The Dynamics of Differential Impacts of COVID-19 on African Countries Compared to Other Parts of the World

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ABSTRACT: Corona virus disease (COVID-19) is an infectious disease caused by a newly discovered corona virus. Most people who fall sick with COVID-19 experience mild to moderate symptoms and recover without special treatment. A number of deaths have been recorded across world. The aim of this study is to investigate and compare the extent the virus affects Africa relative to other parts of the world and it significant. One hundred and eighty seven (187) countries were selected randomly based on their continents and cases of infection. Data from each country were obtained from United Nations Geo scheme and WHO as at October 12, 2020 and were analyzed and compared to that of the United State of America (USA). USA was used as a Comprise Factor (CF) because it has one of the best healthcare system and high COVID-19 cases. Subsequent examination of associations between the proportion of COVID-19 cases, recovery and deaths of each country to the United State of America was carried out. All data used in these analyses are from publicly available data sets. Data analyzed revealed that almost all African countries appears to be least affected by the virus. African countries have the least impacted and lesser number of deaths index. Result from the study suggests that the virus affect Africa the least when compared to USA and other continents in terms of cases and mortality. This may be due to among other factors a more robust immune response. The result also helps to provide relative explanation as to how significant developing and providing vaccine may be to various part of the world.

KEYWORD: Africa, USA, COVID-19, Nigeria, infection.

INTRODUCTION

Corona viruses are a group of RNA viruses that cause diseases in mammals and birds. In humans and birds, they cause respiratory tract infections that can range from mild to lethal[1]. Mild illnesses in humans include some cases of the common cold (which is also caused by other viruses, predominantly rhinoviruses), while more lethal varieties can cause SARS, MERS, and COVID-19[1]. Corona viruses are members of the subfamily Orthocoronavirinae, in the family Coronaviridae, order Nidovirales, and realm Riboviria[1,2]. They are enveloped viruses with a positive-sense single-stranded RNA genome and a nucleocapsid of helical symmetry[2]. The genome size of coronaviruses ranges from approximately 26 to 32 kilobases, one of the largest among RNA viruses[2,3]. Coronavirus,any virus belonging to the family Coronaviridae. Coronaviruses have enveloped virions (virus particles) that measure approximately 120 nm (1 nm = 10^{-9} metre) in diameter. Club-shaped glycoprotein spikes in the envelope give the viruses a crownlike, or coronal, appearance. The nucleocapsid, made up of a protein shell known as a capsid and containing the viral nucleic acids, is helical or tubular[4,5,6]. The corona virus genome consists of a single strand of positive-sense RNA (ribonucleic acid). Coronaviridae is generally considered to contain two genera, Corona virus and Toro virus, which differ in nucleocapsid morphology, the former being helical and the latter being tubular[7]. Corona viruses are important agents of gastrointestinal disease in humans, poultry, and bovines. In humans, a species known as SARS corona virus (or Severe acute respiratory syndrome corona virus) causes a highly contagious respiratory disease that is characterized by symptoms of fever, cough, and muscle ache, often with progressive difficulty in breathing. The virus emerged in humans in 2002; it likely jumped to humans from an animal reservoir, believed to be horseshoe bats[8]. The ability of SARS corona virus to jump to humans undoubtedly required genetic changes in the virus. These changes are suspected to have occurred in the palm civet, since the SARS virus present in horseshoe bats is unable to infect human's directly[9].

Corona viruses are a group of RNA viruses that cause diseases in mammals and birds. In humans and birds, they cause respiratory tract infections that can range from mild to lethal (Wertheim et al., 2013). Mild illnesses in humans include

some cases of the common cold (which is also caused by other viruses, predominantly rhinoviruses), while more lethal varieties can cause SARS, MERS, and COVID-19[10]. In cows and pigs they cause diarrhea, while in mice they cause hepatitis and encephalomyelitis. There are as yet no vaccines or antiviral drugs to prevent or treat human corona virus infections. Corona virus disease (COVID-19) is an infectious disease caused by a newly discovered coronavirus[10,11].

The COVID-19 pandemic, also known as the corona virus pandemic, is an ongoing pandemic of corona virus disease 2019 (COVID-19) caused by severe acute respiratory syndrome corona virus 2 (SARS-CoV-2)[12,13]. The disease was first identified in December 2019 in Wuhan, China (ICTV, 2019). The World Health Organization declared the outbreak a Public Health Emergency of International Concern on 30 January 2020 and a pandemic on 11 March. As of 17 September 2020, more than 29.9 million cases have been reported in 188 countries and territories, resulting in more than 942,000 deaths; more than 20.3 million people have recovered[2,14]. The COVID-19 virus spreads primarily through droplets of saliva or discharge from the nose when an infected person coughs or sneezes. Many larger droplets rapidly fall to the ground, however some can be suspended in air as aerosols, especially in indoor spaces[15]. It may also be transmitted via contaminated surfaces, although this has not been conclusively demonstrated[16,17]. It can spread for up to two days prior to symptom onset, and from people who are asymptomatic[18]. People remain infectious in moderate cases for 7-12 days, and up to two weeks in severe cases[19]. .

The attack rate or transmissibility (how rapidly the disease spreads) of a virus is indicated by its reproductive number (Ro, pronounced R-naught or r-zero), which represents the average number of people to which a single infected person will transmit the virus. Whose estimated (on Jan. 23) Ro to be between 1.4 and 2.5[2,20].

There has been concern about the consequence of the viral outbreak in Africa. The United Nations Economic Commission for Africa (UNECA) had in April predicted that anywhere between 300,000 and 3.3 million African people could lose their lives as a direct result of COVID-19[21]. The World Health Organization (WHO) warned African countries to "prepare for the worst", while Melinda Gates, co-chair of the Bill & Melinda Gates Foundation, believed that It was going to be horrible in the developing world. She suggested that part of the reason case numbers don't look very bad is because they don't have access to very many test[22]. The aim of this study is to investigate and compare the extent the virus affects Africa relative to other parts of the world and it significant.

METHOD

One hundred and eighty seven (187) countries from different continent and regions of the world was randomly selected from each continent and based on COVID-19 cases in each country. The list of countries and territories with their continental regional classification is based on the United Nations Geoscheme and WHO. Sources and data used were provided under Latest Updates from WHO/World meter's on October 12, 2020. Data obtained for each country was analyzed and compared to that of the United State of America (USA). USA was used as a Comparism Factor (CF) because it has one of the best healthcare systems in the world and high COVID-19 cases. Subsequent examination of associations between the proportion of COVID-19 cases, recovery and deaths of each country to the United State of America was carried out. All data used in these analyses are from publicly available data sets.

STATISTICAL ANALYSES

Parameters such as total incidences/cases, total deaths and total recovered of countries was compared against figures and values obtained for USA. Bivariate analysis was done with Chi-square test to compare proportions for variables. In reporting these results, country-level characteristics are scaled to represent a comparison of two countries similar in all other respects. Thus, rate ratios greater than one mean that higher levels of a given characteristic are associated with higher rates of COVID-19 cases or deaths, while rate ratios less than one mean that lower levels of a given characteristic are associated with lower rates of COVID-19 cases or deaths.

Result

Infectious, recovery and mortality rate of COVID-19 based on country

Data analyzed revealed that with exception of South Africa, Africa appears to be least affected by the virus

Table 1: Infectious, recovery and mortality rate of COVID-19 based on country

S/N	Country, Other	Total Cases (A)	Total Deaths (B)	Total Recovered (C)	Population (D)
1	World	37,786,413	1,081,848	28,374,689	
2	USA	**7,992,810**	**219,702**	**5,128,390**	331,547,490
3	India	**7,120,538**	**109,184**	**6,149,535**	1,383,789,657

The Dynamics of Differential Impacts of COVID-19 on African Countries Compared to Other Parts of the World

4	Brazil	**5,094,979**	**150,506**	**4,470,165**	212,982,744
5	Russia	**1,312,310**	**22,722**	**1,024,235**	145,952,169
6	Colombia	**911,316**	**27,834**	**789,787**	51,034,004
7	Argentina	**894,206**	**23,868**	**721,380**	45,311,598
8	Spain	**890,367**	**32,929**	**N/A**	46,759,903
9	Peru	**849,371**	**33,305**	**743,969**	33,099,165
10	Mexico	**817,503**	**83,781**	**594,180**	129,310,283
11	France	**734,974**	**32,683**	**100,828**	65,314,276
12	South Africa	**692,471**	**17,780**	**623,765**	59,516,399
13	UK	**603,716**	**42,825**	**N/A**	67,986,204
14	Iran	**500,075**	**28,544**	**406,389**	84,291,482
15	Chile	**481,371**	**13,318**	**453,352**	19,162,070
16	Iraq	**402,330**	**9,852**	**336,157**	40,469,182
17	Bangladesh	**379,738**	**5,555**	**294,391**	165,147,049
18	Italy	**354,950**	**36,166**	**239,709**	60,436,599
19	Philippines	**342,816**	**6,332**	**293,152**	109,985,754
20	Saudi Arabia	**339,267**	**5,043**	**325,330**	34,963,754
21	Indonesia	**336,716**	**11,935**	**258,519**	274,329,617
22	Turkey	**335,533**	**8,837**	**294,357**	84,591,892
23	Germany	**326,482**	**9,702**	**274,700**	83,859,444
24	Pakistan	**319,317**	**6,580**	**304,185**	222,070,579
25	Israel	**291,828**	**1,983**	**238,145**	**9,197,590**
26	Ukraine	**265,454**	**5,015**	**114,410**	43,658,728
27	Canada	**181,864**	**9,613**	**153,219**	37,834,630
28	Netherlands	**174,653**	**6,584**	**N/A**	17,145,573
29	Belgium	**162,258**	**10,191**	**20,272**	11,603,814
30	Romania	**155,283**	**5,411**	**117,942**	19,201,008
31	Morocco	**152,404**	**2,605**	**127,407**	37,032,230
32	Ecuador	**147,033**	**12,191**	**128,134**	17,717,163
33	Bolivia	**138,574**	**8,308**	**101,103**	11,717,177
34	Poland	**130,210**	**3,039**	**81,201**	37,834,855
35	Qatar	**127,985**	**220**	**124,978**	**2,807,805**
36	Panama	**120,313**	**2,491**	**96,164**	4,333,539
37	Dominican Republic	**118,477**	**2,173**	**94,084**	10,878,250
38	Czechia	**117,110**	**987**	**56,203**	10,714,591
39	Kuwait	**111,116**	**658**	**103,268**	4,288,053
40	Kazakhstan	**108,831**	**1,746**	**104,041**	18,839,158
41	Nepal	**107,755**	**636**	**75,804**	29,281,110
42	Oman	**106,575**	**1,046**	**93,222**	5,141,941
43	UAE	**106,229**	**445**	**97,284**	9,923,623
44	Egypt	**104,516**	**6,052**	**97,688**	102,865,105
45	Sweden	**98,451**	**5,894**	**N/A**	10,116,932
46	Guatemala	**97,715**	**3,384**	**86,582**	18,006,746
47	Japan	**88,912**	**1,627**	**81,824**	126,366,347
48	Costa Rica	**87,439**	**1,076**	**52,669**	5,107,110
49	Portugal	**86,664**	**2,080**	**53,187**	10,188,255
50	China	**85,578**	**4,634**	**80,714**	**1,439,323,776**
51	Ethiopia	**84,295**	**1,287**	**38,316**	115,738,799
52	Honduras	**84,081**	**2,512**	**32,012**	9,948,132
53	Belarus	**83,534**	**896**	**77,220**	9,448,442
54	Venezuela	**83,137**	**697**	**74,664**	28,413,033
55	Bahrain	**75,614**	**277**	**71,249**	1,717,395
56	Moldova	**62,151**	**1,461**	**44,357**	4,031,299
57	Uzbekistan	**61,205**	**507**	**58,069**	33,603,532
58	Switzerland	**60,368**	**2,088**	**48,400**	8,672,349
59	Nigeria	**60,266**	**1,115**	**51,735**	207,530,415
60	Singapore	**57,880**	**27**	**57,705**	5,863,218

61	Armenia	56,821	1,026	45,891	2,964,807
62	Austria	56,298	855	44,065	9,020,826
63	Lebanon	53,568	459	23,501	6,816,735
64	Algeria	53,072	1,801	37,170	44,069,055
65	Paraguay	49,675	1,077	32,090	7,156,887
66	Kyrgyzstan	49,528	1,090	44,522	6,553,907
67	Ghana	47,005	306	46,398	31,250,683
68	Palestine	44,299	381	37,942	5,133,781
69	Libya	42,712	631	24,038	6,897,205
70	Ireland	42,528	1,826	23,364	4,953,142
71	Azerbaijan	41,982	609	39,357	10,164,706
72	Kenya	41,546	766	32,000	54,095,241
73	Afghanistan	39,870	1,479	33,118	39,167,927
74	Hungary	38,837	968	11,037	9,653,380
75	Serbia	34,787	763	31,536	8,727,348
76	Tunisia	32,556	478	5,032	11,853,087
77	Denmark	32,422	669	26,380	5,797,948
78	Bosnia and Herzegovina	30,647	928	23,461	3,274,989
79	El Salvador	30,196	894	25,438	6,495,403
80	Myanmar	27,974	646	9,742	54,512,056
81	Australia	27,285	898	24,998	25,582,199
82	Jordan	24,926	191	6,101	10,231,389
83	S. Korea	24,703	433	22,729	51,281,663
84	Bulgaria	24,402	892	15,847	6,933,476
85	Greece	22,358	449	9,989	10,408,537
86	Cameroon	21,203	423	20,117	26,725,710
87	North Macedonia	20,937	792	16,194	2,083,350
88	Croatia	20,621	327	17,582	4,098,036
89	Slovakia	20,355	61	6,031	5,460,390
90	Ivory Coast	20,154	120	19,798	26,556,096
91	Madagascar	16,718	237	16,042	27,884,498
92	Malaysia	15,657	157	10,913	32,481,150
93	Norway	15,524	275	11,863	5,433,105
94	Zambia	15,458	337	14,599	18,523,331
95	Albania	15,399	420	9,500	2,876,906
96	Senegal	15,268	314	13,297	16,863,717
97	Montenegro	13,869	202	9,620	628,089
98	Sudan	13,685	836	6,764	44,128,647
99	Georgia	12,272	92	6,538	3,986,993
100	Finland	11,998	346	8,500	5,543,152
101	Namibia	11,936	128	9,817	2,553,573
102	Guinea	11,022	69	10,324	13,229,375
103	Maldives	10,894	35	9,742	543,167
104	DRC	10,851	276	10,242	90,295,401
105	Tajikistan	10,222	79	9,058	9,596,192
106	French Guiana	10,144	69	9,834	300,785
107	Mozambique	10,001	71	7,338	31,492,481
108	Uganda	9,801	93	6,109	46,129,601
109	Luxembourg	9,722	132	8,038	628,790
110	Haiti	8,882	230	7,104	11,441,165
111	Gabon	8,835	54	8,189	2,240,060
112	Slovenia	8,663	167	5,182	2,079,019
113	Zimbabwe	8,011	230	6,504	14,922,836
114	Jamaica	7,718	139	3,162	2,964,803
115	Mauritania	7,550	163	7,274	4,682,842
116	Cabo Verde	7,072	75	5,981	557,669
117	Guadeloupe	6,483	77	2,199	400,143

The Dynamics of Differential Impacts of COVID-19 on African Countries Compared to Other Parts of the World

118	Angola	6,366	218	2,743	33,141,527
119	Lithuania	6,248	103	2,793	2,711,324
120	Cuba	5,978	123	5,540	11,324,657
121	Malawi	5,821	180	4,647	19,264,273
122	Congo	5,118	90	3,887	5,555,071
123	Trinidad and Tobago	5,101	90	3,252	1,400,765
124	Bahamas	5,078	107	2,900	394,293
125	Equatorial Guinea	5,063	83	4,894	1,415,356
126	Rwanda	4,896	31	3,606	13,039,619
127	CAR	4,854	62	1,924	4,852,912
128	Sri Lanka	4,791	13	3,317	21,438,515
129	Syria	4,718	224	1,296	17,616,485
130	Réunion	4,491	16	3,994	897,102
131	Aruba	4,194	33	3,768	106,894
132	Mayotte	3,989	43	2,964	274,609
133	Estonia	3,883	68	2,967	1,326,787
134	Somalia	3,864	99	3,089	16,013,278
135	Malta	3,776	41	2,967	441,875
136	Thailand	3,641	59	3,454	69,849,390
137	Gambia	3,632	117	2,543	2,435,044
138	Iceland	3,526	10	2,499	341,864
139	Guyana	3,469	103	2,318	787,619
140	Mali	3,286	132	2,527	20,408,512
141	Botswana	3,219	18	834	2,364,654
142	South Sudan	2,777	55	1,290	11,230,230
143	Latvia	2,765	40	1,325	1,880,201
144	Benin	2,411	41	1,973	12,209,431
145	Guinea-Bissau	2,385	40	1,728	1,980,688
146	Sierra Leone	2,306	72	1,736	8,021,477
147	Uruguay	2,294	50	1,942	3,477,121
148	Burkina Faso	2,280	63	1,554	21,058,597
149	Yemen	2,052	595	1,329	30,005,627
150	Togo	1,940	49	1,457	8,331,665
151	New Zealand	1,871	25	1,801	5,002,100
152	Martinique	1,851	22	98	375,183
153	Lesotho	1,805	42	961	2,147,001
154	Liberia	1,363	82	1,245	5,090,112
155	Chad	1,304	92	1,115	16,553,305
156	Niger	1,201	69	1,123	24,440,409
157	Vietnam	1,109	35	1,024	97,583,242
158	Sao Tome and Principe	929	15	892	220,279
159	Curaçao	583	1	315	164,282
160	Papua New Guinea	554	7	532	8,993,618
161	Taiwan	529	7	489	23,828,949
162	Burundi	524	1	472	11,986,354
163	Tanzania	509	21	183	60,194,425
164	Comoros	495	7	475	874,674
165	Gibraltar	485		413	33,688
166	Faeroe Islands	477		461	48,915
167	Saint Martin	466	8	309	38,848
168	Eritrea	414		372	3,560,028
169	Mauritius	395	10	358	1,272,364
170	Cambodia	283		278	16,783,110
171	Monaco	234	2	209	39,320
172	Cayman Islands	221	1	211	65,937
173	Barbados	208	7	186	287,474
174	Bermuda	184	9	170	62,213

The Dynamics of Differential Impacts of COVID-19 on African Countries Compared to Other Parts of the World

175	Caribbean Netherlands	**148**	**2**	**78**	26,291
176	Seychelles	**148**		**144**	98,518
177	Brunei	**146**	**3**	**143**	438,648
178	Liechtenstein	**144**	**1**	**121**	38,159
179	Antigua and Barbuda	**111**	**3**	**97**	98,156
180	British Virgin Islands	**71**	**1**	**70**	30,287
181	St. Barth	**65**		**37**	9,885
182	St. Vincent Grenadines	**64**		**64**	111,039
183	Macao	**46**		**46**	651,790
184	Fiji	**32**	**2**	**28**	898,265
185	Dominica	**32**		**24**	72,036
186	Saint Lucia	**29**		**27**	183,863
187	Timor-Leste	**29**		**28**	1,325,347

Sources and data used were provided under Latest Updates from WHO/World meter's on October 12, 2020

Infectious, recovery and mortality rate of COVID-19 based on country and relative to the USA

When compared against USA, African countries were among the least infected, more recovery and lesser number of deaths.

Table 2: Infectious, recovery and mortality rate of COVID-19 based on country and relative to the USA

S/N	Country, Other	% of A to D (E)	% of B to D (G)	E/2.41 (F$_1$)	F/0.066 (F$_2$)
1	USA	2.411	0.066	1.00	1.00
2	India	0.515	0.008	0.21	0.12
3	Brazil	2.392	0.071	0.99	1.07
4	Russia	0.899	0.016	0.37	0.24
5	Colombia	1.786	0.055	0.74	0.83
6	Argentina	1.973	0.053	0.82	0.80
7	Spain	1.904	0.070	0.79	1.07
8	Peru	2.566	0.101	1.06	1.52
9	Mexico	0.632	0.065	0.26	0.98
10	France	1.125	0.050	0.47	0.76
11	South Africa	1.163	0.030	0.48	0.45
12	UK	0.888	0.063	0.37	0.95
13	Iran	0.593	0.034	0.25	0.51
14	Chile	2.512	0.070	1.04	1.05
15	Iraq	0.994	0.024	0.41	0.37
16	Bangladesh	0.230	0.003	0.10	0.05
17	Italy	0.587	0.060	0.24	0.91
18	Philippines	0.312	0.006	0.13	0.09
19	Saudi Arabia	0.970	0.014	0.40	0.22
20	Indonesia	0.123	0.004	0.05	0.07
21	Turkey	0.397	0.010	0.16	0.16
22	Germany	0.389	0.012	0.16	0.18
23	Pakistan	0.144	0.003	0.06	0.04
24	Israel	3.173	0.022	1.32	0.33
25	Ukraine	0.608	0.011	0.25	0.17
26	Canada	0.481	0.025	0.20	0.38
27	Netherlands	1.019	0.038	0.42	0.58
28	Belgium	1.398	0.088	0.58	1.33
29	Romania	0.809	0.028	0.34	0.43
30	Morocco	0.412	0.007	0.17	0.11
31	Ecuador	0.830	0.069	0.34	1.04

32	Bolivia	1.183	0.071	0.49	1.07
33	Poland	0.344	0.008	0.14	0.12
34	Qatar	4.558	0.008	1.89	0.12
35	Panama	2.776	0.057	1.15	0.87
36	Dominican Republic	1.089	0.020	0.45	0.30
37	Czechia	1.093	0.009	0.45	0.14
38	Kuwait	2.591	0.015	1.08	0.23
39	Kazakhstan	0.578	0.009	0.24	0.14
40	Nepal	0.368	0.002	0.15	0.03
41	Oman	2.073	0.020	0.86	0.31
42	UAE	1.070	0.004	0.44	0.07
43	Egypt	0.102	0.006	0.04	0.09
44	Sweden	0.973	0.058	0.40	0.88
45	Guatemala	0.543	0.019	0.23	0.28
46	Japan	0.070	0.001	0.03	0.02
47	Costa Rica	1.712	0.021	0.71	0.32
48	Portugal	0.851	0.020	0.35	0.31
49	China	0.006	0.000	0.00	0.00
50	Ethiopia	0.073	0.001	0.03	0.02
51	Honduras	0.845	0.025	0.35	0.38
52	Belarus	0.884	0.009	0.37	0.14
53	Venezuela	0.293	0.002	0.12	0.04
54	Bahrain	4.403	0.016	1.83	0.24
55	Moldova	1.542	0.036	0.64	0.55
56	Uzbekistan	0.182	0.002	0.08	0.02
57	Switzerland	0.696	0.024	0.29	0.36
58	Nigeria	0.029	0.001	0.01	0.01
59	Singapore	0.987	0.000	0.41	0.01
60	Armenia	1.917	0.035	0.80	0.52
61	Austria	0.624	0.009	0.26	0.14
62	Lebanon	0.786	0.007	0.33	0.10
63	Algeria	0.120	0.004	0.05	0.06
64	Paraguay	0.694	0.015	0.29	0.23
65	Kyrgyzstan	0.756	0.017	0.31	0.25
66	Ghana	0.150	0.001	0.06	0.01
67	Palestine	0.863	0.007	0.36	0.11
68	Libya	0.619	0.009	0.26	0.14
69	Ireland	0.859	0.037	0.36	0.56
70	Azerbaijan	0.413	0.006	0.17	0.09
71	Kenya	0.077	0.001	0.03	0.02
72	Afghanistan	0.102	0.004	0.04	0.06
73	Hungary	0.402	0.010	0.17	0.15
74	Serbia	0.399	0.009	0.17	0.13
75	Tunisia	0.275	0.004	0.11	0.06
76	Denmark	0.559	0.012	0.23	0.17
77	Bosnia and Herzegovina	0.936	0.028	0.39	0.43
78	El Salvador	0.465	0.014	0.19	0.21
79	Myanmar	0.051	0.001	0.02	0.02
80	Australia	0.107	0.004	0.04	0.05
81	Jordan	0.244	0.002	0.10	0.03

82	S. Korea	0.048	0.001	0.02	0.01
83	Bulgaria	0.352	0.013	0.15	0.19
84	Greece	0.215	0.004	0.09	0.07
85	Cameroon	0.079	0.002	0.03	0.02
86	North Macedonia	1.005	0.038	0.42	0.58
87	Croatia	0.503	0.008	0.21	0.12
88	Slovakia	0.373	0.001	0.15	0.02
89	Ivory Coast	0.076	0.000	0.03	0.01
90	Madagascar	0.060	0.001	0.02	0.01
91	Malaysia	0.048	0.000	0.02	0.01
92	Norway	0.286	0.005	0.12	0.08
93	Zambia	0.083	0.002	0.03	0.03
94	Albania	0.535	0.015	0.22	0.22
95	Senegal	0.091	0.002	0.04	0.03
96	Montenegro	2.208	0.032	0.92	0.49
97	Sudan	0.031	0.002	0.01	0.03
98	Georgia	0.308	0.002	0.13	0.03
99	Finland	0.216	0.006	0.09	0.09
100	Namibia	0.467	0.005	0.19	0.08
101	Guinea	0.083	0.001	0.03	0.01
102	Maldives	2.006	0.006	0.83	0.10
103	DRC	0.012	0.000	0.00	0.00
104	Tajikistan	0.107	0.001	0.04	0.01
105	French Guiana	3.373	0.023	1.40	0.35
106	Mozambique	0.032	0.000	0.01	0.00
107	Uganda	0.021	0.000	0.01	0.00
108	Luxembourg	1.546	0.021	0.64	0.32
109	Haiti	0.078	0.002	0.03	0.03
110	Gabon	0.394	0.002	0.16	0.04
111	Slovenia	0.417	0.008	0.17	0.12
112	Zimbabwe	0.054	0.002	0.02	0.02
113	Jamaica	0.260	0.005	0.11	0.07
114	Mauritania	0.161	0.003	0.07	0.05
115	Cabo Verde	1.268	0.013	0.53	0.20
116	Guadeloupe	1.620	0.019	0.67	0.29
117	Angola	0.019	0.001	0.01	0.01
118	Lithuania	0.230	0.004	0.10	0.06
119	Cuba	0.053	0.001	0.02	0.02
120	Malawi	0.030	0.001	0.01	0.01
121	Congo	0.092	0.002	0.04	0.02
122	Trinidad and Tobago	0.364	0.006	0.15	0.10
123	Bahamas	1.288	0.027	0.53	0.41
124	Equatorial Guinea	0.358	0.006	0.15	0.09
125	Rwanda	0.038	0.000	0.02	0.00
126	CAR	0.100	0.001	0.04	0.02
127	Sri Lanka	0.022	0.000	0.01	0.00
128	Syria	0.027	0.001	0.01	0.02
129	Réunion	0.501	0.002	0.21	0.03
130	Aruba	3.924	0.031	1.63	0.47
131	Mayotte	1.453	0.016	0.60	0.24

132	Estonia	0.293	0.005	0.12	0.08
133	Somalia	0.024	0.001	0.01	0.01
134	Malta	0.855	0.009	0.35	0.14
135	Thailand	0.005	0.000	0.00	0.00
136	Gambia	0.149	0.005	0.06	0.07
137	Iceland	1.031	0.003	0.43	0.04
138	Guyana	0.440	0.013	0.18	0.20
139	Mali	0.016	0.001	0.01	0.01
140	Botswana	0.136	0.001	0.06	0.01
141	South Sudan	0.025	0.000	0.01	0.01
142	Latvia	0.147	0.002	0.06	0.03
143	Benin	0.020	0.000	0.01	0.01
144	Guinea-Bissau	0.120	0.002	0.05	0.03
145	Sierra Leone	0.029	0.001	0.01	0.01
146	Uruguay	0.066	0.001	0.03	0.02
147	Burkina Faso	0.011	0.000	0.00	0.00
148	Yemen	0.007	0.002	0.00	0.03
149	Togo	0.023	0.001	0.01	0.01
150	New Zealand	0.037	0.000	0.02	0.01
151	Martinique	0.493	0.006	0.20	0.09
152	Lesotho	0.084	0.002	0.03	0.03
153	Liberia	0.027	0.002	0.01	0.02
154	Chad	0.008	0.001	0.00	0.01
155	Niger	0.005	0.000	0.00	0.00
156	Vietnam	0.001	0.000	0.00	0.00
157	Sao Tome and Principe	0.422	0.007	0.17	0.10
158	Curaçao	0.355	0.001	0.15	0.01
159	Papua New Guinea	0.006	0.000	0.00	0.00
160	Taiwan	0.002	0.000	0.00	0.00
161	Burundi	0.004	0.000	0.00	0.00
162	Tanzania	0.001	0.000	0.00	0.00
163	Comoros	0.057	0.001	0.02	0.01
164	Gibraltar	1.440	0.000	0.60	0.00
165	Faeroe Islands	0.975	0.000	0.40	0.00
166	Saint Martin	1.200	0.021	0.50	0.31
167	Eritrea	0.012	0.000	0.00	0.00
168	Mauritius	0.031	0.001	0.01	0.01
169	Cambodia	0.002	0.000	0.00	0.00
170	Monaco	0.595	0.005	0.25	0.08
171	Cayman Islands	0.335	0.002	0.14	0.02
172	Barbados	0.072	0.002	0.03	0.04
173	Bermuda	0.296	0.014	0.12	0.22
174	Caribbean Netherlands	0.563	0.008	0.23	0.12
175	Seychelles	0.150	0.000	0.06	0.00
176	Brunei	0.033	0.001	0.01	0.01
177	Liechtenstein	0.377	0.003	0.16	0.04
178	Antigua and Barbuda	0.113	0.003	0.05	0.05
179	British Virgin Islands	0.234	0.003	0.10	0.05
180	St. Barth	0.658	0.000	0.27	0.00
181	St. Vincent Grenadines	0.058	0.000	0.02	0.00

182	Macao	0.007	0.000	0.00	0.00
183	Fiji	0.004	0.000	0.00	0.00
184	Dominica	0.044	0.000	0.02	0.00
185	Saint Lucia	0.016	0.000	0.01	0.00
186	Timor-Leste	0.002	0.000	0.00	0.00

Figures obtained for USA were used as the comparism factor (CF), which is a ratio of figure obtained to the respective country population divided by the value obtained for USA.

Values of F_1 and F_2 represent case/incidence and mortality index.

Factor of more than 1 = very high infection and mortality index

Factor of approximately 1 = high infection and mortality index

Factor of ≤1 but ≥0.5 = moderately high infection and mortality index

Factor of ≤ 0.5 but ≥ 0.1 = low infection and mortality index

Factor of <0.1 = very low infection, mortality and recovery index
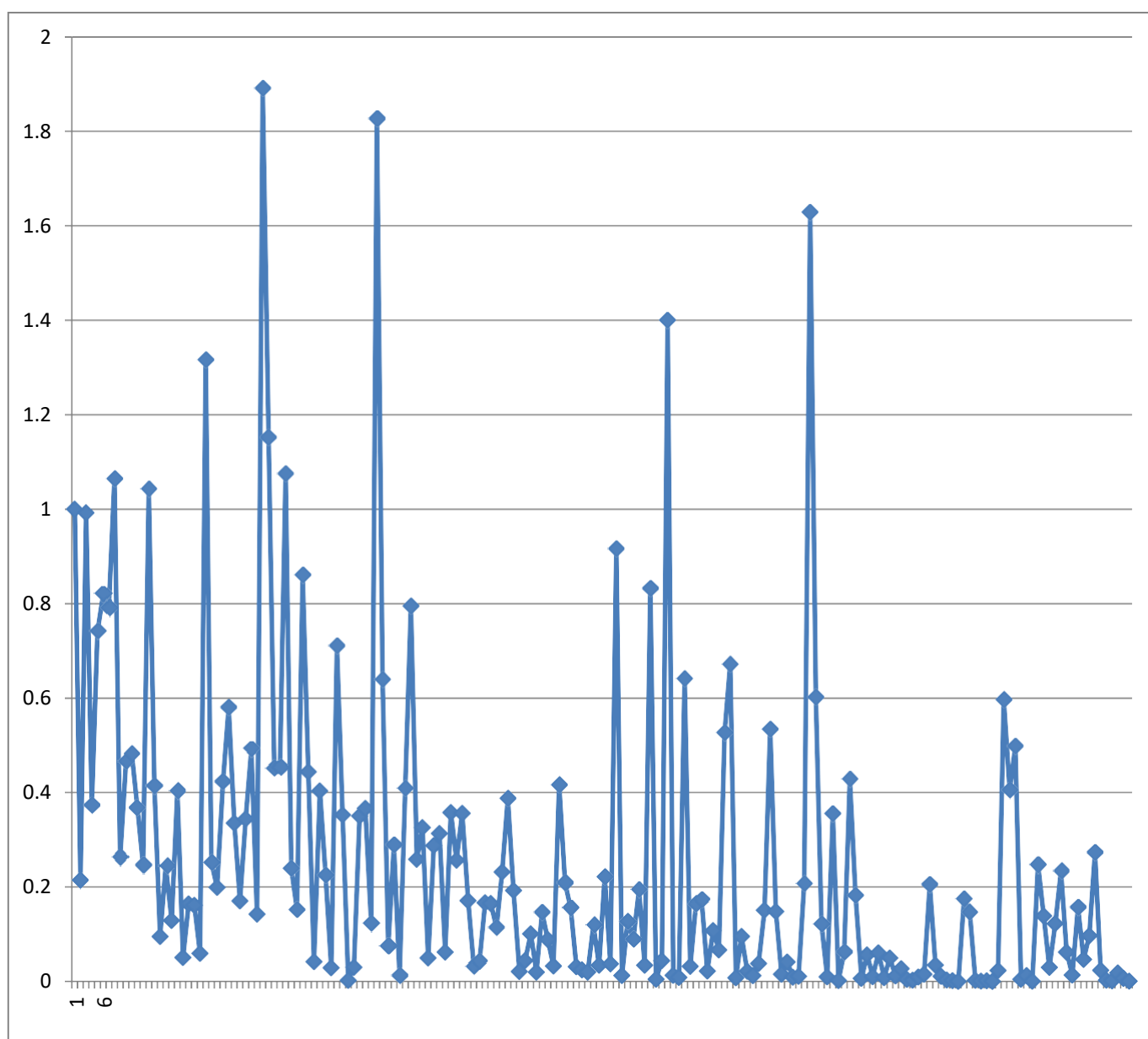
Figure 1: graph comparing infection per country relative to USA

The Dynamics of Differential Impacts of COVID-19 on African Countries Compared to Other Parts of the World
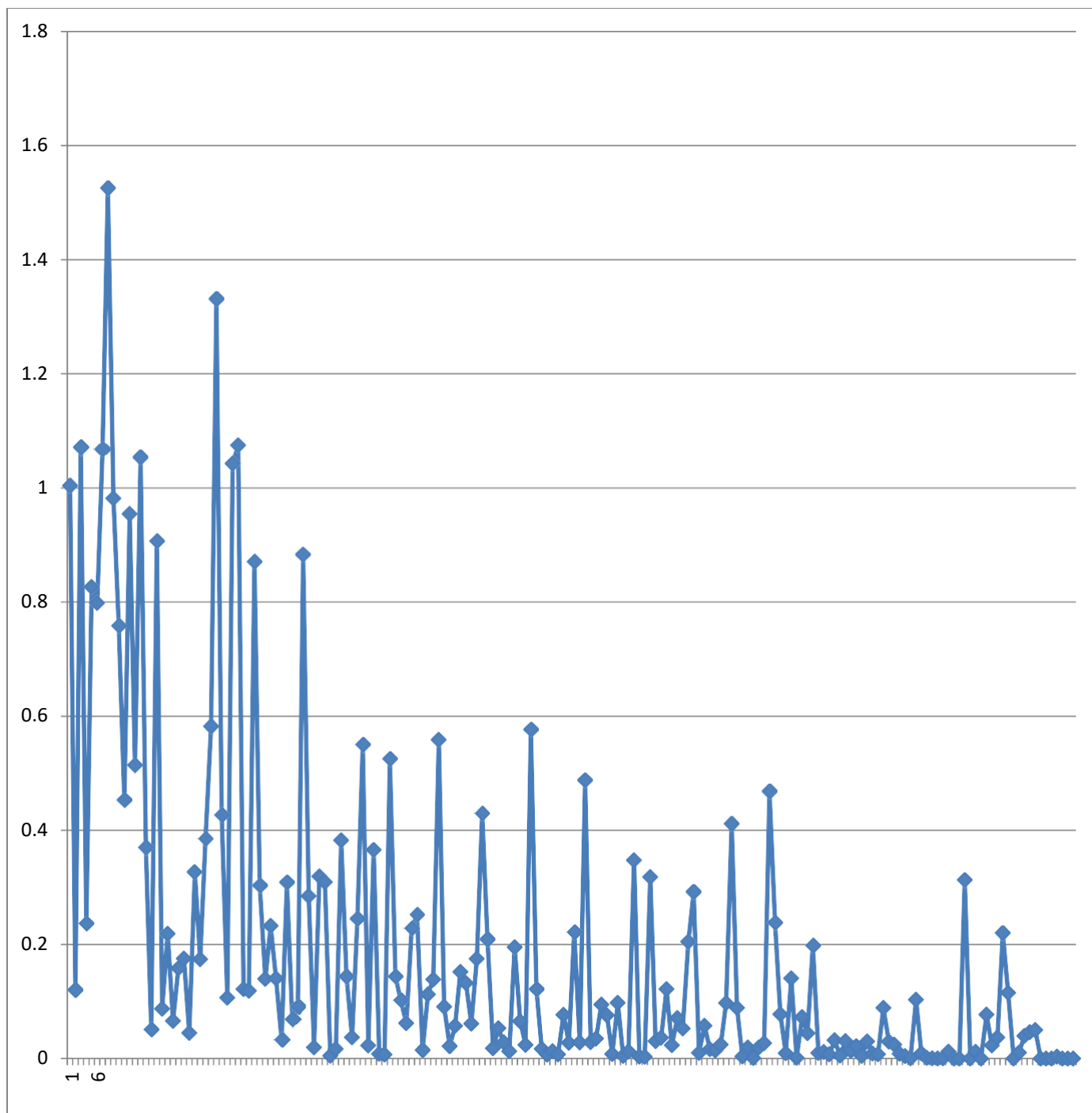
Figure 2: graph comparing death per country relative to USA

DISCUSSION

Africa is the world's second-largest and second-most populous continent, after Asia[23,24,25,26]. It is confronted by a heavy burden of communicable and non-communicable diseases[23,25]. Cost-effective interventions that can prevent the disease burden exist but coverage is too low due to health systems weaknesses[27,28]. The World Health Organization (WHO) has rushed to beef up the ability of African countries to test for the virus and train health professionals in caring for people affected by it[2]. From the table above South Africa is the only African country with moderately high infection and mortality. Morocco, Ghana, Equatorial Guinea etc. have low infection and mortality, while most African countries have very low infection and mortality. Most countries in Africa have a communal lifestyle compared to the isolation lifestyle of the western countries. Hence, it is possible that a large proportion of Africans may have been exposed to COVID-19 but few have presented visible symptoms or tested positive to the virus. Interestingly, Africa-American are the most hit among other Americans by this pandemic[29].

It is expected that due to the virus mode of transmission, the index value is supposed to be very high for African countries. There have been several suggestions to explain why Africa appears to be less affected by the pandemic. These include notable

difference in the population age pyramids of USA, European and African countries, slow or low testing rate, low records of hospital reporting the disease, relatively high temperature and high humidity and high consumption of antioxidant food/fruit substances[25]. Because of the density of the virus in tropical Africa, it cannot travel far. Hence, the recommendation of two meters of social distancing rule does not apply because the virus cannot go far. Africans food contents also raised the diet factor. African foods have a lot of zinc, vitamin C and other antioxidants. They take all these on a daily basis without even thinking about it[25]. They also take a lot of phyto medicines which contains a lot of antioxidant[30].

Evolutionary or adaptive immune response to the virus may also have immensely contributed to low infectious and mortality case in Africa. The African-American population is more affected by COVID-19 when compared to other Americans in the USA[30,31,32,33]. Therefore, it is unlikely to be genetic, but more likely related to the environment. A study showed that children in low- and middle-income countries experience a high incidence of infectious disease in their first years of life[34,35,36,37]. Babraham Institute (2020) studied immune responses of African children compared to Dutch children. They found that the immune systems of African children develop faster than those of Dutch children[38]. Exposure to germs in childhood may have helped to strengthen the immune system and protect children from developing allergies, asthma and other infectious diseases, on subsequence exposure to the same/similar allergen/pathogen or cross allergen/pathogen. This supports the 'hygiene hypothesis'[39,40,41,42], which contends that such diseases are more common in the developed world where the prevalence of antibiotics and antibacterial reduce children's exposure to microbes[43,44,45]. Thus, early exposure to some diseases in Africa may have resulted in a more robust innate and/or adaptive immune response. As a result countries in Africa are both vulnerable and potentially more resilient to the corona virus.

The immune system is a host defense system comprising many biological structures and processes within an organism that protects against disease[46]. To function properly, an immune system must detect a wide variety of agents, known as pathogens, from viruses to parasitic worms, and distinguish them from the organism's own healthy tissue. The immune system protects its host from infection with layered defenses of increasing specificity. In simple terms, physical barriers prevent pathogens such as bacteria and viruses from entering the organism[47]. If a pathogen breaches these barriers, the innate immune system provides an immediate, but non-specific response. Innate immune systems are found in all plants and animals. The innate response is usually triggered when microbes are identified by pattern recognition receptors, which recognize components that are conserved among broad groups of microorganisms,[48] or when damaged, injured or stressed cells send out alarm signals, many of which (but not all) are recognized by the same receptors as those that recognize pathogens.[49] Innate immune defenses are non-specific, meaning these systems respond to pathogens in a generic way.[50] This system does not confer long-lasting immunity against a pathogen.[50]

If pathogens successfully evade the innate response, vertebrates possess a second layer of protection, the adaptive immune system, which is activated by the innate response. Here, the immune system adapts its response during an infection to improve its recognition of the pathogen. This improved response is then retained after the pathogen has been eliminated, in the form of an immunological memory, and allows the adaptive immune system to mount faster and stronger attacks each time this pathogen is encountered. The adaptive immune system evolved in early vertebrates and allows for a stronger immune response as well as immunological memory, where each pathogen is "remembered" by a signature antigen.[50] The adaptive immune response is antigen-specific and requires the recognition of specific non-self antigens during a process called antigen presentation. Antigen specificity allows for the generation of responses that are tailored to specific pathogens or pathogen-infected cells. The ability to mount these tailored responses is maintained in the body by memory cells.[47,50]

CONCLUSION

This is a unique study because the virus is new in many aspects. The study was focused on effect of COVID-19 on countries in Africa. African countries maybe more exposed to the virus, but they do not appear to be significantly affected by it. Many factors may have contributed to low case and mortality, such as the population age pyramids, relatively high temperature and high humidity, high consumption of antioxidant food/fruit substances, evolutionary and/or adaptive immune response. Also, Africa is home to several viral diseases such as dengue fever, small pox, chicken pox, measles, Ebola and polio disease some of which the body system has developed and evolved a way to cope with. This may have resulted in direct or indirect cross immune response/defense that is beneficial on exposure to same, similar or different viral infection including corona virus disease.

Also, the communal system and poor government health regulation in Africa would have allowed for rapid transmission of the virus from person(s) to person(s) within the shortest possible time. This means most Africans may have been exposed to the virus without showing noticeable symptoms and may have recovered, but very few people have shown symptom to it. Therefore, there is need for COVID-19 antibody testing, which will reveal the true picture of who has been exposed than the current antigen testing which only provides active disease information.

The Dynamics of Differential Impacts of COVID-19 on African Countries Compared to Other Parts of the World

The study also shows that Africa need vaccine, but vaccination may relatively not be an emergency when compared to western world because most individuals in Africa countries may have been naturally and unconsciously inoculated.

Recommendation

More studies and surveys need to be conducted to understand why and how primarily the virus affects Africa and it significances to Africa and maybe the world.

CONFLICT OF INTEREST

The authors declare that there are not any potential conflicts of interest.

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