Physics and Chemistry of the Earth 130 (2023) 103388

Contents lists available at ScienceDirect

Physics and Chemistry of the Earth

journal homepage: www.elsevier.com/locate/pce

Seasonality, mass vaccination and critical policy evaluation on global exit strategy of COVID-19 crisis

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ARTICLE INFO

Keywords:
COVID-19
Seasonality
Vaccine
Flu
Temperature
Peer-review
Transparency
Clinical trial
Solutions
Mass vaccination

ABSTRACT

There is a strong coordinated effort by vaccination groups all over the world to put an end to the current crisis of COVID-19. Now sufficient data are available to analyse and compare some results to explore the aftereffects of vaccination. Some influence variables on transmissions of the disease were discussed e.g., mass vaccination, lockdown and seasonality. Most studies covered here are up to the beginning of July 2022, while some analyses focused on the earlier period of mass vaccination. Well established, simple statistical techniques to evaluate results were presented those used open data sources of authoritative bodies. Some comparisons between vaccinated vs. unvaccinated were also discussed based on data from UK Government Health Security Agency (UHSA). In terms of mass vaccination, adverse reactions after vaccination received attention, as health and safety issues of the general public are of prime importance. Apart from direct side effects, the secondary effect of mass vaccination needs attention too. After the initiation of the vaccination programme, almost all countries experienced a sudden surge in transmission and most countries had to impose strict lockdown measures. Many countries, with a low prevalence of disease, suddenly showed a steep jump and some countries even followed a synchronized pattern between the rate of transmissions and the variation of vaccine doses. Time series analyses and bar diagram presentations were able to capture those features. In that context, fast mutation of the virus and new variants after mass vaccination and possible mechanisms/consequences were also attended. To understand the effect of seasonality, similarities between COVID-19 and the seasonal Flu are discussed for Europe and US to gain useful insight. Using time series analyses and spatial plots of regional temperature composites we showed, like Flu, seasonality played a dominant role in transmissions of COVID-19 in the Europe. Regulations of vaccine dose and policy implication were explored too. From 22nd December 2021, global vaccine doses were reduced substantially, which followed a dramatic reduction in cases and thereafter deaths with around one month's lag between each. As strong dependency on seasonality is noticed in certain countries and observing that regulation of vaccine doses has roles in modulating the transmission with certain lags, globally as well as regionally, our results have policy implications for the management of COVID. Debating, questioning and criticism are always the foundation of great science and the major pillars of its progress. Following that objective, it is an effort to explore pragmatically, supported by scientific analyses, areas relating to the effectiveness of the COVID-19 vaccine and the exit strategy via the pathway of vaccination.

1. Introduction and background

The recent COVID-19 pandemic first originated in the Wuhan Province of China in December 2019. At a very rapid rate, it spread all over the globe and by 15 December 2021, more than 5,348,990 people had died (Worldometers). The number of deaths reached 6,370,890 by 8th July 2022, which is 6,781,625 till date (10th February 2023) (Worldometers). Global deaths and cases are in a declining state in the later period (Worldometers). Global cases up to 10th February 2023 are 677, 434,047, while daily cases and deaths worldwide on the day are 155,375

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https://doi.org/10.1016/j.pce.2023.103388
Received 21 August 2022; Received in revised form 12 February 2023; Accepted 20 February 2023
Available online 5 March 2023

and 910 respectively. Detailed discussions on the nature of the disease and characteristics of the virus are outlined in recent research (Chen and Lanjuan, 2020; Gorbalenya et al., 2020).

The disease is highly contagious in nature and hence at the beginning of the outbreak, most countries worldwide imposed strict lockdown. Initial lockdowns started around the third week of March 2020 (Wikipedia: https) and continued for the whole of April. As no proven cure for the disease is found yet, the economy and mental health are suffering tremendously. Mass vaccination started on the 8th of December 2020, but there are many limitations. Regarding exit pathways via vaccination, one concise comment from the journal Lancet was: 'rapid regulatory approval and roll-out of several vaccines have ignited much optimism. However, this optimism has been dampened by the emergence of several new virus variants that are more transmissible and less sensitive to vaccine-induced antibodies' (Sanders, 2021). At least 4 principally different COVID-19 vaccines are in place: i) inactivated virus from China and India, ii) m-RNA Vaccines, iii) vector-borne vaccines (Astra-Zeneca), and iv) viral surface proteins [Centers for Disease Control and Prevention (CDC) (Heinz and Stiasny, 2021),]. This analysis is an effort to explore pragmatically, areas relating to the exit strategy and various consequences associated with the COVID-19 mass vaccination programme. It also analysed proclaimed apparent vaccine success stories with a critical mindset. In fact, some success stories suggested contradiction and lacked uniformity.

Adverse effects on people after the vaccine and how those are monitored, scrutinized and attended by respective authorities are some of the most crucial areas before the launch of any mass vaccination programme. Some adverse effects of COVID-19 vaccination were reported by CDC, US and other government regulatory bodies around the globe e.g., anaphylaxis, thrombosis with thrombocytopenia syndrome (TTS), Guillain-Barré Syndrome (GBS), myocarditis and pericarditis among others (CDC, 2019a). A recent review sufficiently discussed the scientific basis of many adverse reactions to the COVID-19 vaccine (Seneff and Nigh, 2021; Seneff et al., 2022). Apart from direct side effects, indirect effects after mass vaccination which were often overlooked also need attention. In this regard, questions were raised on the indirect effect of mass vaccination (Roy, 2021a). Few points raised are as follows: i) After initiation of the vaccine programme, almost all countries experienced a sudden surge and most countries had to impose strict lockdown measures. ii) Even for UK/Israel, where massive vaccination started first, total deaths in three months after vaccination reached overall deaths of the past 10 months before vaccination. iii) A highly populated country India was having a steady decrease for five months. India passed major festive seasons where social distancing was very difficult to be maintained, still cases and deaths continued to decline. Vaccination started on 16 January 2021 and from around 16th February 2021, India started showing a rise in cases and thereafter deaths. iv) For Brazil, vaccination started in mid-January 2021 and a sharp rise in cases is observed since mid-February 2021. Such a steep rise in deaths in Brazil that happened after that never happened in the whole period of the pandemic. Those are also discussed in later works (Roy, 2021b).

To develop useful timely urgent insights, the resemblance between Flu and COVID-19 needs attention too. Every winter, tens of thousands of people die in the UK, Europe and northern America from Influenza (Flu), a virus-borne respiratory disease. In spite of many differences, there are striking similarities between COVID-19 and Flu as discussed by the American Society for Microbiology (American Society for Microbiology, 2020). 'The Flu season occurs in the fall and winter. In the U.S., that means October–March, and in the southern hemisphere, June–September. Although the reason for this seasonality is not entirely understood, the influenza virus has been shown to survive longer at low temperatures and low humidity. Other suggested explanations include weakened host immunity due to decreased sunlight and vitamin D and increased exposure to the virus due to indoor cohabitation in the winter' (American Society for Microbiology, 2020). People mainly from old and vulnerable groups are vaccinated against Flu viruses at the beginning of every winter in affected countries, but still, it is not yet been possible to eradicate Flu. On the contrary, it became more destructive and powerful in later years. The main reason is that the virus is mutating over space and time, in spite of several new vaccines that were developed over time. Hence the obvious question arises, could it be similar for COVID-19?

Between the COVID-19 vaccine and other known vaccines (polio, smallpox, etc.) there are dissimilarities too. Unlike other vaccines, if people are vaccinated for COVID-19, they can still be infected and transmit the disease and even can die (CDC, 2019b). People can be a carrier of the disease even after 15 days of the second dose (CDC, 2019b). Breakthrough cases and deaths among the vaccinated are now observed to be a very high percentage in all countries (Public Health England, 1009; Government of Israel, 2807; Public Health Scotland). 'Breakthrough cases' happen when people test positive even after 14 days of the 2nd vaccine dose. Moreover, it is worth mentioning that vaccines have not yet been invented for many virus-borne diseases like, AIDS, H1N1 and MERS etc. Hence attention to varied research and exploration of alternate solutions for COVID-19 other than the vaccine is equally necessary. A recent review also discussed drug effectiveness studies and clinical therapeutics (Sacristán et al., 2020).

Considering emergency situations some urgent, simple heat-based solutions for the initial stages of the disease were also proposed as early as 17th March 2020 (Roy, 2020a) and a series of research afterwards has since been completed (Roy, 2020a, 2020b, 2020c, 2020d, 2020e) purely based on science. Those solutions were proposed (and supported by) based on science as follows: i) exploring results of statistical analyses on the global transmission of COVID-19 as numerous studies showed seasonal temperature played a profound role in the transmission (Roy, 2020a, 2020b, 2020c, 2020d, 2020e; Scafetta, 2020); ii) observed temperature-dependent behaviours of similar category viruses (Van Doremalen et al., 2013; Chan et al., 2011; Lowen et al., 2007; Casanova et al., 2010; Seung et al., 2007); iii) temperature-based clinical trial experiments with similar category viruses (Lowen et al., 2007; Casanova et al., 2010); iv) successful clinical trial experiments with heat-based intervention for COVID-19 patients (Marca et al., 2021) and v) biological mechanism/response in human bodies to heat-based solution for COVID-19 from a medical doctor's perspective (Cohen, 2020). Those solutions (presented in Figs. 5 and 6 of Roy, 2021b) are practically without side effects, can be even practised in own home and there is no vested interest involved.

If at the initial stages of the disease these heat-based simple solutions become popular then long COVID, whilst further lockdown, mutated variants, losing immunity from vaccine after few months etc would be minimized. The empirical experiences which have been clinically proven are important to improve the response to this and other pandemics and provide a quick exit strategy. In this regard, a quote from a famous Physicist is worth mentioning "Education isn't about the ability to remember and repeat, in which people study to pass exams, and teach others to pass exams, but nobody knows anything. It is the ability to learn from experience, to think, solve problems, and use our knowledge to adapt to new situations" [Prof Richard Feynman].

In this study, further exploration is made on the exit strategy of COVID-19 via pathways of vaccination, (which is opted for by the policymakers as the only possible exit pathway). This analysis suggests critical evaluation of any strategy with useful timely insight and thorough monitoring is very important. Pragmatic outlook, identifying problem areas beforehand has enormous potential not only to mitigate huge economic burdens but also to give directions to solve a prolonged crisis. Differentiating between optimism vs. pragmatism is another crucial aspect, which is very important for policy purposes in the current COVID-19 scenarios. With that objective in mind, here we analysed and compared some results by applying simple statistical techniques to explore aftereffects of mass vaccination. Some influence variables on transmissions of the disease e.g., mass vaccination, lockdown and seasonality are considered and this work has important policy implications.

2. Materials and methods

Well established, simple statistical techniques e.g., time series analyses, bar diagram presentation, compositing techniques (for spatial plots) were used to evaluate results. Open access data sources from authoritative bodies are used. Results of some earlier published plots and data were also explored for useful insights. Some comparisons between vaccinated vs. unvaccinated were discussed based on data from UK Government Health Security Agency (UHSA).

Simple statistical methods were adopted in this study, while critical approaches were used to interpret various observed results. Most studies covered here the period of COVID-19 pandemic up to the beginning of July 2022, while some analyses also focused only on the earlier period of mass vaccination. Open data sources used are mainly from Worldometers and Ourworldindata. For Ourworldindata, data are generated by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University (JHU). For Worldometers, data are used from official websites of ministries of health or other government institutions and government authorities' social media accounts. Data used for specific countries are clearly documented with sources (Worldometers). The main data used are COVID-19 deaths, cases and vaccine doses in various countries. Data for daily deaths, cases and vaccine doses for 7-day averages in terms of the overall population are used. Cumulative measures of those parameters have also been used in some analyses to grasp certain variations better. For vaccine doses, number of daily COVID-19 doses administered is considered, where all doses are counted individually (including boosters) (Ourworldindata). For mass vaccination and global transmission, time series plots and bar diagrams mostly suited our objectives. To explore seasonality, this study analysed global air temperature data from NCEP/NCAR Reanalysis product, a joint product from the National Center for Atmospheric Research (NCAR) and National Centers for Environmental Prediction (NCEP). It has a temporal coverage of Monthly as well as Daily values from 1948 January till recent dates. The data is freely available (Website: Physical Sciences Laboratory (PSL)). Plots of spatial patterns of mean 2m air temperature were presented around the European region in a form of daily composites. Europe was chosen here as the region was one of the worst affected parts of the world during the initial period of pandemic. Europe is always impacted heavily in winter due to seasonal Flu too. Hence to discuss seasonality for COVID-19, analyses of Europe are presented. To understand the seasonal transition of temperature and transmission better, we analysed data for around one whole year between Mid-April 2020 to mid-May 2021. That period covered one full winter when deaths due to COVID were very high globally as well as in Europe. Apart from spatial plots of mean 2m air temperature composites, time series plots of deaths and cases were also presented and compared for the same period using data from Ourworldindata, to understand seasonality.

3. Results and discussion

A few important aspects of current COVID-19 situations from critical viewpoints are discussed as follows.

3.1. Short-term adverse effects reported after vaccination

For any new vaccination drive short-term, medium as well as long-term adverse effects are important areas those need scrutinizing with enough attention. For COVID-19 vaccine, there were hardly any possibilities to test the long-term and medium-term adverse effects in the short time frame of clinical trials. Even in the short term, many complicated interactions among various underlying health issues are likely to be missed out and could not be tested because of the small sample size. Only a few thousand people took part in trials among which half were given Placebo.

Questions were also raised about short-term adverse effects (Vaccine Adverse Event Reporting System). Till 26 February 2021, a total of 1136 individuals died in the United States, after receiving mRNA vaccines for COVID-19, of which, 587 (51.7%) died within a week. Among the dead 94 (8.3%) died on the same day, 150 (13.2%) died the day after, 105 died 2 days after, and 68 within 3 days (Vaccine Adverse Event Reporting System (VAERS);The Epoch Times, 2338). Up to 8 March 2021 the number of deaths were 1637 and up to 5 April 2021 it was 2794 (CDC, 2019c). Thus, adverse reporting of deaths after vaccination seemed consistent over time. Anaphylaxis, temporary facial paralysis, blood clots and Bell's palsy were reported among the majority of critical patients, while Cardiac arrest was one of the main causes of death (Seneff and Nigh, 2021; Vaccine Adverse Event Reporting System; The Epoch Times, 2338; CDC, 2019c). Biological processes and physical scientific basis of such observations of adverse reactions are reported in a recent review (Seneff and Nigh, 2021; Seneff et al., 2022). It could be wise to track vaccinated people afterwards and to monitor if they were affected by any of those diseases or related symptoms in later stages. Though straight monitoring of patients is compulsory in all pharmacovigilance systems, especially for severe drug adverse reactions (EMA: EMA (European Medicines Agency)), but monitoring patients on medium and long-timescale and for moderate adverse reactions also deserves attention. The task is extremely difficult when millions of people are vaccinated on a regular basis. It is worth mentioning that for highly populated third-world countries such tracking could be practically impossible. A work studied the incidence of heart-related disease, myocarditis and pericarditis in a large cohort of COVID-19 patients after recovering from the acute infection, who were not vaccinated. The main finding was that there was no increase in the incidence of myocarditis or pericarditis from day 10 after positive SARS-CoV-2 among unvaccinated groups (Tuvali et al., 2022). A monitoring system could be proposed to check if deaths caused due to some of those specific symptoms/diseases or apparent unexplained reasons are exceeding normal counts or not in the post-vaccination period. Such anomaly counts of death, as well as adverse symptoms, among vaccinated vs unvaccinated can give some ideas of medium and long-term side effects due to vaccination.

A comparison from VAERS (Vaccine Adverse Event Reporting System) adverse reporting between deaths after the COVID vaccine and Influenza (Flu) is useful in this regard. A total of 45 deaths occurred for Flu vaccine in 2019 influenza season, which is 0.0000265% of the total vaccination. However, 1136 deaths are reported for the COVID vaccine, as of February 26, 2021. It is approximately a rate of 0.0024%, which is 100 times high than reported deaths, due to vaccine adverse effect, from Flu vaccines (Vaccine Adverse Event Reporting System).

In the UK, as of 4th August 2021, 101,483 adverse reporting was made for the Pfizer/BioNTech vaccine, 226,959 for the AstraZeneca vaccine and 12,569 for the vaccine Moderna (Government of UK). It is decided that clotting syndrome must be listed as a very rare side-effect in Oxford Astra Zeneca vaccine (CDC, 2019c; Guardian, 2021a). Reports indicated a plausible causal relationship between the Johnson and Johnson COVID-19 vaccine and a rare and serious adverse event, blood clots with low platelets, which has caused deaths (CDC, 2019c).

3.1.1. Some disproportionate adverse reporting on the young and male population

In the US, vaccination above 12 years was initiated quite early compared to the rest countries and adverse reporting was available in CDC based on the record up to 11th June 2021 (CDC, 2021). There was a likely link reported between rare heart inflammation (known as myocarditis) and vaccines, in adults under age 30, especially after the second dose [Table 1 and Fig. 1]. Table 1 shows females are performing better than males counterpart. Young males were worst affected, which was more prominent after the 2nd dose. Fig. 1 indicates adverse reporting is higher after the 2nd dose, which is more prominent in younger groups (16–28 years).

As the adverse reporting was disproportionate based on gender, dose and age, it got attention and such features need monitoring (CDC, 2021). A recent study (Le Vu et al., 2022) also identified age and sex-specific

Table 1
Preliminary reports of Pericarditis/Myocarditis to VAERS after mRNA COVID-19 vaccination by age groups and doses, up to June 11, 2021. Red box indicates males were worse affected after the 2nd dose compared to females in various age groups (Source, CDC (CDC, 2021),).

	Overall reporting rate per million doses			Reporting rate in females per million doses			Reporting rate in males per million doses		
Age groups	All doses	Dose 1	Dose 2	All doses	Dose 1	Dose 2	All doses	Dose 1	Dose 2
12-17 yrs	18.1	5.3	37.0	4.2	1.1	9.1	32.4	9.8	66.7
18-24 yrs	15.9	4.8	28.4	3.6	1.5	5.5	30.7	8.7	56.3
25-29 yrs	6.7	2.5	10.8	2.0	0.8	2.6	12.2	4.5	20.4
30-39 yrs	4.2	1.7	5.6	1.8	1.4	1.8	6.9	2.0	10.0
40-49 yrs	2.7	0.9	3.8	2.0	0.9	2.8	3.5	1.0	5.1
50-64 yrs	1.7	1.0	2.0	1.6	1.0	1.8	1.9	1.0	2.3
65+ yrs	1.1	0.7	1.3	1.1	0.6	1.2	1.2	0.7	1.4

risks of heart related complications (myocarditis and pericarditis) following Covid-19 m-RNA vaccines. However, that study also found estimates of excess cases attributable to vaccination reveal a substantial burden of both pericarditis and myocarditis in both females and males and across other age groups too.

3.2. *Indirect effect of mass-vaccination*

Many indirect consequences of mass vaccination were not properly apprehended before the start of mass vaccination, neither are they monitored globally, at country-level or the regional level. Following observed data, concerns were raised as early as 11th March 2021 in scholarly platforms (Roy, 2022a) and on 22nd March 2021 in BMJ (Roy, 2021a).

Globally COVID-19 cases and deaths started increasing after 5 weeks of a steady decline (Worldometers) and coincidentally, the period of rising matched when the mass vaccination programme was first initiated worldwide (Fig. 2). A distinct difference is noticed between the number of deaths in the pre-vaccination and post-vaccination stages, and that is true for cases too (Fig. 2A). The two highest peaks in Fig. 2A occurred after the start of mass vaccination. A peak in the winter just after the start of mass vaccination was the highest peak of all. It did not return to the pre-vaccination stage till mid-December 2021 (Fig. 2A), neither for cases nor deaths, even after many vaccination doses were administered. More than 8.59 billion vaccine doses were administered all over the globe till late December 2021; while 56.5% world population received at least one dose (Ourworldindata).

3.2.1. *Synchronization of cases with vaccine doses*

Many countries showed synchronized patterns between new cases and new vaccination doses as shown in Fig. 3. Few are presented here but there are many more countries showing a similar pattern (Ourworldindata). Before the onset of mass vaccinations, all those countries had low cases and deaths, though such features suddenly increased after the onset of vaccinations. For India, the rise and fall in the 2nd peak were unusually steep. Cases however maintained a certain lag with vaccine doses, probably due to the very high population. Like India, another example of a steep fall in cases happened in Bahrain and that fall coincided the same time frame of vaccine doses [Fig. 3]. Similar patterns of rise and fall in vaccine doses and cases are also noticed in later periods, countrywide as well as globally (Ourworldindata).

The situation again turned uncontrollable in Europe and US since the middle of December 2021. However, that was the first time since the start of vaccination, that the death curve attained that low, near-flat peak (Fig. 2A, bottom). Interestingly, around a similar time, there was a sudden increase in vaccine dose in most European countries and the rising trend in vaccine dose was the steepest for the whole of the pandemic (Fig. 4a). A major surge in cases was observed in highly populated European countries (Ourworldindata). Many European countries attained the highest number of cases and the peak to date (period shown December end, 2021) either became the highest peak or near the highest of respective countries (Fig. 4b). Moreover, as the timing was further matched with the beginning of the winter season (knowing seasonality plays an important role for COVID-19, like Flu), it was likely to fuel the fire and caused such an unusual surge in cases. Global cases reached an all-time high near the end of December 2021 (Fig. 2A, top and 2B, middle) and case numbers were mainly dominated by the US and highly populated European countries (31).

3.2.2. *Vaccine equity and increase in doses*

Interestingly, most of the third world countries were least affected by the disease before the vaccination drive, whereas, the western world was the most hit (Ourworldindata). After the launch of the mass vaccination programme, there was a huge cry about 'Vaccine Equity'. Like Flu, other tropical warm countries e.g., SAARC, South East Asian countries (SEAC), most African countries were least affected by COVID before the start of mass vaccination (Roy, 2020c, 2020d, 2020e). Arguments could also be raised/debated on vaccine equity stating whether the distribution of vaccinations (countrywide) would be based on the death rate of COVID-19 or not.

After the vaccine doses were initiated and increased, those countries with a low prevalence of diseases started showing a massive surge. The situation for one of the countries, Indonesia is shown in Fig. 5. For some consecutive days, it experienced the highest daily deaths in the whole world. Reported daily deaths were 1093 and 1338 respectively on 18th

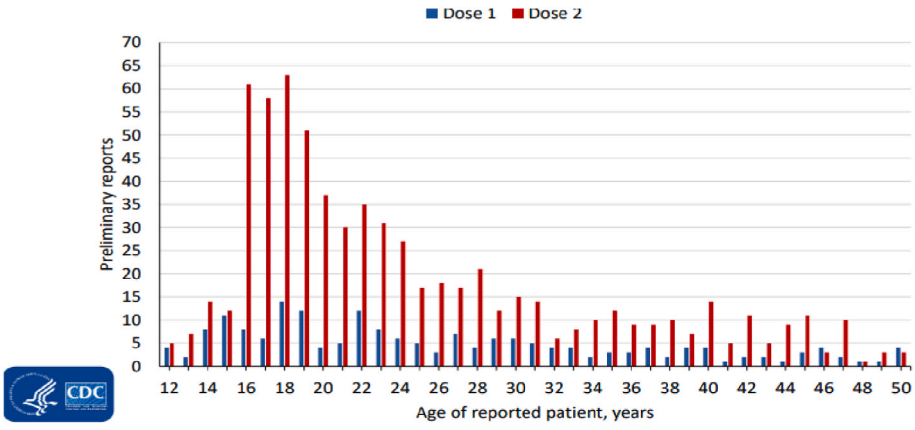

Fig. 1. Reporting to VAERS of myocarditis/pericarditis after mRNA COVID-19 vaccination by age and dose number, up to June 11, 2021 in a form of a schematic. Age groups from 12 years to 50 years are shown to emphasize the younger age groups. (Source: CDC (CDC, 2021),).

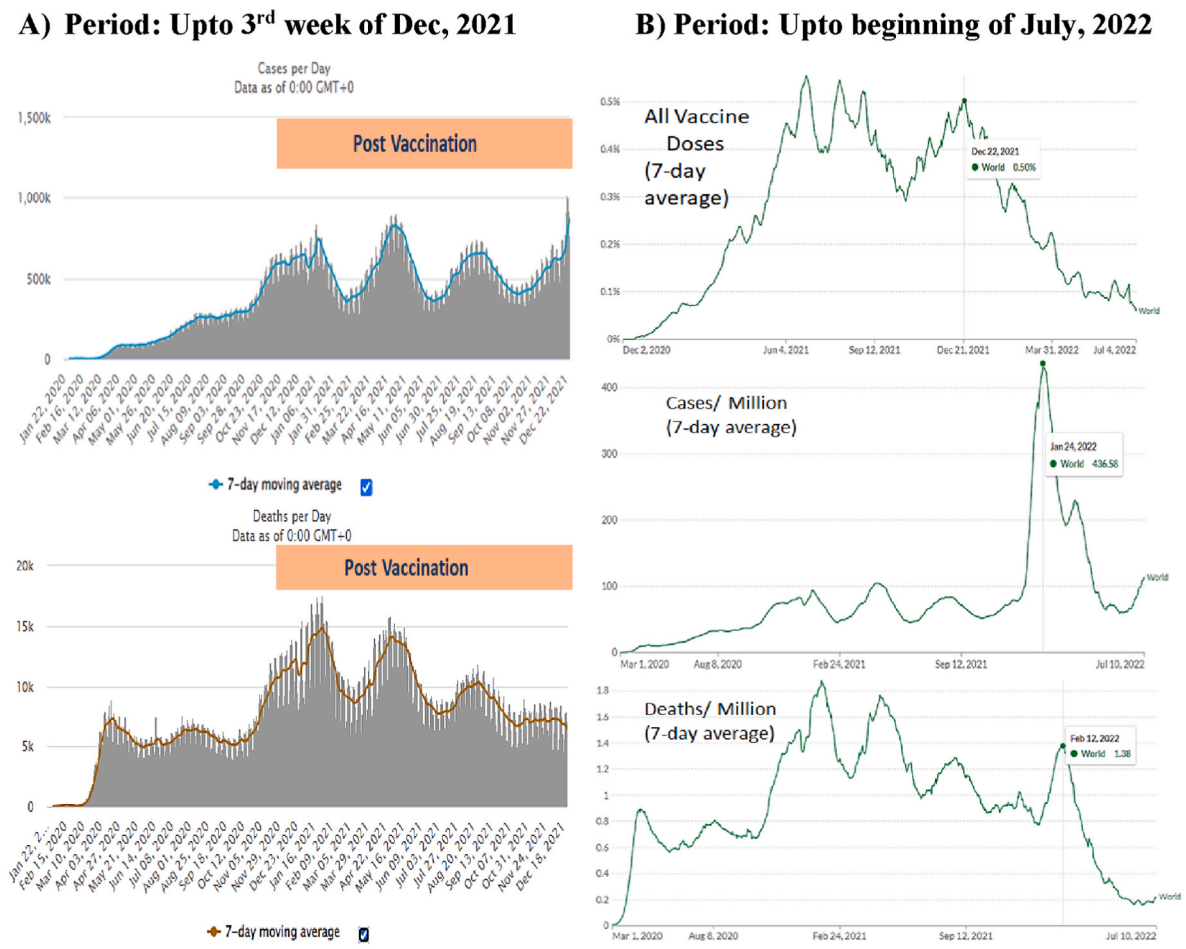

Fig. 2. A) Daily Cases (top) and Deaths (bottom) in the world for COVID-19. Seven-day moving averages are marked by colored thick lines. The vaccination programme started in December 2020 (2nd week), but up to 3rd week of December 2021, it did not reach the pre-vaccination stage (Source: Worldometers). B) Seven-day average of Vaccine Doses (relative to population), Cases per million and Deaths per million in the world up to beginning of July 2022. Vaccine Doses steadily decreased since 22nd December 2021. Cases and Deaths show a clear decreasing trend starting with a certain lag (Source: Ourworldindata).

and 19th July 2021 respectively. In addition to that, Indonesia also reported the 2nd highest number of cases in the world on 18th July 2021 which was 44,721 (Worldometers). More discussions covering the extended periods for other countries are addressed here too.

After the alert was triggered on 11th March 2021 (Roy, 2022a) and thereafter on 22nd March 2021 (Roy, 2021a), some action seems to have reflected relating to vaccine doses by some countries that were most proactive at the initial stages of mass vaccination e.g., Israel, US and UK (Ourworldindata). Israel decreased the vaccine dose since 11th March; whereas the US decreased the dose from mid-April. Since mid-April 2021, US maintained that decreasing trend. For the UK, vaccine doses had never increased the limit that was reached on 22nd March and showed a steady decline in later periods up to September 2021 (Ourworldindata).

At the end of 2021 and the beginning of winter, UK and most European countries suddenly increased vaccine doses (Ourworldindata) and cases skyrocketed (Fig. 4). Cases around the world showed a sudden surge (Fig. 2A, top and 2B, middle). A new variant Omicron was detected in the later period which seemed highly transmissible [World Health Organisation (WHO)]. Interestingly, all the highly populated European countries however started decreasing vaccine doses from 15th December onwards. That rise and fall of vaccine doses in highly populated European countries were the steepest of the entire pandemic (Fig. 6a). Global vaccine dose showed a clear decreasing trend since 22nd December 2021 (Ourworldindata) and subsequently, global cases indicated a declining trend since 24th January 2022 [Fig. 2B]. Interestingly, Global Deaths also started decreasing from 12th February 2022. The time lag between decrease in Vaccine doses were followed by a decrease in cases and thereafter deaths, as expected.

3.2.3. *Whether vaccine dose matters*

An obvious question arises whether vaccine dose matters. At the end of study period, many countries had much higher vaccine doses than the herd immunity threshold e.g., UK, Israel. Interestingly, UK and Israel showed another surge in the later period. In Israel, the third dose of vaccination drive was nearly complete.

Results of vaccination and deaths for five neighbouring countries from the Indian subcontinent are presented during the earlier period of vaccination (up to mid-June 2021) in Fig. 7. Among those countries, the Maldives ranked topmost in terms of the share of people vaccinated (Fig. 7a); whereas, Pakistan and Bangladesh ranked in the bottom two, with India and Nepal in the middle. Interestingly, the ranking of those five countries was maintained in terms of cumulative deaths per million and vaccine doses (Fig. 7b and c) till the period of analyses (shown up to 13th June 2021). A sharp rise in deaths in the Maldives was noticed in later periods in spite of maximum vaccine doses being administered. Deaths/million were lowest in Pakistan and Bangladesh which administered the lowest vaccine doses (Fig. 7b). India and Nepal ranked in the middle in terms of deaths per million and followed the ranking of countries for vaccine doses of Fig. 7a and c. Here we showed a particular feature and covered only up to 13th June 2021. Similar observations can be noticed for many other neighbouring countries, even covering up to

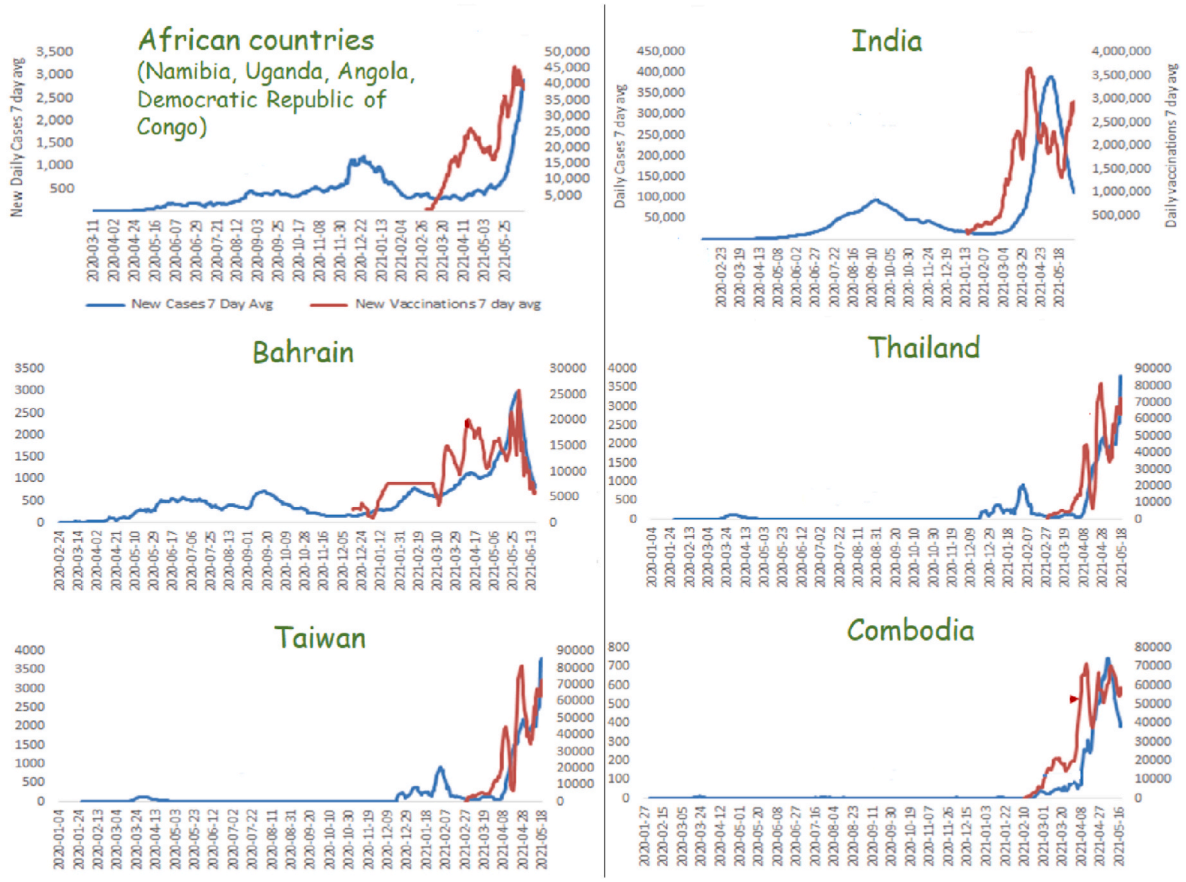

Fig. 3. Countries showing synchronized patterns between new cases (blue, left axis) and vaccination doses (red, right axis) are shown in a form of 7-day average; data used from Ourworldindata, Johns Hopkins University (JHU) (Ourworldindata). The initial period of vaccination drive was the focus and hence shown here. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

latest record. Observation for those countries might also vary as time progresses, but this particular noted feature till mid-June 2021 can never be disregarded by any means.

3.3. *Transparency, healthy peer-review and services to humanity*

Healthy peer-review, constructive criticism and open debate are always the basis of great science. In the COVID-19 era, when the lives of billions of people are involved, they become important. As mass vaccination is an extremely crucial endeavor, transparent and healthy peer-review involving scientists from various disciplines is essential.

Scientists and experts raised many sensible questions on numerous platforms e.g., the trial process for understanding medium and long-term effects, questions on mRNA technique etc. among others (Roy, 2021b). Relating to COVID-19 vaccine trials, it was pointed out in one topmost medical journal BMJ that 'studies seem designed to answer the easiest question in the least amount of time, not the most clinically relevant questions' (Doshi, 2020a, 2020b). Studies further discussed that whether these vaccines can save lives, current trials are not designed to say that (Doshi, 2020b). The frail elderlies were insufficiently recruited in the randomized trials though they are disproportionately contributing to the serious cases of the disease (Doshi, 2021). A very valuable comment in this regard was made by Prof Fiona Godlee, editor in chief, BMJ, '"Science by press release" is just one of many flaws in the way new treatments are evaluated, brought into stark relief by the pandemic' (Godlee, 2020).

A recent record unveiled a list of 40 new billionaires who joined the billionaires' list benefitting from COVID-19 (Forbes, 2021) and many vaccine groups are earning billions (Guardian, 2021b). As there are huge vested interests involved for vaccine and allied industries, long chains of beneficiaries are linked, additional precaution and surveillance/monitoring transparency must have been in place throughout. Some obvious questions could be: i) whether any important research and solutions other than vaccines are sidelined or suppressed and what measures are in place to stop that? ii) Whether biased results and fabricated analyses promoting vaccines and certain narratives are on the headline in everyday news and media or not? How open the critical evaluation process is taking place? Whether transparent open debates involving scientists with varied views (not the same scientists, same institutes, same viewpoints) are equally covered by media or not. iii) Since the beginning of the pandemic, 40 COVID papers are retracted till mid-August 2021. Few questions could be: Is there a single paper retracted that was in favour of vaccines? Why there is unequal distribution, as numbers of retraction for both sides of narratives are likely to be equal. Whether the mechanism of retraction is serving the goal of particular interest groups or not, a secret vigilance operation needs stepping up to safeguard the peer-review publication system and its integrity. Those could be some constructive approaches to eradicate any biases and improve transparency.

Surveillance on excessive economic profit and wealth equity are certain areas which also need addressing. Few safeguarding mechanisms in this regard are suggested too. One proposition in that direction could have been producing and distributing vaccines on a not-for-profit basis by all vaccine groups. As that proposition is not yet implemented by all vaccine groups, an alternative idea can also be proposed that can act toward safeguarding interests of the general public. Imposing a huge tax on the vaccine and allied groups (vaccine or COVID specialty tax/ 'COVID wealth equity' tax) who are making tremendous financial

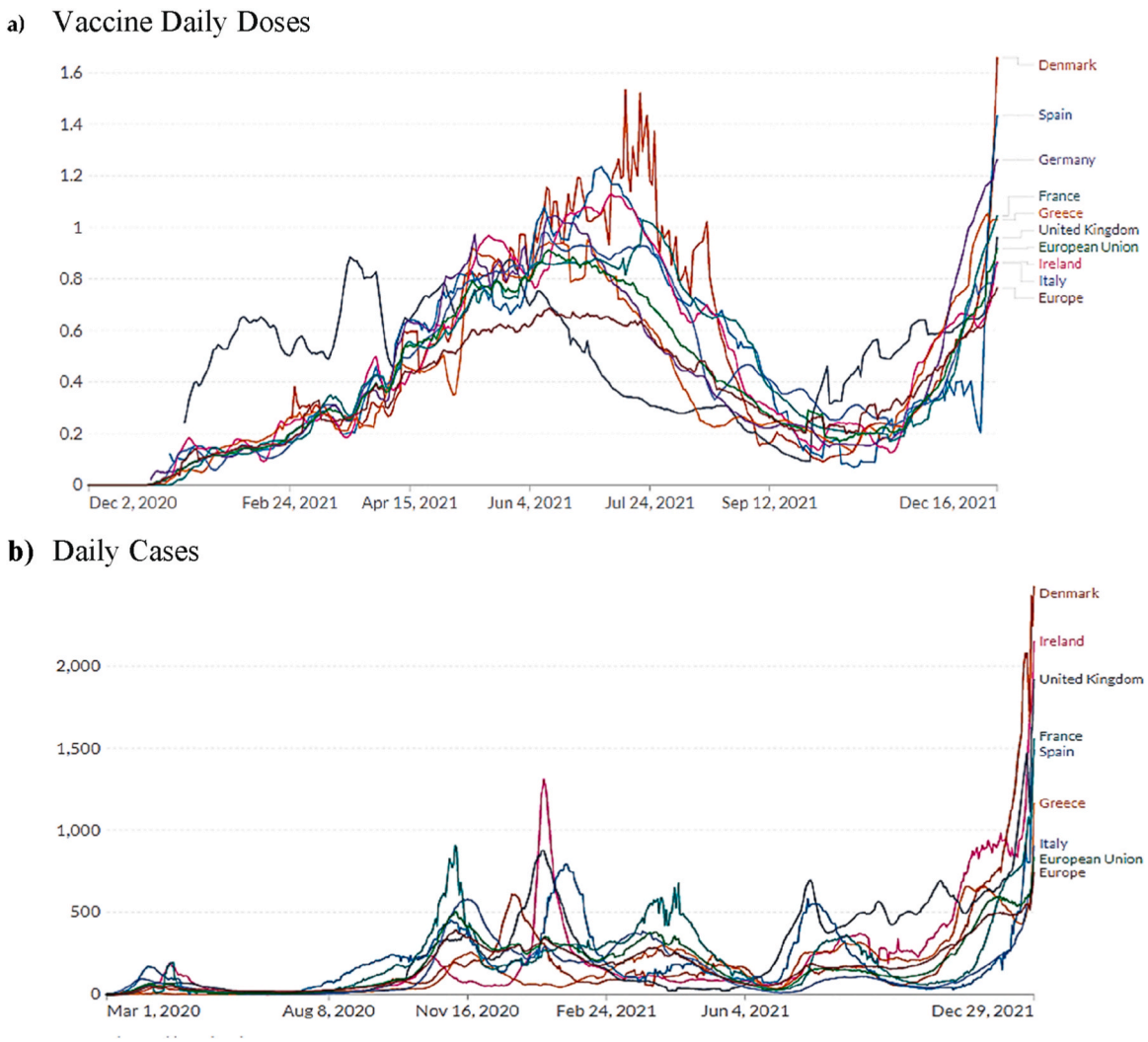

Fig. 4. Vaccine daily doses and cases (7-day rolling average) (Source: Ourworldindata). a) Number of daily COVID-19 vaccine doses administered, divided by the total population of the country. All doses are counted individually, including boosters. b) Daily new COVID-19 cases per million people. Most of those countries showed an unprecedented steep rise in vaccine doses from 15th November up to 15 th December 2021. Cases sored all-time high (shown up to 29th December). For the vaccine dose as well as cases, the rise in trend was unprecedented.

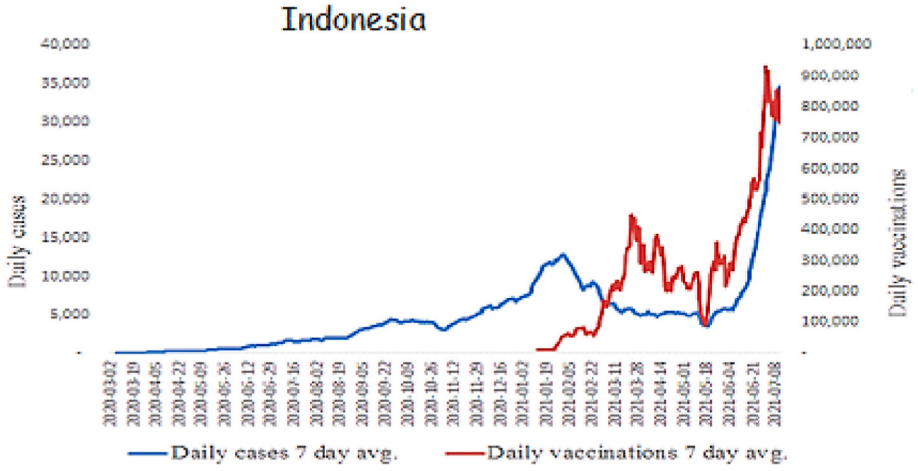

Fig. 5. Control of vaccine dose and change in Cases for Indonesia (data for 7-day rolling mean). Indonesia showed an abrupt increase in vaccine doses around May–June and cases skyrocketed (Source: Ourworldindata).

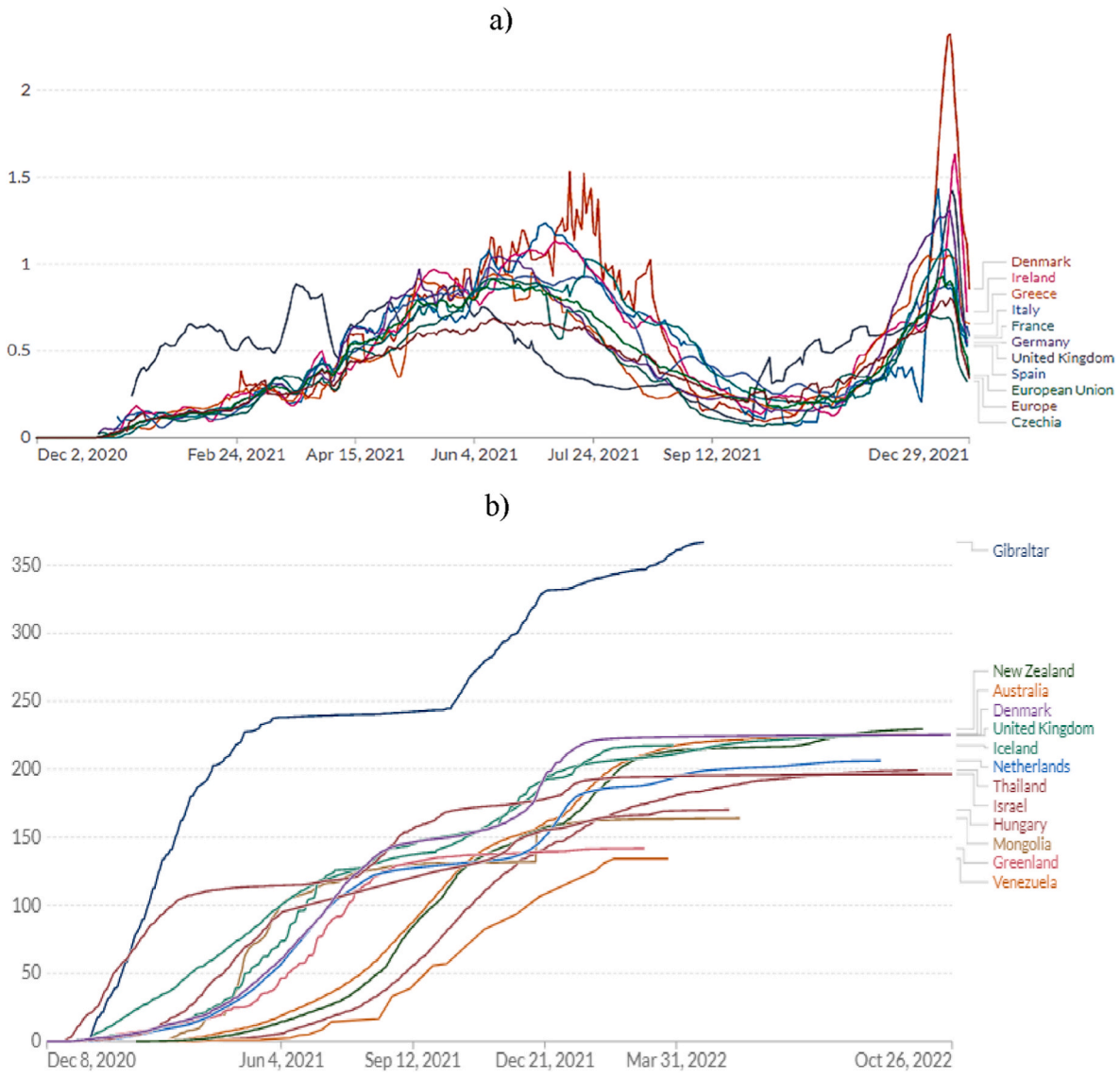

Fig. 6. Number of daily COVID-19 vaccine doses administered. All doses are counted individually (including boosters). a) For 7-day rolling average, divided by the total population of the country and covering end of 2021. All countries that showed steepest rise in vaccine doses, abruptly reduced the dose after 15th December (Source: Ourworldindata). b) Cumulative vaccine doses per 100 people and covering up to 27th of October 2022 (Source: Ourworldindata), accessed on 27th October 2022).

benefits out of this crisis is an important step forward. It could be another way to mitigate the worldwide economic crisis too. All the profit so far accumulated by vaccines and related business could be under that specific tax scheme. Another proposition could be open public auditing of finances for vested interest groups to check various aspects especially, direct and indirect spending on independent public-funded media and promotional activities. Otherwise, there are huge risks that the interests of general people are overlooked or disregarded.

Those could have been very welcoming initiatives from government and policymakers involving all vaccine and allied sectors and would be highly appreciated and valued by the general public.

3.4. *The resemblance with flu and useful timely insight*

Tens of thousands of people die in the UK, Europe and northern America every winter, from a virus-borne respiratory disease, Influenza (Flu). The CDC (Centers for Disease Control and Prevention) estimated 61,000 deaths in the US from influenza during 2017–2018, which was higher than any season since 2009 (CDC, 2017).

Fig. 8A shows peak flu activity during flu seasons in the US by month from 1982 to 1983 through 2017–2018. During this 36-year period, Flu activity most often peaked in February. For COVID-19 also, countries that are Flu prone, peaked in cases and deaths in February 2021. The spatial pattern of Flu activity level is shown in Fig. 8B. Brown and dark brown indicates a high prevalence of Flu which dominates later periods (2017–18 and 2016–17); whereas the green and light green suggest a low prevalence of Flu as seen for the earlier period (2009–10 and 2008–2009). It is clear, Flu deaths in the northern US increased in later periods compared to previous years (Fig. 8B). In spite of many new vaccines over time, it has not yet been possible to eradicate Flu. On the contrary, it became more destructive in later years in spite of many new vaccines. The main reason is that the virus is mutating over time and space.

Other pertinent observations and similarities between Flu and COVID-19 are as follows. i) Both viruses mutate over space and time. Since the first vaccine for COVID-19 came up only in December 2020, many new variants are already detected (King Abdullah University of Science and Technology, 2021) and many are ineffective to the vaccine

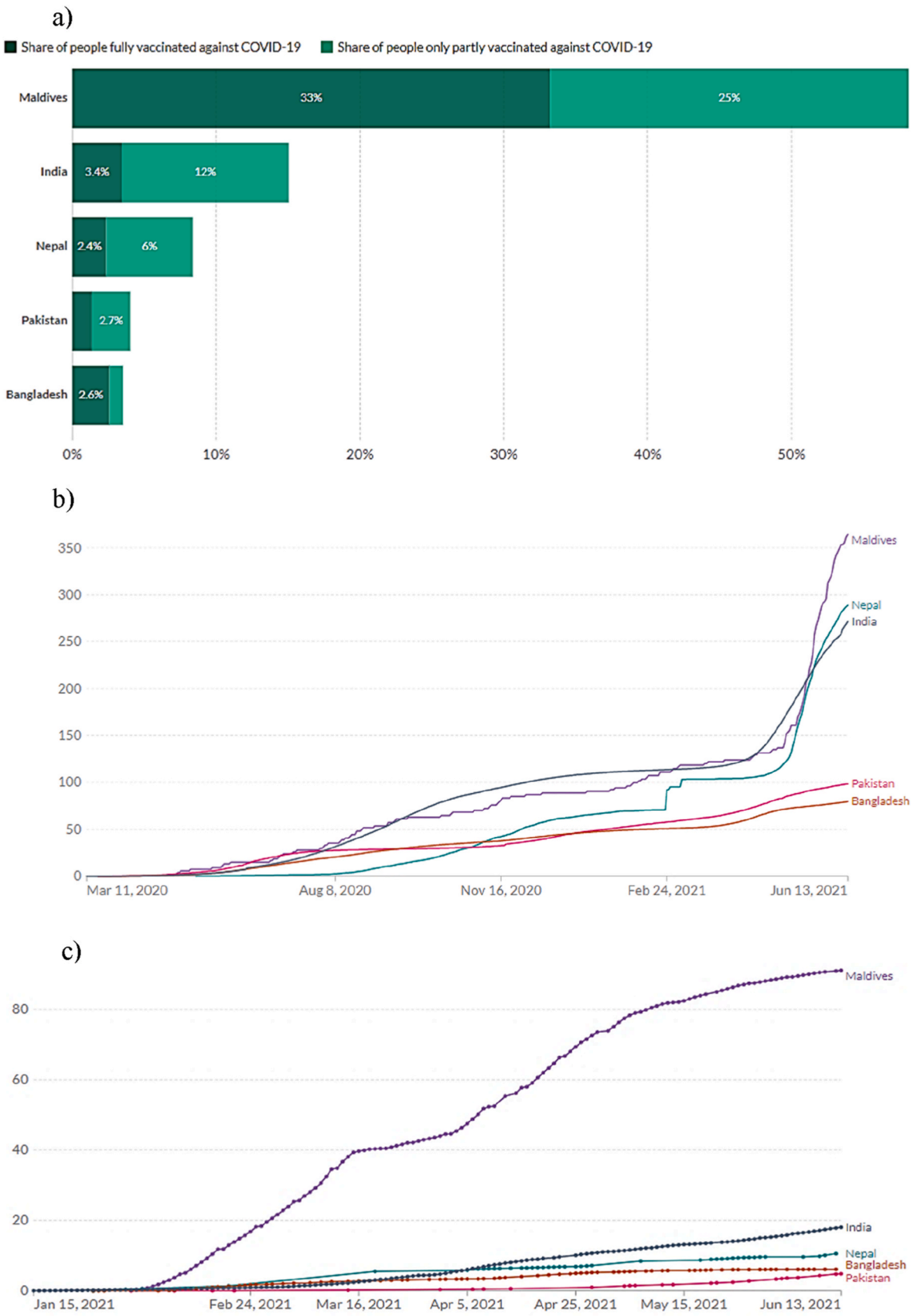

Fig. 7. Comparison of vaccine doses and deaths for five neighbouring countries from the Indian subcontinent: a) share of people vaccinated relative to population; b) cumulative deaths per million; c) Total vaccine doses per 100 people, up to June 13, 2021. (Source: Ourworldindata).

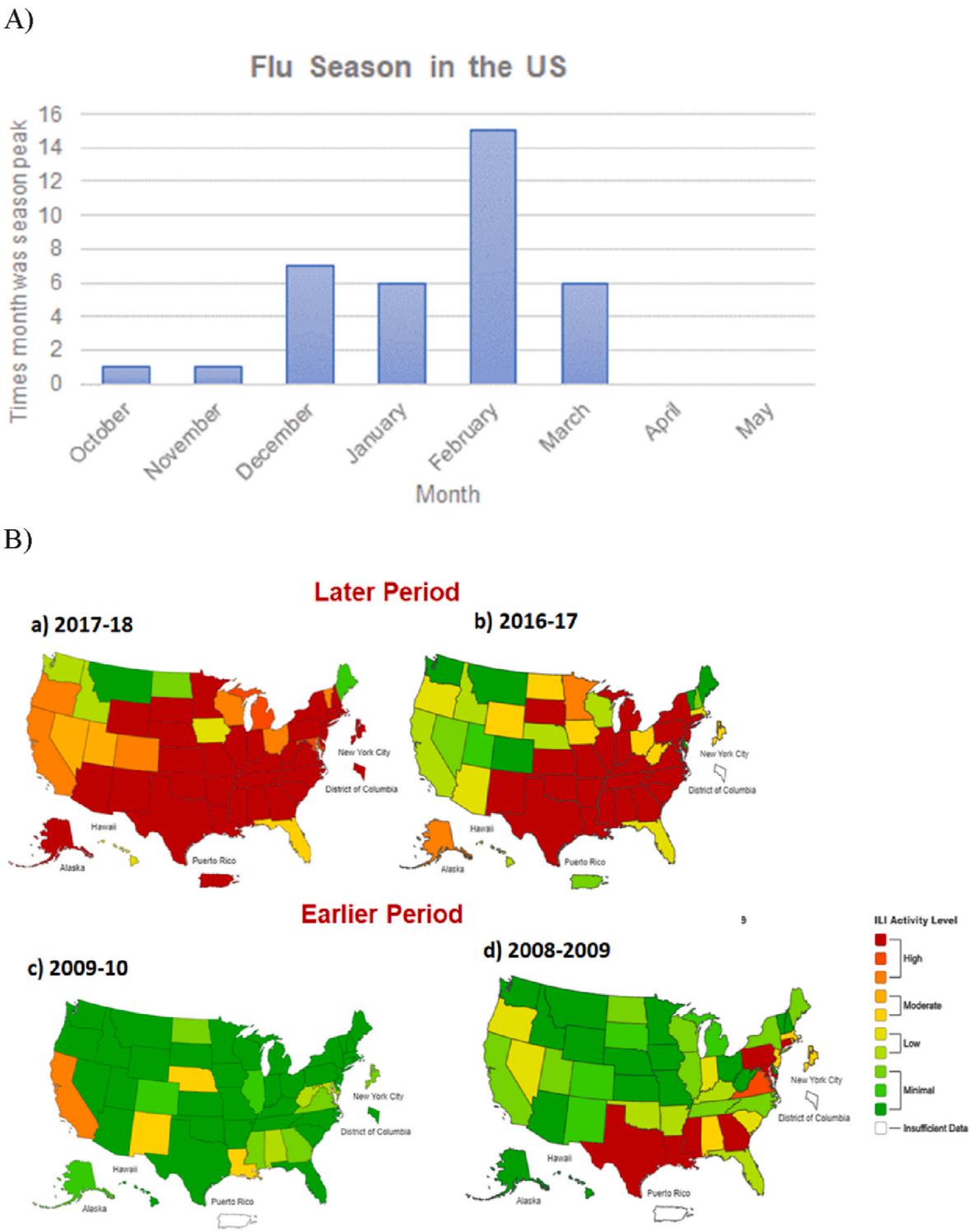

Fig. 8. A) Peak Influenza (Flu) activity in the US by month from 1982 to 1983 through 2017–2018. [Source: CDC, https://www.cdc.gov/flu/about/season/flu-season.htm accessed 21st July 2021]. The spatial pattern of Influenza like illness (ILI) activity level in the middle of February is shown in (B). The top plots (a, b) for later periods (2017–18 and 2016–17) are dominated by brown and the bottom (c, d) for the earlier period (2009–10 and 2008–2009) are dominated by green [Source: CDC, https://www.cdc.gov/flu/weekly/usmap.htm, accessed 21st July 2021]. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

(Sanders, 2021; Guardian, 2021c). ii) During summer 2021, the situation improved in Europe and North America as it happens in every summer for Flu. In the summer of 2020, deaths from COVID-19 in Europe were practically nil, without any vaccination. As after a few weeks, the vaccine-induced immunity to the disease wanes (Shrotri et al., 2021), whether the same vaccine will be effective throughout and the third/fourth dose of vaccine will be administered without any trial and how adverse effects (direct and indirect) will be evaluated for those new doses complicates the matter further. In winter, 2021 a new variant, named Omicron emerged (WHO) and even though millions of people already got the third dose of vaccines, many among those got infected and even died.

A very relevant point here is that the ineffectiveness of Flu vaccine was one responsible factor for an excess of 50,100 deaths in the EU and UK in 2017–18 (Guardian, 2018). Though many vaccines were evolved and modified during the last 40 years, deaths were the highest in more than 40 years. 'The Office for National Statistics said flu and the ineffectiveness of the flu vaccine were key reasons for the rise of excess winter deaths in 2017–18' (Guardian, 2018). The government's public health agency admitted that even in 2016, the rise in deaths in Wales and England for the previous 12 years, was ascribed to the failure to offer an effective Flu vaccine (Guardian, 2016). Those records indicated compared to the past how poorly Flu vaccines performed in later periods. Following our past experience with the Flu vaccine, the situation can also be speculated easily beforehand for the COVID-19 vaccine.

We need to analyse the whole situation to make a timely intervention and need to question whether the intervention with the vaccine is making situations better or worse. We need to judge whether we have more and more liberty to accept excuses when the solution does not work. The proposition of vaccinating billions of people every few months for COVID-19, with the constraints of fixed world resources, raises a very obvious question, whether such an effort is essential and worth it. The indirect and direct costs of that strategy deserve attention, and so does the usefulness of such a strategy.

Interestingly, Flu deaths reduced dramatically in Europe and the northern US when COVID-19 took a stronghold. During the last two winters, (2021 and 2022) Flu deaths in the US were practically nil (Fig. 9). The number of Influenza coded deaths (yellow) was missing after the winter of 2020 (Fig. 9). Among the 3330 Pneumonia, Influenza and COVID-19 (PIC) related deaths reported for the week ending December 11, 2021, (week 49), 2569 had COVID-19 listed as contributing cause of death or an underlying cause on the death certificate. Only eight were listed for Flu, indicating that current mortality among COVID-19 and Flu, was primarily due to COVID-19, the more prevalent circulating virus among those two. Thus, it is interesting to watch whether deaths due to Flu diminish with the prevalence of COVID-19 or not in subsequent winters.

3.5. Fast mutation and new variants

To monitor the progression of mutated variants of COVID-19 virus, an initiative was taken to develop a virus mutation tracker (King Abdullah University of Science and Technology, 2021; Alam et al., 2021) which is immensely beneficial. How rapidly it can mutate over spatial and temporal scales can be monitored. The fingerprints reveal the virus transmission route so as timelines of different mutations. The number of unique variants detected in the UK until early July 2022 since the beginning of pandemic was 5,25,443, of which foreign variants were 19,239 and local variants 5,06,204 [King Abdullah University of Science and Technology, 2021, accessed on 12 the July 2022]. Interestingly, the timeline suggests a sudden increase in new mutations since December 2020 (Guardian, 2021b) (Fig. 10). That is the period when the major vaccination programme started. Prior to that, up to November 2020, (during the initial 11 months of the pandemic), the progression was really slow (see the numbers in Fig. 10, bottom) in comparison.

Bieniasz (2021) states that COVID-19 vaccines can significantly accelerate the evolution of mutation of virus, as vaccines themselves can also drive viral mutations (npj, 2021). According to him, the time between the initial vaccine dose and the next shot to boost the immune response might act a kind of breeding ground to acquire new mutations of the virus. It may give one possible explanation to why there is a surge in mutated variants after the start of mass vaccination, alongside there is the rise in cases of transmission globally.

To check whether vaccines may generate variants, a study analysed countries where the first trial of each vaccine took place (Tan et al., 2021). Fig. 11 shows a Gnatt chart marking the timing and locations where major vaccine trials took place and connects it to the date when different variants were initially identified in those places (Tan et al., 2021). Major variants were identified in the countries where vaccine trials were taking place. Some variants were identified at the beginning of the trial, while some at the end [Fig. 11]. Various biological processes and physical mechanisms involved in how vaccines can accelerate mutation and how vaccines can also increase mass transmission are discussed in a recent review (Seneff and Nigh, 2021).

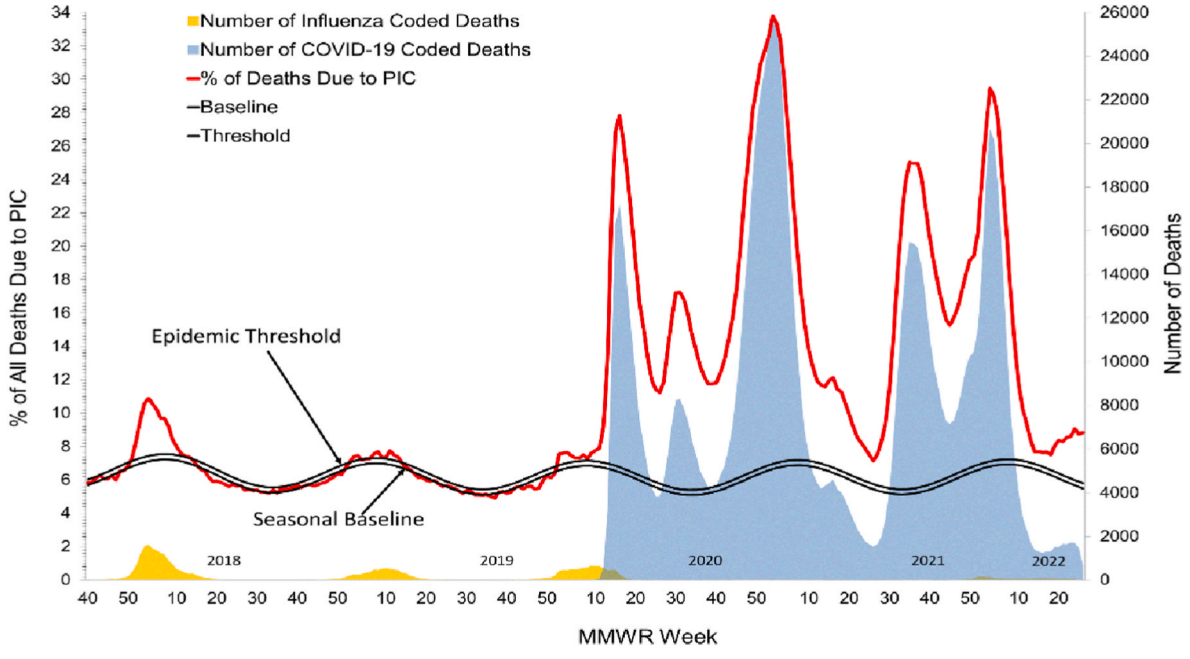

Fig. 9. Pneumonia, Influenza (Flu) and COVID-19 (PIC) mortality from the National Center for Health Statistics Mortality Surveillance System, Data as of 7th July 2022. Flu deaths (by yellow) were in fact negligible after the winter of 2020. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)
(Source: CDC, https://www.cdc.gov/flu/weekly/ dt 08/07/22)

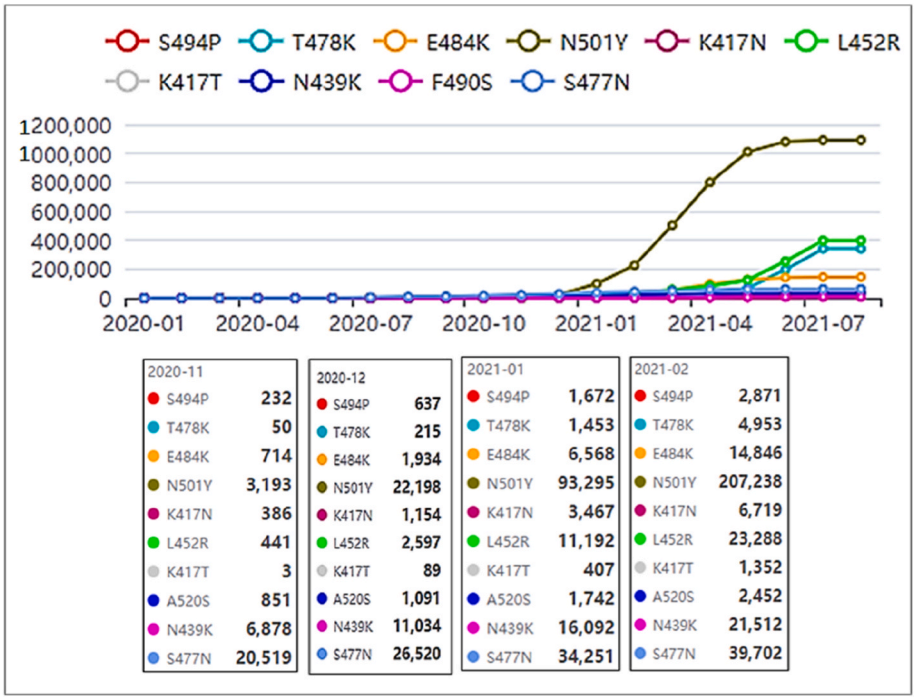

Fig. 10. COVID-19 virus genome isolates from patients are being regularly sequenced worldwide and for each sample, there is an accession number. The temporal patterns with accession numbers are shown. It presents timelines of the top 10 major virus mutations that are progressing at a very rapid rate since December 2020. It depicts how slow the pace was, in comparison, up to November 2020. Numbers in each month from November 2020 to February 2021 are shown at the bottom (Source: King Abdullah University of Science and Technology, (King Abdullah University of Science and Technology, 2021), Accessed on August 09, 2021).

Fig. 11. Gnatt chart showing the timing and locations where major vaccine trials took place, and maps it to the date the different variants were first identified in those places. (Source: Tan et al., 2021).

3.6. Trial experiments/observation: mass vaccination and transmission

Trial protocols and experiments assigned for COVID-19 vaccination did not take into account many indirect and direct effects of mass vaccination. After vaccination, apart from looking into details of direct side effects, the secondary effect that might be triggered after mass vaccination also needs attention. An experiment was conducted in California, at the very early stages of vaccination (m-RNA vaccine) and participants were chosen among vaccinated health care workers, since by being exposed to patients they are more likely to catch the disease. This trial showed that even after 15 days of the 2nd dose, vaccinated people can be a carrier and spread the disease.

In the transmission and spread of SARS-CoV2 infections, as asymptomatic cases also have roles (Muller, 2021), that clinical trial experiments allowed for increased detection of asymptomatic infections (Keehner et al., 2021). The period considered was as early as December 16, 2020, through February 9, 2021. A total of 14,604 were monitored among vaccinated people and out of those, 379 tested positive at least 1 day after vaccination. The majority of infections took place (71%) within the first 2 weeks after the first vaccination. After receiving both doses, 37 health care workers tested positive. Even after 15 or more days of the second dose, when protection against the disease is expected to be stronger, 7 tested positive. Note, that the time period is not adequate to have enough samples after 15 days of the 2nd dose [Table 2 (Keehner

Table 2
New SARS-CoV-2 infections among vaccinated health care workers in the US from December 16, 2020, through February 9, 2021.

Days after Vaccination	Vaccinated Persons		
	With New Infection	Tested	Eligible for Testing
	(N = 379)	(N = 14,604)*	(N = 36,659)+
	Number		*Number (percent)*
Dose 1			
Days 1–7	145	5794	35,673 (97.3)
Days 8–14	125	7844	34,404 (93.8)
Days 15–21	57	7958	32,667 (89.1)
Day 22 or later, Before Dose 2	15	4286	32,327 (88.2)
Dose 2			
Days 1–7	22	5546	23,100 (63.0)
Days 8–14	8	4909	16,082 (43.9)
Days 15 or later	7	4167	14,990 (40.9)

(Source: Keehner et al., 2021 (Keehner et al., 2021), see details there)

et al., 2021),].

To gain useful insight, one interesting point could be to check whether the rate of infection (379 out of 14,604) within two months is comparable with the general infection rate among the unvaccinated adults who are not old, frail or retired. This study indicates that after vaccination, the absolute risks of testing positive for SARS-CoV-2 are higher than the risks noted in the original phase III trial experiments. Moreover, over-confident, vaccinated people, if develop mild symptoms or remain asymptomatic can be super-spreaders in the community.

Such analyses raise obvious questions, as mentioned below, which require in-depth investigation and could have been explored at the start of a rapid mass vaccination program. i) Can vaccines cause more mutation of the virus? ii) If yes, can more forms of mutations be linked to different types of vaccines? iii) For viral mutation, if vaccines have any roles, is it dependent on climate, ethnic groups, past health conditions of individuals, various genetic groups of people, etc.? iv) Are immunocompromised patients playing major parts in viral mutations after vaccination? v) Did mutation originate and progress first in countries where vaccine trials started. vi) If vaccines can cause mutation, is it only travelling that can spread the mutated virus country-wise or region-wise? It can equally happen within any community sooner or later, even with strict lockdown or travel ban. vii) Some countries by reducing vaccine dose could subside transmission which became uncontrollable (e.g., India in April/May 2021, Bahrain in May/June 2021 (Ourworldindata), also see Fig. 3). Such intervention on time showed that policymakers and government can have control over the rate of viral transmission by regulating the number of vaccine doses, spatially as well as temporally (Fig. 2B). Here is another relevant quote (Roy, 2021c), (Roy, 2021d): "Can the timing and severity of global waves (fourth/fifth etc.) in the future be controlled by regulating vaccine doses?" viii) Following patterns of Flu, a surge is predicted to happen in the northern US and Europe, at the beginning of every winter (https://easychair.org/smart-slide/slide/S39n, presentation on July 2021, (Roy, 2021c), (Roy, 2021d)). Thus, we need to be pragmatic and not simply optimistic or pessimistic. We need to explore alternate pathways and be well-prepared side by side with substitute solutions beforehand (Roy, 2020c, 2020d, 2020e). If there is a possible solution without any vested interest and which is easy to practice, that could be worth to be explored.

Moreover, without proper examination of all indirect and direct consequences of mass vaccination, any hasty actions can cause more harm than good. It can lead to severe consequences in high populated countries that we already witnessed. Those areas need urgent attention and thorough investigation on time to arrest further escalation of the deteriorating situation.

3.7. Some comparisons of vaccinated vs. unvaccinated

In December 2021, UK completed one year after the start of mass vaccination and hence there were enough data for comparisons between vaccinated and unvaccinated groups for implementing policy. The main findings among those groups are likely to be similar in other countries too.

3.7.1. Some observations on dominant variants and claims on vaccine success

Cases and deaths in England due to two dominant variants, Alpha and Delta, from 1 February 2021 to 2 August 2021 are shown in Table 3 (Public Health England, 1009). Other variants viz. Beta, Eta, Gamma, Kappa, Lambda, Theta, Zeta variants etc. were also identified earlier. However, those were nominal compared to Alpha and Delta. The fatality rate for Alpha was much higher than Delta; as deaths/cases were 1.1% and 0.2% respectively (Table 3). Death statistics between the vaccinated and unvaccinated categories for Delta indicate that those statistics are comparable [Table 3]. It does not reflect that vaccinated groups are performing better than unvaccinated. It is also noteworthy that under 50 groups also consist of less than 18-year group who were unvaccinated, as vaccination did not start that time. Many of those under 18 years also have comorbidities. For the UK and England, Delta is the most prevalent variant in the last few months up to November (~99%, (Public Health England, 1009), (Ourworldindata)). As percentage of deaths from Delta was also less among the unvaccinated group, it indicateed that Delta was less deadly than Alpha so far irrespective of vaccination category. Thus the claim for UK, which is one of the topmost vaccinated countries, that vaccine is reducing deaths inspite of high cases can not be substantiated by observed data. With the recent emergence of another new variant Omicron [WHO], the data suggested it was less deadly than Delta, though more transmissible [BBC].

3.7.2. Progression of deaths for vaccinated vs unvaccinated

Vaccine efficacy is heavily reduced as time progresses, though initially proclaimed to be very high (above 90%). For England, further analyses were conducted to study the progression of deaths weekly/biweekly due to Delta variants (Public Health England Technical Briefing various issues (Public Health England, 1009)). It indicated that deaths among fully vaccinated were rising at a much higher rate than the other two groups (unvaccinated, as well as people having one dose) [Fig. 12] and it was clearer when we focus on the trend lines. The last biweekly counts of death up to mid-August also indicated consistent results; a total of 277 died from the fully vaccinated group while 137 were from the unvaccinated group [Fig. 12]. For Scotland, up to the 21st of June 2021, a total of 2247 fully vaccinated (28 days after the 2nd dose) people died (Public Health Scotland). In Israel, it was noted that most hospitalised severe patients are fully vaccinated (Government of Israel, 2807).

As the effectiveness of vaccine was waning, Israel first initiated 3rd dose (1st booster) followed by many other countries (Ourworldindata). Israel also initiated the fourth dose first. Gibraltar and Israel with a very high vaccination rate (Ourworldindata) was portrayed earlier as a vaccine success story. Both showed a rise in case numbers and attained another peak in June 2022 (Worldometers; Ourworldindata). Interestingly, Gibraltar (a small country) vaccinated more than 100% of their population (this is because non-resident employees are also fully vaccinated) (Ourworldindata). Analyses monitoring the overall COVID-19 situation globally as well as countrywise time to time, based on simple observed data are now available in scholarly platform (Roy, 2022a, 2022b). Probably monitoring the situation carefully over time (Roy, 2022a, 2022b) Gibraltar and Israel took different stunts in the later period and heavily regulated vaccine doses (Ourworldindata) and see Fig. 6b. Gibraltar stopped all vaccine dose on 20th April 2022, while Israel kept doses very nominal (practically no rise of Doses/without any trend) since March 2022. Many other countries also stopped Doses since

Table 3
Cases and deaths in England due to dominant two variants (1 February 2021 to 2 August 2021, data from Public Health England, Technical Briefing (Public Health England, 1009)).

Variant	Age (Years)	'Cases since 1st Feb'	'Deaths' number(%)	'Post dose1'	'Received 2 dose'	Unvaccinated
Alpha	<50	118,178	66 (0.1%)	Not available		
	≥50	32,274	1548 (4.8%)			
	Total	150,541	1614 (1.1%)			
Delta	<50	265,749	71 (0.0%)	8	13	48
	≥50	33,736	670 (2.0%)	71	389	205
	Total	300,010	742 (0.2%)	79	402	253

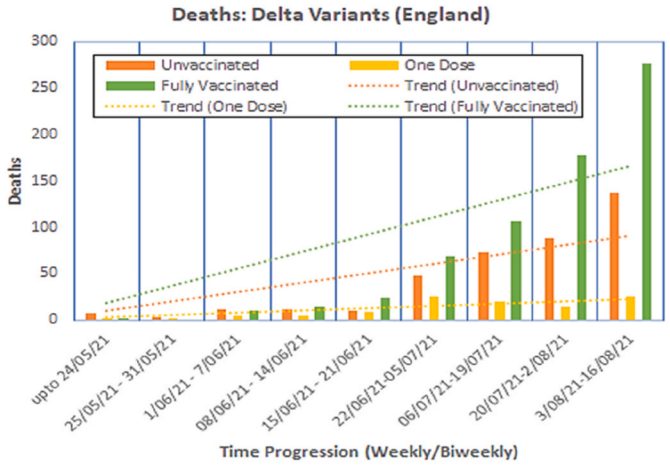

Fig. 12. Time progression of deaths from Delta variants in England, [using data from Public Health England, Technical Briefing, 14] among unvaccinated, fully vaccinated and people with one dose. Trends (with no intercept) are shown by same-colored dotted lines.

March 2022 onwards (Iceland, Mongolia, Hungary, Venezuela and Greenland among others) or kept Doses nominal (Denmark etc.) (Fig. 6b). WHO initiated policy regulating the 4th Dose (WHO, 2022).

Another important point to note is that people within 2 weeks of 1st vaccination were considered as 'unvaccinated' group in England, whereas it was within 3 weeks for Scotland. Interestingly infected cases within 2 weeks of vaccination are exceptionally high compared to the whole infected cases (see Table 3). Thus, the high case number among the unvaccinated group was misleading and will give biased results for that group. If such a definition of threshold is followed, cases among vaccinated and unvaccinated groups also favour the vaccinated category. Such biased results were often portrayed as another vaccine success story.

If there are records of percentage cases separating within 14 days of 1st dose vs. people those did not receive any vaccination at all but naturally got infected, that may give rise to some interesting picture. It might give some explanation why there is a rise in cases for almost all countries after the start of mass vaccination. The scientific basis in this regard is also analysed in a recent review (Seneff and Nigh, 2021). Our discussion indicates that claimed success stories of vaccination need thorough investigation with a critical viewpoint and it is crucial to figure out the actual success stories of vaccines and to do risk vs benefit analyses.

Time progression of deaths from Delta variants in England indicated that the rise in deaths among vaccinated with double doses was rising at a much faster rate than that of the unvaccinated group. Data presented here is up to mid-August though such observation is consistent throughout. As more population are getting double/triple vaccinated as time progresses, such analyses clearly raise doubts of proclaimed vaccine success stories.

3.7.3. Covid deaths absolute numbers (age wise): most unvaccinated or vaccinated?

Data from UK hospitals were also analysed up to week 46, 2021 (3rd week of November) since August and explored age wise variation too. Here are some records of UK government statistics and results are consistent over time. Attention is on people aged 50 years and above as they are the most vulnerable categories.

- *Date till* 12th *September, 2021 in England:*
  a. Cases from the beginning of vaccination till 12th September: double vaccinated 71,991 (14 days after 2nd dose); whereas it is 8551 for the Unvaccinated group [(UK Health Security Agency (UHSA), 2021a), their Table 5].
  b. Serious hospital admission: 3913 who are double vaccinated; whereas it is 1786 for the Unvaccinated group.
  c. Deaths: 1565 who are double vaccinated; whereas it is 590 for the Unvaccinated group.
- *Date: week 40-43, 2021 in the UK*
  COVID-19 deaths within 60 days of a positive specimen or with COVID-19 reported on the death certificate, by vaccination status between week 40 and week 43, 2021 in the UK: Death 2951 for fully vaccinated, while 573 for unvaccinated [(UK Health Security Agency (UHSA), 2021b), their Table 4b].
- *Date: week 43-46, 2021 in the UK*
  Deaths among the unvaccinated group in both attached Table 4a and b are less than 700 hundred (shown by green); whereas it is 2844–3393 among double vaccinated people (14 days after 2nd dose, shown by red) [(UK Health Security Agency (UHSA), 2021c), their Table 10a].

Table 4a shows there are 3456 deaths among which 612 are unvaccinated; whereas 2844 died who are fully vaccinated (double dose >14 days). That means approximately for every 6 deaths from Delta, 5 persons are fully vaccinated, while 1 is unvaccinated. Proportions could be a little less if total numbers of vaccinated and unvaccinated populations are considered. However, considering the absolute numbers (Table 4) a question definitely arises on how effective the vaccines are and whether it agrees with high vaccine effectiveness as claimed initially before the start of mass vaccination. Those statistics for deaths among unvaccinated and vaccinated are shown similarly for the earlier period too.

Honest journalism is also important to disseminate transparency and reality to common people. An article published in the top-level newspaper 'The Guardian' with a headline, 'Covid patients in ICU now almost all unvaccinated' (The Gurdian, 2021).

Following previous data, as presented, how anyone interprets and presents any result is another area that needs attention. Honesty and transparency in journalism are other important areas that deserve improvements.

3.8. COVID-19 and seasonal temperature

Seasonal effects especially the temperature were shown to be a

Table 4
COVID-19 deaths (a) within 28 days (b) within 60 days of positive specimen or with COVID-19 reported on death certificate, by vaccination status between week 43 and 46, 2021.

(a)

Death within 28 days of positive COVID-19 test by date of death between week 43 and week 46 2021	Total**	Unlinked*	Not vaccinated	Received one dose (1-20 days before specimen date)	Received one dose, ≥21 days before specimen date	Second dose ≥14 days before specimen date†
	[These data should be interpreted with caution. See information below in footnote about the correct interpretation of these figures]					
Under 18	9	1	8	0	0	0
18-29	13	0	9	0	2	2
30-39	44	1	28	0	4	11
40-49	104	3	51	0	4	46
50-59	250	5	108	0	11	126
60-69	555	3	154	0	18	380
70-79	1025	6	163	1	9	846
≥80	1,726	7	187	5	35	1,492

(b)

Death within 60 days of positive COVID-19 test by date of death between week 43 and week 46 2021	Total**	Unlinked*	Not vaccinated	Received one dose (1-20 days before specimen date)	Received one dose, ≥21 days before specimen date	Second dose ≥14 days before specimen date†
	[These data should be interpreted with caution. See information below in footnote about the correct interpretation of these figures]					
Under 18	12	1	10	0	1	0
18-29	16	0	9	0	2	5
30-39	52	1	32	0	4	15
40-49	132	4	62	0	5	61
50-59	312	6	134	0	14	158
60-69	658	5	181	0	20	452
70-79	1,195	7	175	1	16	996
≥80	2,054	7	207	6	47	1,787

(Source: UK Health Security Agency (UHSA) (UK Health Security Agency (UHSA), 2021c), their Table 10a and b)

crucial factor for the transmission of COVID-19 in many countries (Roy, 2020c, 2020d, 2020e; Scafetta, 2020). COVID-19 transmission becomes high in wintertime of respective hemispheres (Roy, 2020c, 2020d, 2020e) and months of winter in the Northern hemisphere coincides with the summer in the southern hemisphere and vice versa. By around mid-April 2020, almost all European countries and countries from the northern USA showed a decrease in transmission and that happened without any involvement of vaccines. Reporting of cases is likely to be influenced by various reasons e.g., testing facility, location (remote or urban), some countries had very high testing while some very less. As death reporting is usually authentic, this study considered 'deaths' as a better and more useful metric to analyse results.

Fig. 13 shows COVID-19 deaths in 20 European countries up to 7th August 2021. As it happens for Flu in every year, the transmission of COVID-19 in those countries, in fact, was nominal from mid-June to September 2020, compared to the severity of other months. Here 20 countries are presented and there are varied characteristics of those countries e.g., some are international business hubs with more foreign travellers, while some are popular tourist spots, countries also have different levels of testing, moreover infrastructural and medical facility could also be different. Population density as well as different degrees of lockdown restrictions also affects results. Interestingly, in spite of all dissimilarities, still, there is one common factor which is deaths (shown as a 7-day average) for all those 20 neighbouring countries were practically nominal from July 15 to Sept 15, 2020 (Fig. 13a) Whereas, high deaths were noticed from 15th October 2020 till 15th May 2021 to all those countries. Now as the absolute number of deaths varies based on population, to analyse the degree of vulnerability, deaths/million population of a country is also considered in Fig. 13b. Results are plotted as cumulative measures to understand the seasonal transition better. It shows, considering the whole period of pandemics, that the trend was nominal in most countries between 15th May and 15th October 2020. Such nominal trend is again noticed from 15th May 2021 (Fig. 13b, horizontal lines are distinct after dotted black lines).

If vaccines were not in place, it would have been also expected to be like that from mid-April in 2022. After major vaccination started, there were surges in transmission in almost all countries and most countries had to impose strict lockdown conditions. Monitoring situations of the summer of 2020 and 2021 may give ideas on how the effect of vaccines, (including the proportion of vaccinated percentage, time of major vaccination programme) may override the effect of seasonality in countries of northern US and in various European countries.

To study the effects of global temperature, some analyses were done with global 2m air temperature using NCEP reanalyses data (Fig. 14). Using different data sources and other temperature parameters (say, 1000 mb air temperature), also suggested similarlies. Spatial plots of 2 m mean air temperature in different periods of the pandemic are shown. From mid-July to mid-September 2020, COVID-19 deaths and transmission were the lowest in Europe among the whole pandemic (Fig. 13a, between red dotted line) is shown in Fig. 14a. On the other hand, from mid-October 2020 to mid-May 2021 deaths in Europe were very high as shown in Fig. 14b (between black dotted lines, Fig. 13b). Interestingly, the temperature upper and lower bound changed 20° in Fig. 14a to b; the maximum temperature decreased from 310K to 290K, whereas, the minimum temperature from 280K to 255K. Knowing that this virus and similar generic viruses are very sensitive to temperature (Roy, 2020c, 2020d, 2020e; Scafetta, 2020; Van Doremalen et al., 2013; Chan et al., 2011; Lowen et al., 2007; Casanova et al., 2010; Seung et al., 2007; Marca et al., 2021; Cohen, 2020), such a huge change in air temperature around Europe in a few months' time could be playing an important role. This is true for Flu as well as COVID-19. Temperature spatial plots in two transition periods when the trend of deaths was very steep (Fig. 13) are also shown (Fig. 14c and d). Fig. 14c is for mid-April to mid-May 2020 and Fig. 14d is for mid-October to mid-November 2020. The minimum temperature limit is reduced from 280K in Figs.. 14a to 265K and 255K respectively in Fig. 14c and d. Not only minimum temperature bound reduced by 15K and more, but a sudden decrease in the maximum temperature bound is also noticed. The maximum

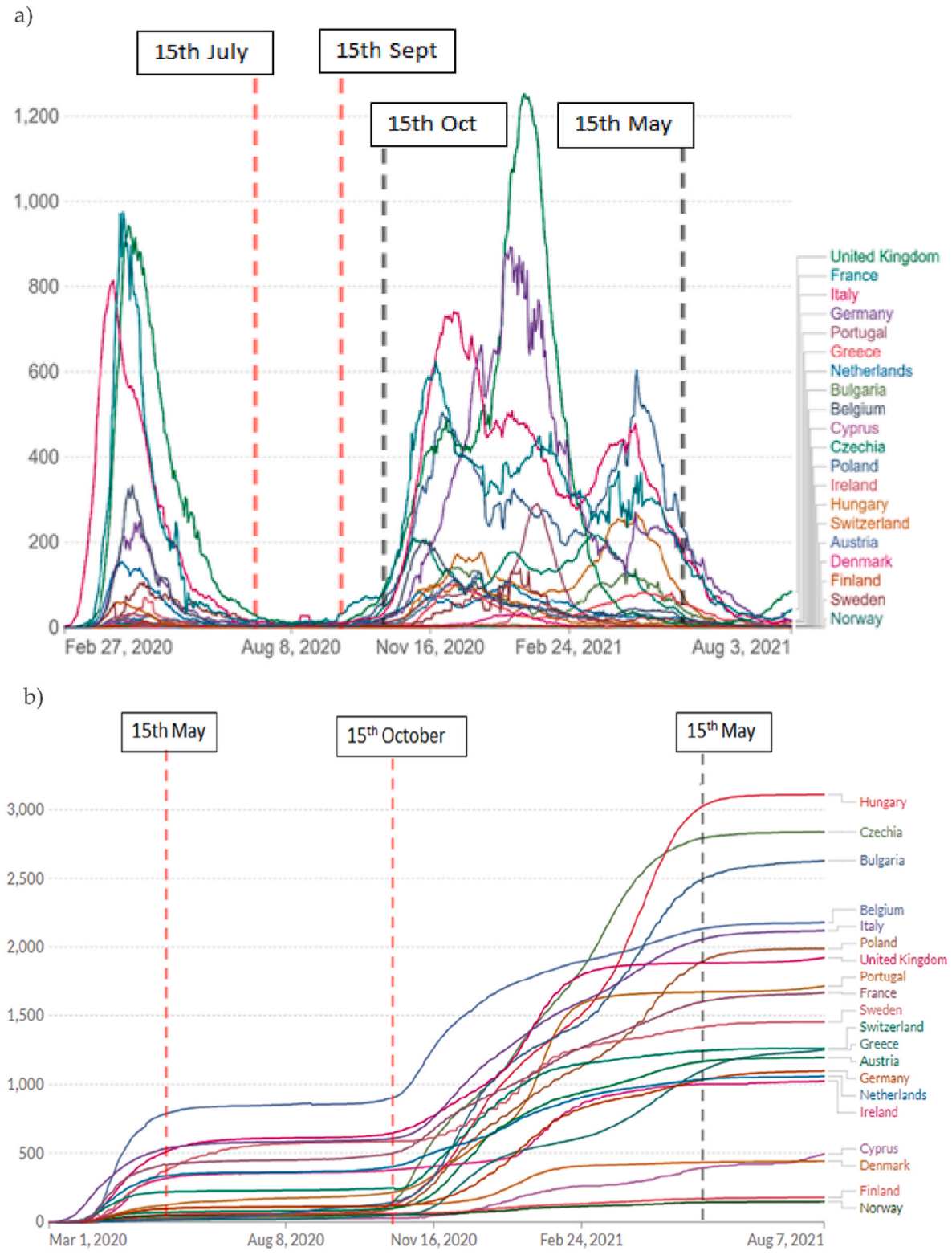

Fig. 13. COVID-19 deaths in 20 European countries up to 7th August 2021. a) Daily new deaths 7-day average; b) Cumulative deaths per million people. a) shows deaths are practically nil between 15th July to 15th September 2020 for all the countries (periods shown between red dotted lines). High deaths are noticed from 15th October 2020 to 15th May 2021 (shown between black dotted lines). b) shows considering the whole period of a pandemic, the trend was nominal in most countries between 15th May to 15th October 2020 (marked by dotted red, the horizontal part between those lines is quite distinct). Such nominal trend is again noticed since 15th May 2021 (horizontal lines are distinct after dotted black lines). (Plots generated using the site Ourworldindata). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

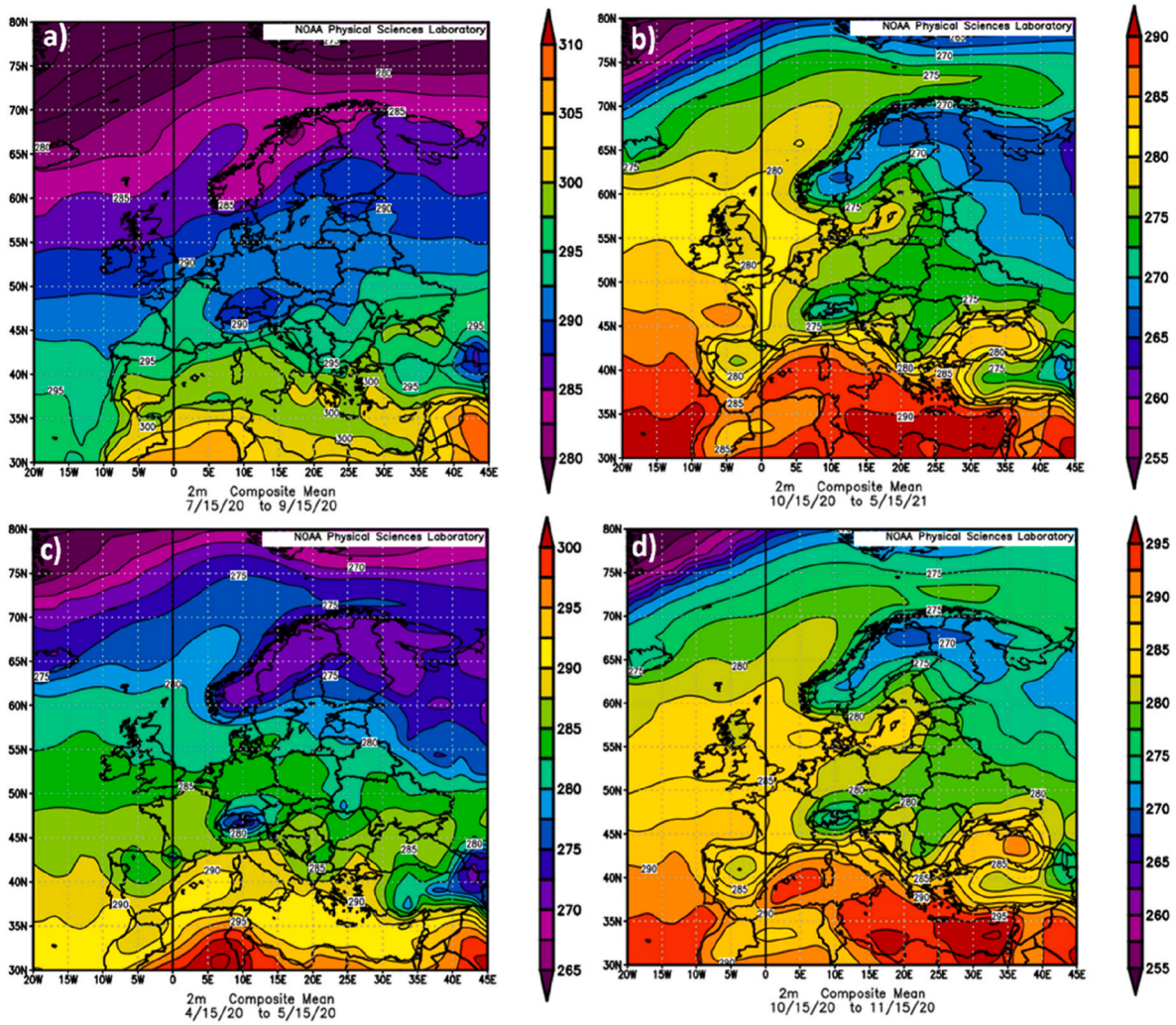

Fig. 14. The spatial plot of 2 m mean air temperature in different periods of the pandemic from NCEP Reanalysis data. a) mid-July to mid-September 2020 when COVID-19 deaths and transmission were lowest in Europe among the whole pandemic. b) mid-October 2020 to mid-May 2021 where deaths in Europe were very high. c) mid-April to mid-May 2020 and d) mid-October to mid-November 2020 the two transition periods when deaths suddenly increased. Plots generated using site (Physical Sciences Laboratory (PSL), (Website: Physical Sciences Laboratory (PSL))).

temperature is also reduced by 10K or more in Figs. 14c and d with respect to Fig. 14a. Such a sudden decrease in temperature for minimum and maximum bound happened in only a very short period of time.

One of the main dominant factors, seasonal temperature, for COVID-19 transmission is undermined by the science community and most important publications. Thus, the concept of avoidable deaths as speculated by models which did not take proper consideration of seasonality could be pure speculation rather than a reality. Moreover, there are many other unknowns and cofounding factors too for the spread of COVID-19 transmission which makes modelling of its spread and estimated death counts far from reality.

A systematic review work (Paulo et al., 2020) studied the effect of seasonal temperature by selecting sixteen relevant articles and all unanimously stated that cool and dry conditions were potential factors for the spread of COVID-19, with the spread being largely absent under very hot and extremely cold conditions. The authors found there was great homogeneity in the results of the effect of temperature on the seasonal variability and spread of the virus. However, based on their Table 3 (Paulo et al., 2020), the authors finally concluded that certainty of the evidence was graded as low. A careful observation suggests that 'low' grading is not supported by their Table 3 from (Paulo et al., 2020). On the contrary, it is completely the other way round.

Very few limited studies are there that disregarded the effect of temperature on transmission of the disease (Paulo et al., 2020; Kassem, 2020). Some studies were already excluded from the final analyses of systematic review stating obvious biases in those analyses (Paulo et al., 2020) while the other study (Kassem, 2020) used a technique that is not suitable to explore effects of seasonal temperature. The latter study (Kassem, 2020) also mixed data from lockdown and non-lockdown periods. Moreover, it used the non-linear least-squares method to study the relationship between COVID-19 transmission and temperature where many confounding factors play roles. They separated countries into three groups based on the first reporting cases of the disease in January, February and March respectively. To study the effect of seasonal temperature to categorize countries based on criteria, which is heavily linked with foreign travel, is not at all appropriate. On the contrary most of the studies that detected the effect of seasonal temperature categorized countries based on temperature viz. very cold, moderately cold and warm [20–23 among others]. The relationship between temperature and transmission is also not linear; e.g., very cold and warm countries showed less transmission while moderate cold countries showed maximum transmissibility and deaths. Hence the transition from one state to another to any country based on temperature makes a huge difference to the risk and vulnerability of any country (Roy, 2020c, 2020d, 2020e).

Though for COVID-19 transmission, the dependency on seasonal

temperature was very apparent throughout, till vaccination started, but surprisingly undermined by the scientific community. Could it be because of the earlier experiences with the seasonal Flu Vaccine?

4. Conclusions

A strong coordinated effort is in place from vaccination groups to put an end to the current COVID-19 crisis. The mass vaccination programme was initiated in early December 2020 and countries all over the world are part of it. There is now enough data to compare results to study the effectiveness, shortcomings and aftereffects of mass vaccination. Most studies covered here are up to the beginning of July 2022, while some analyses focused on earlier periods of mass vaccination. Well established, simple statistical techniques to evaluate results were presented, and those used open access data sources of authoritative bodies. This study explores exit strategies of the COVID-19 crisis using pathways of vaccination. It is a pragmatic approach to address various aspects of the strategy with an open and critical mindset.

Seasonality played an important role in the global transmission of the disease before mass vaccination and some contrary findings/publications in that respect were attended. To address seasonality, many similarities between seasonal Flu and COVID-19 received attention to gain useful insight. In spite of modern and evolving vaccines, it is not yet been possible to eradicate Flu. The main reason is that the Flu virus is mutating over time and space. Hence this study questioned whether COVID-19 could be similar to Flu in the long run or not. Moreover, it is important to remember that there are yet not any successful vaccines developed/passed the trial phase for some virus-borne diseases too (e.g., AIDES). Thus, the question arises whether the world is prepared with any alternate strategies. Some published research, clinical trial experiment and supported analyses suggested that heat-based simple solutions at the initial stages of the disease could be a useful solution that deserves attention (Roy, 2023). It does not have any vested interest.

Trial protocols and experiments designed for COVID-19 vaccination did not take into account many direct and indirect consequences of mass vaccination. Adverse reporting of data raised questions about short-term direct effects, which is compared with adverse report data of other vaccines. Some disproportionate adverse reporting on the young and male populations were also discussed. Furthermore, when attention is on indirect consequences, it was observed that almost all countries experienced a sudden surge of transmission after the initiation of vaccine programs, and most countries had to impose strict lockdown. Many countries also showed synchronized patterns between new cases and vaccine doses. Countries with a low prevalence of diseases in the earlier period of pandemic (e.g., many countries from African continents, SAARC, and SEAC etc.) showed a massive surge when vaccine dose was suddenly increased. Such observation has relevance to vaccine equity. In this regard, the country Indonesia was discussed when a sudden rise in vaccine dose coincided with the highest daily deaths among the world during July–August 2021.

Doses of the vaccine were again varied abruptly in European countries at the end of 2021, the start of winter. From around the middle of November 2021, UK and most European countries suddenly increased vaccine doses, which again matched with the winter seasonal cycle and cases skyrocketed. Cases around the world showed an unprecedented surge. Following that unusual surge, most European countries however started decreasing vaccine doses from 15th December onwards. Such rise and fall of vaccine doses in highly populated European countries were the steepest of the entire pandemic. Vaccine Doses globally were steadily decreased since 22nd December 2021. Cases and Deaths show a clear decreasing trend starting with a certain lag. In that context, new variants and fast mutation of the virus with relevance to mass vaccination were addressed with a critical mindset.

This study further discussed whether vaccine dose matters and whether countries with high percentage of vaccinated population perform better or not than those that did not. Results of vaccination and deaths for five neighbouring countries from the Indian subcontinent are presented covering initial period of vaccination, where the Maldives ranked topmost in terms of share of people vaccinated; whereas, Pakistan and Bangladesh ranked in the bottom two, with India and Nepal in the middle. Surprisingly, the rankings of those five countries were shown to be maintained in terms of cumulative deaths per million too. Performances for highly vaccinated countries like Gibraltar, Israel, Portugal raise many obvious questions on the future direction of the mass vaccination program and its aim and achievable proposed objectives.

Many people were infected not only after the first dose but even after 14 days of the 2nd dose (breakthrough cases), though the infection rate among the vaccinated group is unusually high within 14 days of the first dose. These were supported by clinical trial experiment. Vaccinated, over-confident people, if asymptomatic or develop mild symptoms, can act as super-spreaders. Time progression of deaths in England indicates that death counts were rising faster among the vaccinated group (with two doses) than the other two groups, unvaccinated or with a group of one dose. A trial experiment with vaccinated healthcare workers from the US suggested that infected cases within 2 weeks of 1st vaccination were exceptionally high compared to the whole infected cases of the sample group.

In December 2021, as UK completed one year after the start of vaccination, some comparison between vaccinated and unvaccinated groups were made consulting government of UK Health Security Agency (UHSA) data. Honesty and transparency in journalism are other important areas that deserve improvements too and discussed.

Observed and analysed facts discussed in this study provided directions to urgent timely policy action. This study will greatly benefit policymakers, academics, patients, and common people.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

All data sources are mentioned in the paper and are open sourced.

Acknowledgement

Three preprint versions available: the first version dt 20th March 2021 https://doi.org/10.22541/au.161642232.28976638/v1 (Roy, 2021c); 2nd version dt 8th July 2021 https://doi.org/10.22541/au.162584191.11801390/v1 (Roy, 2021d) and 3rd version dt 14th January 2022. https://doi.org/10.22541/au.164216595.51633523/v1. Presentation https://t.co/M7nu0JUAu1 and video https://t.co/k09eajW9iu

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