

Analysis: Re-opening schools in times of pandemics (III). A first evaluation, three weeks later.

In Spain, primary and secondary schools re-opened between 7th and 14th of September, depending on the Autonomous Community (region). Therefore, children and teenagers have gone to school for three to four weeks. Given the characteristic time of 10-14 days to observe the effects of control measures in this epidemic, it is time to carry out a first evaluation of the impact of such re-opening.

In previous reports⁴, we discussed that the most important risk factor in schools is the surrounding incidence. In this sense, we showed that most of expected positive cases in the schools would come from the exterior, and that transmission inside the schools was not expected to be relevant. Now, we want to check: (1) if the incidence trends of late September have been affected by the re-opening of the schools, and (2) if the pattern of incidence by age has displaced towards pediatric age. Given that Spain does not publish retrospective data series of cases disaggregated by age, we will focus on those communities that do so: Andalucía, Castilla y León, Catalunya and Comunitat Valenciana (see map). We will also add Comunidad de Madrid in the global analysis, given its current importance in terms of epidemiological situation.



Incidence level at the re-opening time

Primary and secondary schools re-opened between 7th and 14th September. At that time, 14-day cumulative incidence (A_{14}) in Spain was between 230 (7th) and 248 (14th) per 100,000 inhabitants, according to data from the Health Ministry⁵. Nevertheless, incidence levels were quite heterogeneous (Figure 1).

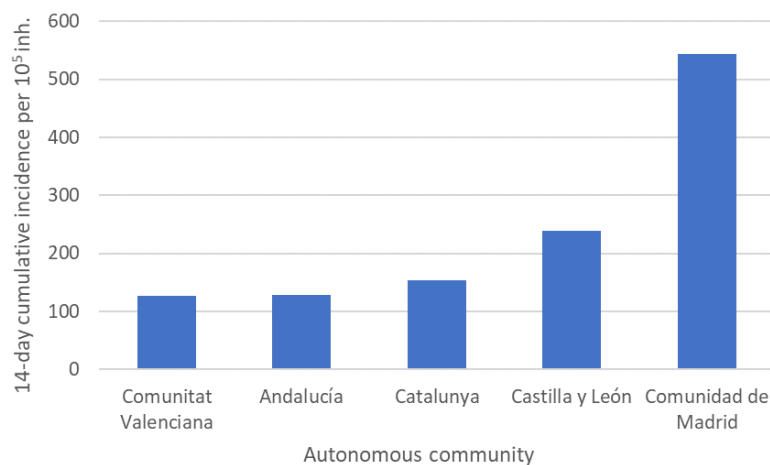


Figure 1: 14-day cumulative incidence the day at which each Autonomous Community re-opened schools.

⁴ <https://upcommons.upc.edu/handle/2117/328694>, <https://upcommons.upc.edu/handle/2117/328695>

⁵ <https://www.msbs.gob.es/profesionales/saludPublica/ccayes/alertasActual/nCov/situacionActual.htm>

Among these regions, the day at which schools opened doors, A_{14} ranged from the 127 per 10^5 inhabitants of Comunitat Valenciana until the 544 cases per 10^5 inh. of Comunidad de Madrid. In all cases, high incidences that forced communities to establish serious hygiene and prevention protocols. In most of the regions, in addition to the compulsory use of masks for children above 6 years and the distancing, hygiene and ventilation measures, the control is based on the organization of children in closed groups (bubble groups) that are quarantined whenever a positive case is detected. Moreover, in communities like Catalunya there is a specific program of scholar mass screenings in high burden counties.

Effect of the re-opening in the global incidence

If schools had acted as amplifiers of the contagions, we should already observe an effect on the global incidence. Let us focus on the value of A_{14} . Figure 2 shows its value at five different weeks since 31st August⁶. We also indicate in the plot the day at which schools were opened in each case.

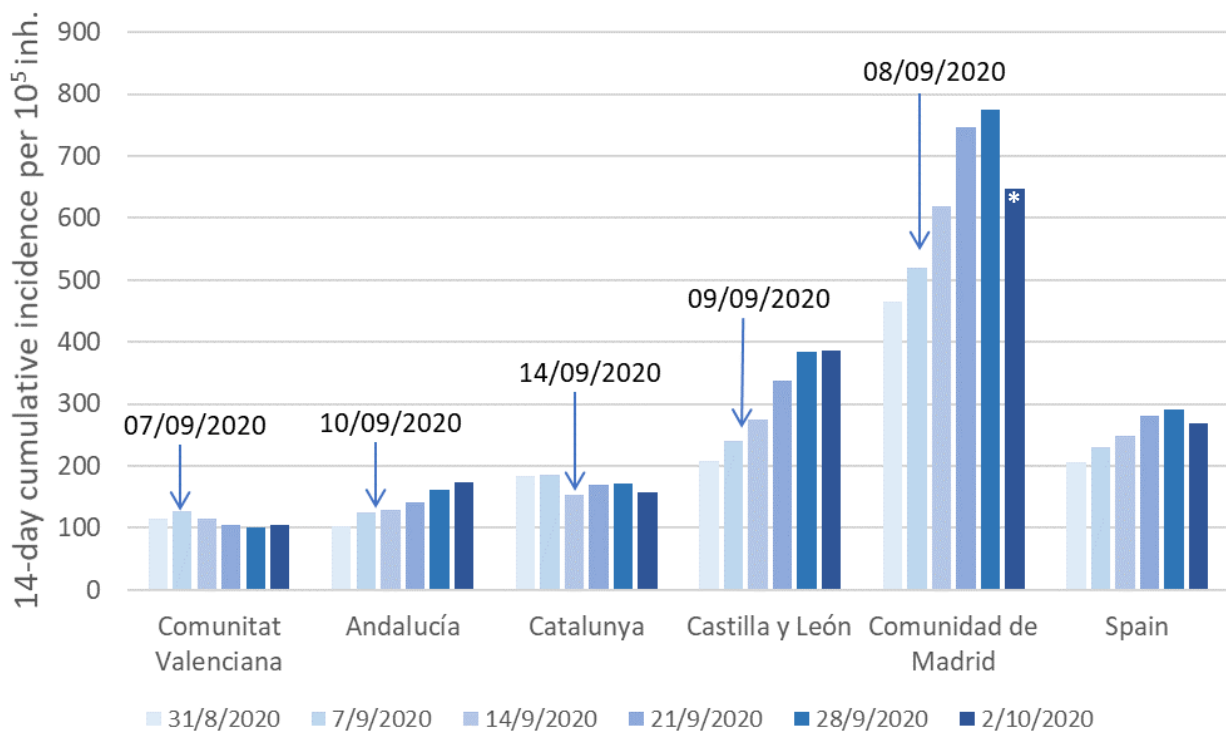


Figure 2: Evolution of 14-day cumulative incidence in some Autonomous Communities, showing the period immediately before and after reopening the schools. The dates and arrows indicate the day at which schools were opened in each case. *Madrid's last point should be validated in further updates.

At first view, re-opening the schools has not significantly modified the trend in any Autonomous Community. Global decreasing trend in Comunitat Valenciana has been maintained for the first three weeks after re-opening, while this week the incidence shows a slight increase. Andalucía maintains a similar increasing trend from the beginning of the month. Catalunya is still oscillating around an incidence of 150 cases per 100,000 inh. Before re-opening, Castilla y León and Madrid were immersed in an increasing trend that was maintained afterwards but that could have stopped last week (to be confirmed next week).

Figure 3 shows the ratio of A_{14} between two consecutive weeks. If either the growth had been accelerated or the decrease had been slowed down by reopening the schools, we should observe an increase in this ratio the last two weeks, when the effects could be perceived. The constant incidence level is indicated as a horizontal dotted line.

⁶ <https://www.mscbs.gob.es/profesionales/saludPublica/ccayes/alertasActual/nCov/situacionActual.htm>

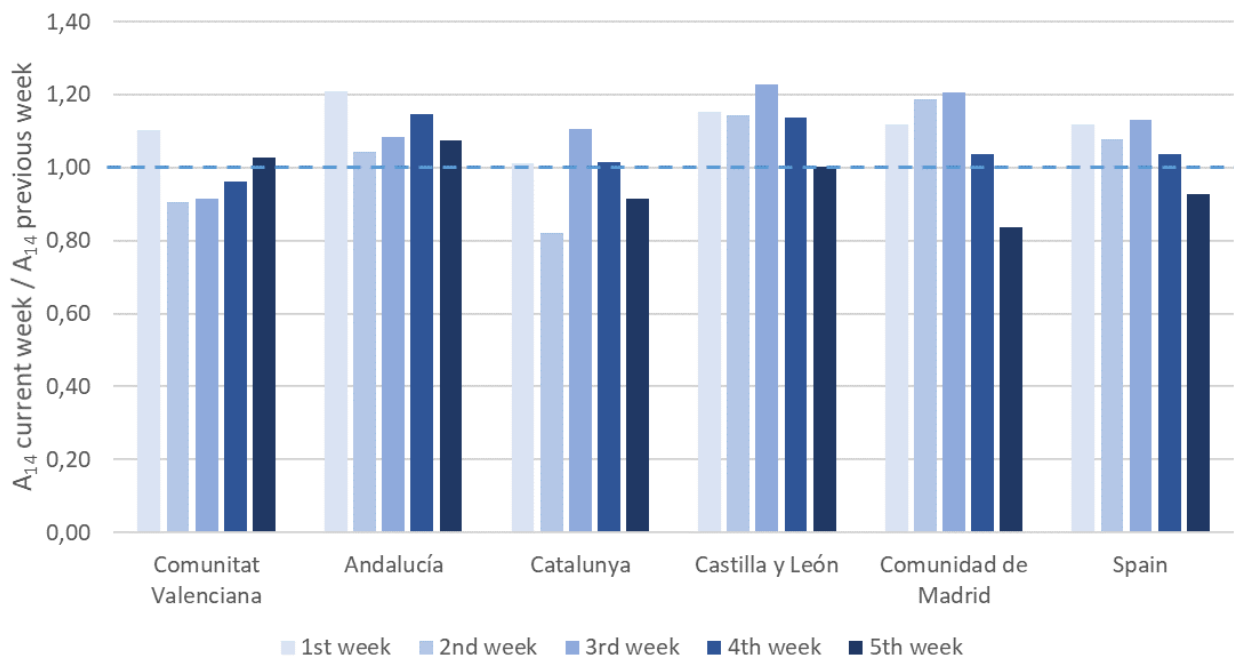


Figure 3: Ration between A_{14} of a certain week and A_{14} the previous one, showing the increasing or decreasing trend in the incidence and the magnitude of this trend.

1st week: $A_{14}(7^{th} \text{ Sept})/A_{14}(31^{st} \text{ Aug})$; 2nd week: $A_{14}(14^{th} \text{ Sept})/A_{14}(7^{th} \text{ Sept})$; 3rd week: $A_{14}(21^{st} \text{ Sept})/A_{14}(14^{th} \text{ Sept})$; 4th week: $A_{14}(28^{th} \text{ Sept})/A_{14}(21^{st} \text{ Sept})$; 5th week: $A_{14}(2^{nd} \text{ Oct})/A_{14}(28^{th} \text{ Sept})$

As shown in Figure 3, last two weeks we observe a decrease in the A_{14} ratios in most cases, **suggesting no effect of re-opening the schools in terms of global incidence**. There are two exceptions. First, Comunitat Valenciana, where this ratio increases the last two weeks. Nevertheless, as shown in Figure 2, this is the region with lowest incidence and, in fact, it seems to be stuck at the level of 100 cases per 100,000 inh. Andalucía slightly accelerated the growth on the penultimate week, but this growth slowed down last one.

Effect of re-opening in the pattern of incidence by age

Now, we are to see the dynamics of incidence disaggregated by age. The goal is to detect if the re-opening of the schools has caused a displacement of incidence pattern towards pediatric ages. Next tables show, month by month, the distribution of incidence among age groups. We have calculated the cumulative incidence in each age group as the number of cases per population in that age group. Then, we have evaluated which percentage of total incidence correspond to each age group.

Table 1: Percentage of monthly incidence that corresponds to each age group. September is divided in two fortnights, so that the possible effect of re-opening schools can be evaluated. Data from Catalunya⁷. Color scale is arbitrary (highest-red, lowest-green).

CATALUNYA									
Month	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80+
March	0,2%	0,4%	5,2%	6,8%	8,4%	12,2%	14,8%	20,2%	31,7%
April	0,1%	0,5%	5,5%	5,4%	6,4%	8,6%	7,5%	10,8%	55,0%
May	2,1%	2,7%	9,7%	8,8%	9,5%	11,1%	7,9%	9,3%	38,9%
June	3,7%	7,3%	14,6%	13,2%	12,9%	11,5%	8,6%	8,3%	19,8%
July	8,1%	9,2%	21,5%	16,4%	12,6%	10,3%	7,0%	5,5%	9,3%
August	9,0%	10,8%	20,6%	14,8%	11,5%	10,1%	7,7%	6,2%	9,2%
September (1-13)	8,8%	11,8%	18,1%	14,1%	12,1%	10,7%	8,2%	6,9%	9,3%
September (14-30)	12,0%	13,7%	15,0%	12,7%	11,3%	10,0%	7,9%	7,1%	10,3%

⁷ <https://dadescovid.cat/descarregues?lang=eng>

Catalunya shows the typical pattern of the epidemic in Spain: the first months, most affected population was the older one, when almost only serious cases were diagnosed in hospitals. The early and long confinement of children is seen as a lack of cases in pediatric ages before Summer. During Summer months, the median was displaced to the range 20-29 years old. Focusing on September, we see a 2-3 points increase of relative incidence in youngest age groups. This increase is compatible with both the contact studies in bubble groups and the mass screening campaigns in schools. It is also worth to mention here that Catalan Government announced last Wednesday that, during first 2 weeks, 87 % of primary cases in schools did not produce a secondary case in their class, 7 % of index cases infected 1 contact in their class, 4 % infected 2 of them, 1 % infected 3 of them and 0.6 % infected more than 3.

Table 2: Percentage of monthly incidence that corresponds to each age group. September is divided in two fortnights, so that the possible effect of re-opening schools can be evaluated. Data from Andalucía⁸. Color scale is arbitrary (highest-red, lowest-green).

ANDALUCÍA						
Month	0-14	15-29	30-44	45-64	65-84	85+
March	0,2%	4,5%	10,3%	18,4%	23,0%	43,6%
April	0,1%	3,2%	6,1%	9,8%	14,2%	66,6%
May	2,3%	10,5%	10,8%	13,4%	14,2%	48,8%
June	7,7%	30,6%	19,7%	13,2%	8,3%	20,5%
July	11,4%	34,0%	24,7%	14,3%	6,7%	8,9%
August	9,2%	30,5%	22,2%	14,9%	9,5%	13,6%
September (1-13)	10,6%	19,6%	17,9%	15,5%	13,8%	22,6%
September (14-30)	12,2%	19,1%	16,2%	15,1%	13,3%	24,1%

Andalucía shows the same pattern as Catalunya. In this case, the increase in the 0-14 age group is around 1.5 points.

Table 3: Percentage of monthly incidence that corresponds to each age group. September is divided in two fortnights, so that the possible effect of re-opening schools can be evaluated. Data from Castilla y León⁹. Color scale is arbitrary (highest-red, lowest-green).

CASTILLA Y LEÓN									
Month	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80+
April	5,1%	4,1%	8,0%	9,4%	10,7%	10,8%	9,1%	10,1%	32,8%
May	6,6%	5,9%	10,2%	11,9%	14,3%	15,8%	12,5%	8,9%	13,9%
June	8,0%	9,3%	12,2%	10,8%	11,7%	12,8%	12,7%	11,3%	11,2%
July	14,2%	12,5%	16,4%	11,1%	9,0%	9,2%	8,7%	9,8%	9,2%
August	12,1%	13,1%	17,7%	12,1%	10,2%	8,6%	7,6%	7,3%	11,3%
September (1-13)	12,7%	12,2%	15,6%	10,9%	11,1%	10,2%	8,7%	9,0%	9,7%
September (14-30)	22,8%	14,6%	12,4%	10,2%	9,3%	7,8%	7,7%	6,7%	8,5%

Castilla y León starts with a similar pattern, but last fortnight shows a significant increase in the 0-9 age group. This would reflect either a certain level of contagions inside the school, or an underdiagnosis of general population of other age groups. In fact, media inform that there have been detected several cases among children and staff of groups with a primary case (137 positive cases among 249 groups with a primary case). The question that remains open is if these positive cases are originated inside the schools or in the exterior.

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https://www.juntadeandalucia.es/institutodeestadisticaycartografia/badea/operaciones/consulta/anual/41135?CodOper=b3_2314&codConsulta=41135

⁹ <https://analisis.datosabiertos.jcyl.es/explore/dataset/situacion-enfermos-por-coronavirus-detectados-en-atencion-primaria-por-tramos-d0/table/?sort=fecha>

Table 4: Percentage of monthly incidence that corresponds to each age group. September is divided in two fortnights, so that the possible effect of re-opening schools can be evaluated. Data from Comunitat Valenciana¹⁰. Color scale is arbitrary (highest-red, lowest-green).

COMUNITAT VALENCIANA									
Month	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80+
April	0,5%	0,7%	5,4%	7,7%	8,7%	11,7%	13,7%	17,1%	34,5%
May	2,1%	3,3%	11,2%	13,6%	13,8%	15,3%	15,3%	12,8%	12,5%
June	2,8%	4,5%	9,0%	10,2%	11,6%	12,1%	11,7%	13,3%	24,9%
July	5,3%	9,7%	22,7%	12,2%	10,8%	10,6%	9,0%	9,4%	10,4%
August	7,9%	10,5%	24,6%	16,2%	10,6%	9,3%	7,2%	5,8%	7,9%
September (1-13)	9,0%	11,9%	19,5%	14,0%	10,5%	10,6%	8,2%	6,5%	9,8%
September (14-30)	8,5%	10,3%	15,2%	11,8%	10,0%	9,7%	20,5%	6,0%	7,8%

On the contrary, Comunitat Valenciana reports a decrease in relative incidence in 0-9 and 10-19 age groups after the re-opening of the schools. Nevertheless, this can be biased by a significant increase in the range 60-69 years old, that could be associated to a particular outbreak.

We can also see the deviation among expected mean incidence, assuming the incidence to be the same in all age groups. Next set of tables shows, for each age group, time period and Autonomous Community, the ratio between the incidence in each age group and the mean incidence of that time period in the region.

Table 5: Ratio between the incidence in each age group and the mean incidence of that time period in the region, for each period. September is divided in two fortnights. Color scale is arbitrary (highest-red, lowest-green).

CATALUNYA									
Month	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80+
March	0,02	0,03	0,47	0,61	0,76	1,10	1,33	1,82	2,86
April	0,01	0,05	0,50	0,49	0,58	0,77	0,68	0,98	4,95
May	0,19	0,24	0,87	0,79	0,86	0,99	0,71	0,84	3,50
June	0,34	0,66	1,32	1,19	1,16	1,04	0,77	0,74	1,78
July	0,73	0,83	1,94	1,47	1,13	0,93	0,63	0,50	0,84
August	0,81	0,98	1,86	1,34	1,03	0,91	0,70	0,56	0,83
September (1-13)	0,79	1,06	1,63	1,27	1,09	0,96	0,74	0,62	0,84
September (14-30)	1,08	1,23	1,35	1,14	1,02	0,90	0,72	0,64	0,93

ANDALUSIA						
Month	0-14	15-29	30-44	45-64	65-84	85+
March	0,01	0,27	0,62	1,10	1,38	2,61
April	0,00	0,19	0,37	0,59	0,85	4,00
May	0,14	0,63	0,65	0,80	0,85	2,93
June	0,46	1,83	1,18	0,79	0,50	1,23
July	0,68	2,04	1,48	0,86	0,40	0,53
August	0,55	1,83	1,33	0,90	0,57	0,82
September (1-13)	0,63	1,18	1,07	0,93	0,83	1,36
September (14-30)	0,73	1,14	0,97	0,90	0,80	1,45

Cyl									
Month	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80+
April	0,46	0,37	0,72	0,84	0,97	0,97	0,82	0,91	2,95
May	0,60	0,53	0,92	1,07	1,28	1,43	1,12	0,80	1,26
June	0,72	0,84	1,10	0,97	1,05	1,15	1,15	1,02	1,01
July	1,27	1,12	1,47	1,00	0,81	0,82	0,78	0,89	0,83
August	1,09	1,18	1,59	1,09	0,92	0,78	0,68	0,66	1,02
September (1-13)	1,15	1,10	1,40	0,98	1,00	0,92	0,78	0,81	0,87
September (14-30)	2,05	1,32	1,12	0,91	0,84	0,70	0,69	0,60	0,77

Valencia									
Month	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80+
April	0,05	0,06	0,48	0,69	0,78	1,06	1,23	1,54	3,10
May	0,19	0,30	1,01	1,23	1,25	1,38	1,38	1,15	1,13
June	0,25	0,41	0,81	0,91	1,04	1,08	1,06	1,20	2,24
July	0,48	0,87	2,05	1,09	0,97	0,95	0,81	0,84	0,93
August	0,71	0,94	2,21	1,46	0,96	0,83	0,65	0,52	0,71
September (1-13)	0,81	1,07	1,76	1,26	0,94	0,95	0,74	0,59	0,88
September (14-30)	0,76	0,93	1,37	1,07	0,90	0,88	1,85	0,54	0,70

¹⁰ <https://dadesobertes.gva.es/va/dataset/dades-covid-19-percentatge-i-nombre-de-casos-per-rang-edat-i-sexe>

These ratios show which age groups are above and below the mean incidence in each time period. In all cases, this ratio is high for the old people at the beginning of the epidemic, and moves towards range 20-29 range in Summer months. **School re-opening is followed by a slight increase in some of the youngest bins**, with a ratio of 1.2 in Catalunya (10-19) and 1.14 in Andalucía (15-29), as well as a significant increase in Castilla y León (ratio of 2 in 0-9 and 1.3 in 10-19).

To conclude, we must recall that the global incidence evolution suggests no significant effects of the re-opening of schools, and that, in most cases, there is either absence of increase in cases of pediatric ages or a slight increase that is compatible with current diagnostic effort in the schools. The particular case of Castilla y León remains open for future research.