

# CoViD-19: Weekly Mortality Cycle and Sunday Protective Phenomenon.

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## Abstract.

*Background.* The Weekly Mortality Cycle among CoViD-19 patients has been studied.

*Methods.* Mortality data obtained from the 'Worldometer' website were analyzed with a comparison of absolute values, percentages, and p-value.

*Results.* For patients suffering from CoViD-19, the most favorable or the safest days of the week were Sundays and Mondays.

*Conclusion.* The weekly cycle with decreased mortality on Sundays and Mondays is a unique phenomenon observed among victims of CoViD-19. Presumably the decreased mortality on certain days of the week related to the optimized therapeutic protocols used on the "safest days".

*Keywords.* CoViD-19, Mortality, Weekly Cycle, Weekly Mortality Cycle.

*Abbreviation.* HLM – is a ratio between a number of deaths on the day with the highest mortality and a number of deaths on the day with the lowest mortality.

## Introduction.

The CoViD-19 Pandemic is the first documented coronavirus pandemic in history,<sup>1</sup> that will remain in the human memory as one of the famous disasters in this century. There were a new virus and information about it which were spreading throughout the world speedily. At the present time Google offers more than 6 billion results per query for "CoViD-19".<sup>2</sup>

Based on the analysis of pandemic outbreak one can define that the first patient presumably infected with SARS-CoV-2, appeared in China around October or November 2019, at least 1-2 months prior to the story on seafood market in Wuhan became popular.<sup>3</sup> It can be concluded that epidemic was not originated by the animal-to-human transmission in Wuhan market, but the market was a temporary place allowing virus transmission from the infected patients to the new victims.<sup>4</sup> According to the estimation based on the susceptible-infected removed model for the dynamics of the epidemic waves, the CoViD-19 pandemic probably began in August 2019.<sup>5</sup>

Diagnostic kits to identify SARS-CoV-2 infected patients became available beginning of January 2020.<sup>3</sup> Since then, statistics related to the new disease became available for analysis.<sup>6</sup>

In the first report provided by a group of experts from Imperial College London, there were 41 confirmed cases with 2 deaths; the estimated number of infected people was 1,723,<sup>7</sup> (the estimated mortality rate was around - 0.12 %). In the second report provided by the same group of experts, there were 440 confirmed cases with 9 deaths, and the estimated number of infected people was around 4000,<sup>8</sup> (the estimated mortality rate was around - 0.23 %). According to the subsequent studies, the mortality rate among SARS-CoV-2 infected people is less than 1 %, <sup>9</sup> and can vary around 0.3-0.5 %.<sup>10</sup>

Collection of the data dealing with the current pandemic should be done with great care otherwise coronavirus mortality overestimation can lead to wrong decisions.<sup>11</sup>

### 1. Challenges of CoViD-19 Pandemic.

From the first days of the pandemic outbreak, it became clear that disease-oriented approach in medicine, which had been used successfully to cope with the task of stabilizing the symptoms encountered in the case of chronic diseases, had limited value when the new acute infectious disease emerged.

It is well known that acute disease is not a stable and constant pathological condition, but it has several phases, and each of them requires different medication and care. Therefore, it is not logical to look for a drug for the treatment of CoViD-19 in general, but it is reasonable to look for groups of medications that could be effective to treat various phases of this disease.

Due to the fact that CoViD-19 is a *new disease*, world public health care had to start new clinical trials to find medicines that could be safe and effective in treating patients with CoViD-19 and co-morbidities. As a result, all people infected with SARS-CoV-2 have been automatically converted into participants for the most extensive clinical trials in the history of mankind. Efficacy of these trials can be analyzed on the basis of global and local statistics.

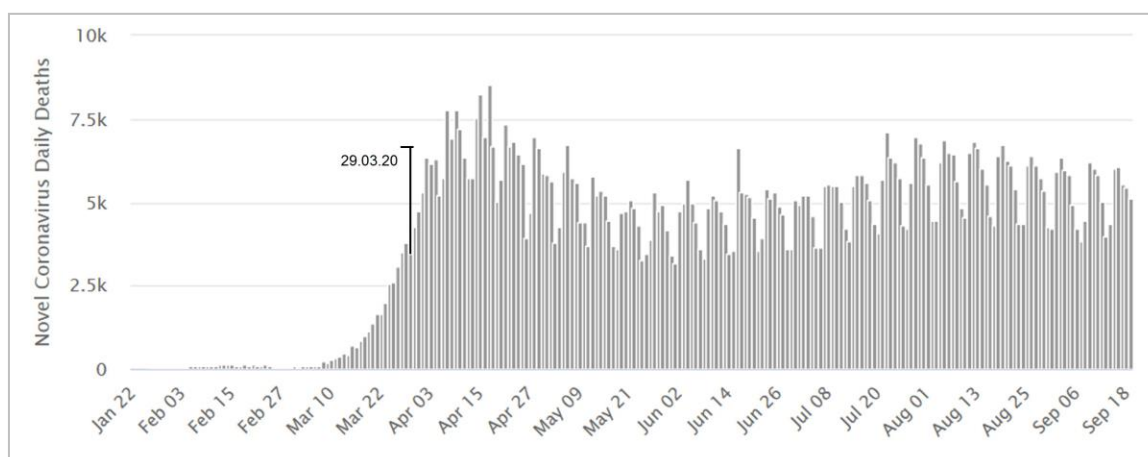


Figure 1. Daily New Deaths due to CoViD-19 worldwide (screenshot, on September 20, 2020).

## 2. A Global Weekly Mortality Cycle related to CoViD-19.

*Background:* On the CoViD-19 mortality statistics presented on the 'Worldometer' website,<sup>6</sup> a weekly cycle of decreased mortality on Sundays and Mondays is evident (Fig. 1). This cycle can vary in different countries,<sup>12</sup> but the main trend is decreased mortality towards weekends.<sup>13</sup>

*Objective:* To study weekly mortality cycle among CoViD-19 patients.

2.1. *Methods:* Since July 6, 2020, data from 'Worldometer' website were collected every 5-6 days in the form of numbers and screenshots. The date when information was collected is given in the text. Data processing was divided into two parts: the first was calculating mortality on certain days of the week worldwide; the second was calculating mortality on certain days of the week in various countries.

Table 1. Global Mortality Due to CoViD-19 from January 24 to August 5, 2020 [collected on August 6, 2020].

week, #	Sun	Mon	Tue	Wed	Thu	Fri	Sat	
						*16	15	* Jan 24
1	24	26	26	38	43	46	*45	* Feb 1
2	58	64	66	73	73	86	89	
3	97	108	97	146	122	143	143	
4	106	98	136	117	121	113	100	
5	158	81	64	37	58	65	54	
6	*73	67	85	83	102	106	105	* Mar 1
7	228	197	274	330	353	448	414	
8	691	645	819	986	1101	1384	1648	
9	1648	1937	2495	2593	2966	3478	3711	
10	3381	4185	4749	*5201	6304	6018	6156	* Apr 1
11	5080	5652	7905	6804	7686	7417	6339	
12	5682	5731	7452	8201	7045	8494	6703	
13	4994	5580	7237	6668	6783	6424	6200	
14	3855	4537	6775	6650	5854	*5709	5337	* May 1
15	3601	4124	5862	6876	5642	5531	4332	
16	4065	3521	5572	5263	5318	5061	4404	
17	3687	3520	4628	4673	5008	4698	4232	
18	3225	3370	3838	5378	4733	4972	4189	
19	3329	*3123	4728	4989	5626	4968	4343	* Jun 1
20	3575	3229	4824	5233	5085	4703	4353	
21	3384	3496	6658	5306	5252	5212	4563	
22	3445	3904	5517	5146	5266	4928	4677	
23	3561	3517	5147	*4949	5260	5300	4626	* Jul 1
24	3720	3670	5628	5671	5523	5537	5131	
25	4254	3891	5592	5917	5879	5681	5125	
26	4423	4122	5838	7180	6368	6243	5741	
27	4354	4234	5682	7036	6457	6468	*5664	* Aug 1
28	4483	4377	6303	6838				
Sum, n	74,698	76,629	107,694	111,544	110,028	109,233	98,424	Σ = 688,250
Mean	2,767	2,838	3,989	4,131	4,075	4,046	3,645	
SD	±1,858	±1,936	±2,732	±2,785	±2,674	±2,651	±2,329	
%	10.85	11.13	15.65	16.21	15.98	15.87	14.30	HLM = 1.47

There were comparisons between the total mortality on certain days of the week in absolute values and percentages. There was an additional criteria used, that was a ratio between a number of deaths on the day with the highest mortality and a number of deaths on the day with the lowest mortality, that can be termed as high/low mortality ratio or HLM. In the initial study 27 weeks were analysed (26.01.20 – 01.08.20).

*Results:* During the mentioned weeks there have been a total of 688,250 deaths from CoViD-19, worldwide (Table 1). 74,698 (10.85%) patients died on Sundays, 76,629 (11.13%) on Mondays, 107,694 (15.65%) on Tuesdays, 111,544 (16.21%) on Wednesdays, 110,028 (15.98%) on Thursdays, 109,233 (15.87%) on Fridays, and 98,424 (14.30%) on Saturdays.

The highest daily mortality was on Wednesday and the lowest daily mortality was on Sunday. The HLM ratio, calculated as 111,544 divided by 74,698, was 1.493.

*2.2. Methods:* For the further study only 18 weeks were analysed (29.03.20 – 01.08.20). By the limitation of the time frame, unstable deviations of death numbers related to the initial exponential growth phase were eliminated partly (Fig. 1).

*Results:* there were a total of 656,362 deaths from CoViD-19, worldwide (Table 2): 71,615 (10.91%) patients died on Sundays, 73,406 (11.18%) on Mondays, 103,632 (15.79%) on Tuesdays, 107,141 (16.32%) on Wednesdays, 105,089 (16.01%) on Thursdays, 103,364 (15.75%) on Fridays, and 92,115 (14.04%) on Saturdays. The HLM ratio was 1.496.

Table 2. Global Mortality Due to CoViD-19 on Various Days of the Week (29.03.20 – 01.08.20).

	Total	Sun	Mon	Tue	Wed	Thu	Fri	Sat
Sum, n	656,362	71,615	73,406	103,632	107,141	105,089	103,364	92,115
Mean		3,979	4,078	5,757	5,952	5,838	5,742	5,118
SD		±695	±817	±1084	±998	±789	±993	±829
%	100 %	10.91	11.18	15.79	16.32	16.01	15.75	14.04

*2.3. Methods:* The comparison of the global daily mortality between various days of the week done with the calculation of the *p*-value. If *p*-value was 0.001 or less, for example, 0.0005, or 0.00005, it was presented as  $p < 0.001$ . The same approach was used in the further studies. 18 weeks were analysed (29.03.20 – 01.08.20).

*Results:* The global daily mortality on Sundays or Mondays was less than global daily mortality on Tuesdays, Wednesdays, Thursdays, Fridays and Saturdays ( $p < 0.001$ ).

*Discussion:* If the low mortality on Sundays was related to the registration of the deceased, one could assume that all cases not recorded on Sundays must be added to the death cases on Mondays, and as a result, the number of deaths on Mondays must be not less than on other days of the week. In reality, the number of deaths on Mondays was almost as low as on Sundays.

*Conclusion:* For patients suffering from CoViD-19 worldwide, the most favorable or safest days of the week were Sundays and Mondays (Fig. 2).

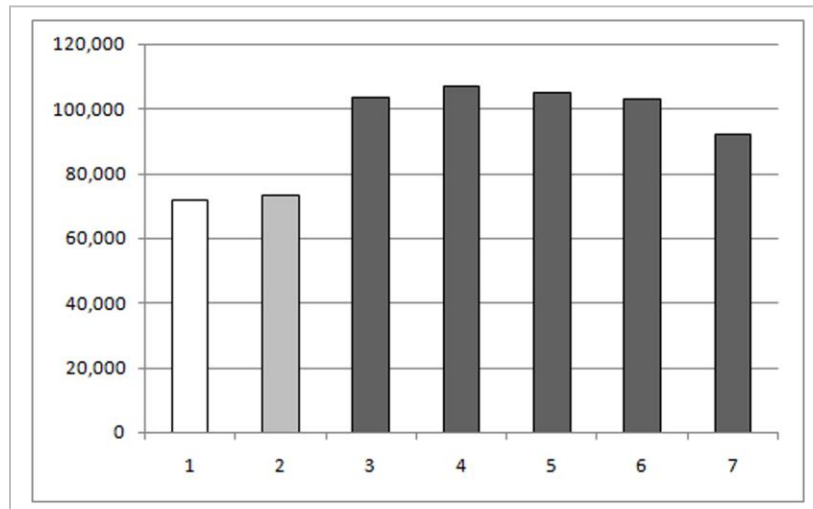


Figure 2. Global Mortality Due to CoViD-19 on Various Days of the Week (29.03.20 – 01.08.20).  
1. Sunday (white), 2. Monday (grey), 3. Tuesday, 4. Wednesday, 5. Thursday, 6. Friday, 7. Saturday (all black).

### 3. The Weekly Mortality Cycle related to CoViD-19 in Various Countries.

*Background:* The global trend that may be termed the "Weekly Mortality Cycle" with more or less certainty, has been revealed in various countries including Brazil, Chile, Germany, Mexico, Russia, the United Kingdom and the United States of America.

Table 3: Mortality in various days of the week in Brazil, Chile, Mexico, Germany, Russia, USA and UK.\*

Countries: Dates:	Total HLM	Sun	Mon	Tue	Wed	Thu	Fri	Sat
United States: 29.03-01.08	155,115 1.99	13,825 8.91%	16,024 10.33%	27,178 17.52%	27,525 17.74%	25,638 16.53%	24,302 15.67%	20,623 13.3%
Brazil: 26.04-01.08	89,571 2.09	7,398 8.26%	9,153 10.22%	15,378 17.17%	15,161 16.93%	15,498 17.30%	14,423 16.1%	12,560 14.02%
United Kingdom: 29.03-01.08	44,670 2.06	4,041 9.05%	3,646 8.16%	8,333 18.65%	7,598 17.01%	6,834 15.30%	7,723 17.29%	6,495 14.54%
Mexico: 19.04-01.08	46,142 2.31	5,425 11.76%	3,704 8.03%	4,598 9.96%	8,441 18.29%	8,548 18.52%	7,847 17.01%	7,579 16.43%
Russia: 26.04-01.08	13,377 1.57	1,499 11.20%	1,414 10.57%	2,093 15.64%	2,204 16.48%	1,966 14.70%	2,224 16.63%	1,977 14.78%
Chile 17.05-01.08	8,496 2.70	1,354 15.94%	719 8.46%	552 6.50%	1,360 16.01%	1,490 17.54%	1,448 17.04%	1,573 18.51%
Germany: 29.03-23.05	7,933 2.18	698 8.80%	1,165 14.70%	1,337 16.85%	1,521 19.17%	1,321 16.65%	1,129 14.23%	762 9.60%

As it was presented above, the lowest worldwide mortality due to CoViD-19 was on Sundays and Mondays. In various countries days of the week with the lowest mortality can vary nevertheless they either belong to the weekend or they are near the weekend.

\* Data base was collected on August 10, 2020.

Due to the fact that the time of CoViD-19 outbreak varied in the different countries, the analysed weeks varied too. All analysed periods started on a Sunday and ended on a Saturday.

*Methods:* The data on mortality from CoViD-19 in different countries were taken from the site 'Worldometer'.<sup>14</sup> A comparison of the total mortality on certain days of the week in absolute values and percentages in various countries was carried out (Table 3).

*Results:* A comparison of the total mortality on certain days of the week has revealed that in the analysed countries daily mortality on Sundays or Mondays was less than on other days of the week, excluding Chile, where the lowest mortality due to CoDiD-19 was on Tuesdays. The highest HLM ratio was in Chile (2.70), the lowest one was in Russia (1.57).

*Conclusion:* For patients suffering from CoViD-19, the safest days of the week were mostly Sundays or Mondays.

#### 4. "Sunday Protective Phenomenon" and "Monday Protective Phenomenon".

There are several combinations of days with the lowest mortality, but the most common are Sundays and Mondays. These may be termed "Sunday Protective Phenomenon" (Fig. 3) and "Monday Protective Phenomenon" (Fig. 4) respectively.

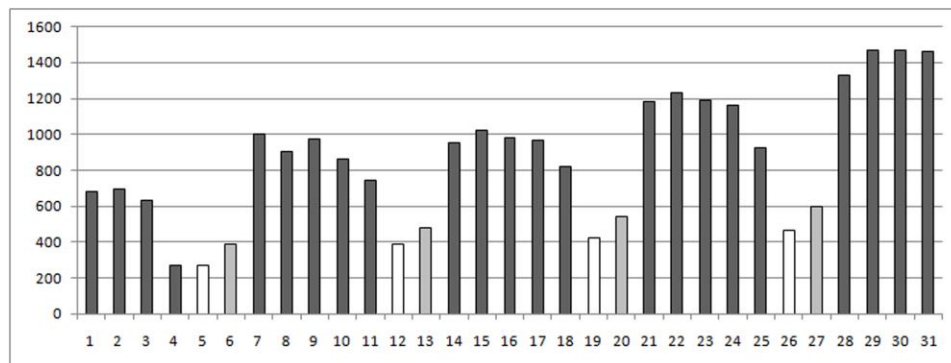


Figure 3. Daily New Deaths due to CoViD-19 in the United States of America, in July 2020. Sunday is white color; Monday is grey; Tuesday, Wednesday, Thursday, Friday and Saturday all are black.

In some countries analysis of the daily mortality in July (2020), revealed a stable weekly cycle with the one and the same day of the lowest mortality being either Sunday (Fig. 3) or Monday (Fig. 4); but in others, the day of the lowest mortality varied being both Sunday or Monday (Fig. 5).

##### 4.1. "Sunday Protective Phenomenon" discovered in the United States, Brazil and Germany.

*Methods:* The comparison of the daily mortality between various days of the week in various countries done with the calculation of the  $p$ -value.

*The United States of America (29.03-01.08):* On Sundays, the daily mortality was less than on Tuesdays, Wednesdays ( $p < 0.001$ ), Thursdays, Fridays ( $p < 0.005$ ), and Saturdays ( $p < 0.05$ ). On Mondays,

the daily mortality was less than on Wednesdays ( $p<0.005$ ), Tuesdays, Thursdays ( $p<0.01$ ), and Fridays ( $p<0.05$ ).

*Brazil* (26.04-01.08): On Sundays, the daily mortality was less than on Tuesdays, Wednesdays, Thursdays, Fridays, Saturdays ( $p<0.001$ ) and Mondays ( $p<0.05$ ). On Mondays, the daily mortality was less than on Tuesdays, Wednesdays, Thursdays, and Fridays ( $p<0.001$ ), and Saturdays ( $p<0.05$ ).

*Germany* (29.03-23.05): On Sundays, the daily mortality was less than on Mondays, Tuesdays, Wednesdays and Thursdays ( $p<0.05$ ). On Saturdays, the daily mortality was less than on Wednesdays ( $p<0.05$ ).

#### 4.2. "Monday Protective Phenomenon" discovered in the United Kingdom, Mexico and Russia.

*Methods:* The comparison of the daily mortality between various days of the week in various countries done with the calculation of the  $p$ -value.

*The United Kingdom* (29.03-01.08): On Mondays, the daily mortality was less than on Tuesdays, Wednesdays, and Fridays ( $p<0.05$ ). On Sundays, the daily mortality was less than on Tuesdays and Wednesdays ( $p<0.05$ ).

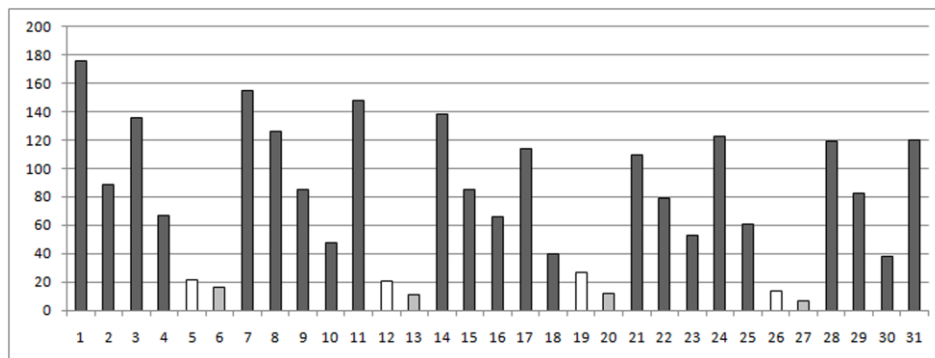


Figure 4. Daily New Death due to CoViD-19 in the United Kingdom, in July 2020: Sunday is white color; Monday is grey; Tuesday, Wednesday, Thursday, Friday and Saturday all are black.

*Mexico* (19.04-01.08): On Mondays, the daily mortality was less than on Wednesdays, Thursdays, Fridays and Saturdays ( $p<0.005$ ). On Tuesdays, the daily mortality was less than on Wednesdays, Thursdays, Fridays and Saturdays ( $p<0.05$ ). On Sundays, the daily mortality was less than on Wednesdays and Thursdays ( $p<0.05$ ).

*Russia* (26.04-01.08): On Mondays, the daily mortality was less than on Tuesdays, Wednesdays, Fridays ( $p<0.001$ ), Thursdays ( $p<0.005$ ), and Saturdays ( $p<0.05$ ). On Sundays, the daily mortality was less than on Wednesdays, Fridays ( $p<0.001$ ), Tuesdays ( $p<0.005$ ), Thursdays, and Saturdays ( $p<0.05$ ).

*Chile* (10.05-01.08): On Tuesdays, the daily mortality was less than on Sundays, Thursdays, Fridays, Saturdays ( $p<0.01$ ) and Wednesdays ( $p<0.05$ ). On Mondays, the daily mortality was less than on Sundays, Thursdays, Fridays and Saturdays ( $p<0.05$ ).



*Conclusion:* The weekly mortality cycle was discovered in Brazil, Chile, Germany, Mexico, Russia, in the United Kingdom and United States of America. In majority of these countries, for patients suffering from CoViD-19, the safest days of the week were either Sundays or Mondays. In Chile, the safest days of the week were Mondays and Tuesdays (Table 3).

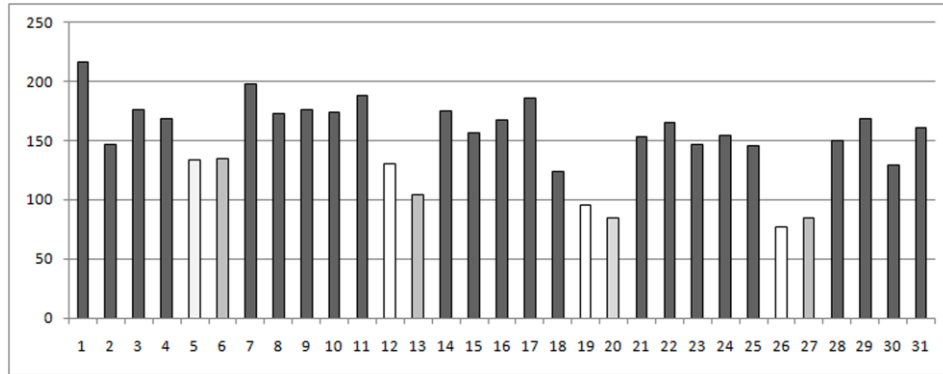


Figure 5. Daily New Deaths due to CoViD-19 in Russia, in July 2020:  
Sunday is white color; Monday is grey; Tuesday, Wednesday, Thursday, Friday and Saturday all are black.

### 5. The Weekly Mortality Cycle in the States of the United States with the highest mortality.

*Background:* Due to the fact that the United States had the highest numbers of death related to CoViD-19,<sup>14</sup> the weekly mortality cycle was analysed in the states of Arizona, California, Connecticut, Georgia, Florida, Illinois, Louisiana, Massachusetts, Michigan, New Jersey, New York, Ohio, Pennsylvania, and Texas.\*

Table 4: Total Daily Mortality on Various Days of the Week in the certain States of the USA (29.03-01.08).

States:	Total HLM ratio	Sun	Mon	Tue	Wed	Thu	Fri	Sat
United States:	155,115 1.99	13,825 8.91%	16,024 10.33%	27,178 17.52%	27,525 17.74%	25,638 16.53%	24,302 15.67%	20,623 13.3%
New York	31,358 1.26	4,462 14.23%	4,351 13.88%	5,067 16.16%	5,034 16.05%	4,140 13.20%	4,298 13.71%	4,006 12.77%
New Jersey	15,896 2.67	1,342 8.44%	1,121 7.05%	2,836 17.84%	2,945 18.53%	2,995 18.84%	2,398 15.09%	2,259 14.21%
Pennsylvania	7,246 3.73	414 5.715	518 7.15%	1,391 19.20%	1,545 21.32%	1,376 18.99%	1,142 15.76%	860 11.87%
Texas	7,234 3.16	439 6.07%	626 8.65%	1,117 15.44%	1,388 19.19%	1,365 18.87%	1,299 17.96%	1,000 13.82%
Georgia	3,746 5.87	138 3.68%	581 15.51%	810 21.62%	671 17.91%	571 15.25%	649 17.33%	326 8.70%
Arizona	3,716 8.28	207 5.57%	89 2.4%	737 19.83%	672 18.08%	673 18.11%	629 16.93%	709 19.08%

*Methods:* There were comparisons between the total mortality on certain days of the week in absolute values, percentages and a calculation of HLM ratio (Table 4). A comparison of daily mortality between certain days of the week with the calculation of the *p*-value has been done too.

\* Data base was collected on August 10, 2020.



*Results:* Significant differences in mortality due to CoViD-19 between various days of the week were revealed in the states of Arizona, California, Florida, Georgia, Illinois, Louisiana, Michigan, New Jersey, Ohio, Pennsylvania and Texas ( $p < 0.05 \div p < 0.001$ ).

*Conclusion:* The weekly mortality cycle was discovered in the United States as a whole country and in the certain states. In majority of states, for patients suffering from CoViD-19, the safest days of the week were either Sundays or Mondays.

## 6. Countries with the Unconfirmed Weekly Mortality Cycle.

In Belgium, Canada, China, Colombia, France, India, Iran, Italy, Netherlands, Peru, South Africa, Spain, Sweden and some other countries, the difference in total mortality between certain days of the week was not significant ( $p > 0.05$ ).<sup>\*</sup> Nevertheless, in the majority of countries examined, the days with the lowest mortality were either Sundays (Table 5) or Mondays (Table 6)

Table 5: Daily Mortality due to COVID-19 was the lowest on Sundays.

Country: Dates:	Total HLM	Sun	Mon	Tue	Wed	Thu	Fri	Sat
Italy 08.03-23.05	32,441 1.24	4,035 12.44%	4,314 13.30%	4,778 14.73%	4,678 14.42%	4,657 14.35%	4,993 15.39%	4,986 15.37%
Spain 15.03-13.06	28,088 1.15	3,797 13.52%	3,911 13.92%	4,003 14.25%	4,378 15.59%	4,035 14.37%	3,986 14.19%	3,978 14.16%
France 22.03-16.05	27,063 2.21	2,325 8.59%	3,564 13.17%	4,494 16.61%	4,051 14.97%	5,148 19.02%	4,121 15.23%	3,360 12.41%
Peru 29.03-01.08	19,387 1.13	2,593 13.37%	2,626 13.54%	2,770 14.29%	2,825 14.57%	2,847 14.69%	2,795 14.42%	2,931 15.12%
Iran 01.03-01.08	16,976 1.09	2,333 13.74%	2,425 14.29%	2,451 14.44%	2,458 14.48%	2,538 14.95%	2,365 13.93%	2,406 14.17%
South Africa 17.05-01.08	7,509 1.68	744 9.91%	1,042 13.87%	1,248 16.62%	1,020 13.58%	1,232 16.41%	1,160 15.45%	1,063 14.16%

Table 6: Daily Mortality due to COVID-19 was the lowest on Mondays.

Country: Dates:	Total HLM	Sun	Mon	Tue	Wed	Thu	Fri	Sat
India 10.05-01.08	33,641 1.27	4,348 12.92%	4,197 12.48%	4,739 14.09%	5,312 15.79%	4,911 14.6%	5,104 15.17%	5,030 14.95%
Colombia 12.04-01.08	10,230 1.46	1,343 13.13%	1,164 11.38%	1,356 13.25%	1,429 13.97%	1,694 16.56%	1,698 16.60%	1,546 15.11%
Belgium 22.03-13.06	9,047 1.48	1,161 12.84%	1,038 11.47%	1,178 13.02%	1,539 17.01%	1,426 15.76%	1,480 16.36%	1,225 13.54%
Canada 12.04-20.06	7,615 1.52	887 11.65%	884 11.61%	1,117 14.67%	1,158 15.20%	1,344 17.65%	1,095 14.38%	1,130 14.84%
Netherlands 15.03-20.06	5,815 2.04	641 11.02%	488 8.39%	994 17.1%	969 16.66%	951 16.36%	894 15.37%	878 15.10%
China 26.01-14.03	3,143 1.20	497 15.81%	415 13.21%	436 13.87%	442 14.06%	436 13.87%	472 15.02%	445 14.16%

<sup>\*</sup> Data base was collected on August 10, 2020.

## 7. Revision of some numbers dealing with mortality due to CoViD-19.

In several countries after revision of death record related to CoViD-19, some amount of the fatal cases were added, and this fact can be recognized as a sharp spike of deaths in the daily mortality chart.

Sudden increase of death number happened in China on April 17, 2020, when 1,290 new fatal cases were added (Fig. 6).<sup>15</sup> The local authorities provided the following explanation: "The revisions were made in accordance with related laws and regulations, as well as the principle of being responsible for history, the people and the deceased".<sup>16</sup>

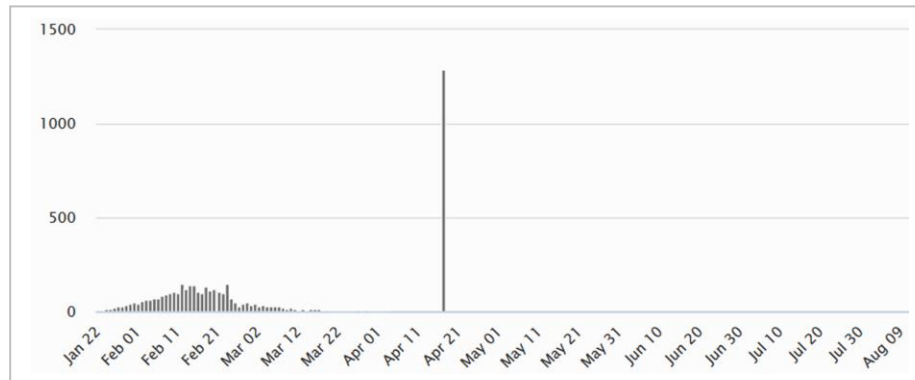


Figure 6. Daily New Death due to CoViD-19 in China [screenshot, on August 12, 2020].  
Sudden increase of death number in China on April 17, 2020.

Similar corrections happened in Canada on May 31, 2020, when 222 new fatal cases were added,<sup>17</sup> in Chile on June 7, 2020, when new 653 fatal cases were added,<sup>18</sup> and in India on June 16, 2020, when new 2006 fatal cases were added.<sup>19</sup> In all these cases to calculate weekly mortality cycle an average daily mortality of the affected week was applied.

There was also an opposite correction that took place in France: a number of CoViD-19 victims was decreased by 217 cases on May 19, 2020.<sup>20</sup>

## 8. Updating Global Mortality Data and Weekly Mortality Cycle related to CoViD-19.

*Background:* During the current observation death numbers on the 'Worldometer' website related to the whole world and to the various countries were updating constantly.

*Objective:* To study if updating and correction of the mortality data affects the global weekly mortality cycle related to CoViD-19.

8.1. *Method:* In order to know if the correction of the data for the past days affects the results of the current study, new data were collected on September 20, 2020 (Table 7).

There were comparisons between the total mortality on certain days of the week in absolute values and percentages, calculation of HLM ratio, and the comparison of the daily mortality between various days of the week with the calculation of the *p*-value. 34 weeks were analysed (26.01.20-19.09.20).

Table 7. Global Mortality Due to CoViD-19 (26.01.20-19.09.20) [data were collected on September 20, 2020].

week, #	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Comments
						*16	15	* Jan 24
1	24	26	26	38	43	46	*45	* Feb 1
2	58	64	66	73	73	86	89	
3	97	108	97	146	122	143	143	
4	106	98	136	117	121	113	100	
5	158	81	64	37	58	65	54	
6	*73	67	85	83	102	106	106	* Mar 1
7	228	197	275	329	357	451	418	
8	697	647	831	994	1116	1398	1658	
9	1678	1970	2540	2607	3084	3521	3785	
10	3454	4255	4738	*5301	6346	6149	6287	* Apr 1
11	5224	5722	7788	6898	7782	7216	6364	
12	5753	5747	7530	8244	6983	8513	6669	
13	5019	5696	7341	6661	6824	6459	6171	
14	3911	4705	6973	6631	5886	*5842	5629	* May 1
15	3774	4285	5924	6742	5735	5586	4394	
16	4411	3676	5759	5229	5339	5211	4447	
17	3679	3585	4697	4726	5092	4843	4304	
18	3286	3466	3875	5319	4761	4924	4177	
19	3393	*3196	4751	4977	5664	4969	4390	* Jun 1
20	3621	3212	4815	5225	5067	4724	4351	
21	3449	3564	6626	5298	5280	5166	4546	
22	3536	3950	5397	5118	5306	4902	4660	
23	3615	3619	5077	*4936	5221	5212	4595	* Jul 1
24	3667	3655	5495	5546	5474	5494	5031	
25	4226	3850	5519	5833	5828	5592	5071	
26	4367	4076	5710	7132	6351	6185	5714	
27	4324	4199	5578	6959	6784	6366	*5527	* Aug 1
28	4462	4442	6219	6886	6482	6463	5639	
29	4850	4529	6506	6843	6617	6029	5522	
30	4589	4327	6377	6748	6257	6128	5409	
31	4349	4370	6102	6395	6106	5748	5370	
32	4252	4232	*5925	6352	5978	5840	4916	* Sep 1
33	4210	3850	4466	6230	5998	5816	5028	
34	3961	4381	6000	6085	5579	5460	*5142	* Sep 19
Total, n	106,501	107,847	149,308	156,738	153,816	150,766	135,751	$\Sigma = 960,727$
Mean	3132	3172	4391	4610	4524	4434	3993	
SD	$\pm 1798$	$\pm 1841$	$\pm 2571$	$\pm 2654$	$\pm 2536$	$\pm 2474$	$\pm 2180$	
%	11.09	11.23	15.54	16.31	16.01	15.69	14.13	HLM = 1.47

*Results:* There were a total of 960,727 deaths from CoViD-19, worldwide. 106,501 (11.09%) patients died on Sundays, 107,847 (11.23%) on Mondays, 149,308 (15.54%) on Tuesdays, 156,738 (16.31%) on Wednesdays, 153,816 (16.01%) on Thursdays, 150,766 (15.69%) on Fridays, and 135,751 (14.13%) on Saturdays (Table 7). The HLM ratio between Wednesday and Sunday was 1.47.

The comparison of the global daily mortality between various days of the week has revealed that global daily mortality on Sundays or Mondays was less than global daily mortality on Tuesdays, Wednesdays, Thursdays and Fridays ( $p < 0.05$ ). If to analyse only the last 25 weeks (29.03 – 19.09.20), global daily mortality on Sundays or Mondays would be less than global daily mortality on Tuesdays, Wednesdays, Thursdays, Fridays and Saturdays with the higher significance ( $p < 0.0001$ ).

*Conclusion:* For patients suffering from CoViD-19 worldwide, the safest days of the week were Sundays and Mondays (Fig 7). Updating global mortality data didn't affect results of the study.

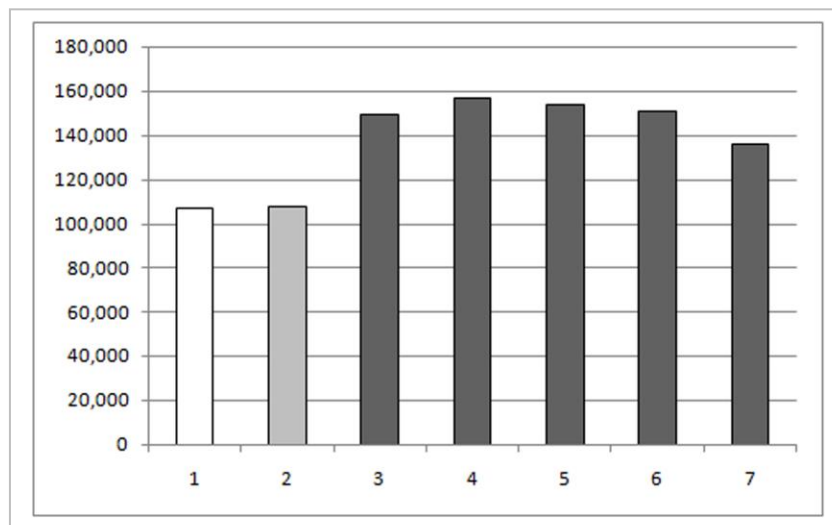


Figure 7. Global Mortality Due to CoViD-19 on Various Days of the Week (26.01.20 – 19.09.20).

1. Sunday (white), 2. Monday (grey), 3. Tuesday, 4. Wednesday, 5. Thursday, 6. Friday, 7. Saturday (all black).

8.2. *Method:* In order to know how update of the database affects the absolute values of the total global mortality and mortality on the various days of the week, a comparison of death numbers for the first 23 weeks (26.01.20 – 04.07.20), obtained at the different dates, has been done (Table 8).

Table 8. Global Mortality Due to CoViD-19 on Various Days of the Week (26.01.20 – 04.07.20). There are absolute values,  $\pm\Delta$ , and HLM ratio. Data were obtained on different dates.

Date	Total	$\pm\Delta$	Sun	Mon	Tue	Wed	Thu	Fri	Sat	HLM
06.07	532,817	n/a	57,351	60,200	84,380	85,075	85,151	84,617	76,043	1.485
12.07	532,972	+ 155	57,360	60,208	84,401	85,093	85,181	84,641	76,088	1.485
02.08	536,657	+ 3685	57,872	60,643	84,891	85,679	85,674	85,226	76,672	1.480
06.08	537,221	+ 564	57,947	60,712	84,954	85,740	85,801	85,304	76,763	1.481
17.08	539,314	+ 2657	58,575	61,464	85,213	85,703	86,085	85,385	76,889	1.470
27.08	538,730	- 584	58,719	61,708	84,941	85,420	86,050	84,985	76,907	1.465
03.09	538,718	- 12	58,719	61,708	84,941	85,420	86,038	84,985	76,907	1.465
07.09	541,679	+ 2961	59,242	61,935	85,405	85,723	86,357	85,641	77,376	1.458
09.09	541,679	0	59,242	61,935	85,405	85,723	86,357	85,641	77,376	1.458
15.09	541,679	0	59,242	61,935	85,405	85,723	86,357	85,641	77,376	1.458
18.09	541,709	+ 30	59,244	61,936	85,411	85,729	86,362	85,645	77,382	1.458
20.09	541,709	0	59,244	61,936	85,411	85,729	86,362	85,645	77,382	1.458

*Results:* During the current study the total numbers of deaths related to the time frame between January 26 and July 4, 2020, were not stable. There was a fluctuation of the death numbers in the various days of the week, nevertheless the lowest numbers of deaths were on Sunday and the

highest numbers of deaths were mostly on Thursday. A ratio between the death numbers on Thursday and Sunday decreased from 1.485, on July 12, to 1.458, on September 7.

8.3. *Method:* In order to know how update of the database affects the absolute values of the total global mortality and mortality on the various days of the week, a comparison of death numbers for other 18 weeks (29.03.20 – 01.08.20), obtained at the different dates, has been done (Table 9).

Table 9. Global Mortality Due to CoViD-19 on Various Days of the Week (29.03.20 – 01.08.20). There are absolute values,  $\pm\Delta$ , and HLM ratio. Data were obtained on different dates.

Date	Total	$\pm \Delta$	Sun	Mon	Tue	Wed	Thu	Fri	Sat	HLM
02.08	655,799	n/a	71,540	73,337	103,569	107,080	104,963	103,286	92,024	1.497
06.08	656,362	+ 563	71,615	73,406	103,632	107,141	105,089	103,364	92,115	1.496
17.08	655,904	- 458	72,038	73,964	103,294	106,701	105,038	103,032	91,837	1.481
27.08	654,940	- 964	72,086	74,127	102,928	106,335	105,270	102,532	91,662	1.475
03.09	654,917	- 23	72,084	74,127	102,929	106,334	105,255	102,528	91,660	1.475
07.09	658,879	+ 3962	72,707	74,454	103,579	106,765	105,714	103,343	92,317	1.469
09.09	658,879	0	72,707	74,454	103,579	106,765	105,714	103,343	92,317	1.469
15.09	658,879	0	72,707	74,454	103,579	106,765	105,714	103,343	92,317	1.469
18.09	658,938	+ 59	72,709	74,458	103,593	106,775	105,723	103,353	92,327	1.469
20.09	658,938	0	72,709	74,458	103,593	106,775	105,723	103,353	92,327	1.469

*Results:* During the current study the total numbers of deaths related to the time frame between March 29 and August 1, 2020, were not stable. There was a fluctuation of the death numbers in the various days of the week, nevertheless the lowest numbers of death were on Sunday and the highest numbers of death were on Wednesday. A ratio between the death numbers on Wednesday and Sunday decreased from 1.497, on August 2, to 1.469, on September 7, 2020.

*Conclusion:* The fluctuation of the total mortality due to CoViD-19 and mortality on the various days of the week didn't affect the Weekly Mortality Cycle in general. Nevertheless additional study is required to know a reason for decrease and increase of the death numbers related to the past dates.

## 9. Updating Global Mortality Data and Weekly Mortality Cycle in various countries.

*Background:* During the current observation death numbers on the 'Worldometer' website were updating constantly. In some countries mortality data related to the past were fairly stable, in others, the correction occurred weekly or even every 2-3 days: either up or down.

*Objective:* To study if the correction of the data for the days related to the past affects the weekly mortality cycle in the countries which have been already analysed in the sections # 3, 4, 6.

*Methods:* New data were collected on September 10, 2020 (Tables # 9-11) and a comparison of the total daily mortality on the certain days of the week in absolute values and percentages in various

countries was carried out. Then a comparison of the new results with the results obtained on August 10, 2020 (Tables # 4-6) was done. The difference in the total death numbers presented as  $+/-\Delta$ .

Table 9: Mortality in various days of the week in Brazil, Chile, Mexico, Germany, Russia, USA and UK (10.09.20).

Countries: Dates:	Total $+/-\Delta$	Sun	Mon	Tue	Wed	Thu	Fri	Sat
United States: 29.03-01.08	155,399 + 284	13,827 8.90%	16,028 10.31%	27,180 17.49%	27,525 17.71%	26,015 16.74%	24,289 15.63%	20,535 13.22%
Brazil: 26.04-01.08	89,571 0	7,398 8.26%	9,153 10.22%	15,378 17.17%	15,161 16.93%	15,498 17.30%	14,423 16.1%	12,560 14.02%
United Kingdom: 29.03-01.08	39,745 - 4925	3,737 9.40%	3,524 8.87%	7,187 18.08%	6,745 16.97%	6,147 15.47%	6,726 16.92%	5,679 14.29%
Mexico: 19.04-01.08	46,142 0	5,425 11.76%	3,704 8.03%	4,598 9.96%	8,441 18.29%	8,548 18.52%	7,847 17.01%	7,579 16.43%
Russia: 26.04-01.08	13,377 0	1,499 11.20%	1,414 10.57%	2,093 15.64%	2,204 16.48%	1,966 14.70%	2,224 16.63%	1,977 14.78%
Chile 17.05-01.08	8,496 0	1,354 15.94%	719 8.46%	552 6.50%	1,360 16.01%	1,490 17.54%	1,448 17.04%	1,573 18.51%
Germany: 29.03-23.05	7,933 0	698 8.80%	1,165 14.70%	1,337 16.85%	1,521 19.17%	1,321 16.65%	1,129 14.23%	762 9.60%

Table 10: Daily Mortality due to COVID-19 was the lowest on Sundays (10.09.20).

Country: Dates:	Total $+/-\Delta$	Sun	Mon	Tue	Wed	Thu	Fri	Sat
Italy 08.03-23.05	32,593 + 152	4,035 12.44%	4,314 13.30%	4,778 14.73%	4,678 14.42%	4,657 14.35%	4,993 15.39%	4,986 15.37%
Spain 15.03-13.06	28,088 0	3,797 13.52%	3,911 13.92%	4,003 14.25%	4,378 15.59%	4,035 14.37%	3,986 14.19%	3,978 14.16%
France 22.03-16.05	27,039 - 24	2,324 8.60%	3,561 13.17%	4,490 16.61%	4,046 14.96%	5,143 19.02%	4,118 15.23%	3,357 12.41%
Peru 29.03-01.08	23,451 + 4064	3,307 14.10%	3,298 14.06%	3,357 14.32%	3,224 13.75%	3,464 14.77%	3,346 14.27%	3,455 14.73%
Iran 01.03-01.08	16,939 - 37	2,331 13.76%	2,421 14.29%	2,447 14.45%	2,455 14.49%	2,531 14.94%	2,357 13.92%	2,397 14.15%
South Africa 17.05-01.08	7,509 0	744 9.91%	1,042 13.87%	1,248 16.62%	1,020 13.58%	1,232 16.41%	1,160 15.45%	1,063 14.16%

Table 11: Daily Mortality due to COVID-19 was the lowest on Mondays (10.09.20).

Country: Dates:	Total $+/-\Delta$	Sun	Mon	Tue	Wed	Thu	Fri	Sat
India 10.05-01.08	33,641 0	4,348 12.92%	4,197 12.48%	4,739 14.09%	5,312 15.79%	4,911 14.6%	5,104 15.17%	5,030 14.95%
Colombia 12.04-01.08	10,230 0	1,343 13.13%	1,164 11.38%	1,356 13.25%	1,429 13.97%	1,694 16.56%	1,698 16.60%	1,546 15.11%
Belgium 22.03-13.06	9,412 + 365	1,322 14.05%	1,315 13.97%	1,376 14.62%	1,354 14.39%	1,447 15.37%	1,278 13.58%	1,320 14.02%
Canada 12.04-20.06	7,615 0	887 11.65%	884 11.61%	1,117 14.67%	1,158 15.20%	1,344 17.65%	1,095 14.38%	1,130 14.84%
Netherlands 15.03-20.06	5,940 + 125	649 10.93%	492 8.28%	1,013 17.05%	985 16.58%	969 16.31%	924 15.56%	908 15.29%
China 26.01-14.03	3143 0	497 15.81%	415 13.21%	436 13.87%	442 14.06%	436 13.87%	472 15.02%	445 14.16%

*Results:* For the majority of countries, mortality data for the past months was stable and did not change over time [ $\Delta = 0$ ]. Small changes have occurred in database of Netherlands [+125], Italy [+152], the United States of America [+284] and Belgium [+365]. Significant changes have been observed in the databases of Peru [+4064] and the United Kingdom [-4925].

*Netherlands:* The total number of deaths related to the analysed weeks (15.03-20.06) increased from 5,815 up to 5,940 cases [ $\Delta = +125$ ], HLM ratio was increased from 2.04 up to 2.06; but the day with the lowest daily mortality was not changed.

*Italy:* The total number of deaths related to the analysed weeks (29.03-01.08) increased from 32,441 up to 32,593 cases [ $\Delta = +152$ ], HLM ratio and the day with the lowest daily mortality was not changed.

*The United States of America:* The total number of deaths related to the analysed weeks (29.03-01.08) increased from 155,115 up to 155,399 cases [ $\Delta = +284$ ], HLM ratio and the day with the lowest daily mortality were not changed. The comparison of the daily mortality between Sundays and Thursdays revealed increasing significance of the difference from ( $p < 0.005$ ) to ( $p < 0.001$ ).

*Belgium:* The total number of deaths related to analysed weeks (22.03-13.06) increased from 9,047 cases up to 9,412 cases [ $\Delta = +365$ ], HLM ratio decreased from 1.48 to 1.13, and the day with the lowest daily mortality was changed from Monday to Friday.

*Peru:* The total number of deaths related to the analysed weeks (29.03-01.08.20) increased from 19,387 up to 23,451 cases [ $\Delta = +4064$ ], HLM ratio was decreased from 1.13 to 1.07, and the day with the lowest daily mortality was changed from Sunday to Wednesday (Fig. 8).

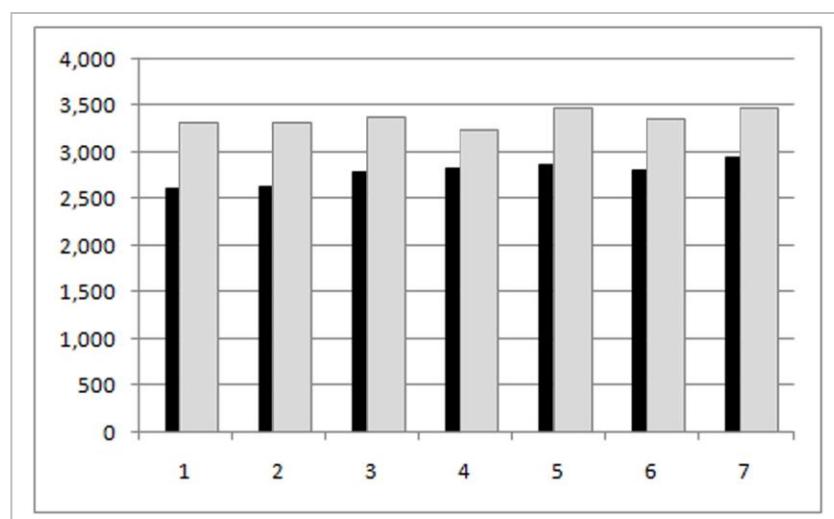


Figure 8. Mortality due to CoViD-19 on Various Days of the Week in the Peru (29.03.20-01.08.20). There are death numbers according to the database collected on August 10 (black) and September 10 (grey). The difference in the total death numbers was +4064: 1. Sunday (+714), 2. Monday (+672), 3. Tuesday (+587), 4. Wednesday (+399), 5. Thursday (+617), 6. Friday (+551), 7. Saturday (+524).



*The United Kingdom:* The total number of deaths related to analysed weeks (29.03-01.08) decreased from 44,670 to 39,745 cases [ $\Delta = -4925$ ]. After adjustment HLM was decreased from 2.06 to 2.04 and the difference in the daily mortality between various days of the week became not significant ( $p > 0.05$ ). Monday remained to be the day with the lowest mortality (Fig. 9).

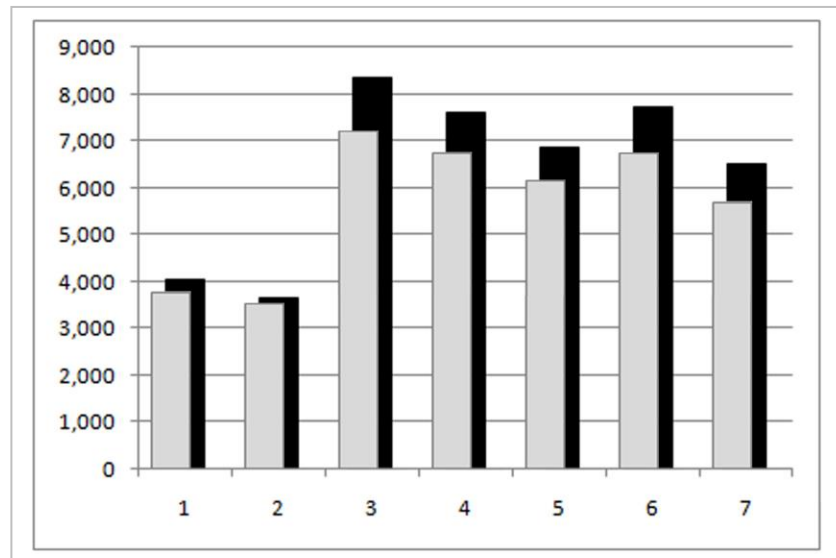


Figure 9. Mortality due to CoViD-19 on Various Days of the Week in the UK (29.03.20-01.08.20). There are death numbers according to the database collected on August 10 (black) and September 10 (grey). The difference in the total death numbers is  $-4925$ : 1. Sunday ( $-304$ ), 2. Monday ( $-122$ ), 3. Tuesday ( $-1146$ ), 4. Wednesday ( $-853$ ), 5. Thursday ( $-687$ ), 6. Friday ( $-997$ ), 7. Saturday ( $-816$ ).

*Argentina:* After collection new data on September 10, the weekly mortality cycle was revealed in Argentina. In the analysed 22 weeks (05.04-05.09), on Sundays, the daily mortality was less than on Tuesdays, Wednesdays, Thursdays and Fridays ( $p < 0.05$ ). HLM (Friday/Sunday) was 2.31.

*Remark:* Further monitoring (10.09-20.09.20) of the database related to the countries analysed before, revealed them to be stable [ $\Delta = 0$ ], excluding database of the United States of America that was replenished with the new 55 cases.

*Conclusion:* For patients suffering from CoViD-19, the safest days of the week were mostly Sundays or Mondays. Updating and correction of global and local mortality data didn't affect Weekly Mortality Cycle in general, but affected this cycle in certain countries, including Argentina, Belgium, Peru and the United Kingdom.

## 10. A Weekly Cycle relates to the Human Civilization.

In the 18th century, Antoine-Yves Goguet wrote: "We can consider as the first step that men have taken to obtain a measure of time, was the establishment of the small period of seven days,

which bears the name of the week. We see that, from time immemorial, it has been used by almost all peoples, and that the arrangement has been perfectly uniform".<sup>21</sup>

Our contemporary, Joseph Needham, expressed a modern view on the calendar and said, that some of its elements are based on those astronomical cycles which have obvious importance for man, such as the day, the month and the year; others are artificial, such as the week and the subdivisions of the day.<sup>22</sup> Eviatar Zerubavel, describing the characteristics of the weekly cycle, titled his book "Hidden Rhythms".<sup>23</sup>

## **11. Discussion.**

On the one hand, a week as a time frame obviously exists, but on the other, there is no natural basis that could explain a weekly cycle.

As described above the weekly mortality cycle with the trend towards decreased mortality on weekends is a unique phenomenon that has been observed among victims of CoViD-19. It has an opposite pattern compared to increased hospital mortality on weekends in the United Kingdom discussed in 2015.<sup>24</sup>

## **12. Conclusion.**

It is vitally important to recognize factors which formed the basis of decreased mortality on Sundays, Mondays and some other "safest days" of the week. These factors can relate to various aspects of healthcare, including therapeutic protocols and work schedules, or to human habits and traditions. Presumably, they relate to the optimised therapeutic protocols used on the "safest days".

If the factors, which reduced mortality on certain days of the week, could be identified, their positive effect should be spread to other days of the week. As a result many lives of CoViD-19 patients could be saved in future.

## **Acknowledgment:**

I am grateful to my colleagues from Brazil, China, Italy, Malaysia, and the USA who shared with me therapeutic protocols used at their hospitals for CoViD-19 patients.

## **Disclosure Statement:**

The author declares there are no any conflicts of interest in the submitted manuscripts.

## **Final Remark:**

The first study on the Weekly Mortality Cycle among CoViD-19 patients was completed on Aug 1, the second one was completed on Aug. 14, the last study was completed on Sep 21, 2020.

A manuscript of the second study was sent to my colleagues living in different countries. From that time they began their own investigations on their places.

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