Reopening Schools and the Dynamics of SARS-CoV-2 Infections in Israel: A Nationwide Study

Ido Somekh MD[1,2],

Tamy Shohat MD[2],

Lital Keinan Boker MD[3,4],

Eric A. F. Simões MBBS, DCH MD[5],

Eli Somekh MD[2,6]

[1] Department of Pediatric Hematology Oncology, Schneider Children's Medical Center of Israel, Petach Tikva.
[2] Sackler Faculty of Medicine, Tel Aviv University, Tel Aviv, Israel;
[3] Israel Center for Disease Control, Israel Ministry of Health;
[4] School of Public Health, University of Haifa, Haifa, Israel;
[5] University of Colorado School of Medicine, Aurora, CO, USA;
[6] Department of Pediatrics, Mayanei Hayeshuah Medical Center, Bnei Brak, Israel;

Correspondence: Eli Somekh, MD,
Mayanei Hayeshuah Medical Center, 17 Povarski St, Bnei Brak, Israel.
E-mail: esomekh@gmail.com
Phone: +972523683481

Summary:
School reopening on May 2020 did not have a major effect on SARS-CoV-2 resurgence in Israel during June-July. Rather, the easing of restrictions on large-scale gatherings was primarily responsible for this resurgence, and the increased hospitalizations and mortality.

ABSTRACT:

BACKGROUND: The benefits of school reopening must be weighed against the morbidity and mortality risks and the impact of enhancing spread of COVID-19. We investigated the effects of school reopening and easing of social distancing restrictions on the dynamics of SARS-CoV-2 infections in Israel, between March-July 2020.

METHODS: We examined the nationwide agewise weekly incidence, prevalence, SARS-CoV-2 PCR tests, their positivity, COVID-19 hospitalizations and associated mortality. Temporal differences in these parameters following school reopening, school ending, and following easing of restrictions such as permission of large scale gatherings, were examined.

RESULTS: The incidence of SARS-CoV-2 infections gradually increased following school reopening in all age groups, with a significantly higher increase in adults compared to children. Higher relative ratios (RRs) of sample positivity rates 21-27 days following school reopening relative to positivity rates prior to openings were found for the age groups 40-59 (RR: 4.72, 95% CI: 3.26 - 6.83) and 20-39 years (RR: 3.37 [2.51 - 4.53]), but not for children aged 0-9 (RR: 1.46 [0.85 - 2.51]) and 10-19 years (RR: 0.93 [0.65 - 1.34]).

No increase was observed in COVID-19 associated hospitalizations and deaths following school reopening. In contrast, permission of large-scale gatherings was accompanied by increases in incidence and positivity rates of samples for all age groups, and increased hospitalizations and mortality. **CONCLUSIONS:** This analysis does not support a major role of school reopening in the resurgence of the COVID-19 curve in Israel. Easing restrictions on large scale gatherings was the major influence on this resurgence.

Keywords: COVID-19; SARS-CoV-2; Children; Schools; Reopening;

Introduction:

While the COVID-19 pandemic has been controlled in many countries by lockdowns and potentially early school closings,[1] the effect of school closing on reducing SARS-CoV-2 spread is less clear.[2-4] Potential reasons include low rates of infection in children; [5-7] less severe symptoms,[8-10] and lower rates of intra-family infection than adults.[11-14] Nonetheless, U.S. data suggest that school closure might have prevented up to 128 SARS-CoV-2 infections per 100,000 population and 1.5 fewer deaths per 100,000 populations during the lockdown,[15] and proactive school closures in China might have reduced the peak incidence by 40-60%.[16]

In contrast to the rapidity of closing schools in most countries of the world, reopening has been a challenge in many countries. The benefits of school reopening for scholar's academic development, social interactions, social equity and physical fitness are well documented.[17] Nevertheless, the potential impact on public health and economics has tempered widespread reopenings of schools.[17-18] Frameworks for reopening of schools have been drafted by international organizations and countries with differing recommendations, reflecting this current challenge.[19-22]

During two major waves of COVID-19 in Israel, in March-July 2020, schools were closed (March 14) and later partially and finally completely reopened (May 3 and May 17, respectively). As routine in Israel, high schools and elementary schools ended the academic year on June 19 and June 30, respectively. This study examined the dynamics of COVID-19 resurgence in Israel in light of school reopening, school ending and the easing of social restrictions.

Methods:

Data Sources:

SARS-CoV-2 PCR tests: Data on the daily number of tests performed on the populace were obtained from several public national data sources (the sources of information are detailed in Supplementary Panel A).

COVID-19 Cases: Daily counts of COVID-19 cases and fatalities attributed to COVID-19 were obtained from Ministry of Health reports and sites.[23] Indications for SARS-CoV-2 PCR testing are detailed in Supplementary Panel A.

Population: The age specific breakdown of the Israeli population was obtained from the Israel Central Bureau of Statistics.[24] For purposes of analysis the population was stratified into two pediatric/adolescent groups 0-9 and 10-19 years; and three adult groups: 20-39, 40-59, and 60 years and above, respectively.

Relevant Time Periods: Time periods related to school closure and openings are outlined in Supplementary Panel C.

Learning conditions and COVID-19 epidemiology on school reopening: During the first stage of school reopening (May 3, 2020), children were divided into separate groups that attended school at different times on different days. However, these restrictions were lifted on May 17, schools were completely reopened resuming all day in-person learning with instructions to keep social distancing rules. Children aged > 7 yr. were required to wear masks in classrooms and in public areas. Classmates and teachers of SARS-CoV-2 infected pupils or teachers were screened for SARS-CoV-2 regardless of whether they were symptomatic or asymptomatic. Schools were reopened following a substantial decrease in incidence and positivity rates of SARS-CoV-2 PCR tests from the peak in COVID-19 spread observed at the end of March 2020.

Statistical Analysis:

Temporal trends of the following parameters were examined: the numbers of SARS-CoV-2 PCR tests; the positivity rates of tests, and numbers of hospitalizations and deaths from COVID-19 by age group; the prevalence in the different age groups; the daily and weekly incidence of SARS-CoV-2 PCR positivity (for the total population and for children separately) including incidence adjusted for the number of PCR tests; the cumulative proportions of COVID-19 cases in children as a proportion of all cases. Adjustment of tests was performed on a weekly basis. For each age group, incidence rate (weekly number of new cases /100,000 population of the specific age group) was multiplied by the proportion of this age group in the general population to the proportion of the samples obtained from individuals of this age group. Data were stratified according to SARS-CoV-2 PCR test results, age groups and date of testing.

The putative effects of partial and complete school reopening and school ending at the close of the academic year and following easing of restrictions on COVID-19 incidence and positivity rates of tests were examined. These were based on data obtained at days 14-20, and 21-27 days following the implemented measures. Differences in the incidence, prevalence and positivity rates of tests were analyzed using two-proportion z-tests and chi square tests. Associations with hospitalizations and mortality were examined 14-27 and 21-34 days, respectively, after each measure was instituted. These data were compared to the weekly mortality when each measure was instituted, and also to the weekly number of hospitalized patients and mortality in the prior week.

We examined the weekly combined number of hospitalized patients classified as moderately and severely ill. This was intended to avoid bias derived from changing definitions of severity during the epidemic; and also excluded mildly ill patients who might have been hospitalized not for medical reasons, but to ensure appropriate quarantine measures.

A lag period of 21-34 days between possible exposure and mortality that was based on an average time of 17 days between symptoms and mortality and inclusion of additional period of 4-6 days for a child who was infected in school, to infect an adult. This period was extended to a lag time of 34 days to account for the possible effect of several rounds of infection.

Weekly data were used in order to avoid incidental daily fluctuations. Categorical variables were expressed as counts and percentages.

Results:

The incidence rates, adjusted incidence rates (incidence rates adjusted for the number of SARS-CoV-2 tests), and prevalence of SARS-CoV-2 infection gradually increased following complete school reopening in all age groups (**Fig. 1A-C and Table S1-S3**). During this period, the number of SARS-CoV-2 PCR tests performed also increased for all age groups, and particularly for the 0-9 and 10-19 age groups (7.1 and 8.2-fold higher, than the reference, respectively) (**Fig. 1D and Table S4**). Positivity rates of samples increased gradually following complete school reopening, for the adult age groups but not for pediatric age groups: Positivity rate ratios (RR) of samples obtained 21-27 days following school reopening relative to positivity rates prior to openings were: 1.46 for children aged 0-9 yr. (95% confidence interval [CI]: 0.85 - 2.51), 0.93 for children aged 10-19 yr. (95% CI: 0.65 - 1.34), 3.37 for adults aged 20-39 (95% CI: 2.51 - 4.53), 4.72 for adults aged 40-59 yr. (95% CI: 3.26 - 6.83), and 2.75 for adults older than 60 yr. of age, (95% CI: 3.26 - 6.83). A similar trend was observed when analyzing data 14-21 days following reopening. (**Table 1 and Table S3**).

A single peak of a high rate of SARS-CoV-2 infections was observed at the end of May 2020 in children aged 10-19 years, related to a single cluster of COVID-19 in a high school in Jerusalem.[25] (**Fig. 1E and Fig. S1B**). This resulted in a weekly 6% sample positivity from

May 24-May 30 in that age group. However, during the two subsequent weeks (May 31-June 13), the proportions of positive samples in children aged 10-19 years were substantially reduced to baseline levels (1.0% and 1.5%, respectively, (**Fig. 1E, and Table S3**).

Following the identification of the first two SARS-CoV-2 cases in a high school in Jerusalem, the school was closed, quarantine instructions were implemented, and all students and staff members were tested for SARS-CoV-2. No additional mitigation protocols were implemented following the reopening of this school after the outbreak. The source of this outbreak has remained unknown.[25] Infection rates in the community were similar to the low rates observed prior to school reopening, however some increase in incidence rates were noted mainly in adults aged 20-59 years (**Fig. 1B, 1C**).

Adjusted incidence rate ratios (aIRRs) were calculated by comparing the incidence adjusted for the number of SARS-CoV-2 tests performed during the 14-20, and 21-28 days following complete school reopening to the adjusted incidence during the week prior to reopening. The aIRRs increased for all age groups, but mostly in adults. (**Fig. 2A, 2B, and Table 1**) The increase in aIRR 14-20 days following reopening was most prominent in individuals aged 40-59 (aIRR: 6.22, [3.6-10.7]), and 20-39 years (aIRR: 5.25, [3.5-7.8]). The smallest increase was observed in children aged 0-9 (aIRR: 2.2 [1.56-3.11]), and 10-19 years (aIRR: 1.29 [0.94-1.76]). Higher aIRRs were also demonstrated in adults compared to children, 21-28 days following school reopening. (**Fig. 2B and Table 1**).

Increases in all the abovementioned parameters (e.g., incidence, prevalence, number of samples tested and their positivity rates) were observed for all the age groups after school ending, at the close of the academic year (**Fig. 1A-C, Fig. 2C, and Table S5**). It should be mentioned that school endings occurred in conjunction with the relaxation of social restrictions. The highest increments following school ending were in children aged 10-19

years. (**Table S5**). As of July 31, 2020, children aged 0-9 and 10-19 years comprise 10% and 19% of all COVID-19 patients, respectively (**Fig. 2D, and Table S6**).

Following easing of social restrictions undertaken on May 20 (**Fig. S2, Supplemental Panel C**), rate ratios (RRs) to increased SARS-CoV-2 PCR positivity test rates were initially similar to those of school reopening (**Table S3**). However, following the lifting of restrictions on large scale gatherings on June 12, increased RRs, aIRRs and increased positivity rates were observed in all age groups. (**Fig. 2A, 2B, and Table 1**)

The weekly number of hospitalizations and fatal cases of COVID-19 patients did not increase following partial and complete school reopening. (**Fig. S3, S4, and Tables 2,3, S7,S8**). The lack of increased mortality was observed even up to 49 days following school reopening (**Table S7**). In contrast, the weekly number of COVID-19 fatal cases significantly increased following high school and elementary school ending for summer vacation. (**Fig. S4 and Table 2**) Risk ratios were 15.2 (5.5-41.9) and 17.2 (6.3-47.3) following 28-34 days of each measure, respectively. A significant increase in mortality was also observed following a lag time of 21 days (**Fig. S4 and Table 2**). No significant increases in mortality and hospitalizations were observed following partial easing of social restrictions on May 20. (**Table S7-S8**). However, a significant increase in hospitalizations (risk ratio: 3.95 [95% CI: 3.2-4.8]), and in mortality (risk ratio: 4 [1.9-8.3]) occurred at 21-28 days and 28-34 days, respectively, following the permission to attend large-scale social events. A significant increase in hospitalizations and mortality was also observed following a lag time of 14 and 21 days, respectively (**Table 2-3, and Tables S7-S8**). There were no fatalities among SARS-CoV-2 infected children during the study period.

Discussion:

National data from Israel suggest that school reopening during May 2020 had a limited effect on SARS-CoV-2 infection rate in children and adults, and that it was not a major contributor to the SARS-CoV-2 attributed mortality. On the other hand, this analysis suggests that easing of restrictions on large-scale gatherings may have been related to the resurgence of the COVID-19 epidemic in Israel, and may explain the observed increased mortality.

SARS-CoV-2 infection prevalence increased gradually in all age groups following complete school reopening. Due to the high proportion of asymptomatic and mildly symptomatic cases, any analysis of COVID-19 incidence must consider the number of SARS-CoV-2 PCR tests performed.

In contrast to the above, school reopening during May 2020, did not have a significant impact on the positivity rates in children and adolescents. These age groups had the lowest RRs for increased COVID-19 positive rates as well as the lowest adjusted incidence rate ratios (aIRRs) compared to the pre-opening weeks. On the other hand, adults in the age 40-59, and 20-39 year age groups had the highest RRs and aIRRs. A single-day surge in positivity rates of children aged 10-19 years, due to a cluster in a Jerusalem high school,[25] constituted the only exception to this trend. This outbreak could be at least partially related to the temporary lift of restrictions on wearing masks from May 19 to May 22 in classrooms and in open spaces in the absence of additional mitigation protocols. However, this cluster was followed by a drop in the positivity rate in this age group to a lower rate than was observed during the period preceding school reopening.

This negative association led us to explore the other well-established potential role of lifting social distancing prerogatives on the epidemic curve.

We found that easing of restrictions related to large-scale gatherings were temporally followed by significantly increased incidence and positivity rates of samples taken from all age groups. This was followed by significant increases both in the number of patients hospitalized in moderate to severe condition and in mortality following a lag period.

Also, individuals aged 20-59 years, and not children, seem to play the leading role in the increasing numbers of COVID-19 infections following school reopening. These findings contrast to those seen in influenza epidemics, in which children played a leading role and their relative risk of infection was higher than that of adults.[26-27] Nevertheless, school reopening should be accompanied by efforts to reduce crowding and to implement appropriate infection control practices in the classroom.[17,21] In addition, schools should probably reopen only when the SARS-CoV-2 epidemic is under control.

The rates of SARS-CoV-2 infection among children in Israel are high compared to those reported in other countries. As of July 31, 2020, the proportions of children aged 0-9 and 10-19 years infected with SARS-CoV-2 in Israel were 9.5% and 19%, respectively.[23] The respective proportions of these age groups in the total population are 19% and 16%.[24] In comparison, according to the European Centre for Disease Prevention and Control (ECDC)report, as of July 26, children made up 4% of cases detected in EU/EEA and in the United Kingdom; [28] US Data demonstrate that the number of COVID-19 cases in children aged <18 years, has reached 10% of the total for US cases o and this age group consists of 22% of the population.[29]

The increased SARS-CoV-2 testing in Israel following reopening of schools may account for some of the discrepancy between the countries. Another possible explanation for the high proportion of SARS-CoV-2 detection rates in the 0-19-year population in Israel is the high person-to-room ratio among populations with disproportionately high rates of SARS-CoV-2 detection, such as ultraorthodox Jews and Arabs. In addition, young people in Israel,

including children, tend to have high degrees of social interaction, which contributes to the high rate of infection.

However, it seems that school attendance per se does not seem to have been a significant explanation for this finding since the relative proportion of SARS-CoV-2 infected children out of the total SARS-CoV-2 cases has not increased during school weeks and did not decrease during school ending.

In the Israeli model of school reopening, all the students were admitted to schools simultaneously. This is in contrast to school openings in Northern Europe where class sizes were limited and teachers were assigned to one class at a time whenever possible.[30] Clearly, SARS-CoV-2 did spread in classes and schools in Israel, but this does not seem to have been the major cause for the June-July resurgence in Israel. Our findings regarding the seeming lack of a relation between school reopening during May 2020 and the surge in cases in the community are in agreement with the experience in several countries worlwide.[17, 31-35] and with a recent ECDC perspective.[27] Probably, one of the major factors contributed to the unsubstantial effect of school reopening on COVID-19 resurgence during June-July 2020 was that on May 2020 the epidemic was under control with low incidence of SARS-CoV-2 infections among all age groups.

Our analysis did not demonstrate any mitigating effect of school ending at the close of academic year on all the parameters examined. Apparently, school closure may reduce the spread of SARS-CoV-2 infection mainly when combined with a lockdown as recently described.[15] On the other hand, in the absence of a lockdown, children may contract infection during regular and casual social encounters outside schools, while at school, children are expected to be supervised, and infection control measures are encouraged and can be enforced.

The physical conditions in schools in Israel, which are more crowded than most OECD countries, and the lack of cohorting that accompanied full reopening of schools suggest that even under these conditions which would promote the spread of SARS–CoV-2, spread of the virus was not an important factor in the resurgence. These results thus might be translated to other countries where there is cohorting and less classroom crowding. The main limitation of our study is its ecological design and the possibility that some findings presented here may have been related to other concurrent interventions. Due to the observational design, this study cannot inform causal relationships. Since the demographic, cultural, and socioeconomic features of Israel evidently affect our results, particular attention should be given to such factors in assessing reopening in specific geographic areas.

Another limitation is that the indication for testing may affect the unadjusted incidence among specific age group. In addition, even incidence adjusted by the number of samples tested could be affected by the testing policies. For these reasons, we examined the putative effects of school reopening and other non-pharmacologic measures by several analyses, namely: Incidence adjusted by the number of tests, positivity rates of samples, weekly number of SARS-CoV-2 related hospitalizations and weekly number of deaths. The main strength of our study is that it is based on a solid and reliable national database and that its main findings are supported by several lines of evidences, as previously mentioned. In addition, we have used several time periods after each measure examined to increase the sensitivity of the study and to strengthen the reliability of the results.

In conclusion, our findings suggest that school reopening did not have a substantial effect on the SARS-CoV-2 infection rate in the general population and suggest a major effect of ease of social restrictions on the COVID-19 resurgence in Israel. Though complete reopening of schools may have contributed to the spread of infection, it does not seem to have played a primary role *per se*, in the June-July 2020 resurgence.

Notes:

1. Author Contributions:

I.S. and E.S. conceptualized the study, I.S., E.A.F.S., and E.S. analyzed the data and drafted the manuscript. T.S. and L.K.B. participated in the study design, data collection, and analysis of results. All co-authors reviewed and approved the manuscript.

2. Sources of information:

A. Ministry of Health, Israel

https://datadashboard.health.gov.il/COVID-19/general?utm_source=go.gov.il&utm_medium=referral

https://data.gov.il/dataset/covid-19/resource/6ad74663-9f40-4bfc-9626-f22da3976355/download/readme-.pdf

https://data.gov.il/dataset/covid-19

B. National Information and Knowledge Center for COVID-19 Pandemic

https://www.gov.il/he/departments/corona-national-information-and-knowledge-center

C. Information and Research Center of the Israeli Knesset

https://main.knesset.gov.il/Activity/Info/mmm/pages/default.aspx

D. Israeli Center for Diseases Control

https://www.health.gov.il/UnitsOffice/ICDC/Pages/default_new.aspx

E. The Hebrew University, Jerusalem, Israel

https://new.huji.ac.il/sites/default/files/mainsite/files/huji_3107.pdf

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3. Conflicts of interest:

E.A.F.S. reports grants, personal fees and non-financial support from Astra Zeneca Inc, grants, personal fees and non-financial support from Merck & Co., grants, personal fees and non-financial support from Regeneron Inc, grants, personal fees and non-financial support from Pfizer Inc, personal fees, non-financial support and other from Abbvie Inc, personal fees from Alere Inc, grants, personal fees and non-financial support from Roche Inc, other from GSK Inc, grants from Johnson and Johnson, grants and non-financial support from Novavax Inc, outside the submitted work. I.S., T.S., L.K.B., and E.S. declare no conflict of interest.

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Table 1. SARS-CoV-2 Positivity Rates of Tests and Adjusted Incidence Rate Ratio (aIRR), Following Different Measures

Complete School Opening (17-May)										
A. 1-7 days prior to reopening			**B. 14-20 days following reopening**				**C. 21-27 days following reopening**			
Date	**10 - 16 May**		**31-May - 06-June**				**07-June - 13-June**			
Age (Years)	positive/samples tested	percent	positive/samples tested	percent	RR*	aIRR*	positive/samples tested	percent	RR#	aIRR#
0-9	14/1950	0.7%	78/9853	0.8%	1.1 (0.63 -1.94)	2.2 (1.56-3.11)	158/15081	1.0%	1.46 (0.85 - 2.51)	3.51 (2.54 -4.85)
10-19	33/2092	1.6%	168/16431	1.0%	0.65 (0.45 – 0.94)	1.29 (1..7- 2.98)	250/16952	1.5%	0.93 (0.65 – 1.34)	2.25 (1.69- 2.98)
20-39	49/11169	0.4%	229/19884	1.2%	2.62 (1.93 - 3.57)	5.25 (3.53- 7.82)	396/26779	1.5%	3.37 (2.51 - 4.53)	8.13 (5.52- 11.96)
40-59	32/9311	0.3%	167/15626	1.1%	3.1 (2.13 – 4.5)	6.22 (3.61-10.7)	276/17568	1.6%	4.72 (3.26 – 6.83)	11.1 (6.5-18.7)
60+	35/13762	0.3%	64/14739	0.4%	1.7 (1.13 - 2.58)	3.42 (1.76 -6.69)	111/15889	0.7%	2.75 (1.88 - 4.01)	6.73 (3.5-12.4)

RR relative ratio; aIRR adjusted incidence rate ratio (adjusted to number of tests); *values B. compared to A.; #values C. compared to A

Permitted Large Events (12-June)										
A. 1-7 days prior to measure			**B. 14-20 days following measure**				**C. 21-27 days following measure**			
Date	**05 - 11 June**		**26-June - 02-July**				**03-July - 09-July**			
Age (Years)	positive/samples tested	percent	positive/samples tested	percent	RR*	aIRR*	positive/samples tested	percent	RR#	aIRR#
0-9	131/15530	0.8%	370/15832	2.3%	2.77 (2.27 - 3.38)	3.11 (2.48-3.92)	719/23377	3.1%	3.64 (3.03 – 4.39)	5.6 (4.5-6.96)
10-19	226/21055	1.1%	1019/18512	5.5%	5.13 (4.45 - 5.92)	5.77 (4.77-6.98)	1551/23122	6.7%	6.25 (5.44 – 7.18)	9.6 (8-11.6)
20-39	339/28182	1.2%	1806/34846	5.2%	4.31 (3.84 - 4.83)	4.85 (4.04-5.8)	3120/51182	6.1%	5.07 (4.53 - 5.66)	7.8 (6.5-9.3)
40-59	265/20320	1.3%	1087/24951	4.4%	3.34 (2.92 - 3.82)	3.8 (3.14-4.5)	1701/33998	5.0%	3.84 (3.37 – 4.36)	5.99 (4.97-7.02)
60+	109/16310	0.7%	534/20036	2.7%	3.99 (3.25- 4.9)	4.5 (3.51-5.74)	800/24612	3.3%	4.86 (3.98 - 5.94)	7.52 (5.91-9.5)

RR relative ratio; aIRR adjusted incidence rate ratio (adjusted to number of tests); *values B. compared to A.; #values C. compared to A

Table 2. Weekly Fatal Cases Following Different Measures

Date	Measure	1-7 Days Prior	21-27-Days Following	RR	P value	28-34-Days Following	RR	P value
03-May	Partial school reopening	30	7	0.23 (0.1-0.5)	0.003	11	0.36 (0.18-0.7)	0.005
17-May	Complete school reopening	21	5	0.2 (0.1-0.6)	0.003	5	0.2 (0.1-0.6)	0.003
20-May	Opening of synagogues and beaches	13	5	NS	NS	4	0.3 (0.1-0.9)	0.03
12-June	Permitted large gatherings	9	26	2.9 (1.4-6.2)	0.006	36	4 (1.9 -8.3)	< 0.0001
19-June	High school ending	4	36	9 (3.2-25.3)	< 0.0001	61	15.2 (5.5-41.9)	< 0.0001
30-June	Elementary school ending	12	57	15.2 (5.5-41.9)	< 0.0001	69	17.2 (6.3-47.3)	< 0.0001

RR relative ratio; NS non-significant

Table 3. SARS-CoV-2 Related Hospitalizations of Moderate-Severely Ill Patients, by Age

A. Partial school reopening	Age (Years)				
Date	0-9	10-19	20-39	40-59	60+
(1) 26-April-02-May	0	2	16	68	254
(2) 17-23-May	0	1	8	21	95
(3) 24-30-May	0	0	5	19	82
B. Complete school reopening	**Age (Years)**				
Date	0-9	10-19	20-39	40-59	60+
(1) 10-16-May	0	1	9	30	121
(2) 31-May -06-June	0	0	4	25	86
(3) 07-13-June	1	0	5	29	83
C. Ease of restrictions	**Age (Years)**				
Date	0-9	10-19	20-39	40-59	60+
(1) 07-13-June	1	0	5	29	83
(2) 28-June -04-July	0	1	15*	60*	206*
(3) 05-11-July	1	1	23^	103^	338^

Number of SARS-CoV-2 related hospitalizations of moderate-severely ill patients were calculated prior to (1) and following (2), (3) school re-openings and permission of large scale gatherings of up to 250 people;

RR (relative ratio) was calculated for the time periods 'following' as compared with 'prior to' each measure. Statistically significant increasing rates are noted:

20-39 years *RR=3 (1.1 -8.2); ^RR=4.6 (1.7-12.1);

40-59 years *RR=2.1 (1.3-3.2); ^RR=3.6 (2.4-5.4);

60+ years *RR=2.48 (1.9-3.2); ^RR=4.1(3.2-5.2)

Figure Legends:

Fig. 1.

Panel A. Prevalence of SARS-CoV-2, by Age

Weekly prevalence rates of COVID-19 were calculated during March-July 2020, in four distinct age groups. For each age group, the number of positive samples was divided by its absolute number in the overall population. Major time points, including school closure, reopening and school ending at the end of the academic year as well as easing of social restrictions are noted.

Panel B. Weekly Unadjusted Incidence of SARS-CoV-2, by Age

The weekly numbers of SARS-CoV-2 positive samples tested during March-July, 2020 in the various age groups are shown. The incidence for each age group was calculated per 100,000-population. The "two epidemic waves" of COVID-19 in Israel are depicted; and the lag of new SARS-CoV-2 infections in children compared with adults are demonstrated, following school re-openings. Major time points, including school closure, reopening and school ending at the end of the academic year, as well as easing of social restrictions, are noted.

Panel C. Weekly Age-Group Specific Incidence of SARS-CoV-2

The weekly numbers of SARS-CoV-2 positive samples tested during March-July, 2020 were calculated for children (aged 0-9 and 10-19 years) and for adults (aged 20-59 and 60+ years), as the number of new weekly SARS-CoV-2 cases per 100,000 of the specific age group population. The increase in the proportions of children aged 10-19 years infected during the "2nd Wave" is shown. Major time points, including school

closure, reopening and school ending at the end of the academic year as well as easing of social restrictions are noted.

Panel D. Number of SARS-CoV-2 Tests Performed, by Age

The monthly numbers of SARS-CoV-2 nasopharyngeal swabs tested by PCR are shown for the different age groups during March-July. An increase in testing, particularly in children, is depicted, following school re-openings in May 2020.

Panel E. SARS-CoV-2 Positivity Rate of Tests, by Age

Weekly SARS-CoV-2 positivity rates of samples tested during March-July 2020 are shown. Positivity rates were calculated for each age group as the positive SARS-CoV-2 samples of all samples tested, by week. Major time points, including school closure, general lockdown, school reopening, and school ending at the end of the academic year, as well as easing of social restrictions are noted.

Fig. 2.

Panel A. Relative Ratios and Adjusted Incidence Relative Rates of SARS-CoV-2 Infections, 14-20 Days Following Different Measures, by Age

Relative ratios (RR) and adjusted incidence relative rates (aIRR) 14-20 days following complete school reopening (May 17) and permission of large gatherings (June 12) are shown. Increases are depicted in RRs and aIRRs, particularly among adults aged 20-39 years and 40-59 years, following complete school reopening. On the other hand, increases in all age groups, and particularly among 10-19 year old children are shown, following permission of large gatherings.

Panel B. Relative Ratios and Adjusted Incidence Relative Rates of SARS-CoV-2 Infections, 21-27 Days Following Different Measures, by Age

Relative ratios (RR) and adjusted incidence relative rates (aIRR) 27-21 days following complete school reopening (May 17) and permission of large gatherings (June 12) are shown. Increases are depicted in RRs and aIRRs, particularly among adults aged 20-39 years and 40-59 years, following complete school reopening. On the other hand, increases in all age groups, and particularly among 10-19 year old children are shown, following permission of large gatherings.

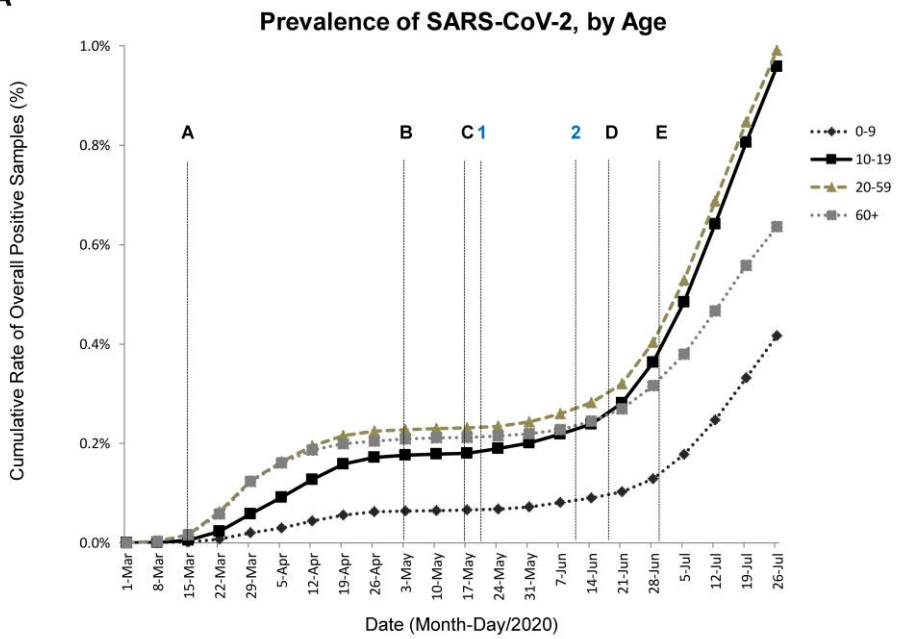
Panel C. RR of SARS-CoV-2 Positivity Rate of Tests, by Age

The RRs of SARS-CoV-2 positivity rate of samples tested following school reopening and ending was calculated for each age group. RRs shown were calculated by comparing positivity rates of tests between 7-13-June and 17-23-May for school reopening, and comparing positivity rates of tests between 26-July-1-August and 19-25-June for school ending.

Panel D. Cumulative Proportions of SARS-CoV-2 Infected Persons

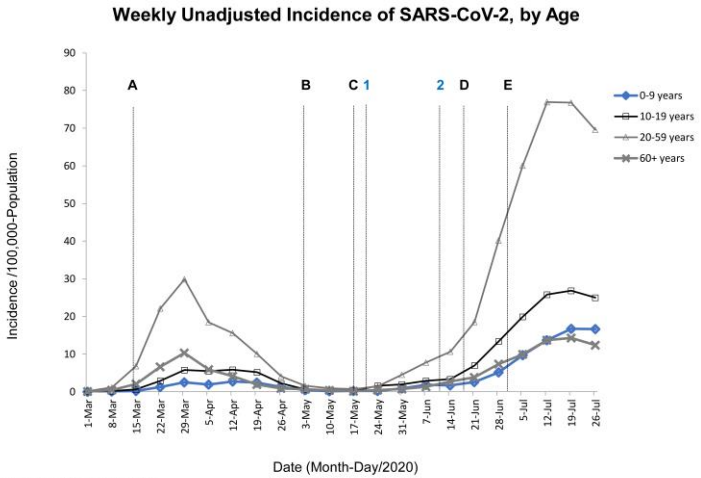
The cumulative proportions of SARS-CoV-2 infected persons according to age group (of overall infected persons) are shown. An increase in the proportion of infected children is depicted; whereas the proportion of older adults (aged 60+ years) decreased over time. Major time points, including school closure, reopening and school ending at the end of the academic year as well as easing of social restrictions are noted.

Fig. 1A



A closure of schools (March 14, 2020)
B partial reopening of schools (May 3, 2020)
C complete reopening of schools (May 17, 2020)
D end of academic year in high schools (June 19, 2020)
E end of academic year in elementary schools (June 30, 2020)
Dates outlined represent day 1 of the studied week
1 ease of social restrictions; e.g., opening of synagogues and beaches
2 further ease of social restrictions; e.g., permitted gatherings in events of up to 250 people

Fig. 1B



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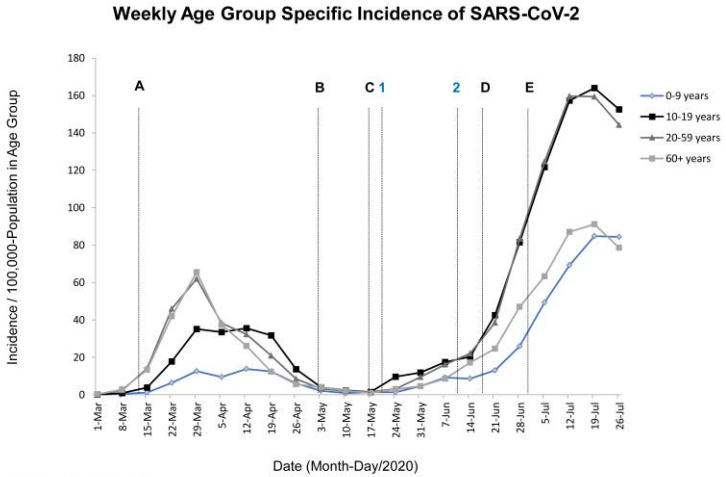
Dates outlined represent day 1 of the studied week
1 ease of social restrictions; e.g., opening of synagogues and beaches (May 20, 2020)
2 further ease of social restrictions; e.g., permitted gatherings in events of up to 250 people (June 12, 2020)

Fig. 1C



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C complete reopening of schools (May 17, 2020)
D end of academic year in high schools (June 19, 2020)
E end of academic year in elementary schools (June 30, 2020)
Dates outlined represent day 1 of the studied week
1 ease of social restrictions; e.g., opening of synagogues and beaches (May 20, 2020)
2 further ease of social restrictions; e.g., permitted gatherings in events of up to 250 people (June 12, 2020)

Fig. 1D

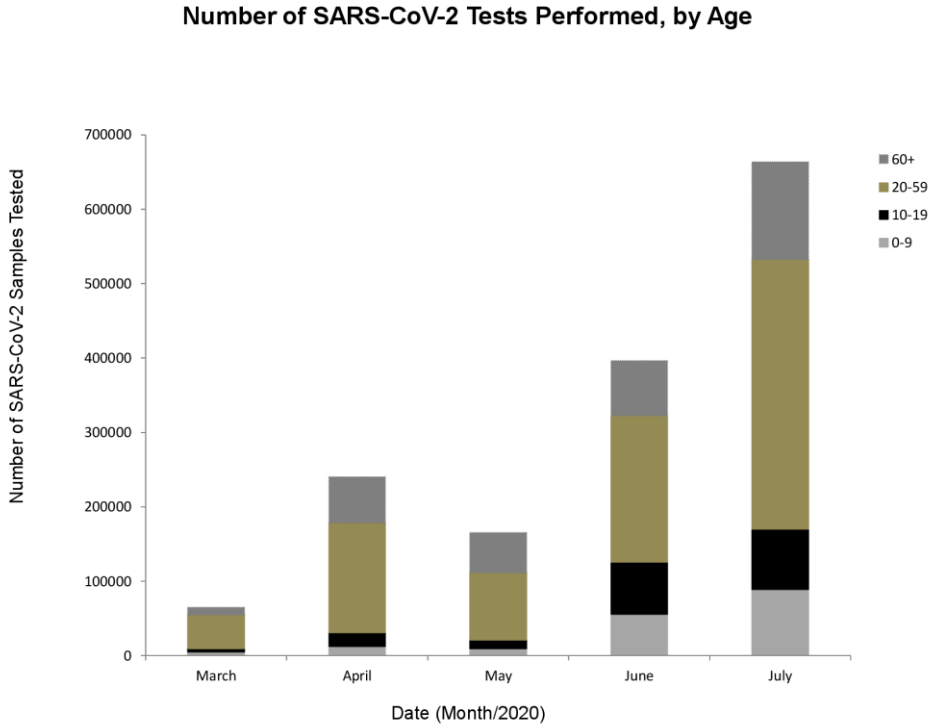
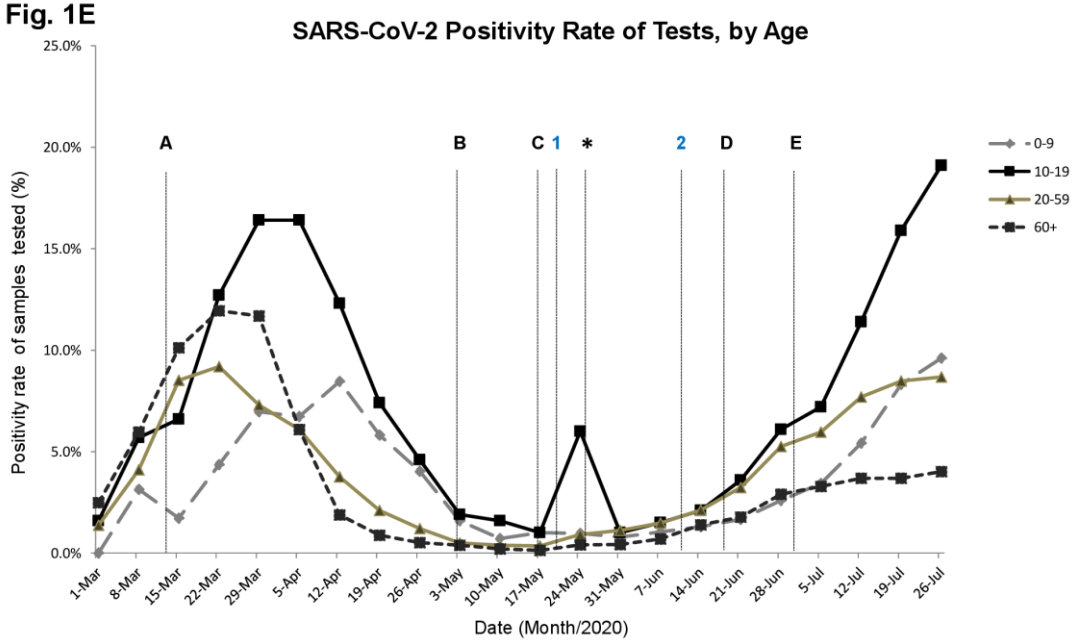


Fig. 1E



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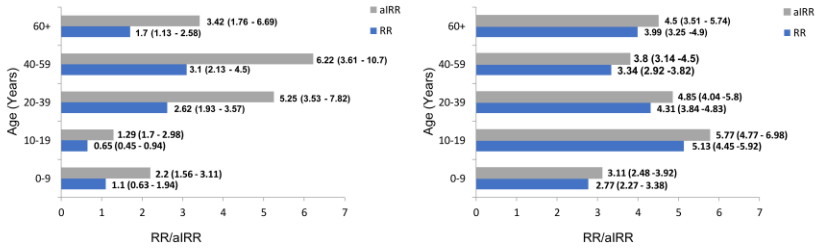
B partial reopening of schools (May 3, 2020)
C complete reopening of schools (May 17, 2020)
D end of academic year in high schools (June 19, 2020)
E end of academic year in elementary schools (June 30, 2020)
Dates outlined represent day 1 of the studied week
* single outbreak in a high school (May 26, 2020)
1 ease of social restrictions; e.g., opening of synagogues and beaches (May 20, 2020)
2 further ease of social restrictions; e.g., permitted gatherings in events of up to 250 people (June 12, 2020)

Fig. 2A

RR and aIRR of SARS-CoV-2 Infections, 14-20 Days Following Different Measures, by Age



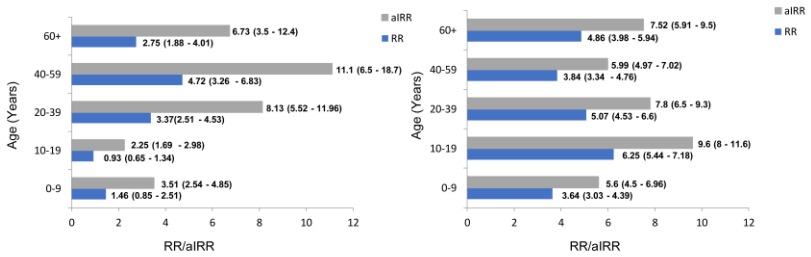
14-20 days following complete school reopening^

14-20 days following ease of restrictions*

RRs (relative ratios) were calculated by comparing positivity rates 14-20 days following and 1-7 days prior to each measure
aIRRs (adjusted incidence relative rates) were calculated by comparing rates 14-20 days following and 1-7 days prior to each measure
^complete school reopening (May 17, 2020); * permitted gatherings in events of up to 250 people (June 12, 2020)

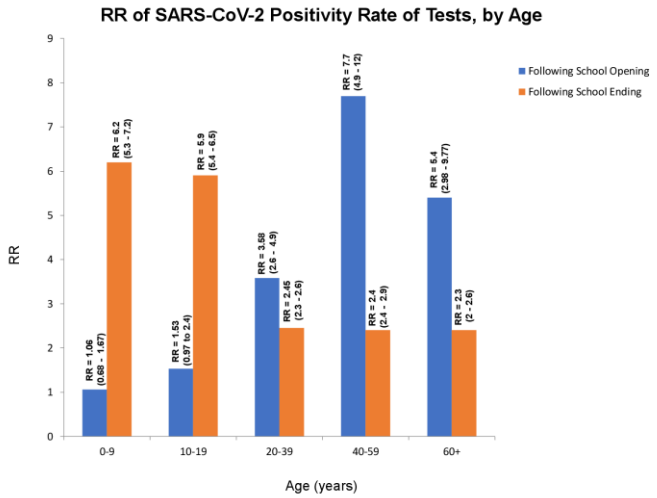
Fig. 2B

RR and aIRR of SARS-CoV-2 Infections, 21-27 Days Following Different Measures, by Age



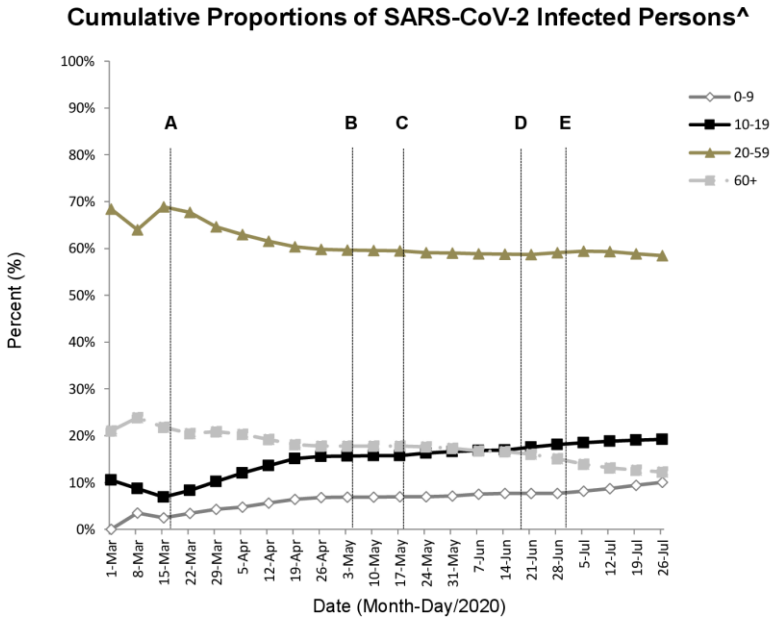
RRs (relative ratios) were calculated by comparing positivity rates 21-27 days following and 1-7 days prior to each measure
aIRRs (adjusted incidence relative rates) were calculated by comparing rates 21-27 days following and 1-7 days prior to each measure
^complete school reopening (May 17, 2020); * permitted gatherings in events of up to 250 people (June 12, 2020)

Fig. 2C



RRs following school reopening were calculated by comparing positivity rates of tests during 7-13-June, 2020 and the 17-23-May.
RRs following school ending were calculated by comparing positivity rates of tests during 26- July - 1-August, 2020 and the 19 - 25-June.

Fig. 2D



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E end of academic year in elementary schools (June 30, 2020)
Dates outlined represent day 1 of the studied week

*Children aged 0-9 and 10-19 yr. comprise 19% and 16% of the general population in Israel, respectively.
^ of overall infected persons