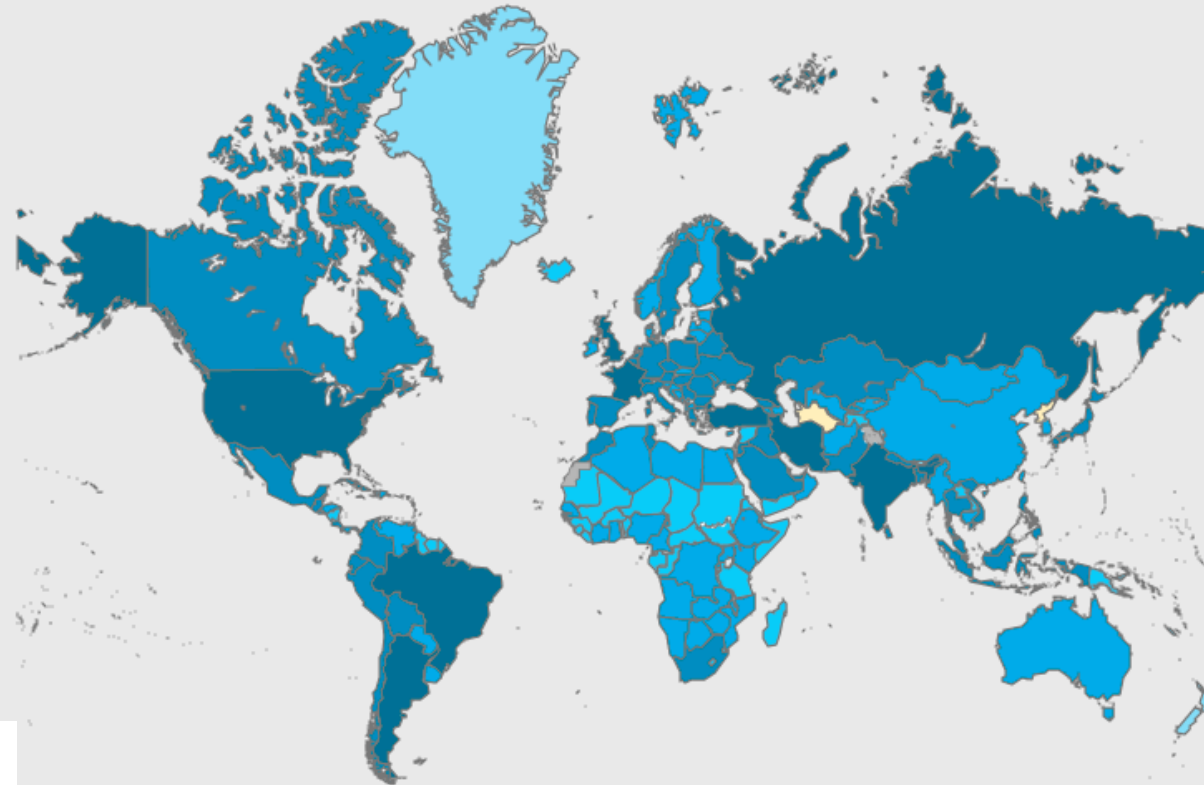


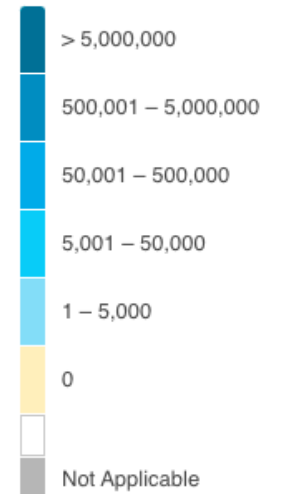


# Challenges in covid vaccination in children

Dr Sheeja Sugunan  
Associate Professor  
SAT, Government Medical College  
Thiruvananthapuram

**WHO Coronavirus (COVID-19) Dashboard**[Overview](#)[Measures](#)[Data Table](#)[Explore](#)

Cases - Count ×



Cases ▾

Total ▾

**73,091**

new cases in last 24hrs

 Worldwide

Total cases


**24.3Cr**

+4.89L

Deaths

**49.4L**

+8,474

 Download Map Data

**Globally**, as of **9:17am CEST, 13 October 2021**, there have been **238,229,951 confirmed cases** of COVID-19, including **4,859,277 deaths**, reported to WHO. As of **9 October 2021**, a total of **6,364,021,792 vaccine doses** have been administered.

# COVID Vaccination Worldwide

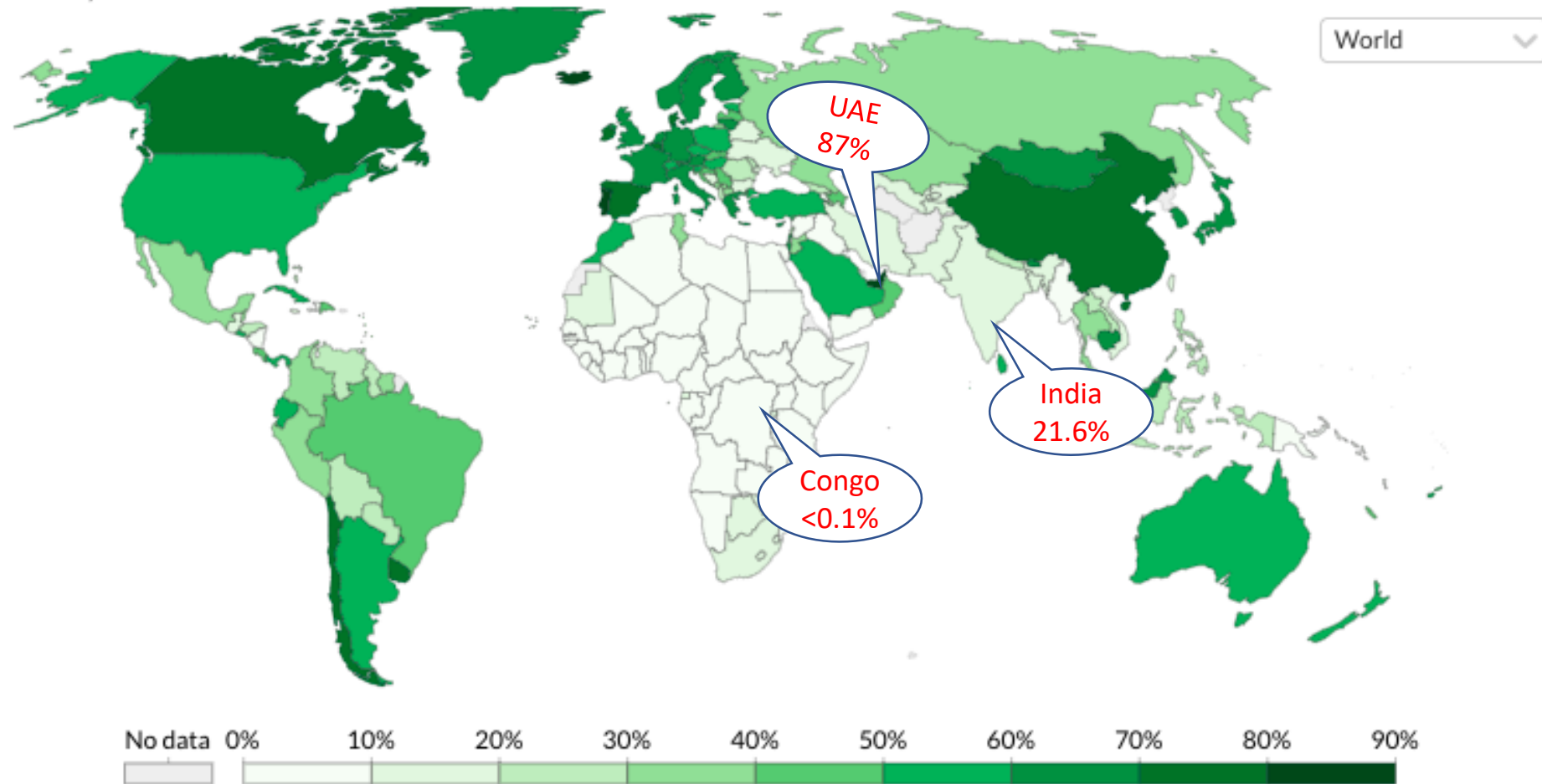


>6.8 billion doses given  
> 290 Cr vaccinated  
> 37% fully vaccinated

# Share of the population fully vaccinated against COVID-19, Oct 12, 2021

Our World  
in Data

Total number of people who received all doses prescribed by the vaccination protocol, divided by the total population of the country.



Source: Official data collated by Our World in Data – Last updated 13 October 2021, 12:30 (London time)

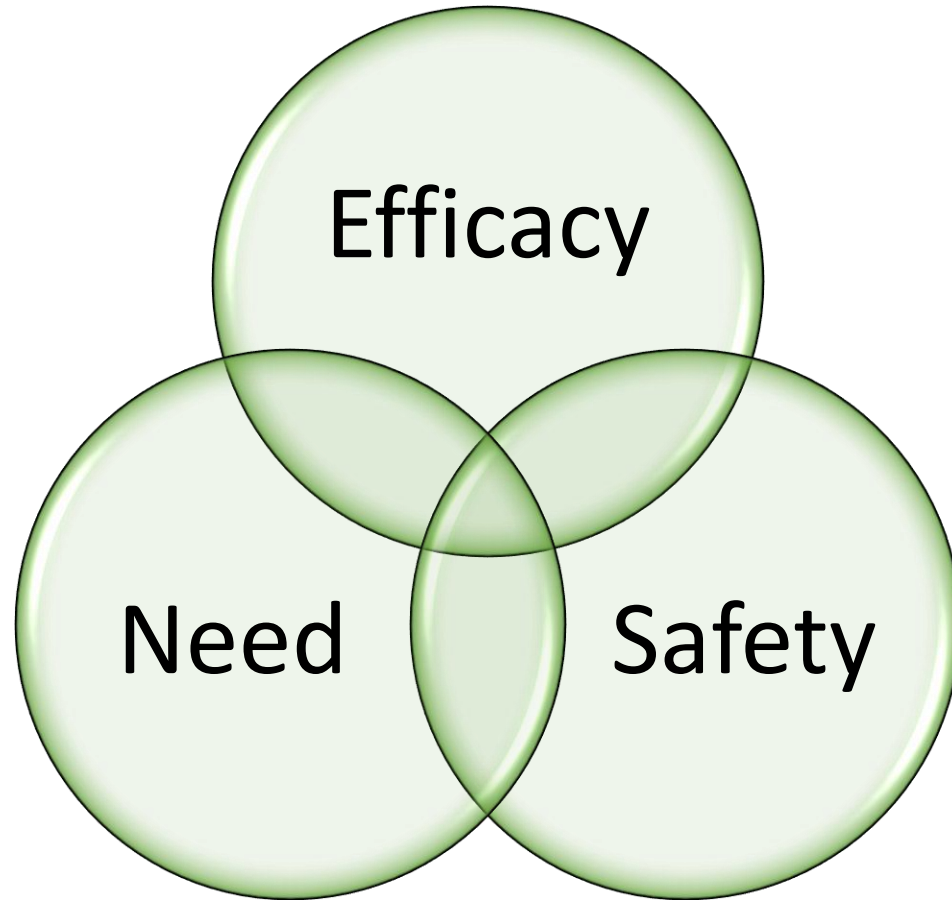
OurWorldInData.org/coronavirus • CC BY

Note: Alternative definitions of a full vaccination, e.g. having been infected with SARS-CoV-2 and having 1 dose of a 2-dose protocol, are ignored to maximize comparability between countries.

▶ Dec 27, 2020

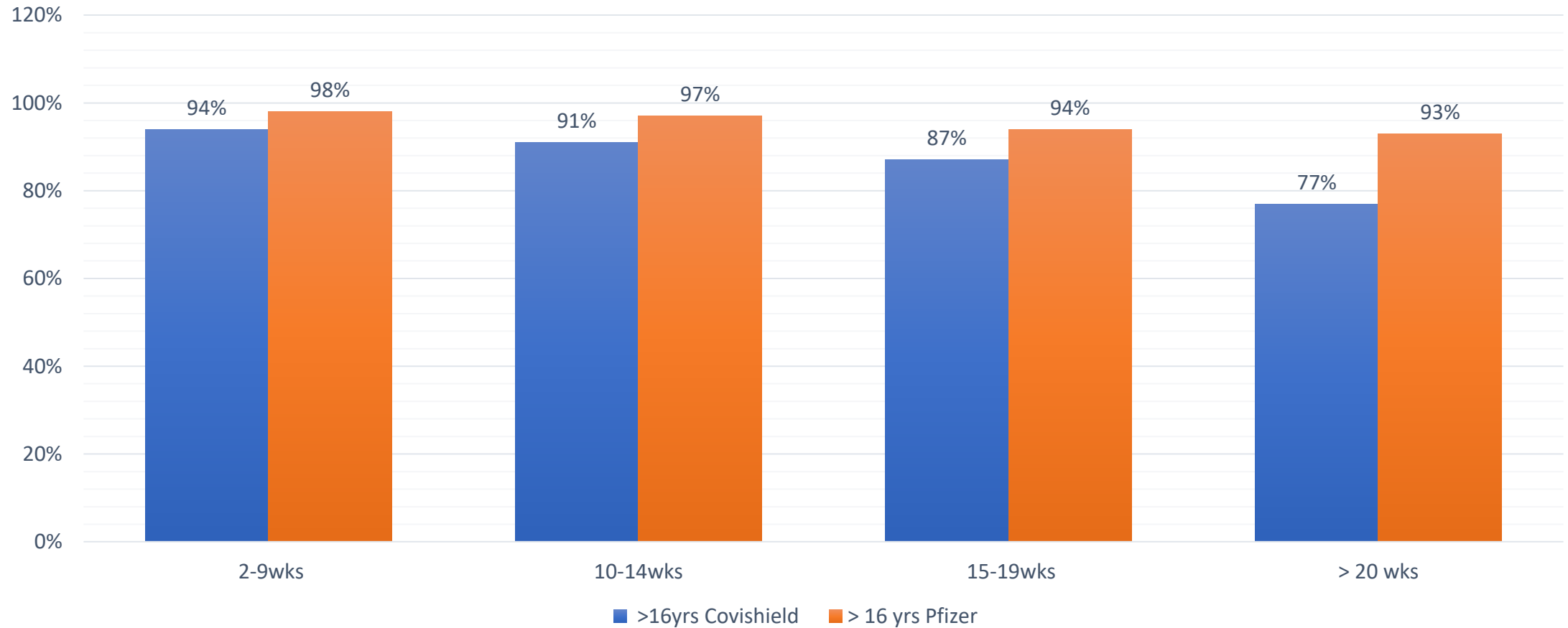
○ Oct 12, 2021

# Vaccination in children



# Vaccine effectiveness in *hospitalization* due to Delta

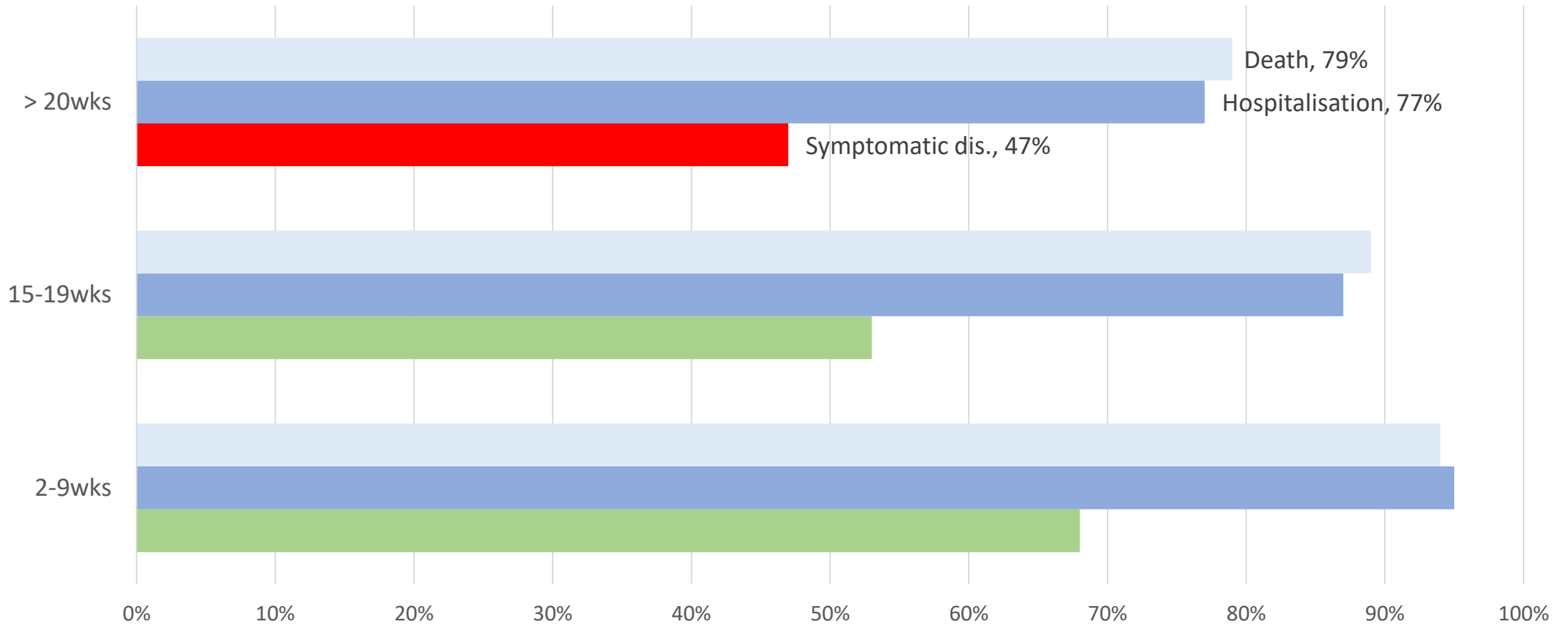
## covishield Vs Pfizer





# Vaccine efficacy : wks post vaccination

Astra zenacea



Nick Andrews<sup>1,2</sup>, Elise Tessier<sup>1</sup>, Julia Stowe<sup>1</sup> Vaccine effectiveness and duration of protection of Comirnaty, Vaxzevria and Spikevax against mild and severe COVID-19 in the UK (pre print)

# Breakthrough infections in vaccinated

## Jan – April 2021

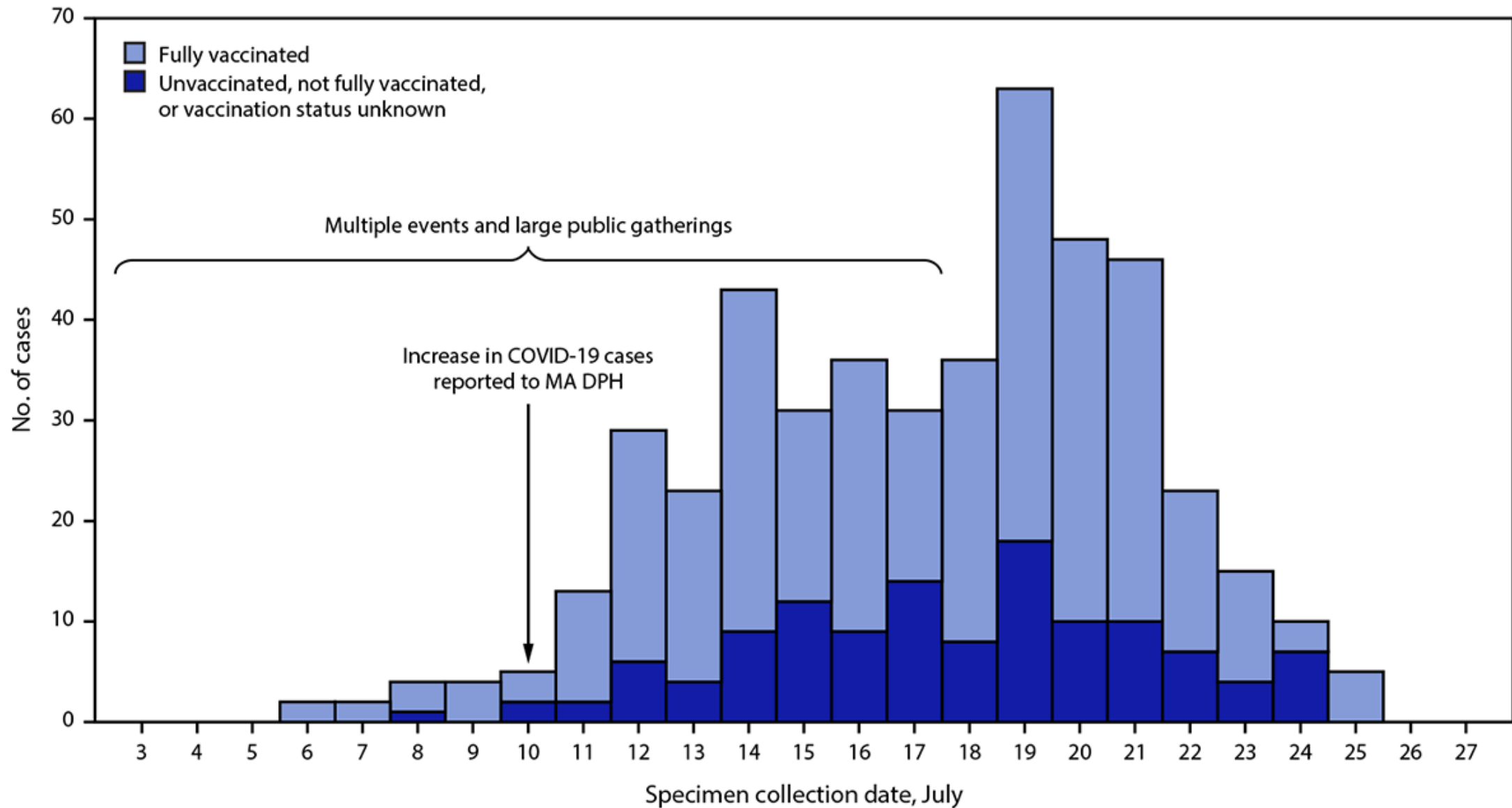
- 101million vaccinated
- 10262 breakthrough infections
- Median age 58 yrs (40-74)
- 88% asymptomatic / MILD



# Death in breakthrough cases

- 2% died due to breakthrough infections
- Median age 82years(IQR 70 -89)]
- 18% of deaths occurred in asymptomatic or due to other disease.
- 5% sequenced
- 64% were SARS COV2 variants of concern.

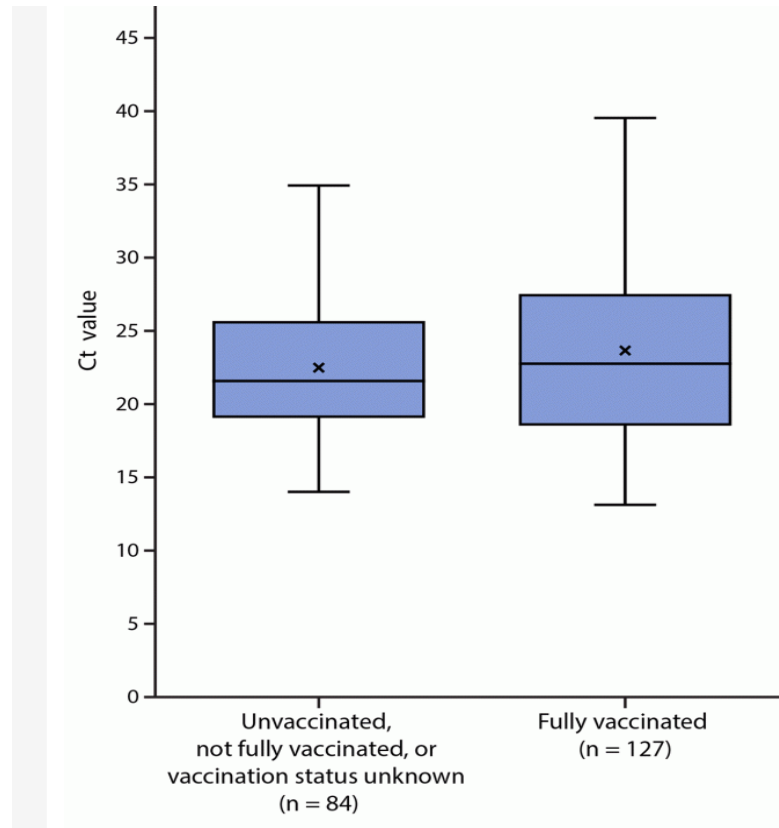
# Massachusetts, July 2021



## In high exposure gatherings...

- July 3 Massachusetts, reported 0 cases in the preceding two weeks.
- 69% of population in Massachusetts, fully vaccinated.
- July(3-17) 2021 469 cases occurred from public gathering.
- $\frac{3}{4}$ (74%) in fully vaccinated. Median age 42 yrs
- 90% Delta variant.
- 70% symptomatic, 4 hospitalization, No death.

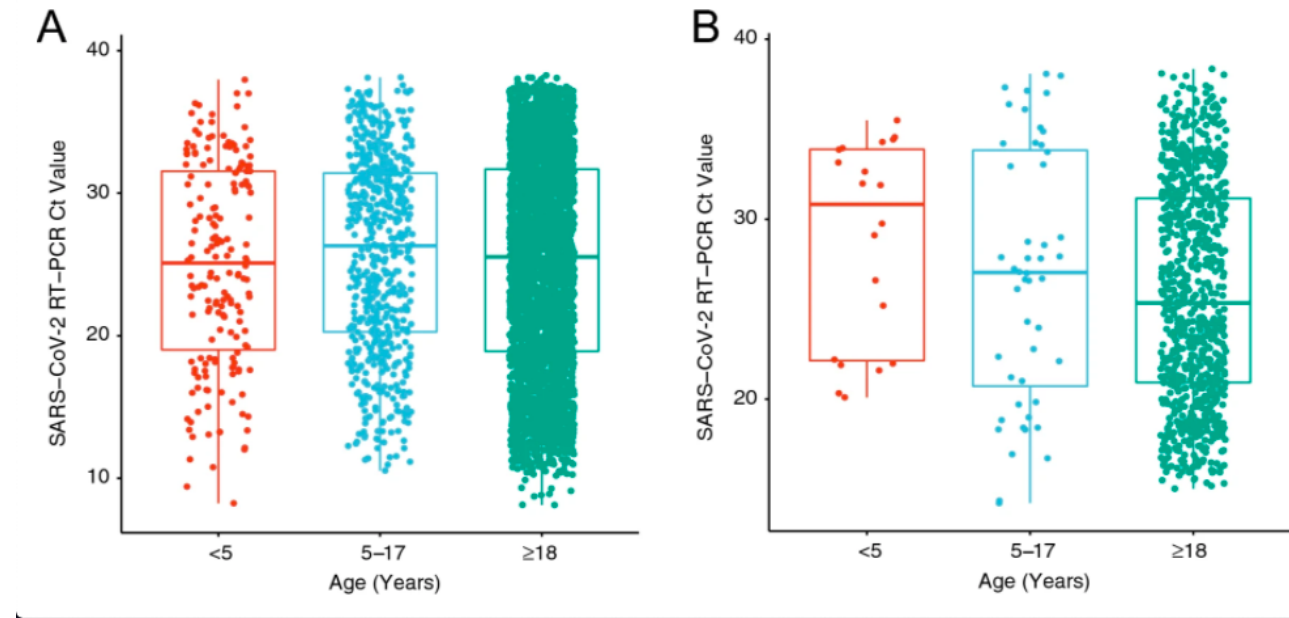
RT-PCR Ct values in vaccinated patients were similar to those among unvaccinated, not fully vaccinated



Brown CM, Vostok J, Johnson H, et al. Outbreak of SARS-CoV-2 Infections, Including COVID-19 Vaccine Breakthrough Infections, Associated with Large Public Gatherings — Barnstable County, Massachusetts, July 2021. MMWR

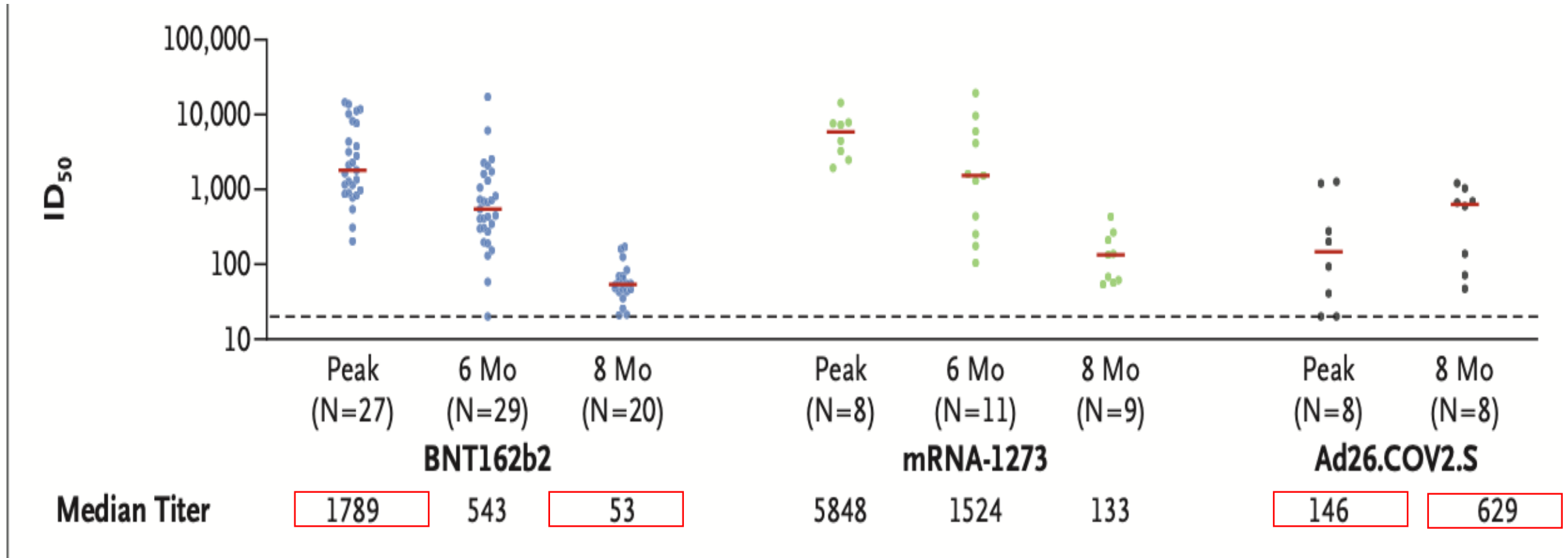
# Viral load

- Same in children and adults
- Same in symptomatic and asymptomatic in children

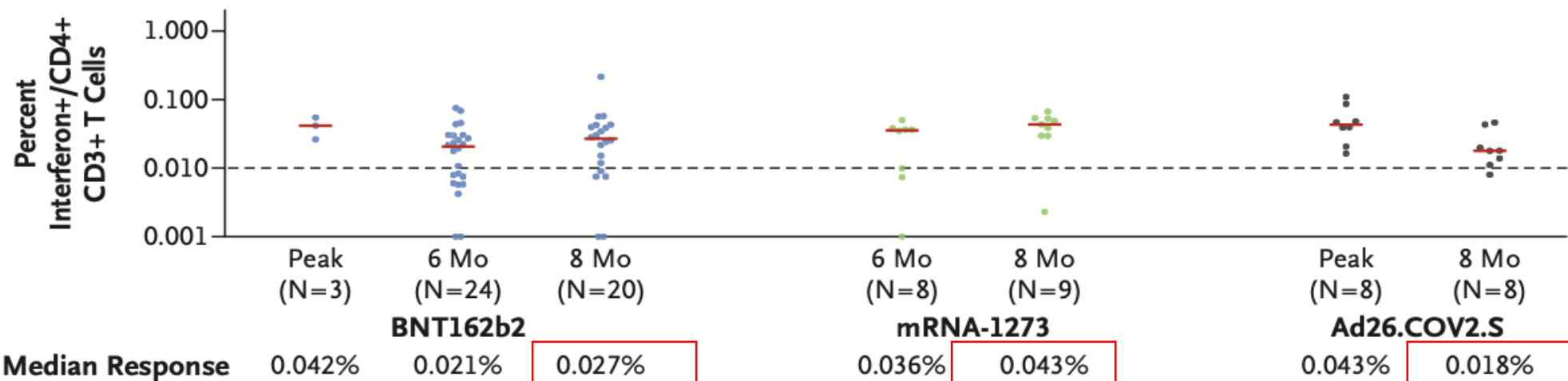


Madera, S., Crawford, E., Langelier, C. *et al.* Nasopharyngeal SARS-CoV-2 viral loads in young children do not differ significantly from those in older children and adults. *Sci Rep* **11**, 3044 (2021). <https://doi.org/10.1038/s41598-021-81934-w>

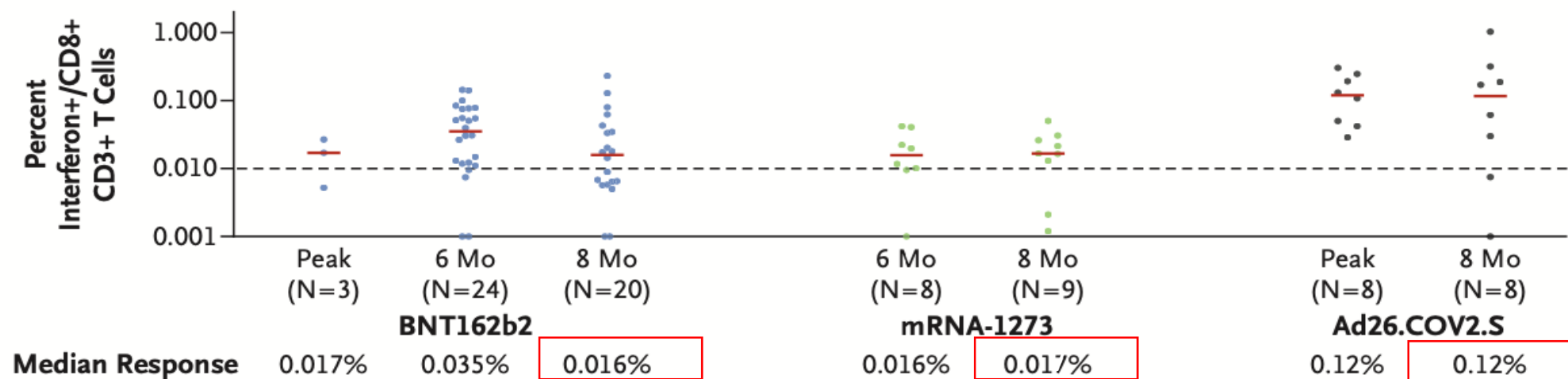
# Live virus neutralizing Antibody



## D CD4 T-Cell Response



## E CD8 T-Cell Response





# CDC recommendations for booster shots

Oct 2021, 0,1,6mo

- 65 years and older
- Age 18+ who live in [long-term care settings](#)
- Age 18+ who have [underlying medical conditions](#)
- Age 18+ who work in [high-risk settings](#)
- Age 18+ who live in [high-risk settings](#)

# Workers who may get Pfizer-BioNTech booster shots (CDC Oct 2021)

- First responders (e.g., healthcare workers, firefighters, police, congregate care staff)
- Education staff (e.g., teachers, support staff, daycare workers)
- Food and agriculture workers
- Manufacturing workers
- Corrections workers
- U.S. Postal Service workers
- Public transit workers
- Grocery store workers

# Vaccine efficacy in adults

- Vaccines does not produce sterilizing immunity.
- Breakthrough infection with newer strains high
- Waning effectiveness of vaccines beyond 5 -8 months
- Lot more research is needed vaccine kinetics
- Chance of hospitalization and death significantly less in vaccinated

VACCINE MAINLY EFFECTIVE AGAINST DEATH AND HOSPITALISATION

*MMRWR august 2021, new covid cases and hospitalisations amog adults by vaccination status may3 –July 25 , 2021*



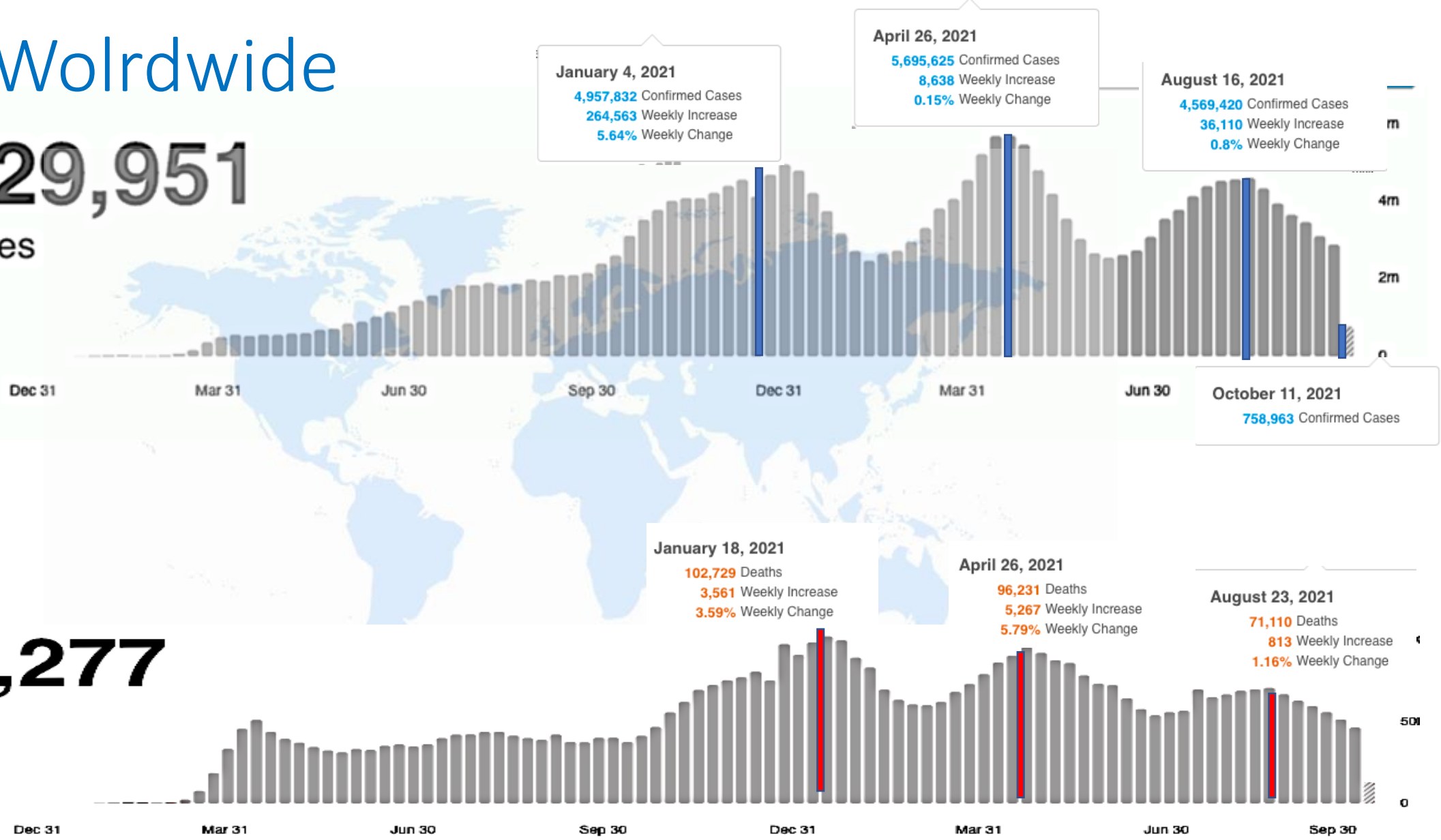
## Need of COVID vaccine in children

# COVID Woldwide

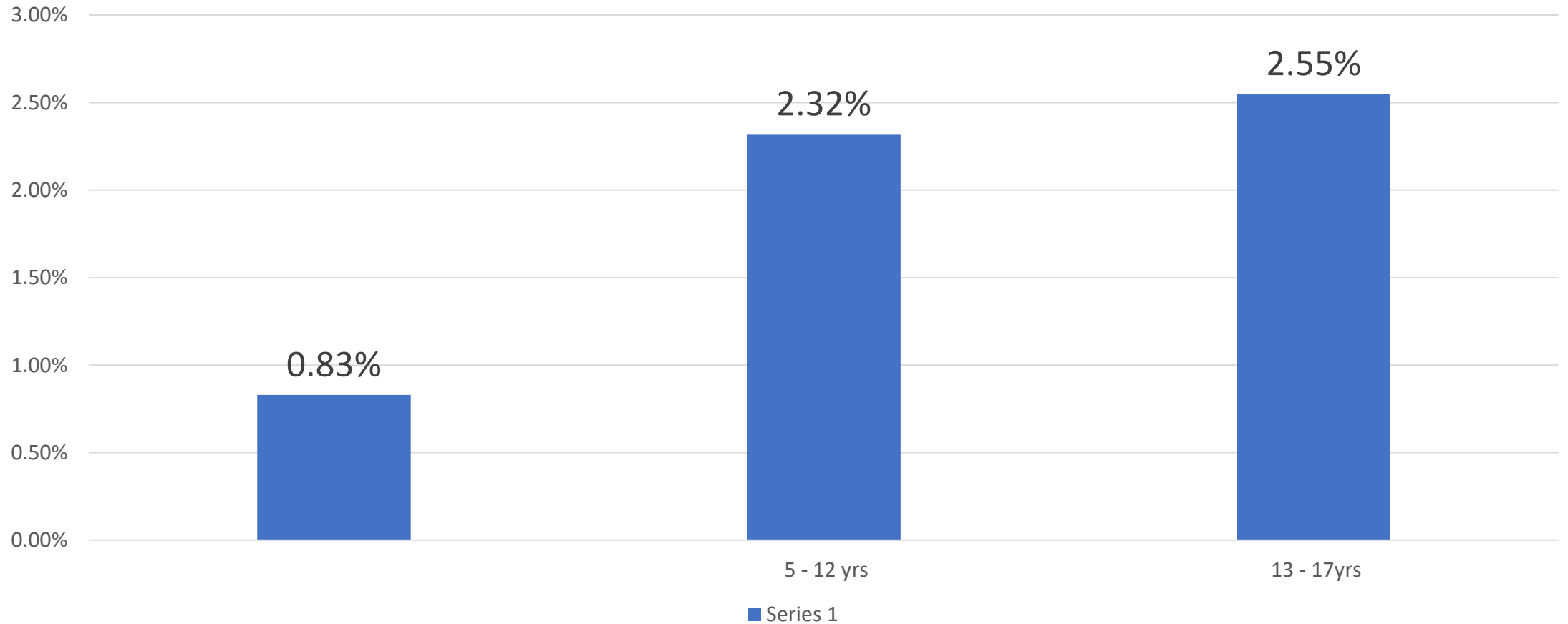
238,229,951  
confirmed cases

4,859,277  
deaths

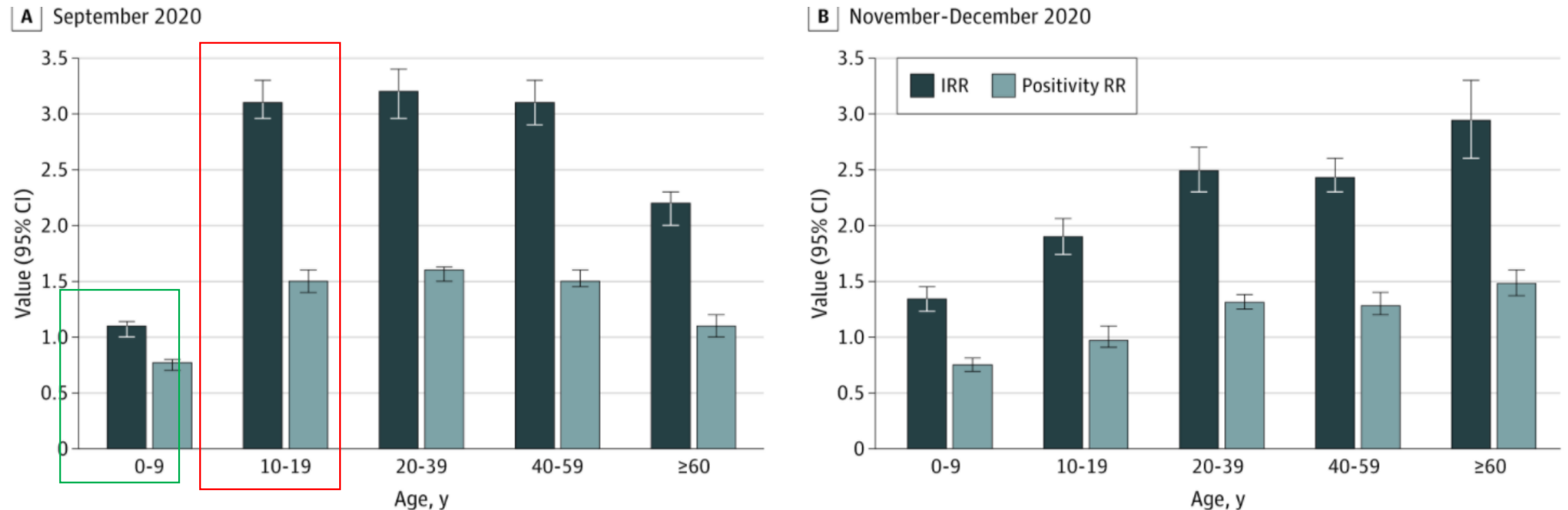
Source: World Health Organization  
Data may be incomplete for the current day or week.



# UK post school opening sep 2021 weighted prevalence (REACT 1study)

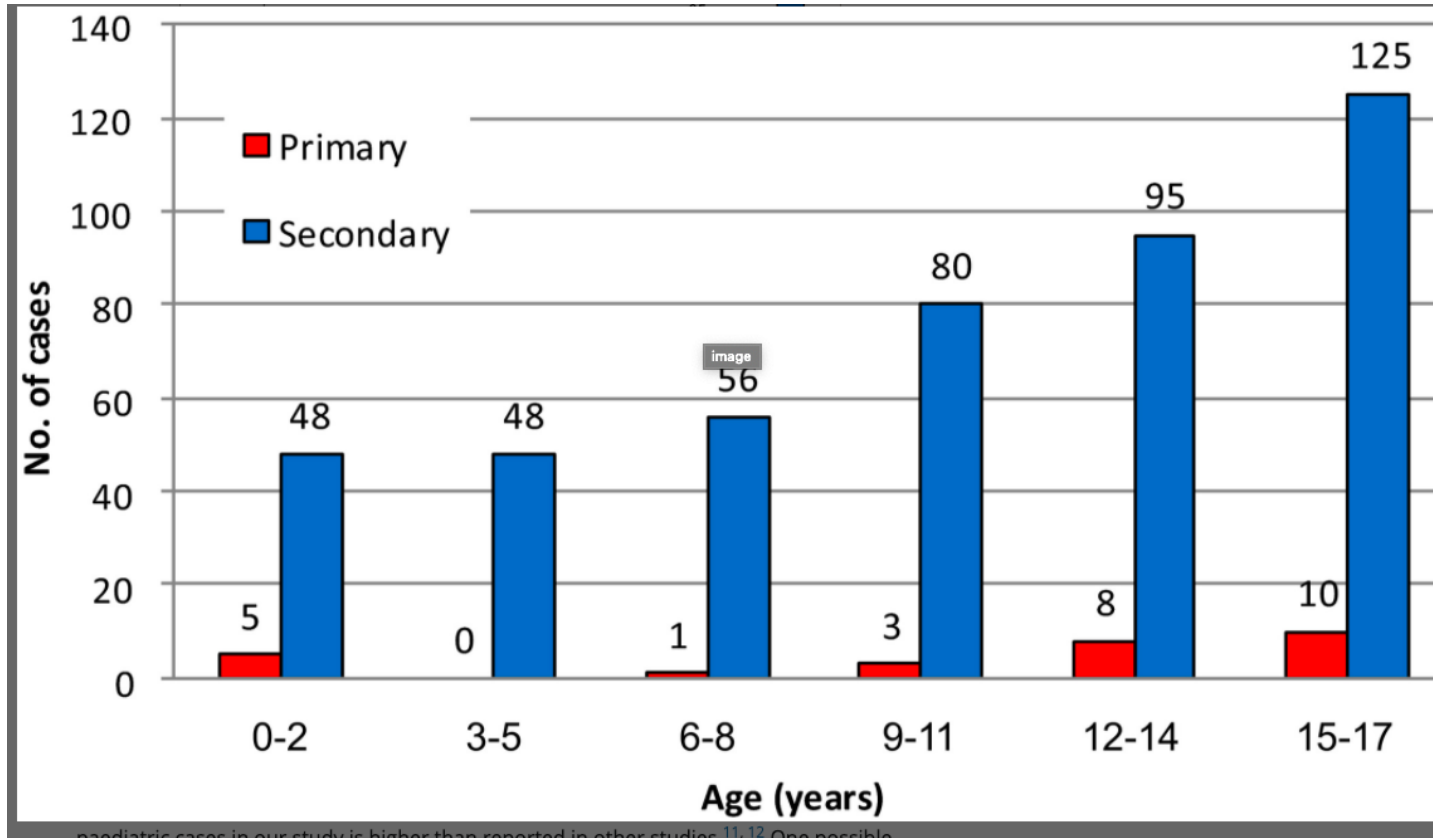


# Incidence rate ratios (IRRs) and test positivity rate ratios (RRs) after school opening

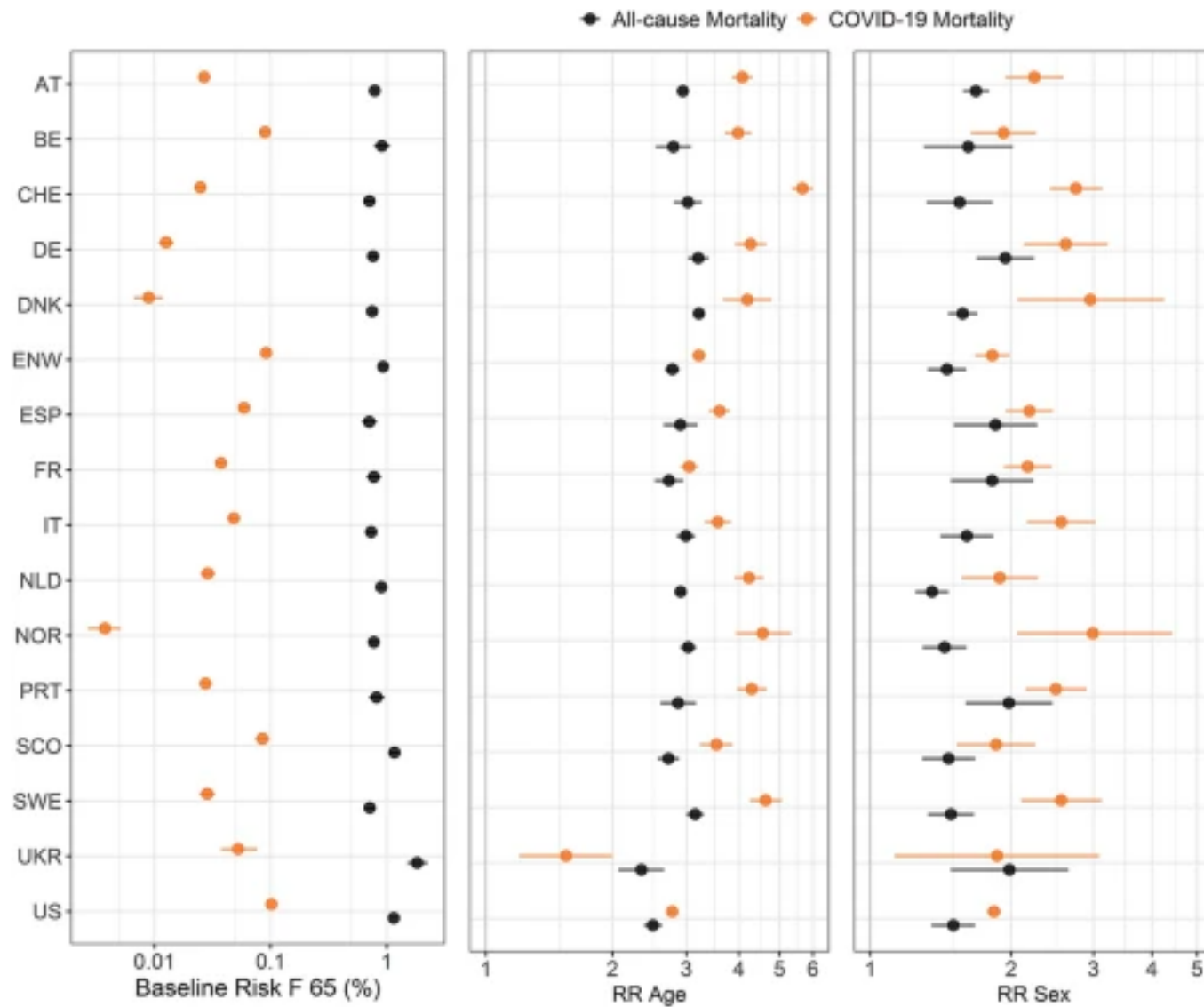




Children were less likely to be the source for SARS-CoV-2 infection within households, while opening educational facilities did not change transmission dynamics.



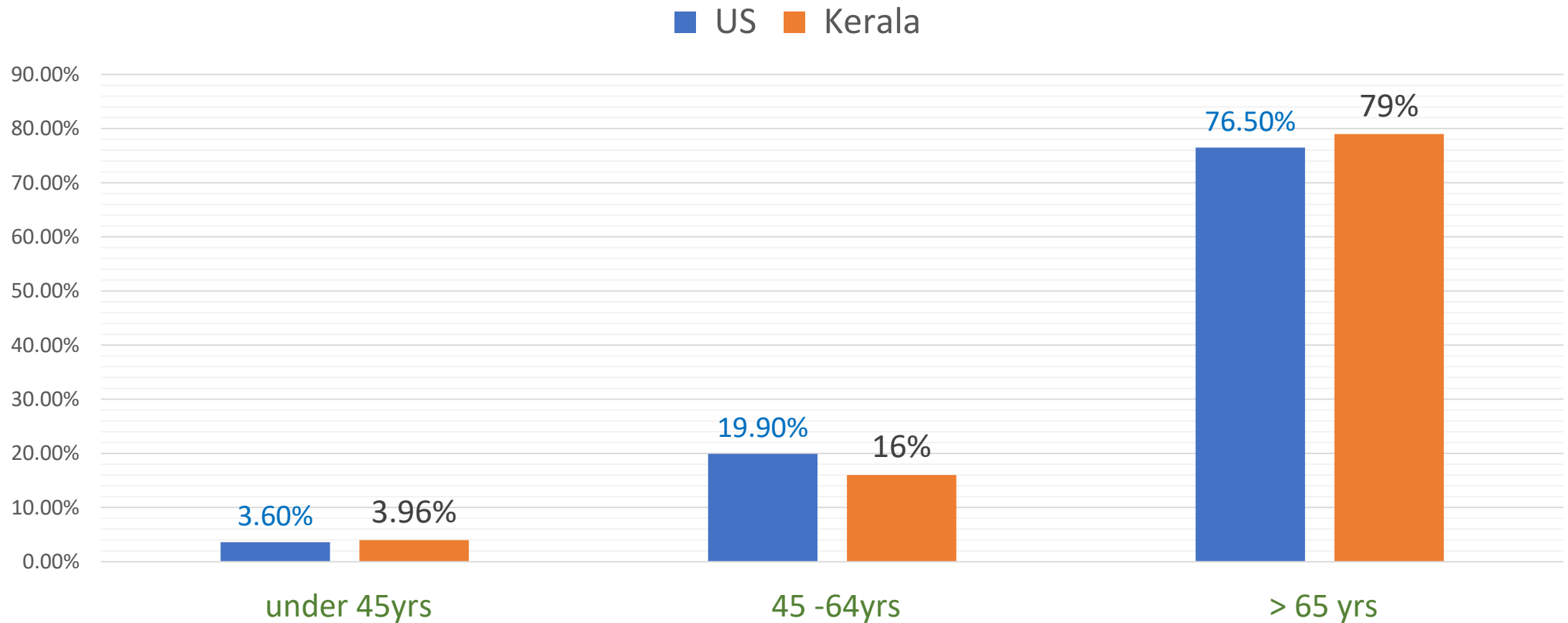
- 9% of children < 18 yrs were the primary source
- 2% less than 10 years were the primary source.



- COVID 19 mortality more in males
- Exponential increase of COVID-19-related mortality with age.
- Increase in age of 10 years increased mortality by *a factor of around 4*

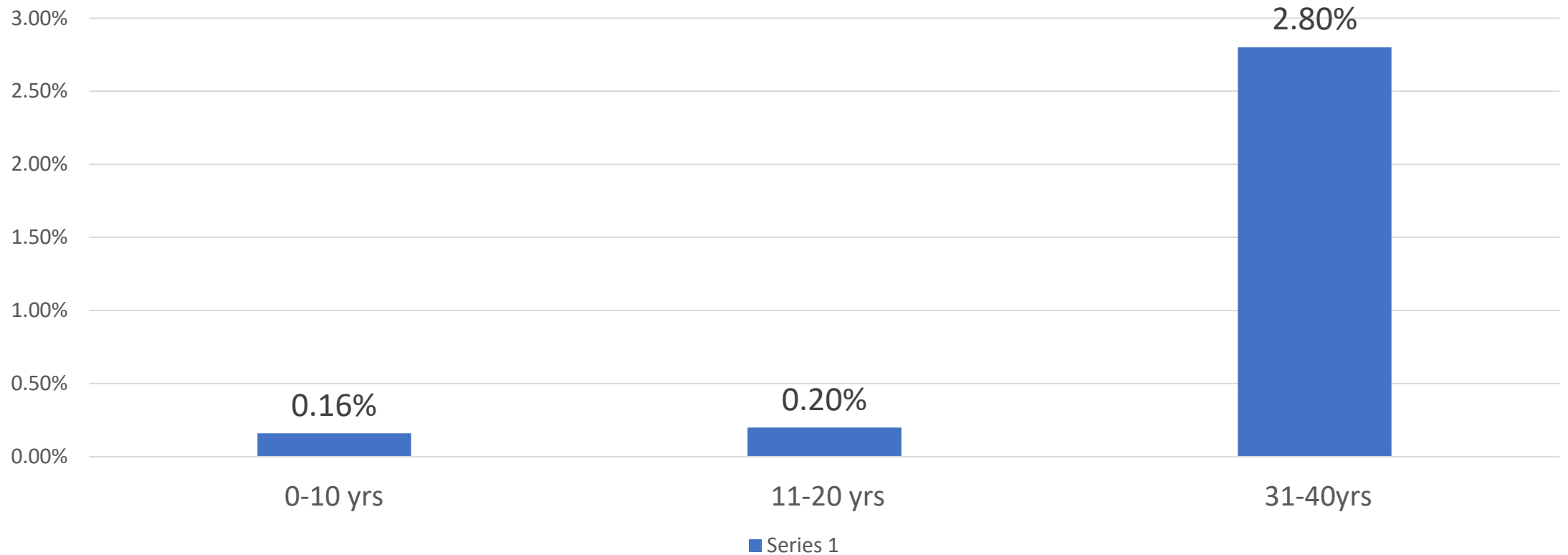
Bauer, P., Brugger, J., König, F. et al. An international comparison of age and sex dependency of COVID-19 deaths in 2020: a descriptive analysis. *Sci Rep* **11**, 19143 (2021). <https://doi.org/10.1038/s41598-021-97711-8>

# Age distribution among COVID 19 deaths



*Technical paper COVID 19 DEATHS Department of Health & Family Welfare Government of Kerala [ 18th June to 3rd Sept 2021]*

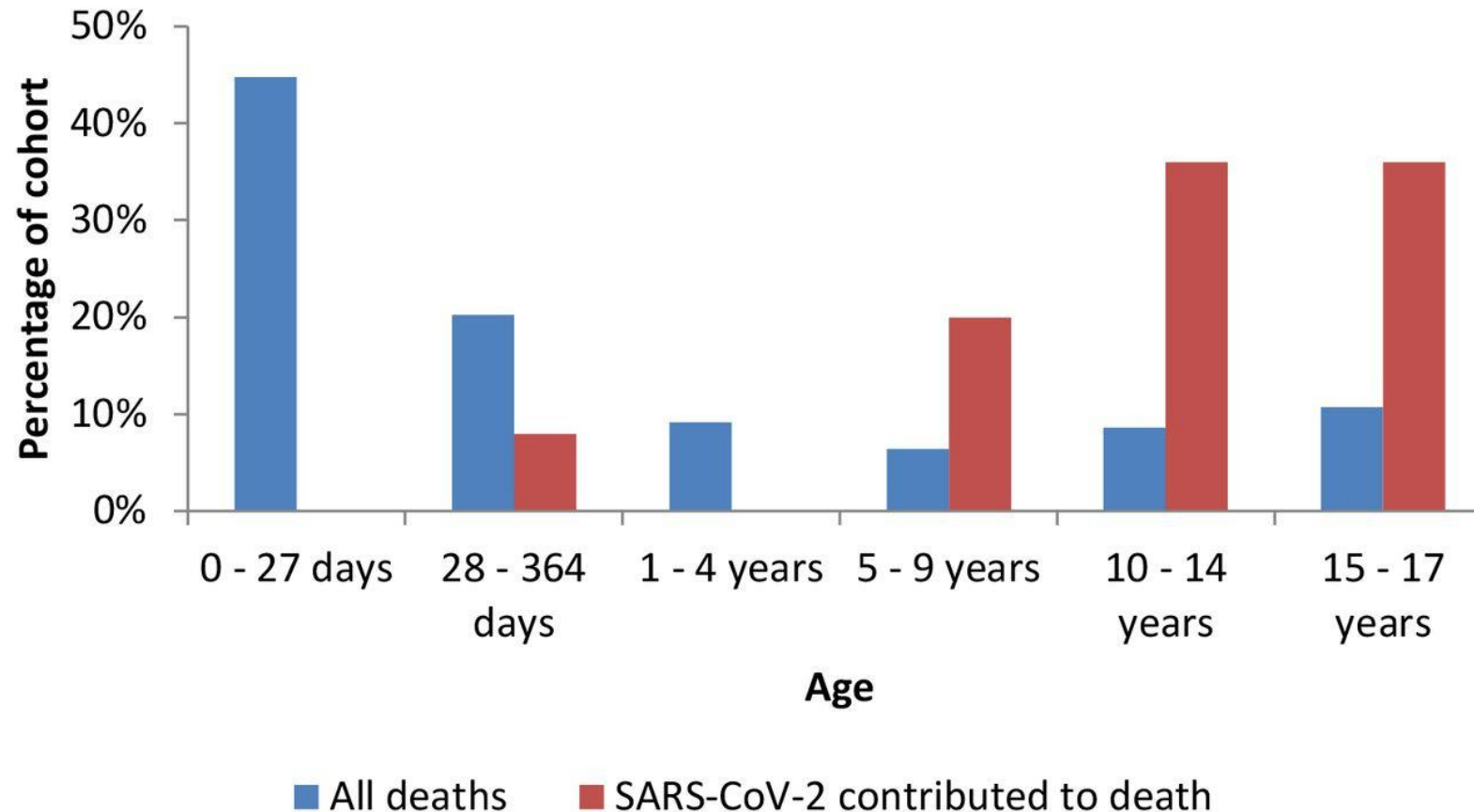
## Age distribution among COVID 19 deaths



Technical paper COVID 19 DEATHS Department of Health & Family Welfare Government of Kerala [ 18th June to 3rd Sept 2021]

# Age group and mortality (<18yrs)

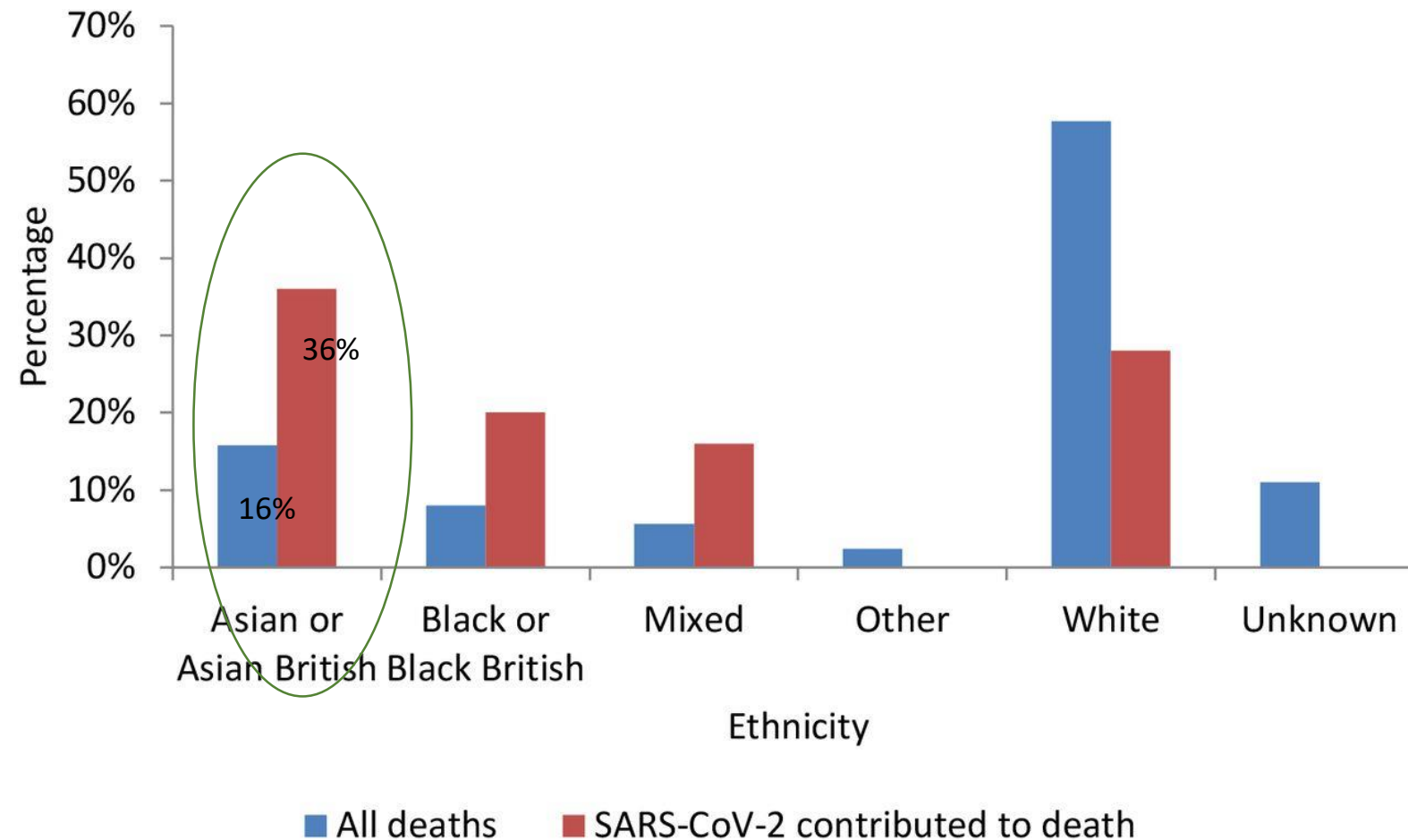
(All cause Vs COVID 19)



C Smith, D Odd, R Harwood, J Ward, M Linney, Deaths in Children and Young People in England following SARS-CoV-2 infection during the first pandemic year: a national study using linked mandatory child death reporting data.

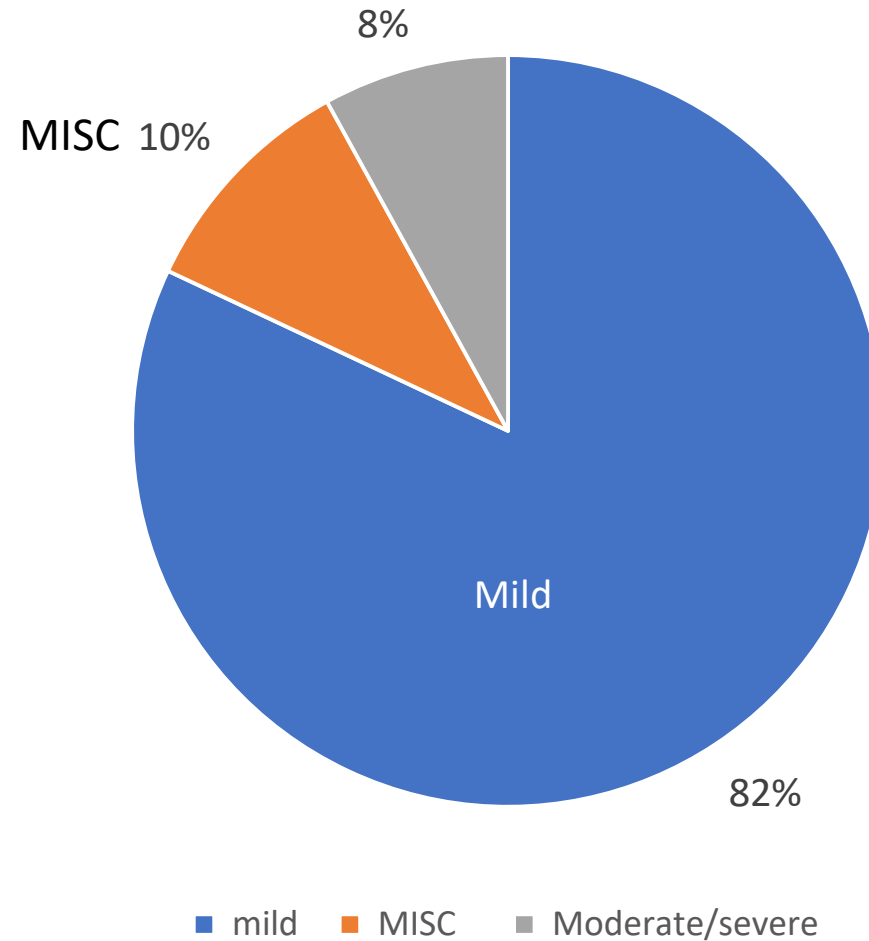
# Ethnic group and mortality (<18yrs)

(All cause Vs COVID 19)



C Smith, D Odd, R Harwood, J Ward, M Linney, Deaths in Children and Young People in England following SARS-CoV-2 infection during the first pandemic year: a national study using linked mandatory child death reporting data.

# COVID 19 in hospitalized Children



Ben-Shimol S, Livni G, Megged O, Greenberg D, Danino et al COVID-19 in a Subset of Hospitalized Children in Israel. J Pediatric Infect Dis Soc. 2021 Aug 17;10(7):757-765. doi: 10.1093/jpids/piab035. PMID: 34129032;



# Deaths in Children and Young People in England following SARS-CoV-2 infection during the first pandemic year: a national study using linked mandatory child death reporting data

C Smith, D Odd, R Harwood, J Ward, M Linney, M Clark, D Hargreaves, SN Ladhani, E Draper, PJ Davis, SE Kenny, E Whittaker, K Luyt, RM Viner, LK Fraser  
doi: <https://doi.org/10.1101/2021.07.07.2125977>

- March 2020 to feb 2021 (total death aprox 80,000)
- 61 deaths were covid positive (5 deaths every 30 days) <18yrs
- 25 died due to COVID 19 (22 due to acute disease and 3 due to MIS-C)
- 3044 died due to other causes (250 deaths every 30 days)
- Case fatality rate 0.005% (5 per 100,000)

# COVID mortality in children

- 76% of COVID deaths in children had comorbidities (74% in all cause death).
- 60% had a life limiting comorbidity
- Neurological comorbidity was the commonest (52%)
- No death in trisomy, asthma, Type 1 DM, Epilepsy (UK)
- Absolute risk of death even in those with life threatening neurodisability was less. ( 88.9 per 100,000 (95%CI 47.3-152) compared to 2,441 per 100,000 (95% CI 2,194-2,707) with life-limiting neurodisability who died of all other causes.)

*C Smith, D Odd, R Harwood, J Ward, M Linney Deaths in Children and Young People in England following SARS-CoV-2 infection during the first pandemic year: a national study using linked mandatory child death reporting data*

# Long COVID in children

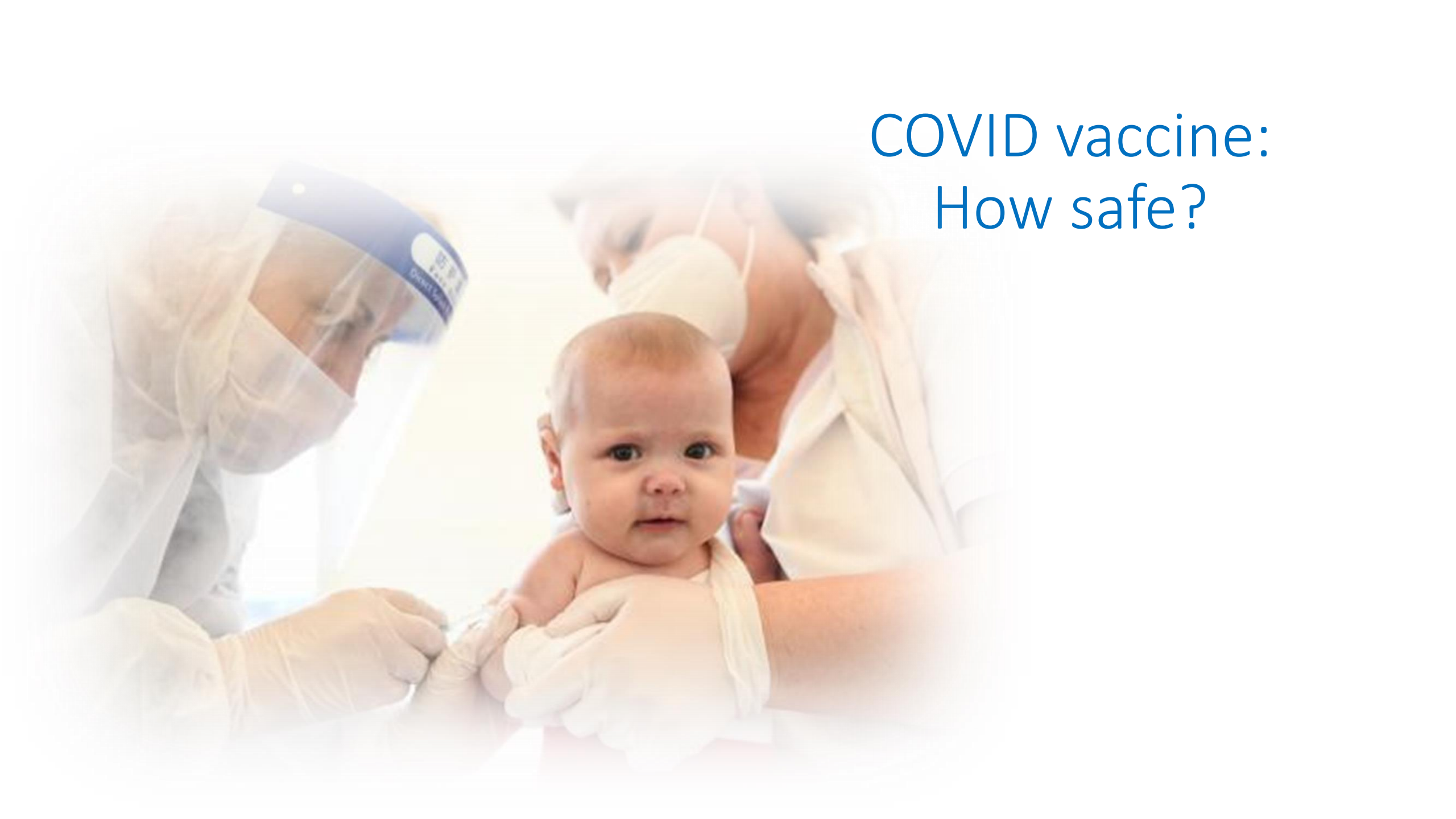
- Headache , fatigue, disturbed sleep , problems concentrating
- 2- 4% of 1734 covid positive children in UK.
- 11% of 13,864 children aged three to 18yrs in Israel.
- PCR proven 11 – 17 year old in UK 3065 Vs 3739 (matched cohort):  
14% have persistent symptoms 15 weeks after testing positive.

Stephenson T, Pereira S, Shafran R, et al Long covid—the physical and mental health of children and non-hospitalised young people 3 months after SARS-CoV-2 infection; a national matched cohort study (The CLoCk) Study.2021. doi:10.21203/rs.3.rs-798316/v1

# Need

- Covid mortality extremely rare (CFR 0.005 – 0.008).
- School reopening has increased cases in children but no exponential increase in adults
- Children as a primary source of infection in household only in 2 – 9%
- 2 -11% of children have long covid
- Increase in infection and admission with covid post school opening.
- Breakthrough infection India 10% , CFR 0.4%

# COVID vaccine: How safe?



# Vaccines and rare side effects

## M RNA

Pfizer, moderna

Pericarditis

Myocarditis

## Vector Vaccines

Covishield, Janssen

Thrombosis

GBS

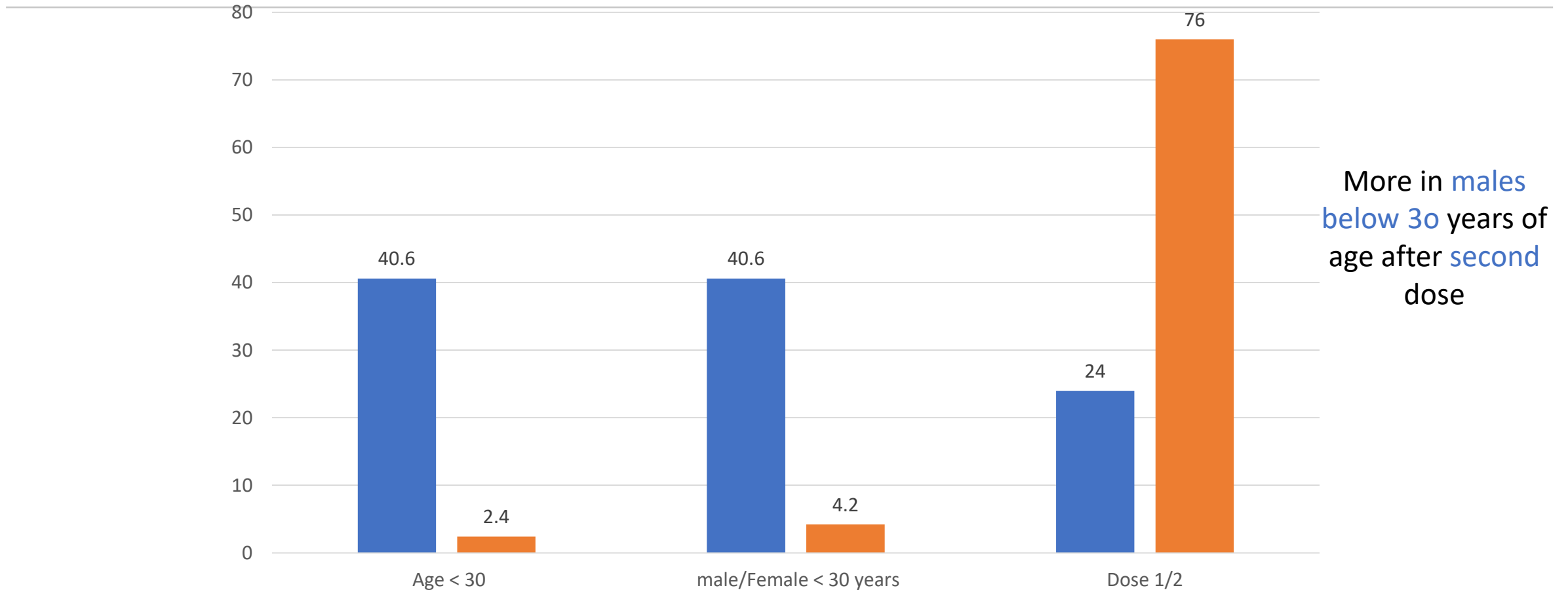
## Killed vaccines

Sinovac, sinopharm

ADEM

Serious nausea

# Post vaccination Myocarditis (cases /million)



Gargano JW, Wallace M, Hadler SC, et al. Use of mRNA COVID-19 Vaccine After Reports of Myocarditis Among Vaccine Recipients: Update from the Advisory Committee on Immunization Practices — United States, **June 2021**. MMWR Morb Mortal Wkly Rep 2021;70:977–982.



# Covid 19 vaccine and myocarditis

---

- Cases reported following mRNA vaccine
- Onset of symptoms median 3 days (range 0 - 179days)
- Median duration of admission 2 days (IQR 2-3days)
- No deaths reported

*Diaz GA, Parsons GT, Gering SK, Meier AR, Hutchinson IV, Robicsek A. Myocarditis and Pericarditis After Vaccination for COVID-19. JAMA. Published online August 04, 2021. doi:10.1001/jama.2021.13443*

# Myocarditis and COVID Vaccine (Pfizer BioNtech)

- Among 2.5 million vaccinated HCO
- **2.13 cases per 100,000 vaccinated** ( >16years)
- CDC 3.8/ 1million 1<sup>st</sup> dose, 57 per 1 million for 2<sup>nd</sup> dose
- Highest incidence 16 -29years
- In 16 -29 yr group ,10.69 cases per 100,000 persons (95% CI, 6.93 to 14.46)

*Guy Witberg, Noam Barda, Sara Hoss et al Myocarditis after Covid-19 Vaccination in a Large Health Care Organization October 6, 2021 DOI: 10.1056/NEJMoa2110737 ISRAEL*

# Myocarditis and COVID Vaccine (Pfizer BioNtech)

- 71% LV function normal at admission
- 76% mild, 22% moderate only 1 case cardiogenic shock
- Follow up echocardiography at day 25(median) was normal in all ( 5 cases results not available)

*Guy Witberg, Noam Barda, Sara Hoss et al Myocarditis after Covid-19 Vaccination in a Large Health Care Organization October 6, 2021 DOI: 10.1056/NEJMoa2110737 ISRAEL*

# COVID 19 infection and myocarditis

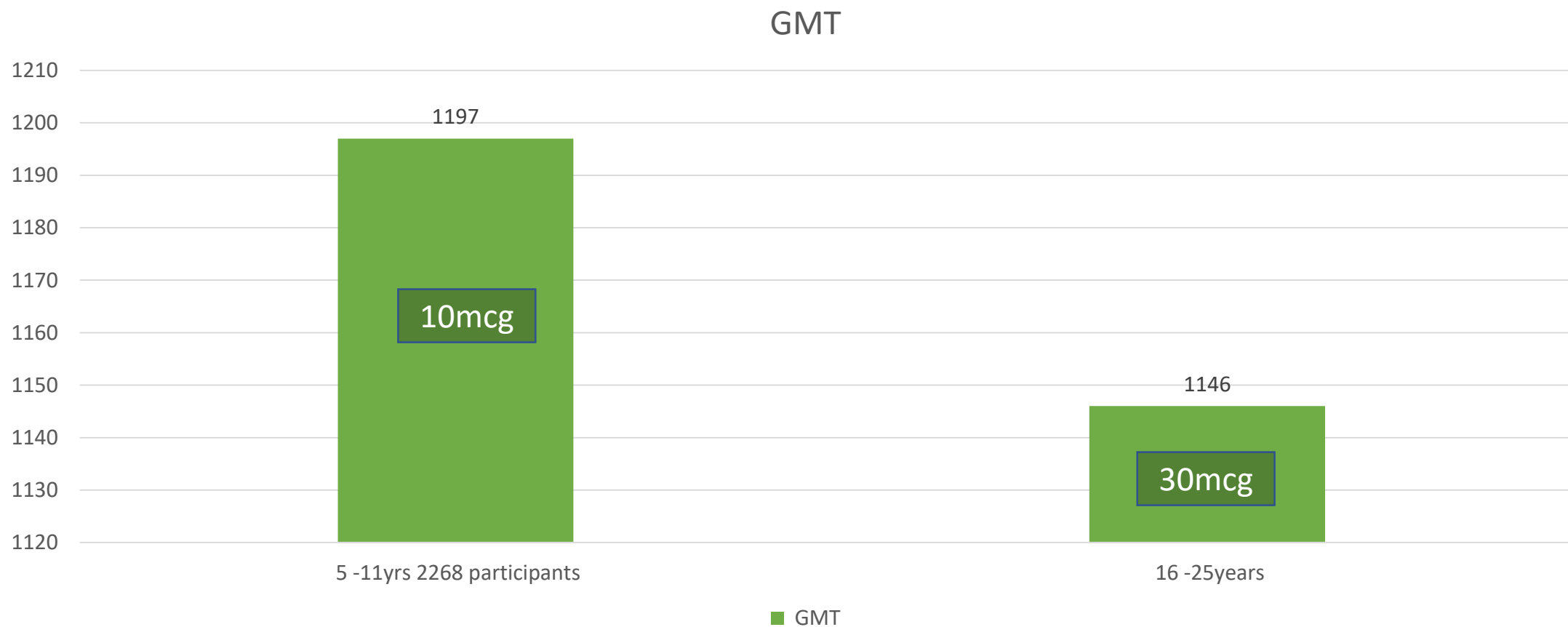
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- 1597 US competitive collegiate athletes
- 2.3% had myocarditis ( 9 clinical and 28 subclinical)
- Follow-up CMR imaging performed in 27 (73.0%) demonstrated resolution of T2 elevation in all (100%) and late gadolinium enhancement in 11 (40.7%).

Daniels CJ, Rajpal S, Greenshields JT, et al. Prevalence of Clinical and Subclinical Myocarditis in Competitive Athletes With Recent SARS-CoV-2 Infection: Results From the Big Ten COVID-19 Cardiac Registry. *JAMA Cardiol*. Published online May 27, 2021. doi:10.1001/jamacardio.2021.2065

# Pfizer study 5 -11years GMT 1 month after 2 dose

United States, Finland, Poland, and Spain from more than 90 clinical trial sites. Under 5: 3mcg





## Plasmid DNA vaccine (Zycov-d)

- World's first human plasmid DNA vaccine.
- Approved for those above 12 years
- They are more stable (3mo at 25C)
- Needle free intradermal injection.
- 67% efficacy with three dose schedule

*Safety and Immunogenicity of a DNA SARS-CoV-2 vaccine (ZyCoV-D): Results of an open-label, non-randomized phase I part of phase I/II clinical study by intradermal route in healthy subjects in India Momin, Taufik et al. EClinicalMedicine, Volume 38,*

# Zycov D safety and efficacy

- Dey A, Chozhavel Rajanathan Tmet al [Immunogenic potential of DNA vaccine candidate, ZyCoV-D against SARS-CoV-2 in animal models](#). Vaccine. 2021 Jul Epub 2021 Jun 1.
- *Momin, Taufik et al.* [Safety and Immunogenicity of a DNA SARS-CoV-2 vaccine \(ZyCoV-D\): Results of an open-label, non-randomized phase I part of phase I/II clinical study by intradermal route in healthy subjects in India](#) *EClinicalMedicine*, Volume 38, July 2021
- *Phase III* 28,216 subjects enrolled . Study yet to be published!! 67% efficacy
- *No DNA vaccine currenty in use in humans*

# COVAXIN

- Killed vaccine, 2 doses 1 month apart
- Used in India, Bangladesh, Myanmar, Nepal, Bhutan, Maldives, Mauritius, Seychelles, Brazil, Morocco, South Africa.
- Phase 3 trials 24,419 subjects 78% efficacy against symptomatic covid.

[Raches Ella, Siddarth Reddy, William Blackwelder, Varsha Potdar, Pragya Yadav et al](#) **Efficacy, safety, and lot to lot immunogenicity of an inactivated SARS-CoV-2 vaccine (BBV152): a, double-blind, randomised, controlled phase 3 trial** **pre print**



# COVAXIN

- 
- Expert recommendation for those > 2 years
- Study done in 1000 subjects.
- More breakthrough infection with COVAXIN .
- Not yet approved by WHO for adults.
- Lower antibody titer – can it lead to antibody mediated enhancement in future not known.

# Safety of covid vaccines in children

- Children are not small adults.
- Their immune system responds differently to vaccines compared to adult.
- Longer life period ahead also may be at higher risk of 1<sup>st</sup> antigen sin.
- Studies of Indian vaccines phase 3 not yet published.
- Indian vaccines authorized for use in children not yet approved by WHO.

# Children if being vaccinated for adults it needs to be very safe : robust study & data transparency

Children need to vaccinated to stop pandemic

Vaccines do not provide sterilizing immunity.

Incidence of disease in vaccinated is far less.

Incidence of symptomatic disease & CFR in children very low.

Children can spread disease to adults

School reopening in other countries have not increased incidence in adults

# To protect children

Infection

Symptomatic  
less but  
increasing

Admission and mortality

CFR  
< 0.005%

Long Covid

2 -11%

Urgent need for more long term safety n  
Immunogenicity data.

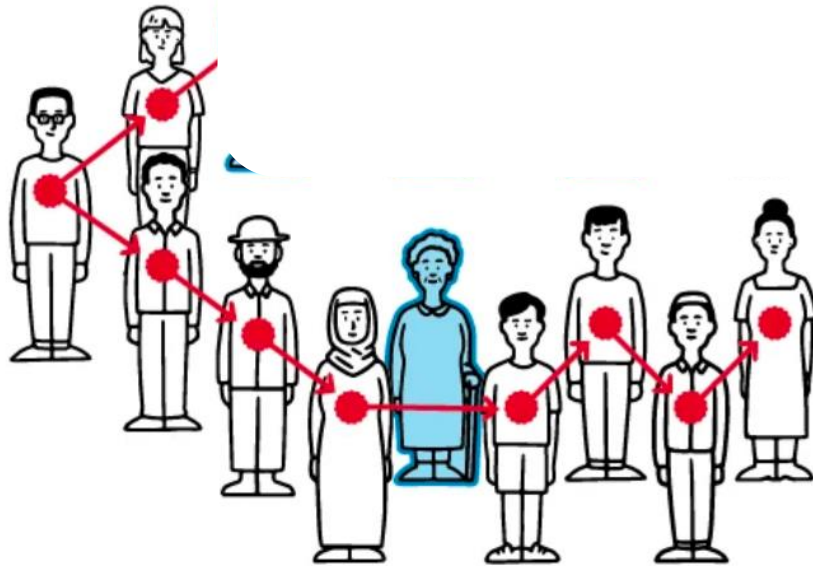


Thank You!  
😊



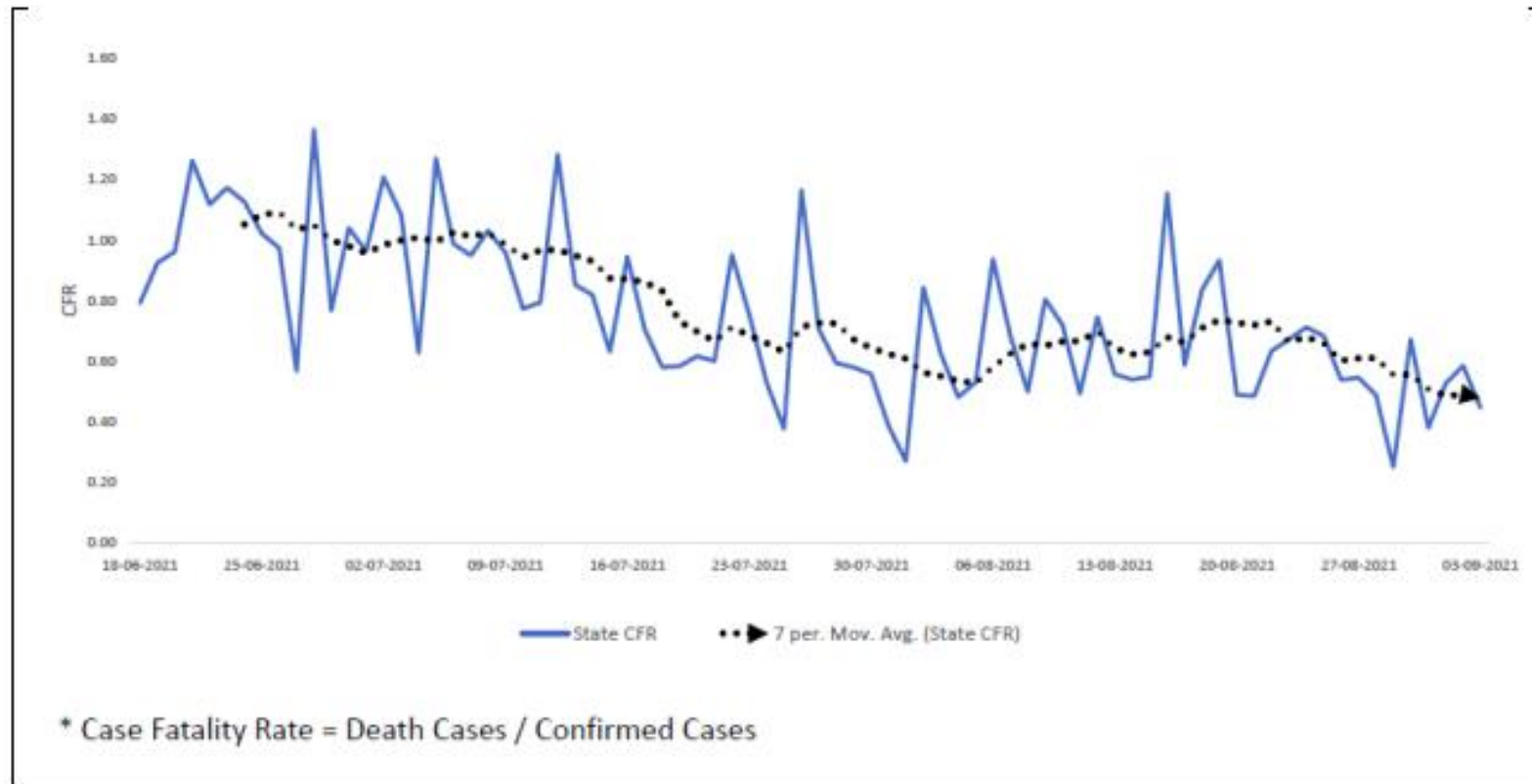
- Anderson M, Stec M, Rewane A, Landay A, Cloherty G, Moy J. SARS-CoV-2 Antibody Responses in Infection-Naive or Previously Infected Individuals After 1 and 2 Doses of the BNT162b2 Vaccine. *JAMA Netw Open*. 2021;4(8):e2119741.  
doi:10.1001/jamanetworkopen.2021.19741
- Dan JM, Mateus J, Kato Y, et al. Immunological memory to SARS-CoV-2 assessed for up to 8 months after infection. *Science* 2021;371(6529):eabf4063-eabf4063.

Vaccines do not provide full (100%) protection,  
so breakthrough infections can happen.



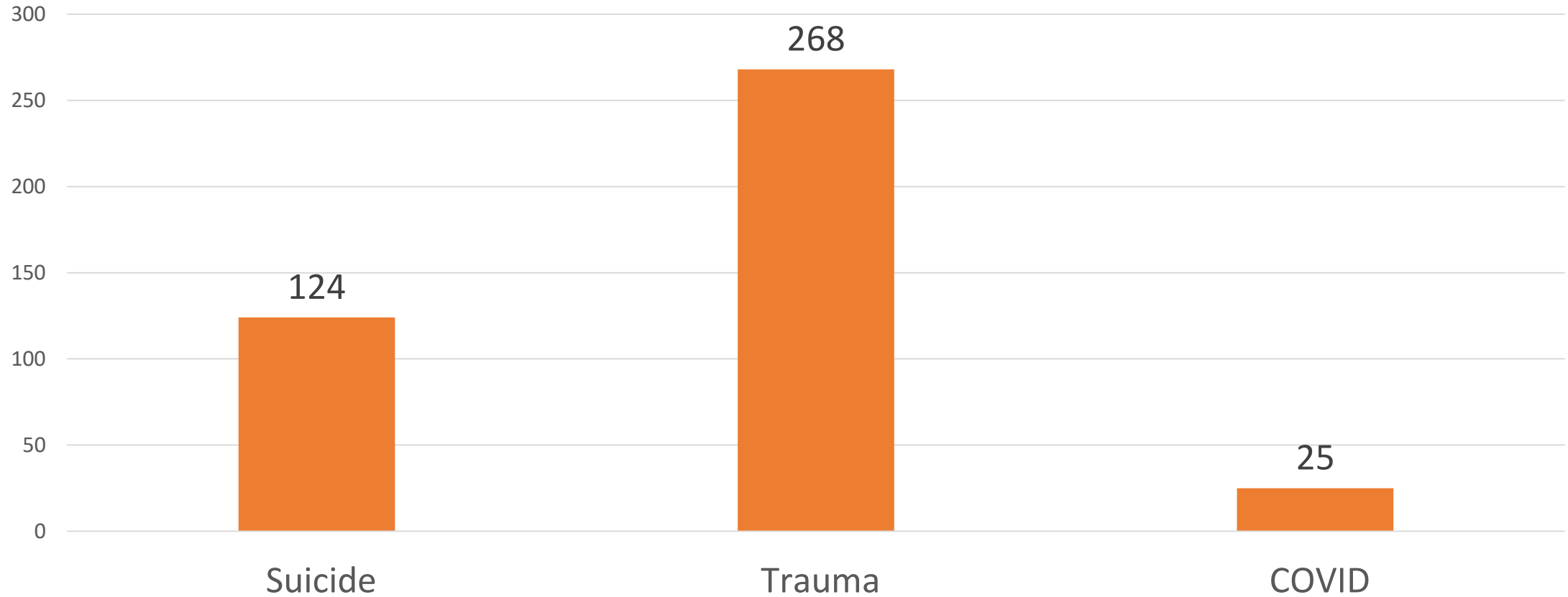


# Time trend case fatality rate Kerala



Time trend analysis of CFR clearly demonstrates that compared to the peak of second wave surge, CFR has gradually come down with time.

# Mortality in < 18 years



*C Smith, D Odd, R Harwood, J Ward, M Linney Deaths in Children and Young People in England following SARS-CoV-2 infection during the first pandemic year: a national study using linked mandatory child death reporting data*

# School opening and covid 19

- Israel : 54% 12 -15 yrs and 84% 16 -19yrs vaccinated, less than 12yrs those with comorbidities.
- Israel opened school in Sep.: 54% of positive tests were in children.
- In Israel 0.2 – 0.5% of ICU admission < 18 years (October 2021)

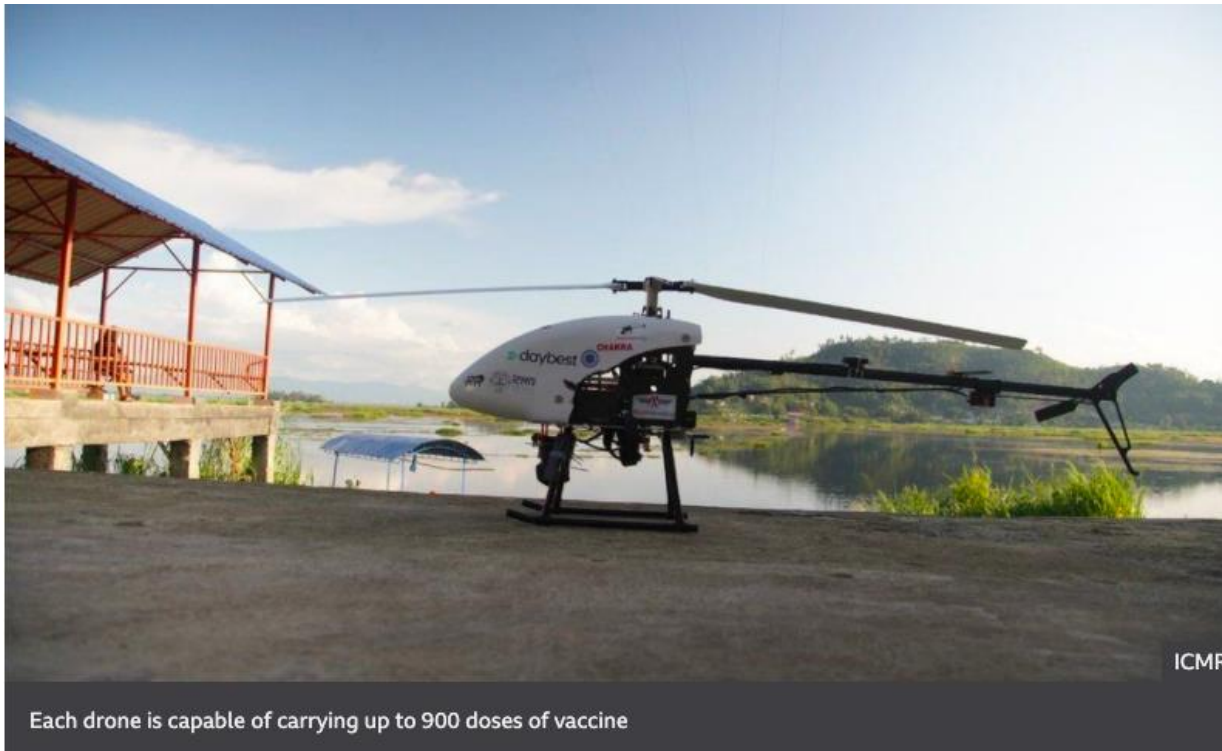
# COVID and mortality in children

- Case fatality rate extremely low (0.005%)
- 75 – 90% have comorbidity .
- Higher incidence in those with neurological life limiting comorbidities.
- Even in those with comorbidities risk of death due to covid per se is very rare

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# Covid vaccine: India drones deliver Covid jabs to remote areas



- 100Cr doses
- 22% fully vaccinated
- 52% 1 dose

# Efficacy in adults covid vaccine

- Vaccine efficacy **against infection** declined from 91.7% to 79.8%(post delta)
- Waning humoral immunity after 24 weeks (booster at 8months) especially , > 65 yrs, immunocompromised.
- Vaccine efficacy for **hospitalization** >90% for mRNA vaccines
- 63% effective against hospitalizations in immunocompromised