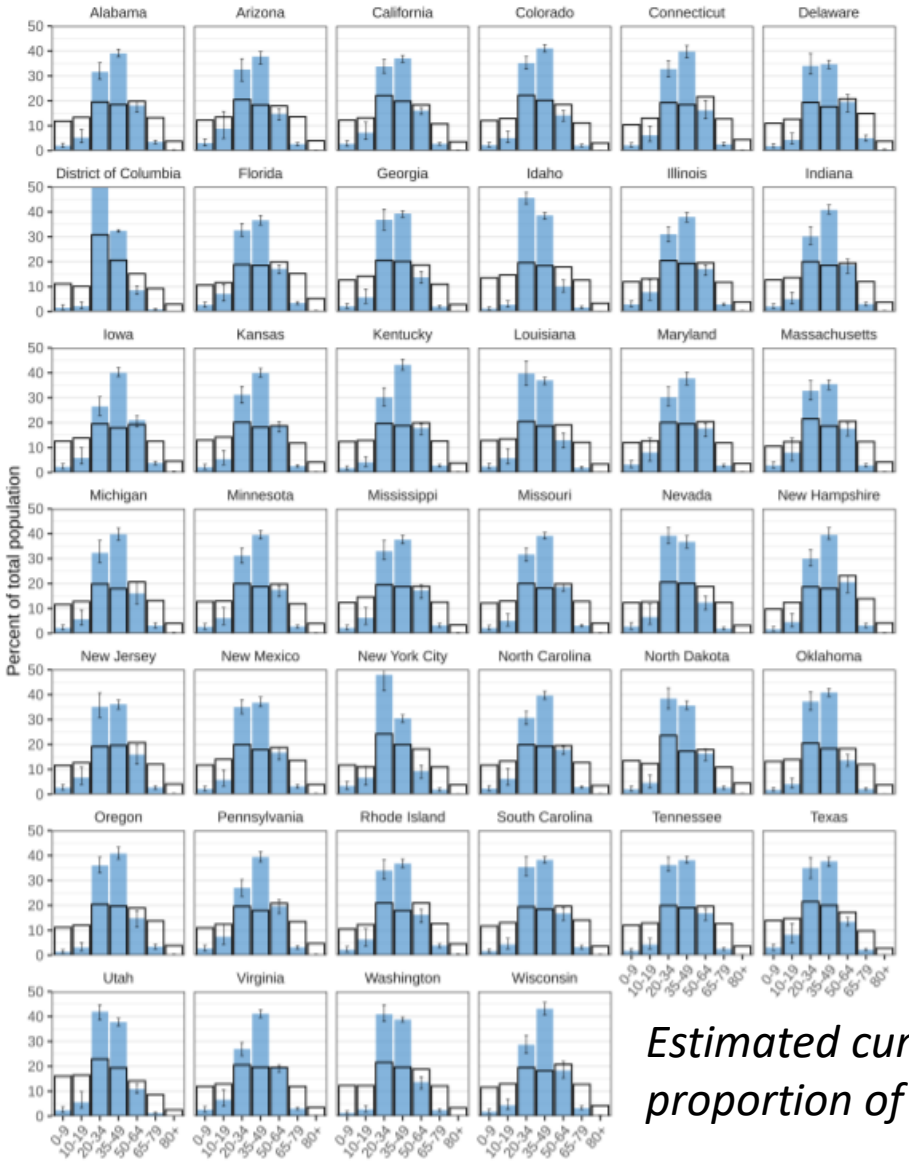


20 years or younger half risk

Viner et al. JAMA Pediatr. Published online September 25, 2020.

https://science.sciencemag.org/.../11/23/science.abe2424

Age groups that sustain resurging COVID-19 epidemics in the United States



Age-related mobility of more than 10 million people in the United States and linked them to age-specific COVID-19 mortality data

Adults aged 20-34 and 35-49 is the only age groups that contribute disproportionally to COVID-19 spread relative to their size in the population

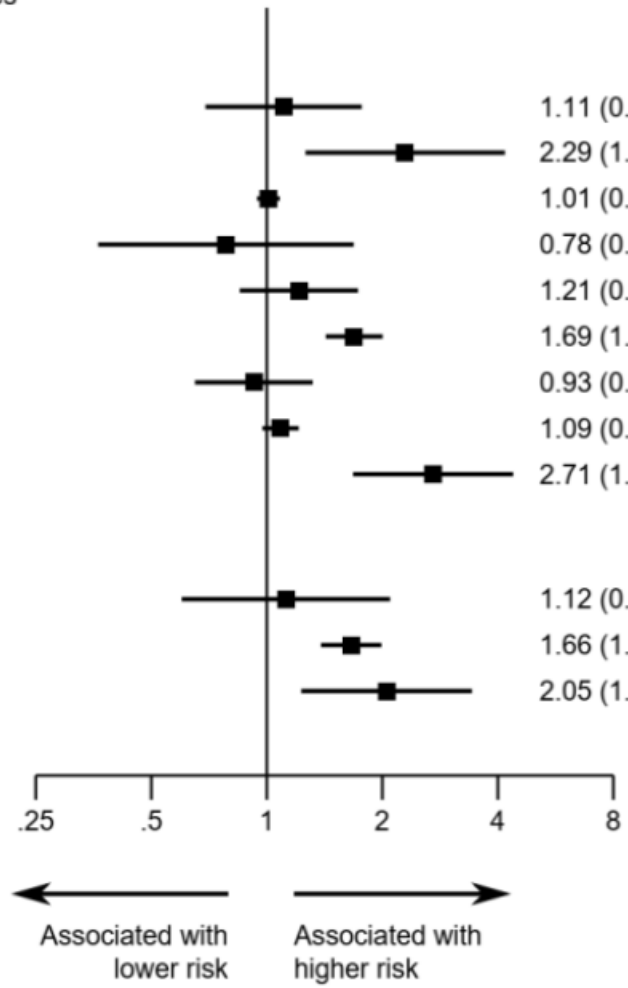
The impact of school reopening is mitigated most effectively by strengthening disease control to adults aged 20-49.

Estimated cumulated contribution of age groups to SARS-CoV-2 infections, versus the proportion of the population in the same age group.

MÉLODIE MONOD et al ON BEHALF OF THE IMPERIAL COLLEGE COVID-19 RESPONSE TEAM. Science 02 feb 2021

Recents austrian study

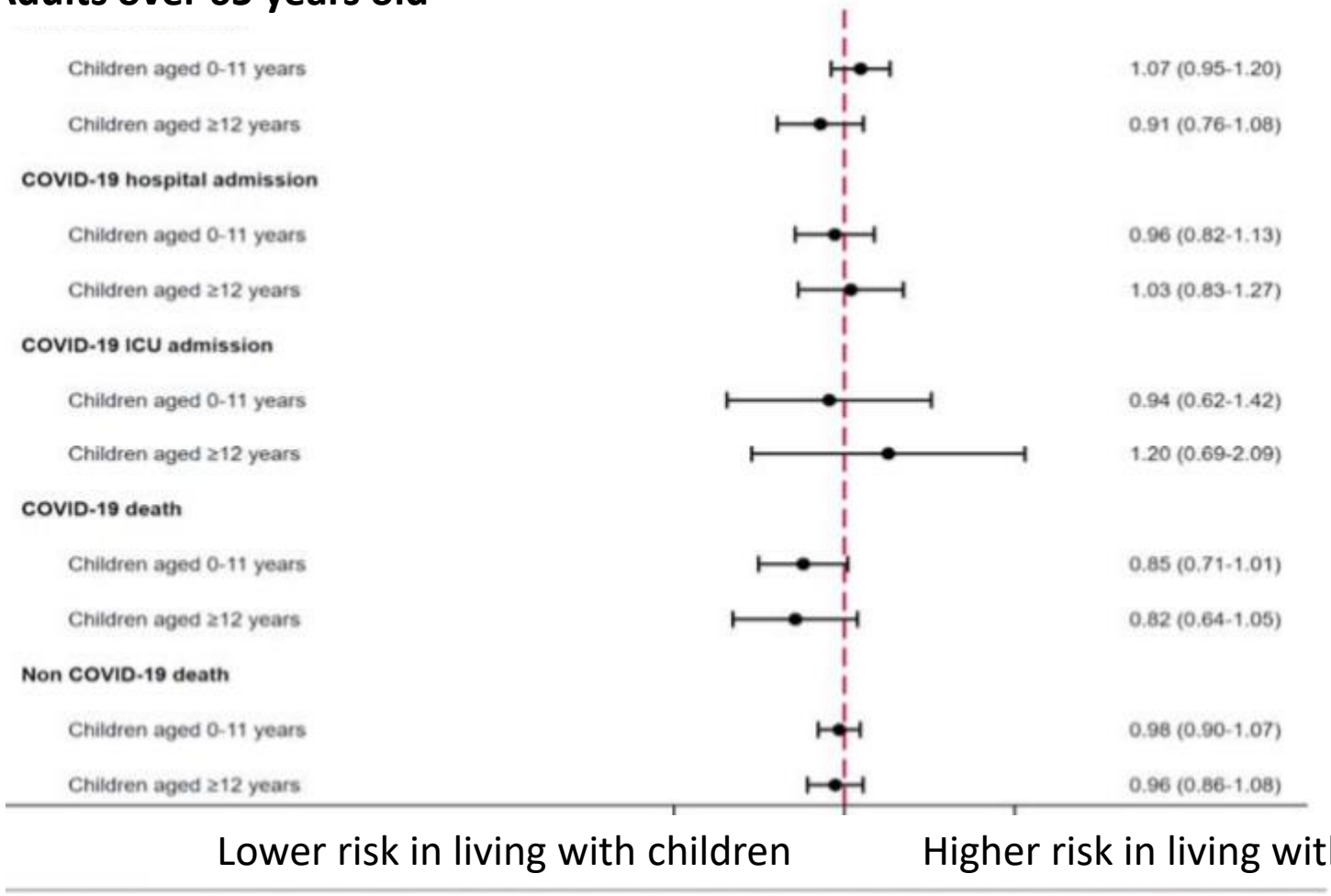
Variable	Comparison	No. of Schools	No. of Participants	No. of Cases	OR for RT-PCR detected SARS-CoV-2 infection (95% CI)	P value
(A) Unadjusted model						
Type of school	Secondary vs. primary	245	10734	93	1.11 (0.69, 1.77)	0.673
Local population density	>500 vs. ≤500 inhabitants/km^2	245	10734	93	2.29 (1.26, 4.17)	0.007
Average no. of pupils/class	Per one additional pupil/class	245	10734	93	1.01 (0.94, 1.08)	0.786
Type of participant	Teachers vs. pupils	245	10734	93	0.78 (0.36, 1.68)	0.531
Sex	Male vs. female	245	10734	93	1.21 (0.85, 1.73)	0.288
Regional 7-day incidence	Per two-fold higher value	245	10734	93	1.69 (1.42, 2.00)	<0.001
Age (teachers)	Per one year older age	241	1255	9	0.93 (0.65, 1.32)	0.667
Age (pupils)	Per one year older age	245	9460	84	1.09 (0.97, 1.21)	0.138
Social deprivation index (pupils)	High/very high vs. low/moderate	242	9337	84	2.71 (1.68, 4.39)	<0.001
(B) Multivariable adjusted model						
Local population density	>500 vs. ≤500 inhabitants/km^2	242	10595	93	1.12 (0.60, 2.10)	0.719
Regional 7-day incidence	Per two-fold higher value	242	10595	93	1.66 (1.38, 1.99)	<0.001
Social deprivation index (pupils)	High/very high vs. low/moderate	242	9337	84	2.05 (1.23, 3.42)	0.006



Prevalence of RT-PCR-detected SARS-CoV-2 infection at schools: First results from the Austrian School-SARS-CoV-2 Study
Peter Willeit et al. medRxiv 2021.01.05.20248952

Cohort study from UK

Adults over 65 years old



12 million people followed-up:

Adults who live with children do not have a worse prognosis than those who live without children.

No significant effect of the closure of schools on the progress of the epidemic

Orbes H, Morton CE, Bacon S, et al. Association between living with children and outcomes from Covid19: an OpenSAFELY cohort study of 12 million adults in England. medRxiv 2020: 2020.11.01.20222315.

Studies that provided a quantitative estimate of the impact school closures on community transmission of SARS-CoV-2.

Author, Year	Finding	Overall Judgement	Likely Direction
Courtemanche, 2020	**No effect**	**Low**	-
Hsiang, 2020	**No effect**	**Low**	-
Auger, 2020	Preventative effect	Moderate	Favours Experimental
Matzinger, 2020	Preventative effect	Moderate	Unpredictable
Iwata, 2020	No effect	Serious	Unpredictable
Juni, 2020	Preventative effect	Serious	Favours Experimental
Neidhofer, 2020	Preventative effect	Serious	Favours Experimental
Wong, 2020	Preventative effect	Serious	Unpredictable
Yehya, 2020	Preventative effect	Serious	Favours Experimental
Stein-Zamir, 2020	Preventative effect	Critical	Unpredictable

Figure 2: Study results, stratified by risk of bias

Studies with lower risk of bias did not report any associations, while those with a higher risk of bias generally reported significant preventive effects.

Do school closures reduce community transmission of COVID-19? A systematic review of observational studies
Sebastian Walsh et al https://www.medrxiv.org/content/10.1101/2021.01.02.21249146v1.full.pdf

ECDC study on 28 European countries

- COVID-19 cases between 1-18 years of age have lower rates of hospitalisation, severe hospitalisation and death than other age groups.
- Younger children appear to be less susceptible to infection, and when infected, less often lead to onward transmission than older adolescents and adults.
- Transmission in schools has accounted for a minority of all COVID-19 cases in each country.
- Educational staff and adults within the school setting are generally not seen to be at a higher risk of infection than other occupations.

https://www.ecdc.europa.eu/en/publications-data/children-and-school-settings-covid-19-transmission

The NEW ENGLAND JOURNAL of MEDICINE

CORRESPONDENCE

Open Schools, Covid-19, and Child and Teacher Morbidity in Sweden

The risk of intensive care for Covid-19 in teachers was found lower compared with other occupations (excluding health care workers)

The sex- and age-adjusted relative risk was:

among preschool teachers RR= 1.10 (95%CI: 0.49 to 2.49)

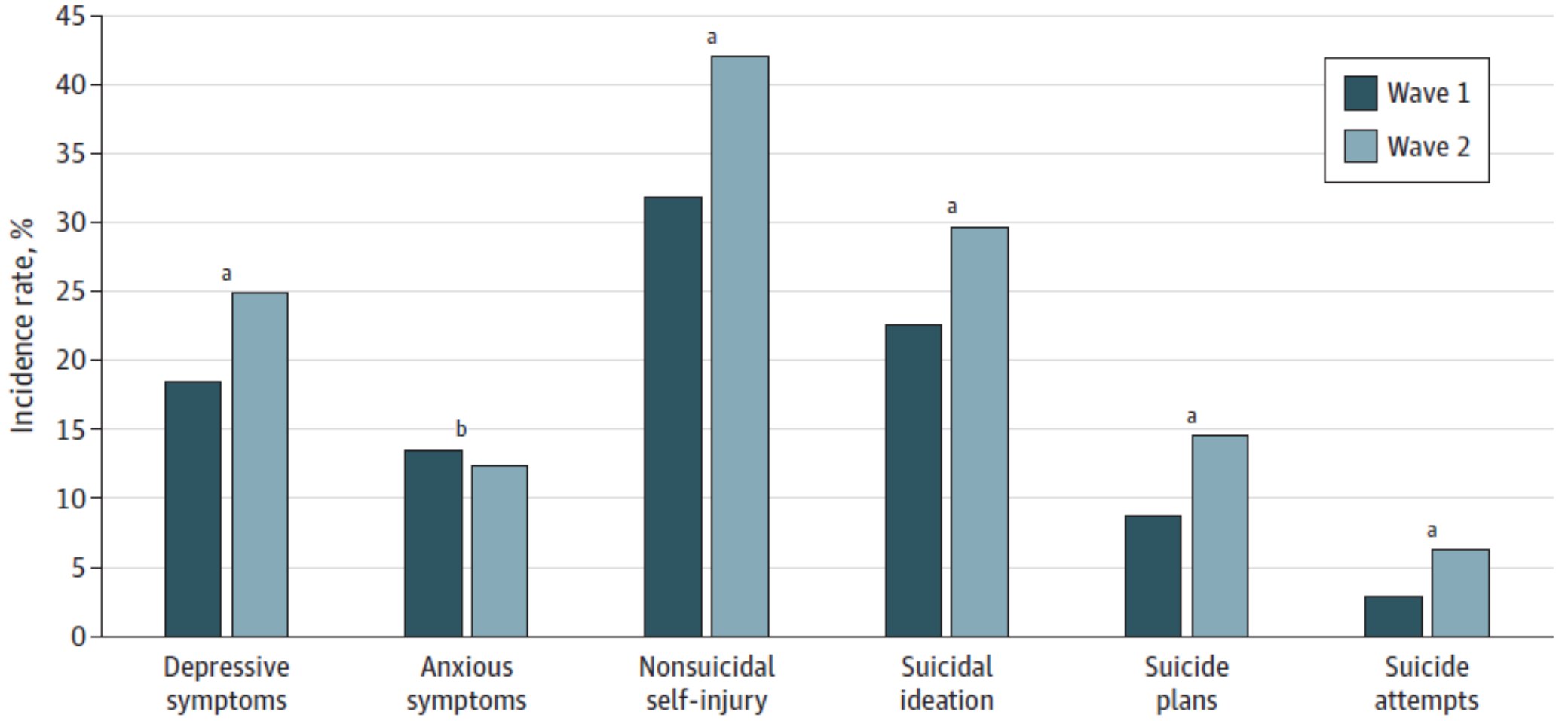
among school teachers RR=0.43 (95%CI: 0.28 to 0.68)

February 18, 2021
N Engl J Med 2021; 384:669-671

Learning and psychological problems related to schools closure

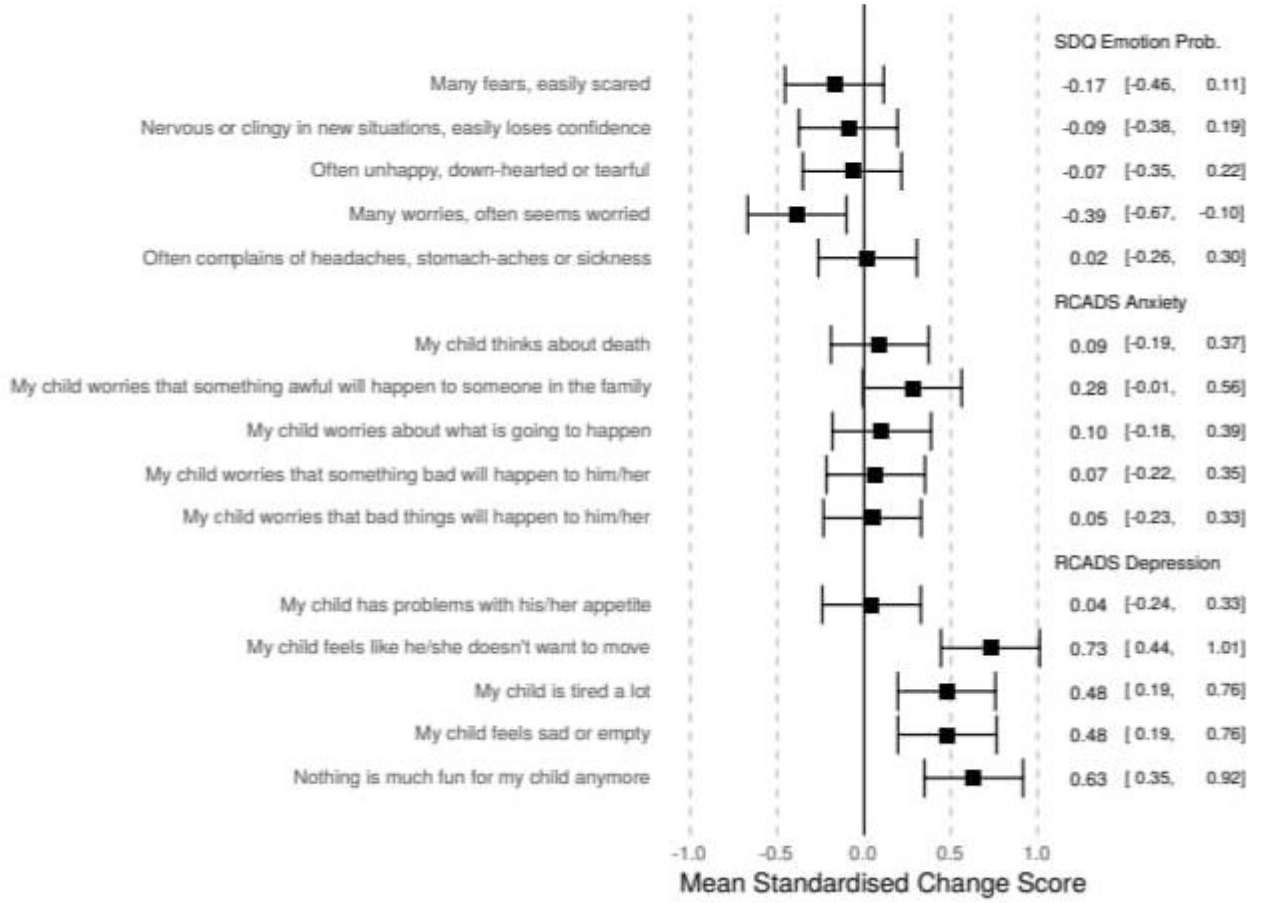
Cohort study of 1241 children and adolescents in China on mental disorders

Before the outbreak begins and 2 weeks
after the school reopens



Lei Zhang et al JAMA Netw Open. 2020

Aumenti significativi dei tassi di depressione nei bambini di 8-12 anni con la chiusura delle scuole in UK



Studio di coorte prospettico from UK ha indagare gli effetti del lockdown e delle chiusure scolastiche sulla salute mentale dei bambini 8-12 anni.

I tassi di depressione dei bambini sono aumentati significativamente durante il blocco, rispetto a 18 mesi prima, con un effetto medio-grande.

Saranno necessarie risorse e formazione aggiuntive per gli insegnanti della scuola per supportare i bambini in difficoltà.

Bignardi G *et al Archives of Disease in Childhood* Published. 09 December 2020

Disagio psicologico negli universitari: studio francese

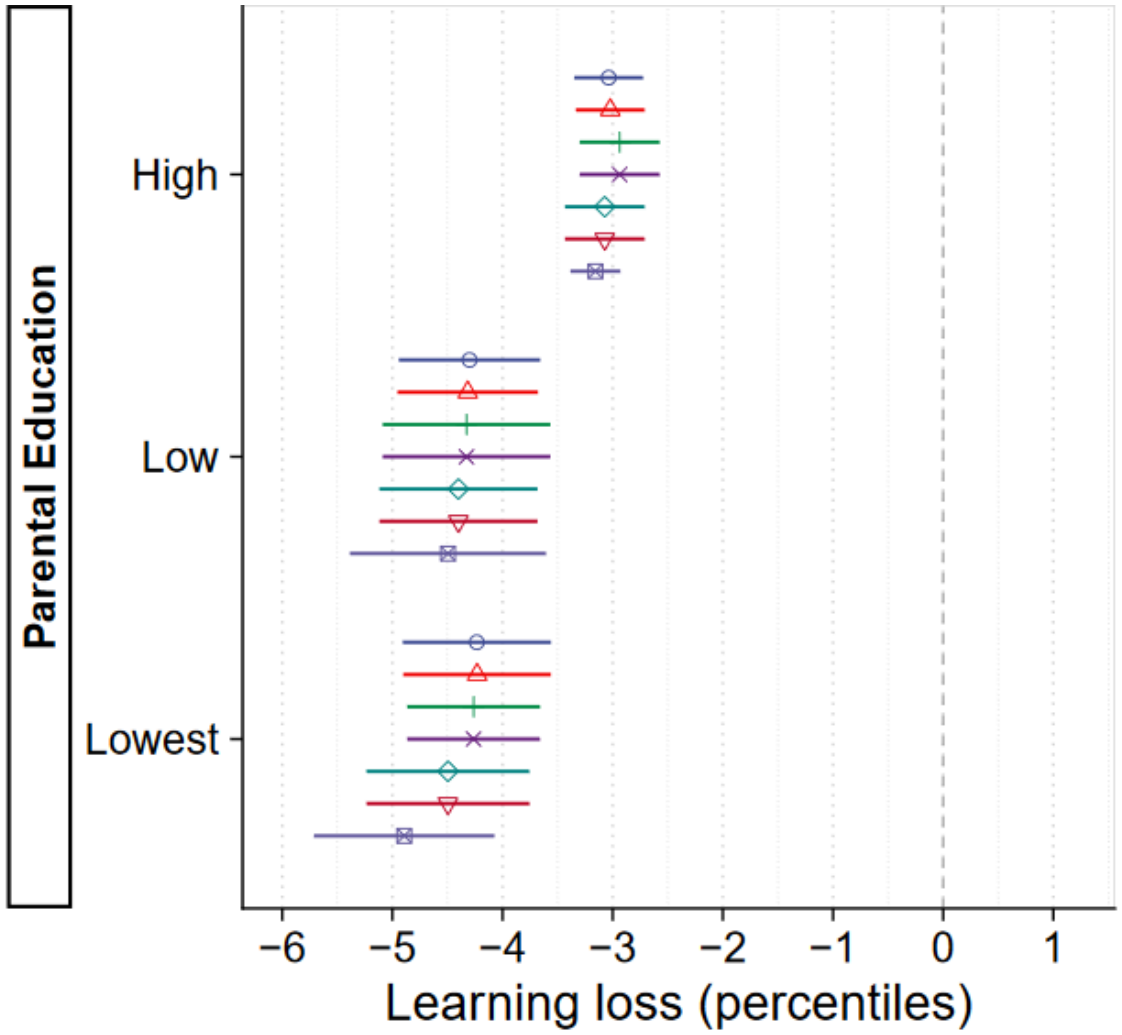
N=69 054 studenti durante la prima ondata

I risultati sono i seguenti:
-prevalenza di pensieri suicidi dell'11,4÷
-grave angoscia: 22,4÷
-alto livello di stress percepito: 24,7%
-depressione grave 16,1%
-alto livello di ansia 27,5%.

I modelli multivariati indicano che la segnalazione di almeno un problema di salute mentale è stata trovata associata significativamente con:
-il genere femminile OR= 2,10 (2,02-2,19)
-il genere non binario OR=3,57 (2,99-4,27)
-la precarietà, perdita di reddito: OR=1,28 (1,22-1,33)
alloggi di bassa qualità: OR=2,30 (2,06-2,57)
-storia di problemi psichiatrici OR=3,28 (3,09-3,48)
-sintomi compatibili con COVID-19 OR=1,55 (1,49-1,61)
-isolamento sociale: debole senso di integrazione: OR=3,63 (3,35-3,92);
bassa qualità delle relazioni sociali: OR, 2,62 (2,49-2,75)
-bassa qualità delle informazioni ricevute: OR=1.56 (1.49-1.64).

Wathelet M et al. JAMA Netw Open. 2020

Learning Loss Due to School Closures During the COVID-19 Pandemic



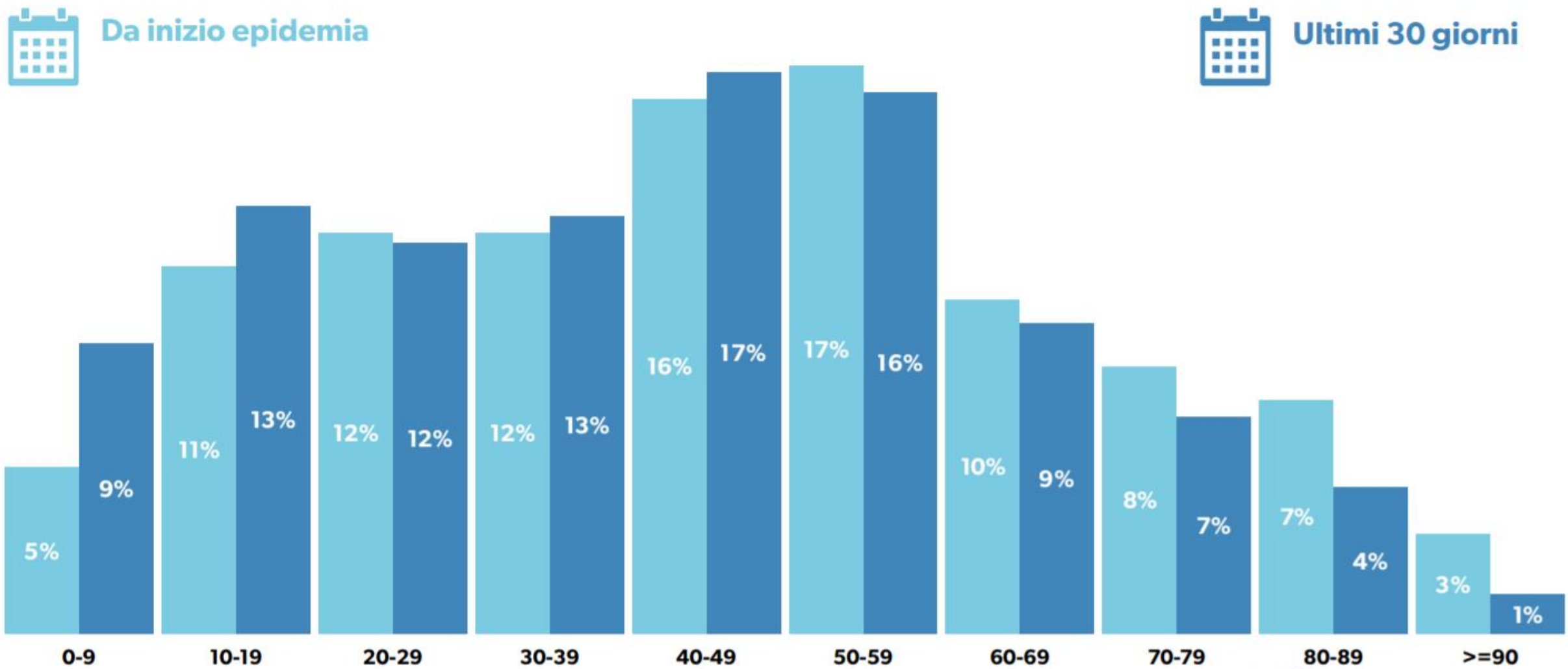
The Netherlands: n≈350,000 people.
After a relatively short lockdown (8 weeks)
The world's highest rate of broadband access.

Findings: A learning loss equivalent to a fifth of a school year.
Losses are up to 60% larger among students from less-educated parents

Engzell, P., Frey, A., & Verhagen, M. D. (2020, October 29). Learning Inequality During the Covid-19 Pandemic.

Situazione con la riapertura delle scuole in Italia nel 2021

Percentuale del numero di casi suddivisi per età. Dati da inizio epidemia e negli ultimi 30 giorni*



Regione Emilia-Romagna

*dati a cura del Servizio regionale Prevenzione collettiva e Sanità pubblica

Aggiornamento del 9 marzo 2021

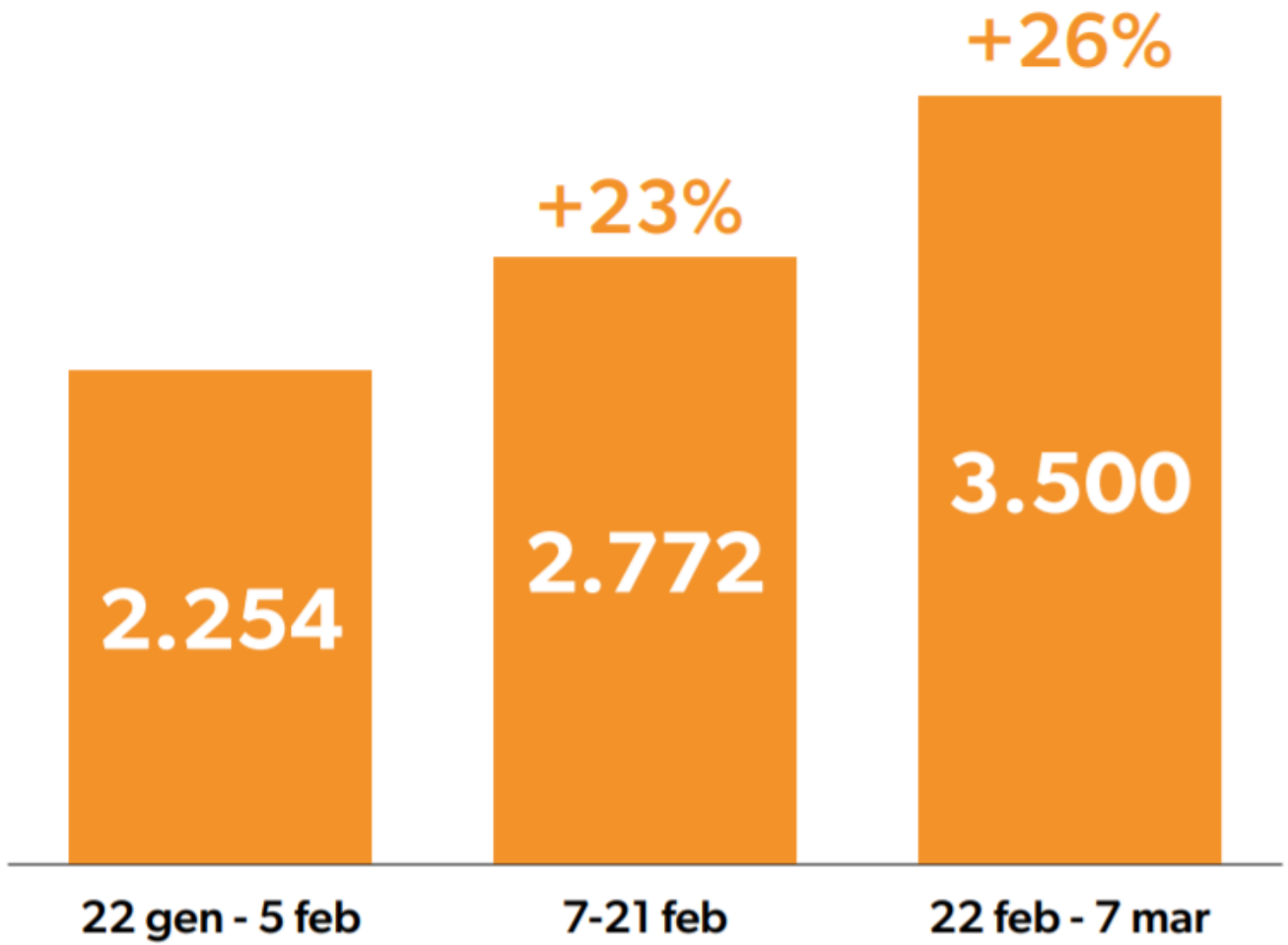
SERVIZIO SANITARIO REGIONALE
EMILIA-ROMAGNA

https://www.regione.emilia-romagna.it/coronavirus/infografiche/report_covid_09-03-2021.pdf

Speciale Scuola
Nuovi casi nel periodo
22 febbraio - 7 marzo 2021

Variazioni casi in ambiente scolastico ogni 15 giorni. Fascia 0-18 anni

STUDENTI E ALUNNI



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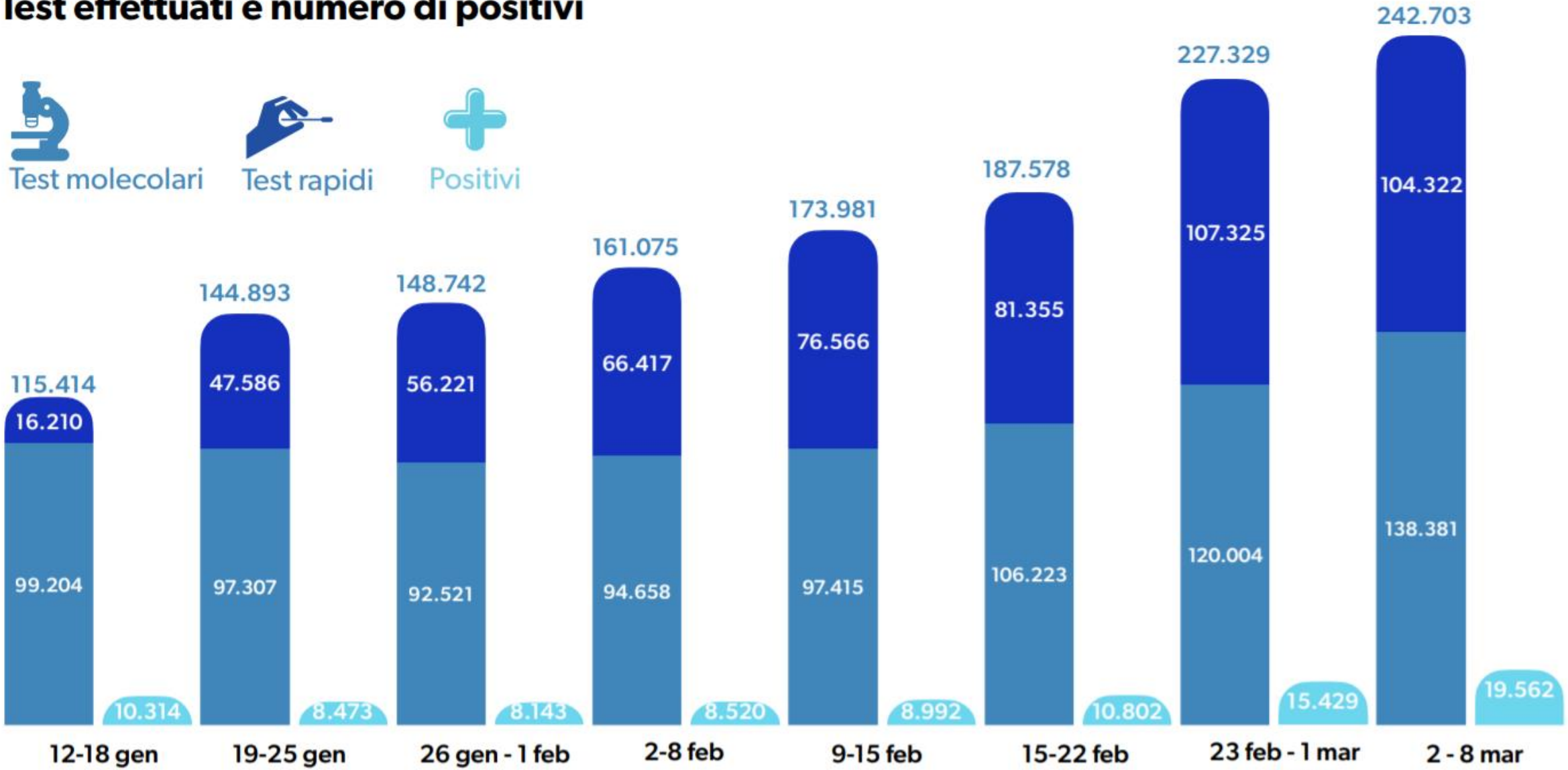
EMILIA-ROMAGNA

Test effettuati e numero di positivi



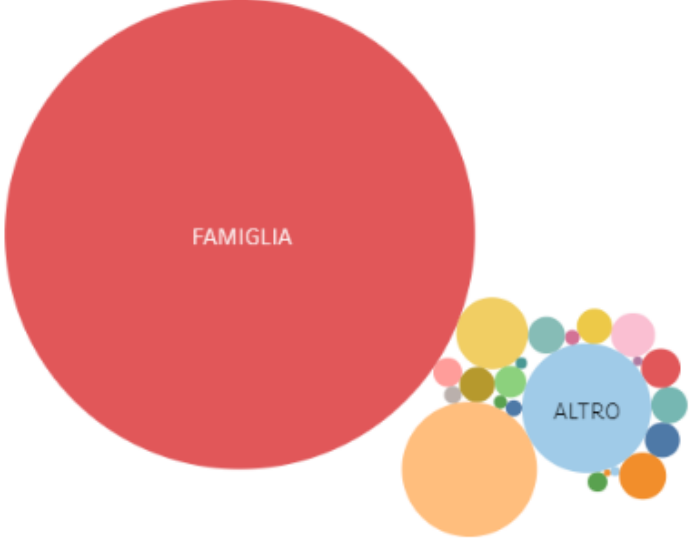
Regione Emilia-Romagna

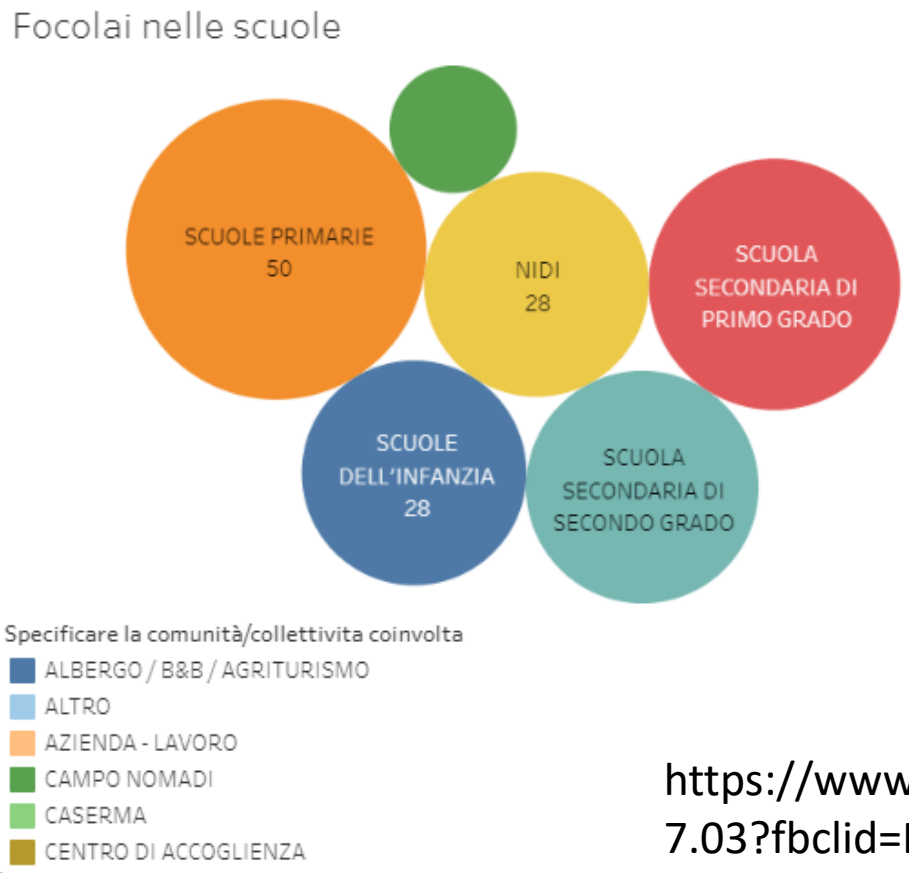
Aggiornamento del 9 marzo 2021

SERVIZIO SANITARIO REGIONALE
EMILIA-ROMAGNA

Focolai a Bologna

Ultimo aggiornamento : 08/03/2021





https://www.ausl.bologna.it/per-i-cittadini/coronavirus/rcps/Report-casi-settimana-1.03-7.03?fbclid=IwAR3Dmzm3xpjoQFpirG1oYStRyiem3GEg1shUOnBZzf8HEzjJ6duF1iwBSRY

Le nuove varianti e le scuole

Un rapporto di gennaio della Public Health England ha mostrato che la variante inglese si trasmette in modo simile in tutte le fasce d'età.

Ha anche scoperto che i bambini, specialmente quelli di età inferiore ai dieci anni, hanno circa la metà delle probabilità degli adulti di trasmettere la variante ad altri.

Le prognosi non è peggiore delle altre varianti.

Un quadro simile sta emergendo su un'altra variante a rapida diffusione, che è stata rilevata per la prima volta in Sud Africa:

non ci sono evidenze di una maggiore diffusione nei giovani.

Dyani Lewis. ***Nature****. 21 Gennaio 2021*

Conclusions

There is a general consensus that the decision to close schools to control the COVID-19 pandemic should be used as a last resort.

The negative physical, mental health and educational impact of proactive school closures on children would likely outweigh the benefits.

Less harmful measures such as the use of tracing protocols and quarantine regimes in schools, as well as improved hygiene and social distancing measures should be considered alternatives to school closures.