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Review article

A comparison of COVID-19 between Egypt and the United Kingdom

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Abstract

The COVID-19 pandemic produced by SARS-CoV-2 was the single most important epidemic in the previous century, with unparalleled international scientific, clinical, and political cooperation. One distinguishing trait is its heterologous presentation in terms of illnesses and death in many countries. In this communication, we look at several of these characteristics in two countries: Egypt and the United Kingdom, which have quite different demographics and public health policies. We investigate alternative explanations for the far poorer outcome that happened in the United Kingdom, which had over ten times the number of deaths per million of the population as Egypt.

Keywords: COVID-19, SARS-CoV-2. The United Kingdom, Egypt

Introduction

SARS-CoV-2 and the infection it induces, COVID-19, have received a lot of attention (1,2). One of the pandemic's many notable features has been the cycles of waves of peaks and troughs in the number of confirmed cases and deaths, with at least five such cycles occurring globally and impacting different nations at different periods and with diverse effect (3,4). These alternating peaks and troughs have been attributed to the effects of many SARS-CoV-2 variants (such as Alpha, Delta, and Omicron), each with its own genetic and clinicopathological profile (5-7).

The virus has traveled west from China, first to Europe and subsequently to the rest of the world, with Germany, Spain, France, and Italy reporting cases in January 2020, and the United Kingdom (UK) on February 1st (3). Egypt reported its first instance on February 14th, Israel on February 21st, Saudi Arabia on March 2nd, and Libya on March 25th (3). The World Health Organization (WHO)(3) is the primary global source of clinical, epidemiological, and other data on this virus. The goal of this communication is to examine the effects of the virus on the populations of Egypt and the United Kingdom, with a focus on confirmed cases and deaths, in order to deconstruct the nature of the pandemic in each country.

The first wave: February 2020 to Mid-2020

According to the WHO dashboard (3), the numerous peaks and troughs in cases and deaths varied dramatically from country to country. For example, in the United Kingdom, the initial trough in deaths was 9 on August 26th, indicating the end of the first wave and the beginning of the second. The similar date in Egypt, where 8 deaths were reported, happened much later - November 1st, 2020. As a result, as seen in the data tables below, a degree of flexibility is required to compare pandemic waves in these two countries, and we acknowledge this restriction.

Table 1. Leading early events in the pandemic in Egypt and the UK

	Egypt	The UK
1st case reported	14th February 2020	1st February 2020
1st death reported	8th March 2020	4th March 2020
Interval between first case and first death	23 days	32 days
Time to 1000 cases	51 days	41 days
Time to 1000 deaths	86 days	22 days

Table 2. Metrics of the first wave in Egypt and the UK

	Egypt			The UK		
	Date	n	n/million*	Date	n	n/million*
Peak in cases	20-6-2020	1,774	17.3	24-4-2020	5,517	81.2
Peak in deaths	16-6-2020	97	0.95	10-4-2020	1,077	15.9
Trough in cases	23-8-2020	89	0.9	14-7- 2020	366	5.4
Trough in deaths	15-10-2020	6	0.1	26-7-2020	7	0.1
Number of cases		97,237	950		291,699	4,296
Number of deaths		6,077	59.4		41,299	608
**Approximate duration (days)	259			199		

*Population of Egypt taken as 102.3 million, the UK 67.9 million. ** Best estimate mid-point between peak/trough in cases and deaths

Table 3. Metrics of the second wave in Egypt and the UK

	Egypt			The UK		
	Date	n	n/million	Date	N	n/million
Peak in cases	*1-1-2021 & 16-5-2021	1,418 1,203	13.9 11.7	31-12-2020	83,090	1,224
Peak in deaths	*4-1-2021 & 11-5-2021	64 68	0.62 0.66	21-1-2021	1,317	19.4
Trough in cases	28-7-2021	31	0.3	3-5-2021	1,432	21.1
Trough in deaths	5-8-2021**	4	0.1	3-6-2021	4	<0.1
Number of cases		186,853	1,826		4,211,555	62,026
Number of deaths		10,473	102.4		87,271	1,285
Approximate duration (days)	316			302		

*Biphasic epidemic.,**mean of several days.

Table 4. Metrics of the third wave in Egypt and the UK

	Egypt			The UK		
	Date	n	n/million	Date	n	n/million
Peak in cases	18-11-2021	960	9.4	*17-7-2021 & 20-10-2021	62,000 57,573	882
Peak in deaths	19-11-2021	73	0.7	*19-9-2021 & 30-10-2021	176 192	2.7
Trough in cases	4-1-2022	723	7.1	6-12-2021	38,783	571.2
Trough in deaths	24-12-2021	10	0.1	7-12-2021	96	1.4
Number of Cases		103,792	1,104		6,218,088	91,577
Number of Deaths		4,960	48.5		18,472	272
Approximate duration (days)	150			209		

*Biphasic epidemic

Table 5. Metrics of the fourth wave in Egypt and the UK

	Egypt			The UK		
	Date	n	n/million	Date	n	n/million
Peak in cases	7-2-2022	2,301	22.5	*5-1-2022 & 23-3-2022	229,900 109,288	3,386 1,609
Peak in deaths	11-2-2022	62	0.6	*18-1-2022 & 9-4-2022	256 231	3.8 3.4
Trough in cases	6-6-2022	5	<1	29-5-22	5,410	79.7
Trough in deaths	8-6-2022	<1	<1	31-5-2022	30	0.44
Number of cases		126,093	1,232		11,568,916	170,382
Number of deaths		2,669	2.6		24,790	365.1
Approximate duration (days)	157			170		

*Biphasic epidemic

Table 6. Waves and variants

Wave	Egypt	The UK	Variant
1	March 2020 – October 2020	March 2020 – July 2020	Wuhan
2	October 2020 – August 2021	July 2020 – May 2021	Alpha
3	August 2021 – December 2021	June 2021 – December 2021	Delta
4	January 2022 – June 2022	December 2021 – May 2022	Omicron BA.1 and BA.2
5	Endemic	June 2022 – May 2023	Omicron BA.4, BA.5, BA.2.75, BA.4.6, XBB, XAW and others

Table 7. Rates of global COVID-19 cases and deaths in relation to median age and World Bank status

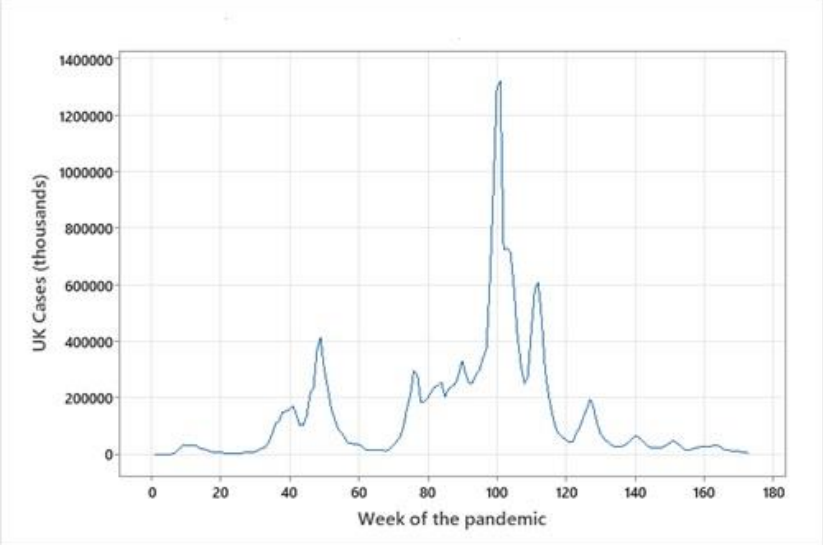
	Median age		Word Bank Status	
	r	**p**	**r**	**p**
Cases	0.41	<0.001	0.38	<0.001
Deaths	0.28	0.004	0.30	0.003
Cases/% population	0.75	<0.001	0.59	0.003
Deaths/% population	0.65	<0.001	0.59	<0.001
Case fatality rate	-0.29	0.003	-0.33	0.001

Pearson correlation (r) based on data from 100 nations.

Table 8. Frequencies of morbidities in Egypt and the UK

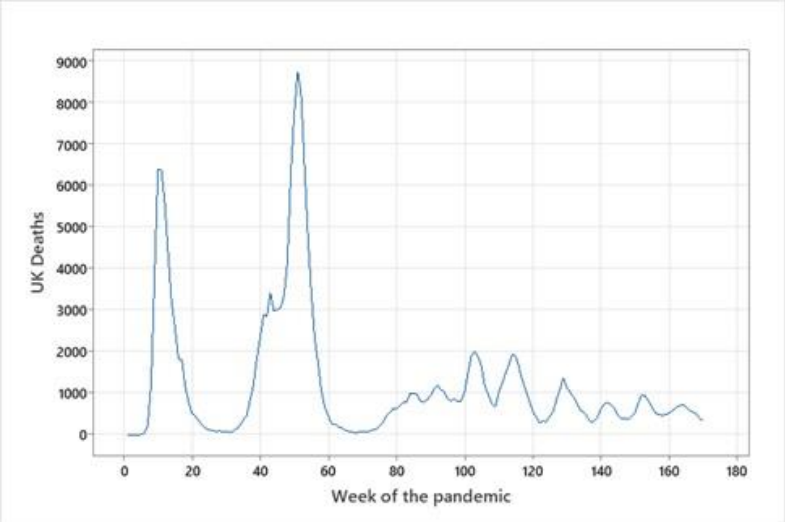
Morbidity	**Egypt (reference)**	**The UK (reference)**
Diabetes	18.4% (30)	7.0.% (31)
Hypertension	26.0% (32)	26.2% (33)
Cardiovascular disease*	46.2% (34)	24.3% (35)
Cancer*	13.8% (34)	28.4% (35)
Pulmonary disease*	4.2% (34)	13.7% (35)
Obesity	39.8% (36)	28.0% (37)

*Mortality. Data are from any of the past 6 years.



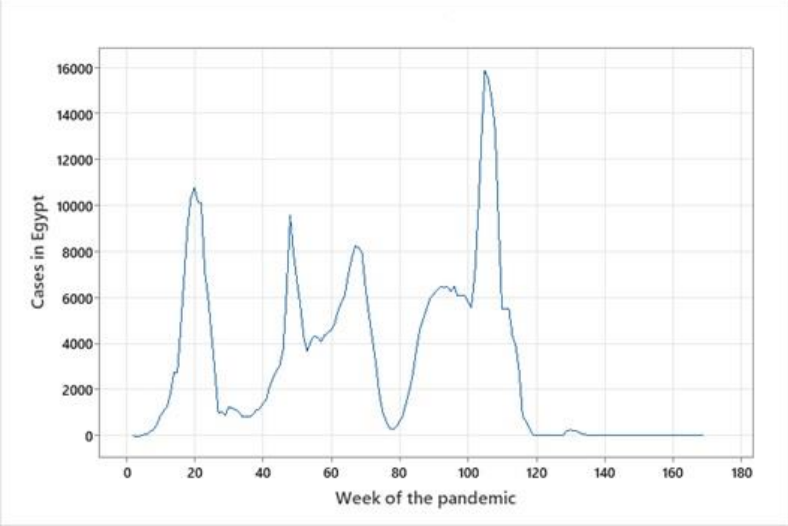
Week 1 = February 3rd 2020, Week 50 = January 11th 2021, week 100 = December 27th 2021, week 150 = December 12th 2022, week 170 = 1st May 2023.

Figure 1. UK cases during the pandemic



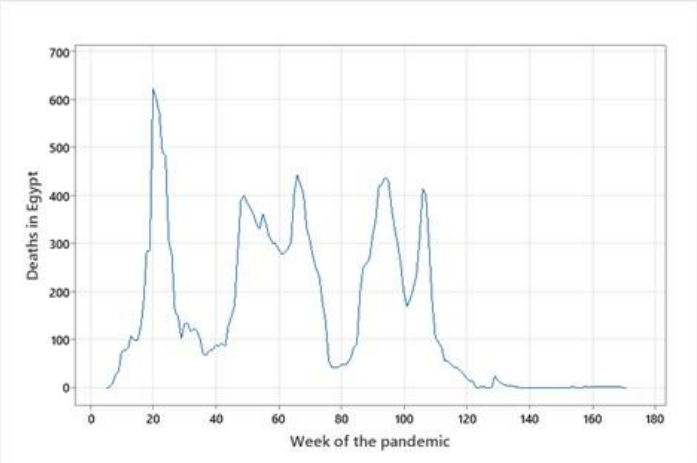
Week 1 = February 3rd 2020, Week 50 = January 11th 2021, week 100 = December 27th 2021, week 150 = December 12th 2022, week 170 = 1st May 2023.

Figure 2. UK deaths during the pandemic



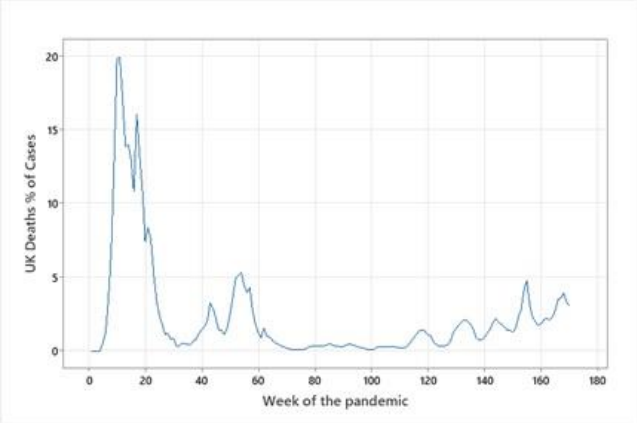
Week 1 = February 3rd 2020, Week 50 = January 11th 2021, week 100 = December 27th 2021, week 150 = December 12th 2022, week 170 = 1st May 2023.

Figure 3. Egypt cases during the pandemic



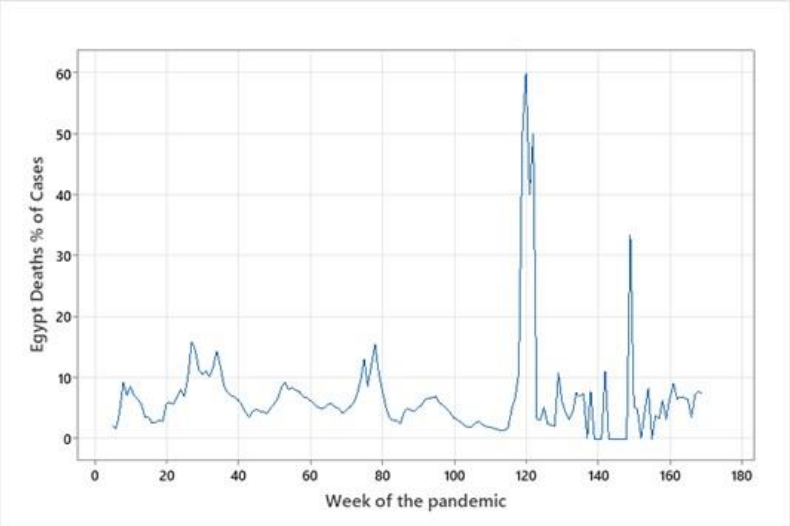
Week 1 = February 3rd 2020, Week 50 = January 11th 2021, week 100 = December 27th 2021, week 150 = December 12th 2022, week 170 = 1st May 2023.

Figure 4. Egypt deaths during the pandemic



Week 1 = February 3rd 2020, Week 50 = January 11th 2021, week 100 = December 27th 2021, week 150 = December 12th 2022, week 170 = 1st May 2023.

Figure 5. Case Fatality rate in UK during the pandemic



Week 1 = February 3rd 2020, Week 50 = January 11th 2021, week 100 = December 27th 2021, week 150 = December 12th 2022, week 170 = 1st May 2023.Certain data after week 125 is likely to be unrepresentative due to small numbers of cases and deaths, some shown here as zero. This small number aspect may also account for the unusually large peaks at week 120 (35 cases, 21 deaths, thus case fatality rate of 60%) and at week 149 (3 cases, 1 death, thus case fatality rate of 33.3%).

Figure 6. Case Fatality rate in Egypt during the pandemic

Clinical epidemiology

Table 1 shows the leading indicators provided by the WHO for the initial response to the pandemic . Egypt reported their first case two weeks after the UK, although the time between the first fatality in Egypt was shorter. However, the period in days to 1000 cases and mortality in the UK was substantially shorter than in Egypt, indicating a faster transmission of the virus within the UK. Daily cases and deaths peaked in Egypt in June 2020, then fell to a trough in August and October, respectively, whereas in the UK, the wave began earlier (April 2020) and ended sooner (table 2). Surprisingly, contrary to the typical development of an infectious disease, the number of deaths peaked before the number of cases in both countries. The most notable statistics are that the UK had over three times as many confirmed cases and over eight times as many deaths, and when the number of deaths is divided by the number of cases, i.e., the case fatality rate (CFR), Egypt's at 6.2% is significantly lower than the UK's at 14.1%.

Discussion

These distinctions are striking: despite being shorter in duration, this phase of the pandemic was significantly worse in the United Kingdom than in Egypt. After adjustment for population size (Egypt 102.3 million, UK 67.9 million) (8), the proportion of cases in the UK was 4.5 times that of Egypt, while the death rate and CFR were increased tenfold and twofold, respectively. There are several explanations for these variances. There was minimal worldwide agreement on the definition of a case or a death in the early days of the pandemic, and there were few opportunities to confirm a true infection with a well-established laboratory method (i.e., polymerase chain reaction), and data collecting was far from rigorous. Another reason is the demographics of the two countries.

Age is the primary risk factor for infection and death: according to WHO global data, 38.2% of COVID-19 deaths occurred in people aged 80 or older, whereas this group accounted for only 3.1% of cases (3). In contrast, the 30 - 39-year-old age group had the highest proportion of cases (18.1%), but only 2.1% of deaths (3). The median age in Egypt is 24.6 years, the UK 40.5 years (globally, 31 years) (9), the proportion of those aged 80 and above is 0.75% and 5.1%, respectively, and the number of people aged 100 or more in the UK outnumbers those in Egypt by a factor of 16 (10). The variation in age structure between the two countries is most likely a

contributing factor to the variance in cases and deaths. Other potential causes include higher ambient temperature and lower humidity, more stringent public-health precautions implemented in Egypt, and a slightly different form (variant) of the virus (11).

The second wave: Autumn 2020-Spring/Summer 2021

Clinical epidemiology

Egypt had an endemic level of about 150-200 cases per day until November 2020, with death around 15-25 per day until December, when locally sourced SARS-CoV-2 mutations exhibited at least 99% identity with the Wuhan strain (12). Following this, the number of cases and deaths increased, with a subsequent biphasic trend. A first sub-wave peaked in early January 2021, followed by a brief trough in February and March, and a second sub-wave peaked in May 2021, following which both dropped to an endemic level of 30-50 cases per day and 4-12 deaths per day in July and August 2021 (table 3).
The daily number of cases in the United Kingdom began to rise in early September 2020, with deaths happening by the end of September (table 3)(3), with peaks in December 2020/January 2021, followed by declines, with troughs in May and June 2021, respectively. The CFR fell by around 10% in Egypt to 5.6%, but by nearly 85% in the UK to 2.1%. The peak and trough of cases and deaths in the UK happened earlier (early summer 2021) than in Egypt (mid-summer 2021).

Discussion

Both countries observed a rise in the number of cases (almost 2-fold in Egypt, nearly 14-fold in the UK) and deaths (1.7-fold in Egypt, slightly more than 2-fold in the UK). In the UK, population-adjusted cases were worse than in the first wave, but the fold-difference in deaths was marginally better. According to Roshdy et al (13), the C.36.3 variation of SARS-CoV-2 was prominent in Egypt during this time period, with the Alpha version (B.1.1.7) being reported by Seadawy et al in March 2021, near the end of the wave (14). It is tempting to believe that the first sub-wave was caused by the C.36.3 version, which peaked in December 2020 and January 2021, and that the second sub-wave was caused by the Alpha variant (as it became known). In the second wave, the CFR for gene-sequenced cases and deaths was 2.0%.
In England, the variant known as 202012/01 was recognized as a potentially harmful mutation in December 2020, and it was later called B.1.1.7, and then Alpha on May 31, 2021 (15). It was found to be 64% more lethal than existing Wuhan variants (16), and its arrival in Egypt in September 2021 (17) might explain the wave's extended length and higher CFR. Despite an increase in cases and deaths in the UK, the CRF (2.1%) had dropped dramatically from 13.5% in the first wave to 2.1% in the second, while the CRF in Egypt had worsened from 5.3% in the first wave to 6.1% in the second. The significant reduction in the CFR in the UK can be attributed to increased Alpha variant infectivity, but it can also be attributed to improved case recognition and data collection, improved public health measures (e.g., lockdowns), and better medical care (e.g., increased use of dexamethasone, tocilizumab, and remdesivir) (18).
Because we are well into the epidemic, these data from both nations are much more likely to be reliable than those from the first wave, and the excessive number of cases/million (34-fold higher) and deaths/million (eight-fold higher) in the UK compared to Egypt are most likely correct. As with the first wave, most of this can be attributed to demographics such as age, albeit this is unlikely to be the dominant driver. Other examples include Egypt's tighter public health plan, which included a curfew from 7 p.m. to 6 a.m., suspension of public transportation, closure of schools and universities, suspension of incoming and outgoing air traffic, and the anti-viral effects of warmer weather and lower humidity (10). To some extent, the first and second waves of data correspond to Yao and colleagues' economic comments (19), which classed the United Kingdom as high income and Egypt as low medium income.

The third wave: Spring/summer 2021 to Winter 2021/2022

Clinical epidemiology

Between the second and third waves, the endemic levels of COVID-19 daily cases and deaths in Egypt were around 40-50 and 6, respectively, but around 2,250 and 8 in the UK. This reflects the latter's high infection rate (table 4). There were around 650 cases per day in Egypt, with 35 deaths per day, compared to 551 and 36, respectively, in the second wave, with a CFR of 4.8%. This phase lasted longer in the United Kingdom, although despite its short duration, it was associated with a daily case rate twice that of the second wave (28,655 v 14,374 respectively). The daily fatality rate, however, was far lower (280/day vs. 92/day). As a result, the CFR was much lower in the first quarter, at 0.3% versus 2.1% in the second.

Vaccination

Beginning in the spring of 2021, the UK population was vaccinated, and by mid-November, 80% of the population had gotten two doses (20). Those at highest risk (the elderly, the immunocompromised) were vaccinated first, followed by those at lowest risk (the young), however it is unclear if this had a significant impact on cases and deaths. Egypt began vaccination in January 2021, with 13% of the total population fully vaccinated by November 2021 (21). The UK had received 223 vaccine doses per 100 individuals by early December 2022, with 75% of the population fully vaccinated, whereas Egypt had received 99 and 39%, respectively (22). At this point, Egypt had received over 101 million doses, while the United Kingdom had received over 151 million (3).

Discussion

Public Health England reported allegations of a novel variant (VUI-21APR-01, also known as B.1.617) being imported into England from India on April 22, 2021 (23). On June 3, 2021, Delta was named, and early gene sequencing revealed that it was present in 4% of COVID-19 cases, compared to 95% in Alpha (15). By the 6th of August 2021, Delta (with a CFR of 0.2%) had overtaken Alpha as the major variant, with a frequency growing to 99.8% of sequenced cases from October to November (24), providing strong evidence that it was responsible for the third wave (table 4).

The fourth wave: Winter 2021/2022 to Summer 2022

Clinical epidemiology

The prevalence of new cases in both countries did not fall to an instantly identifiable trough, as in previous wave transitions, but rather merged with a new, fourth wave. This wave produced a CFR of 2.1% in Egypt, with a peak in February 2022 and a trough in June 2022. In comparison, the national infection pattern in the United Kingdom was markedly different, with two distinct and easily discernible sub-waves lasting 72 and 98 days, respectively, and a CFR of 0.21% (3). This wave was generated by Omicron, a new strain of SARS-CoV-2 discovered in Southern Africa in November 2021 (25).

Discussion

The fourth wave in Egypt witnessed the most daily instances of the pandemic, but with 2,000 fewer deaths than the previous wave, the CFR rate was the lowest of the pandemic, at 2.1%. This position was mirrored by events in the United Kingdom, which likewise witnessed the highest rate of infections, some 86% greater than in the third wave; nevertheless, despite the increased number of deaths, the CFR decreased to its lowest level in the pandemic, at 0.21%. These increases in infectiousness could be explained by novel mutations in the Omicron genome (also known as B1.1.529), many of which are located in the area encoding the spike protein (25-27). These changes improve infectivity, resulting in a substantial increase in cases (28). However, when compared to Delta, Omicron was associated with a lower adjusted hazard ratio [95% CI] for hospital attendance of 0.56 [0.54-0.58], hospital admission of 0.41 [0.39-0.43], and death of (.31 [0.26-0.37], explaining the 34% reduction in deaths/million in tables 4 and 5 (29). Further investigation identified a sub-variant BA.2 of the original Omicron (now termed BA.1) as two peaks, explaining the patterns shown in tables 4 and 5 (30,31).

Thus, the CFR declined consistently in both countries during the four waves, while the CFR in Egypt was 10 times higher in the third and fourth waves than in the UK. This may be explained in part by vaccination rates: by December 2022, Egypt had delivered about 101 million shots (almost 1/person), compared to over 151 million doses in the UK (more than 2.2/person) (3).

The fifth wave: Summer 2022 to Spring 2023

Egypt's number of infections and deaths plummeted to their lowest levels of the epidemic beginning in June 2020. Up to June 3rd, 2023, there were 2,048 extra cases, a 0.4% rise, and 651 additional deaths, a 0.45% increase (3). As a result, the pandemic may be deemed to have ended in Egypt in June 2020, when it became endemic.

However, in the United Kingdom, even though the number of cases and deaths dropped significantly after June 2020, there were still easily identifiable small waves with peaks in July 2022 (30,000 daily cases, 190 deaths), October 2022 (11,700 and 110 respectively), December 2022 (9,000 and 140 respectively), and March 2023 (5,300 and 114 respectively) (3). During this time, the number of cases climbed by over 2.2 million (10%), while the number of deaths increased by over 27,000 (13.8%). These findings contrast sharply with those from Egypt, and may be explained in part by other Omicron variations of ongoing pathogenicity, such as BA.4 and BA.5 (identified as variants of concern in May 2022), recombinant variants of earlier species, such as XE (made from BA.2 and BA.2) (32), and recombinant variants of earlier species, such as XE (derived from BA.2 and BA.2) (32), BF7, BQ.1.1,

BJ.1, BS.1 (October 2022)(35), XBB (a recombinant of BJ.1 and BM.1.1.1), and XAW (an Omicron/Delta recombinant) (36).

Conclusions

A pandemic view

Table 6 summarizes the dates of the COVID-19 waves and sub-waves, as well as their suspected causal variant, whereas figures 1–4 depict timelines of the number of cases and deaths in each nation over the course of the pandemic. Given the age gap between the two populations, it is probably unsurprising that the pandemic would be more severe in the UK than in Egypt. In the United Kingdom, the Pearson correlation coefficient (r) between the nation's age profile and the number of fatalities by age was 0.85 (p0.001) in 2020, and 0.89 (p0.001) in 2021, strongly supporting the premise that age is a primary driver of COVID-19 mortality.

Global data support this notion of the effect of age. When data from the 100 most populous nations (minimum 8.6 million) (3,8) are analyzed, median age connects with total number of cases and deaths, cases and deaths per 100 of the population, and inversely with CFR. However, there is an economic concern, as stated in (19). The World Bank categorizes each country as low income, lower middle income (which includes Egypt), upper middle income (which includes the UK), or high income (37). Similar studies based on age and World Bank status indicate a similar tendency (table 7). Notably, median age connected highly with World Bank Status ($r=0.77$, $p < 0.001$), but while cases and deaths per 100 of the population were both linked to median age in regression analysis (both $p < 0.001$), the link to World Bank Status was weaker ($p=0.01$ and $p=0.067$, respectively). Thus, while World Bank Status is linked to COVID-19 instances and deaths, both relationships are secondary to the most potent influence of age, and both are relevant when examining disparities between Egypt and the United Kingdom.

Figures 5 and 6 show the CFR for each country over the course of the pandemic: with extremely few cases and deaths in Egypt beyond week 120, this data can be criticized as statistically unsound, as we accept. Nonetheless, by June 2023, the CFR in Egypt (4.81%) was more than 5-fold that of the UK (0.92%), compared to a global CFR of 0.90% (3). The reasons for this dichotomy are unknown, but possible factors include disparities in therapies, vaccination, and treatment responses.

Aside from age and socioeconomic position, additional risk variables may play a role: table 8 illustrates the frequency of morbidities associated with COVID-19. Diabetes, cardiovascular disease, and obesity are all more prevalent in Egypt, but cancer and pulmonary illness are more prevalent inthe UK (38-45). We can only hypothesize without a perfect model for predicting the exact risk of each risk factor. For example, the threefold increase in pulmonary disease in the UK compared to Egypt could be an actual primary contribution to the higher COVID-19 mortality. Another factor is the underlying ability of each population's immune systems to defend itself. Although both nations' populations are Caucasian, there are clear ethnic distinctions, as well as differences in HLA and immune response genes, which have been shown to influence the response to SARS-CoV-2 (46,47), and possibly in cytokine responses.

An endemic view

Globally, the number of confirmed cases per week and deaths per week have been steadily declining since January 2023, and by the middle of May, both had reached their lowest levels since March 2020. In Egypt, both metrics hit new lows in the summer of 2022, and while they both increased slightly in August, they were still lower than at any time since March 2020. The number of weekly cases and deaths in November and December 2022 were both in the single digits (3), indicating that the epidemic stage was passed.

Wave severity in the UK decreased steadily in 2022, while it remained greater than during the preceding inter-wave troughs in April and May 2021 (3). Despite this, the number of weekly deaths in England and Wales due to influenza surpassed those owing to COVID-19 in May 2022, a pattern that persisted until December 2022 (48). In the six months afterwards, influenza killed 20% more people than COVID-19. These data support the concept of a possible end to the pandemic (49), albeit this may be premature because other varieties (such as BA.4.7 and BA.2.75), including recombinant species (e.g., hybrids of BA.1 and BA.2), continue to emerge (50,51). Nonetheless, the WHO Emergency Committee on the COVID-19 pandemic declared on May 5, 2023, that COVID-19 is now an established and ongoing health hazard that no longer constitutes a public health emergency of worldwide concern, essentially ending the pandemic (53). On May 18, 2023, NHS England, a key UK government site, stepped down administration, transitioning from a nationally coordinated to a regional level (54), signaling the effective end of severe public health concerns.

A syndemic view

An early recognition of the compounding detrimental impacts of two contemporaneous separate epidemics was made regarding COVID-19 and HIV (51) and later extended to obesity, diabetes, and tuberculosis (55,56). Wider scoping reviews, such as the World Bank grouping noted above, highlighted socioeconomic disadvantage and other factors as worldwide contributors to decreasing outcomes (57,58). These may also contribute to the disparities in infectivity and case fatality rates between Egypt and the United Kingdom.

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