

GLOBAL EXCESS CASES AND DEATHS OF MALARIA

in 2020 during the COVID-19 pandemic

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Global Excess Cases and Deaths of Malaria in 2020 during the COVID-19 Pandemic^[1]

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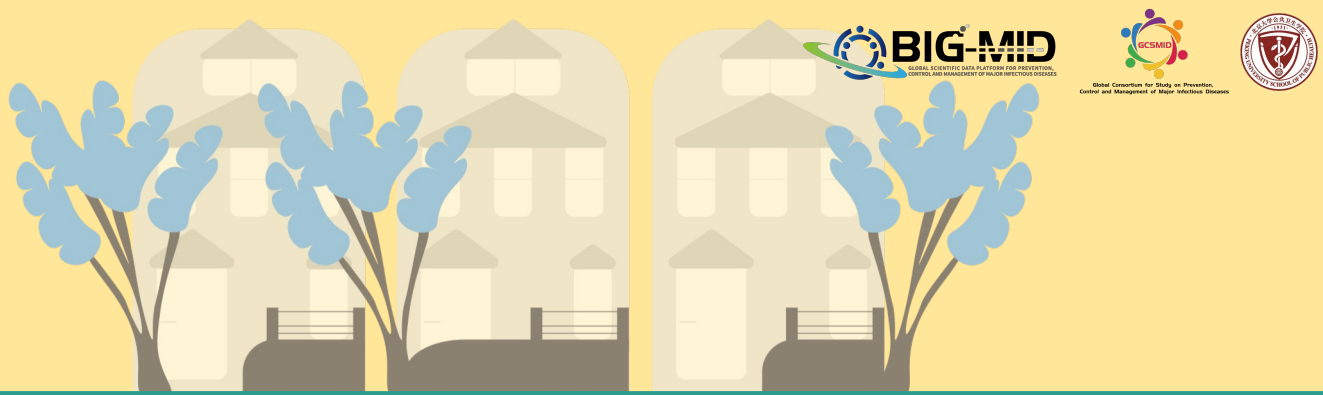
BACKGROUND

There was excess burden of malaria as a result of disruption to health services of malaria due to the COVID-19 pandemic, yet there remains lack of comprehensive global landscape of indirect malaria consequences of the COVID-19 pandemic. We aimed to assess the excess burden of malaria in malaria-endemic countries in 2020 due to the COVID-19 pandemic.

Despite being preventable and curable, malaria is still considered a major public health problem and have a devastating impact on people's health and livelihoods all over the world, especially in malaria-endemic countries. World Health Organization (WHO) reported that an estimated 241 million malaria episodes occurred worldwide in 2020, an additional 14 million episodes compared with 2019; and most of them were in the WHO African Region (95%). [2] WHO also reported an estimated 627000 malaria deaths in 2020, a 12% increase from 2019, with children under the age of 5 accounting for 77% of all malaria deaths across the world. [2] The increase of malaria episodes and deaths in 2020 compared with 2019 worried the world. The Global Technical Strategy for Malaria 2016 to 2030 (GTS), proposed by WHO in 2015, set its first milestone in 2020 to reduce malaria incidence and mortality rates by at least 40%, compared with 2015; however, the progress had stalled or trends were in the wrong direction for global malaria incidence and mortality. [3,4] A previous study demonstrated increasing trends in malaria age-standardized incidence rate (ASIR) in countries with high-middle, middle

and low-middle Socio-demographic Index, and the uptrends remained in 2019. [5] This study also raised concerns that 40 countries had a higher ASIR in 2019 than in 2015. [5]

As was firstly reported in 2019, coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and its various emerging variants, is posing a very high health threat in sustained pandemic waves. To date, there were 635 million confirmed cases and 6.61 million deaths caused by COVID-19 reported all over the world. [6] The COVID-19 pandemic was declared to be a global health emergency by WHO, and has created enormous strain on health systems globally. [7,8] There was increasing evidence showing that the COVID-19 pandemic has impacted adversely on the provision of a wide range of essential health services, especially in low- and middle-income countries. [9-11] Significant disruption to the prevention, diagnoses, treatment and management of tuberculosis, HIV and dengue fever due to the COVID-19 pandemic in certain countries was observed in previous study. [7]



Meanwhile, health services of malaria were also adversely impacted by the COVID-19 pandemic according to previous studies. It was reported that malaria diagnoses fell 56% and malaria treatment services plummeted by 59% in Bangladesh, Cambodia, India, Indonesia, Lao, Pakistan and the Philippines, for April to September 2020, compared with the same period in 2019. [12] As a result, malaria burden in 2020 was worrisome. Modelling study had shown if malaria prevention activities were halted, the malaria burden in 2020 could be more than double that of 2019. [13] Compared to the same period in 2017, 2018 and 2019, there was an excess of over 30,000 malaria cases from January to June 2020 in Zimbabwe. [14] Moreover, another modelling analysis found that under pessimistic scenarios, malaria mortality in Africa could be almost doubled due to COVID-19-related disruption to malaria control. [15] An estimated 68% of the additional malaria deaths in 2020 compared with 2019 were due to health service disruptions during the COVID-19 pandemic. [2]

Although previous studies showed excess burden of malaria as a result of disruption to health services of malaria due to the COVID-19 pandemic, there remains lack of comprehensive global landscape of indirect malaria consequences of the COVID-19 pandemic. With the health service disruptions, government policy responses and all other societal issues under the COVID-19 pandemic, the progress of malaria cases and deaths, at the global level, could be derailed. Therefore, in this study, we aimed to assess the excess incidence and mortality of malaria in malaria-endemic countries in 2020 during the COVID-19 pandemic, using malaria data from WHO Global Health Observatory Dataset. Our findings can serve as an extension and complement to previous studies and help improve understanding of the indirect malaria consequences of the pandemic. We also expect to draw attention to the need for sustained efforts to control malaria amidst the pandemic and meet the goal of global malaria elimination.

FINDING: Excess cases

Globally, during the COVID-19 pandemic in 2020, the total excess number of malaria cases was 18.0 million, and there was a total of 83,291 excess malaria deaths across the world in 2020.

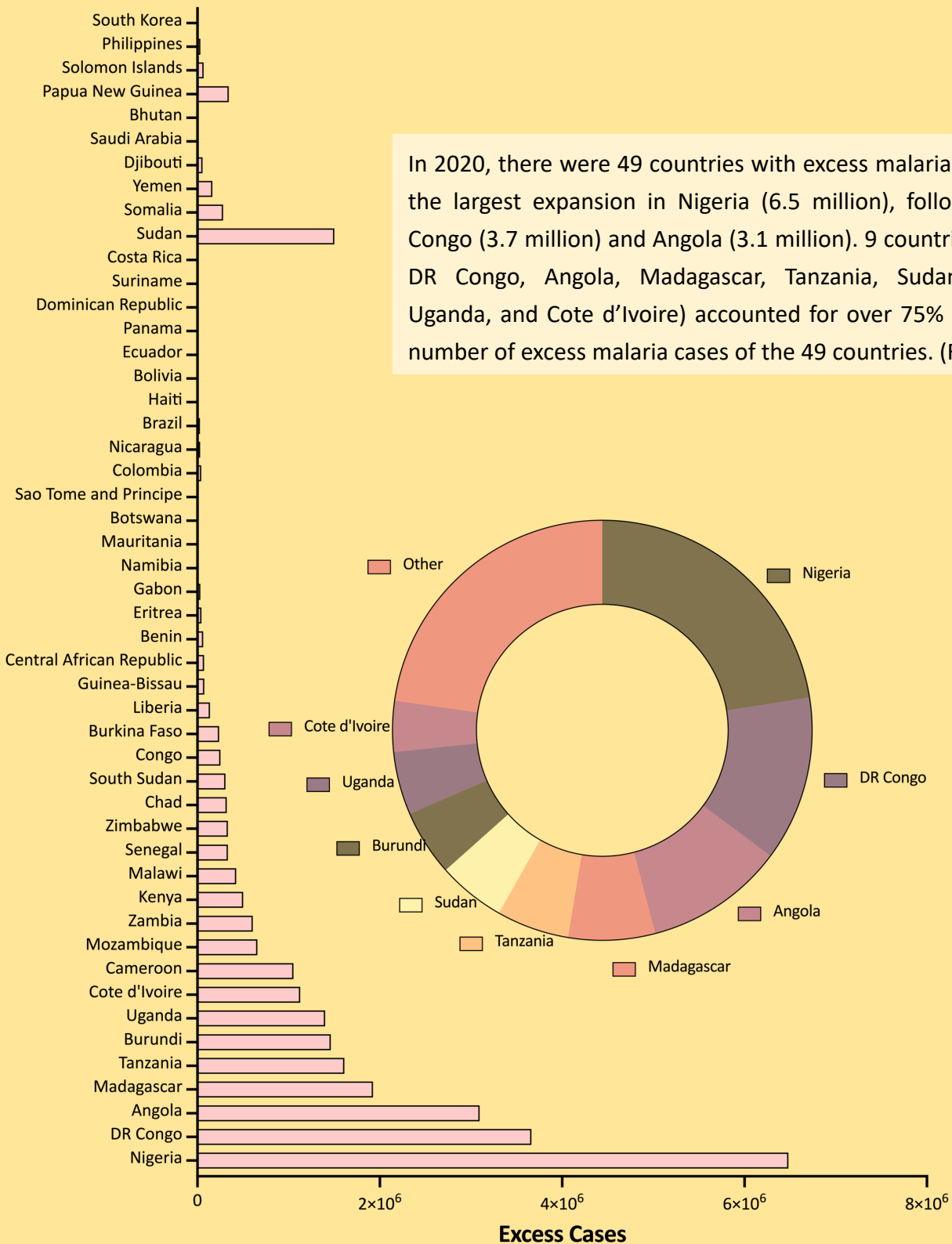


Figure 1. Number of excess malaria cases in 49 countries

Reduced cases

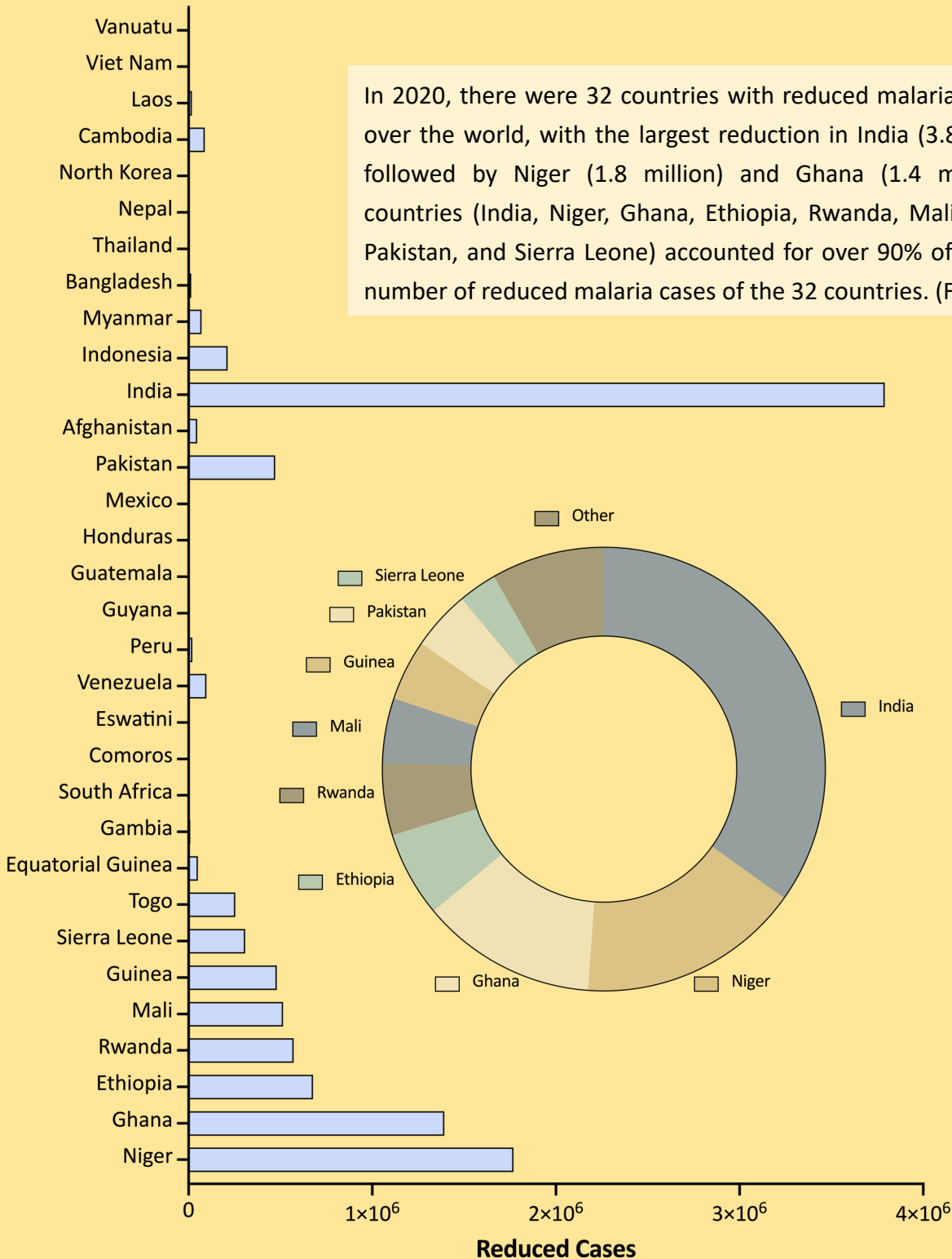


Figure 2. Number of reduced malaria cases in 32 countries

Excess deaths

In 2020, there were 38 countries with excess malaria deaths all over the world, with the largest expansion in Nigeria (29,832 excess deaths), followed by DR Congo (16,391 excess deaths) and Tanzania (5,958 excess deaths). 9 countries (Nigeria, DR Congo, Tanzania, Uganda, Mozambique, Angola, Cameroon, Mali, and Cote d'Ivoire) accounted for over 85% of the total number of excess malaria deaths of the 38 countries. (Figure 3)

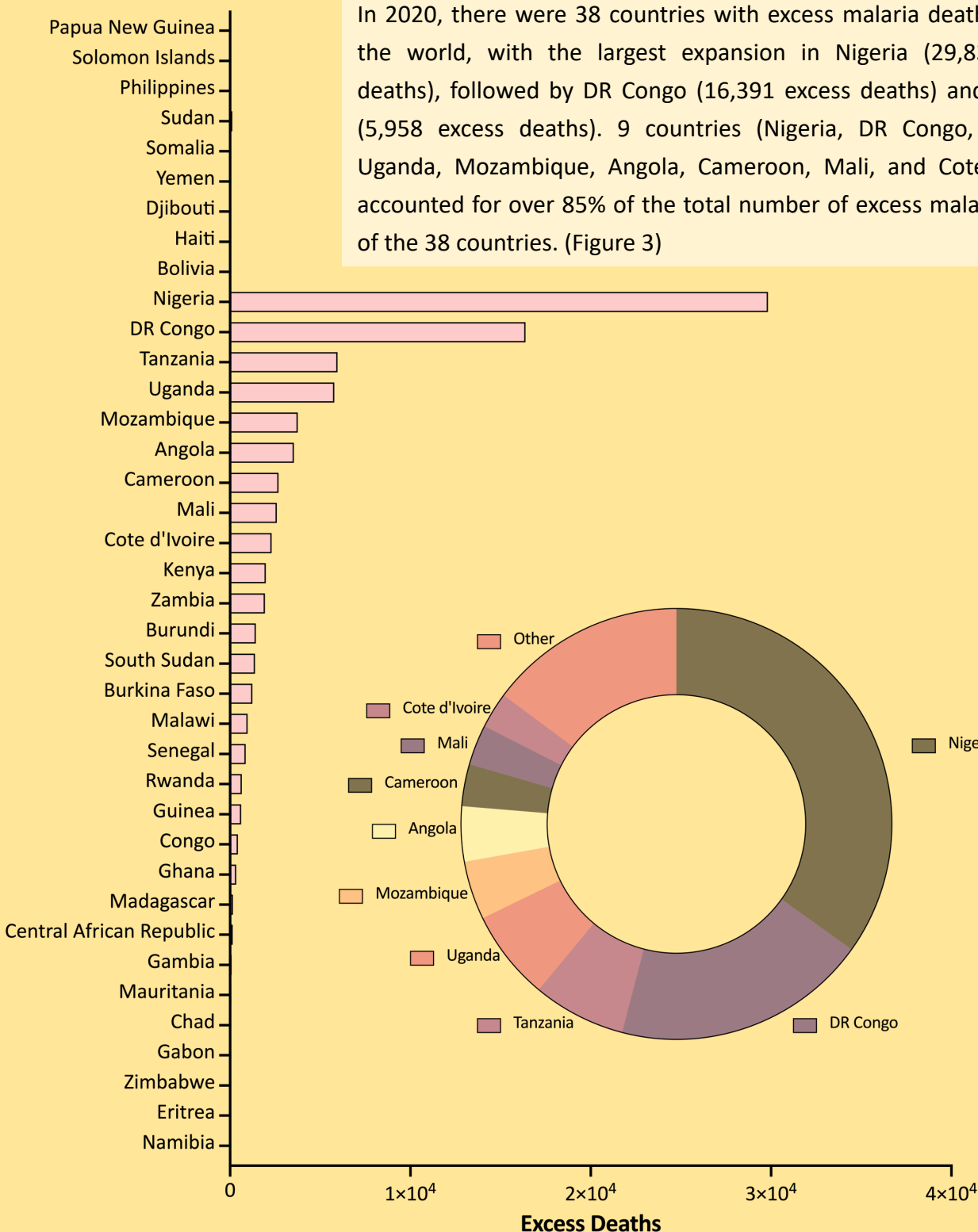


Figure 3. Number of excess malaria deaths in 38 countries

Reduced deaths

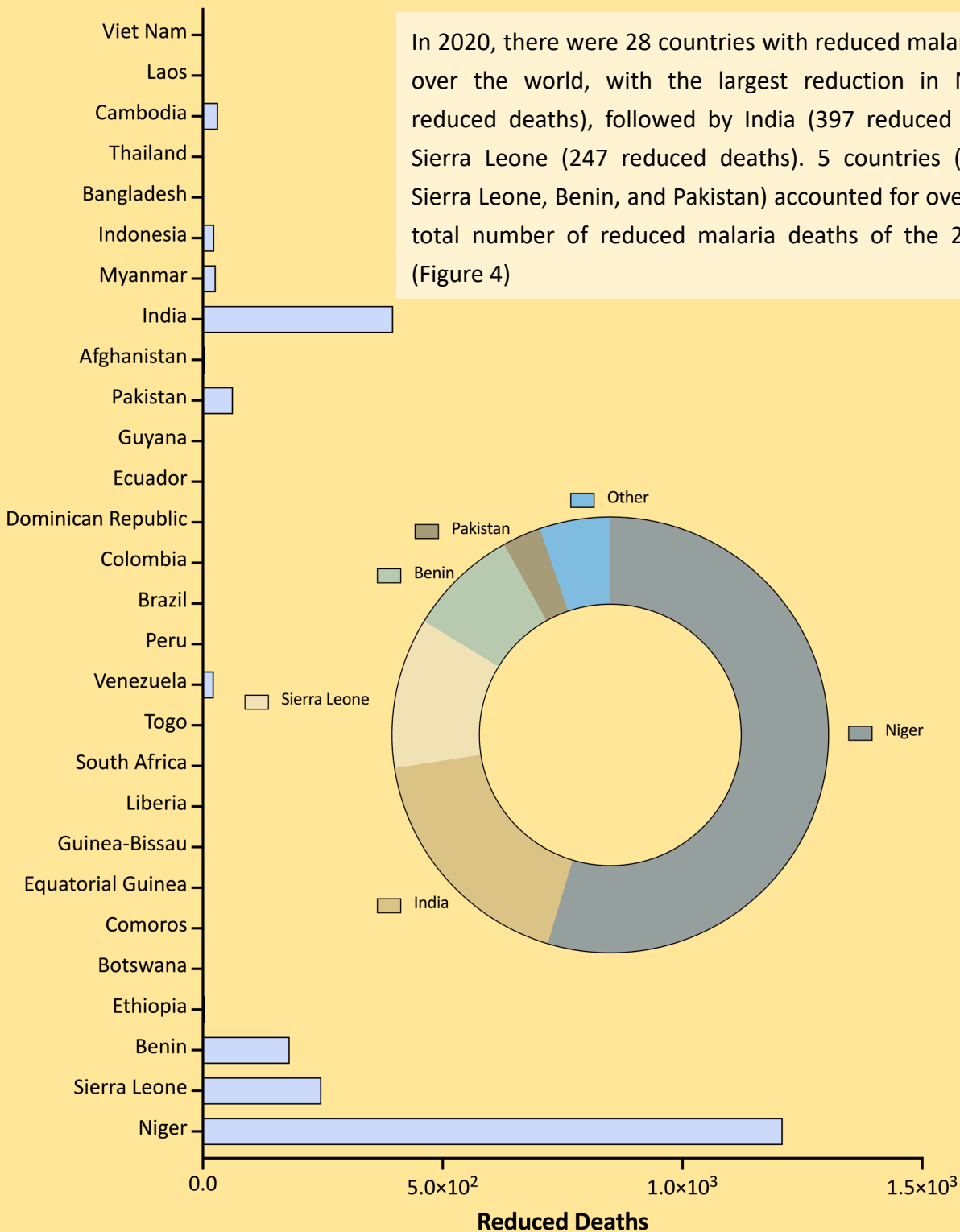
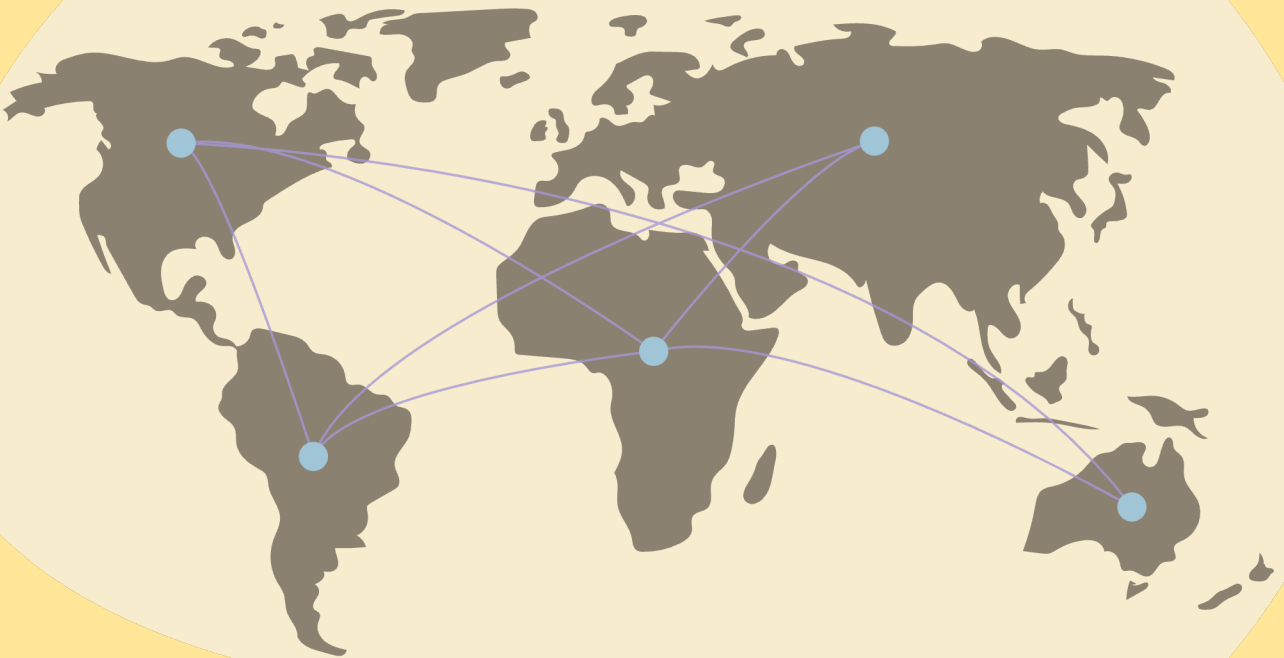


Figure 4. Number of reduced malaria deaths in 28 countries

CONCLUSIONS

Since 2015, the progress had stalled or trends were in the wrong direction for the malaria incidence and mortality at the global level. The emergence of the COVID-19 pandemic additionally complicated the prevalence of malaria and progress in malaria control. In 2020, there were millions of excess malaria cases and tens of thousands of excess malaria deaths all over the world during the COVID-19 pandemic. Global efforts to control the impact of the COVID-19 pandemic should be balanced with the control of malaria, in order to accomplish the GTS global malaria elimination goal.



APPENDIX 1

Table: Number of reported and estimated cases of malaria and their differences

Region	Location	Reported Number of cases in 2020	Estimated Number of cases in 2020	Difference
Africa	Angola	8268572	5173694	3094878
	Benin	4707522	4643013	64509
	Botswana	1759	463	1296
	Burkina Faso	8150690	7911061	239629
	Burundi	3506219	2044237	1461982
	Cameroon	6900814	5846507	1054307
	Central African Republic	1622774	1549584	73190
	Chad	3351197	3028800	322397
	Comoros	4546	4949	-403
	Congo	1176331	923764	252567
	Cote d'Ivoire	7571801	6444254	1127547
	DR Congo	29036471	25372267	3664204
	Equatorial Guinea	337892	388563	-50671
	Eritrea	158889	113434	45455
	Eswatini	233	276	-43
	Ethiopia	4231328	4908606	-677278
	Gabon	479563	447005	32558
	Gambia	210897	220326	-9429
	Ghana	5060166	6453021	-1392855
	Guinea	4196430	4676543	-480113
	Guinea-Bissau	174987	99480	75507
	Kenya	2738383	2237205	501178
	Liberia	1810880	1672219	138661
	Madagascar	3695590	1770226	1925364
	Malawi	4370301	3945667	424634
	Mali	7238665	7752541	-513876
	Mauritania	139446	129152	10294
	Mozambique	10007802	9350933	656869
	Namibia	20258	9008	11250
	Niger	7845520	9614616	-1769096
	Nigeria	64677959	58195148	6482811
	Rwanda	2986047	3557691	-571644
	Sao Tome and Principe	1933	1321	612
	Senegal	836014	500511	335503
	Sierra Leone	2617968	2925766	-307798
	South Africa	4463	5497	-1034
	South Sudan	3211331	2904355	306976
	Togo	1894656	2149165	-254509
	Uganda	12982097	11582009	1400088
	Tanzania	7178459	5565525	1612934
	Zambia	3435936	2828444	607492
	Zimbabwe	1152901	818858	334043

APPENDIX 1

Table: (continued)

Region	Location	Reported Number of cases in 2020	Estimated Number of cases in 2020	Difference
Americas	Bolivia	16506	6389	10117
	Brazil	167097	139631	27466
	Colombia	105995	65062	40933
	Costa Rica	90	3	87
	Dominican Republic	1019	696	323
	Ecuador	1934	220	1714
	Guatemala	1241	2277	-1036
	Guyana	22159	24450	-2291
	Haiti	38078	26123	11955
	Honduras	1098	1254	-156
	Mexico	356	367	-11
	Nicaragua	33244	3255	29989
	Panama	2306	604	1702
	Peru	29745	50368	-20623
	Suriname	147	28	119
	Venezuela	231743	329579	-97836
Eastern Mediterranean	Afghanistan	253158	299965	-46807
	Djibouti	72332	16812	55520
	Pakistan	542960	1014373	-471413
	Saudi Arabia	83	18	65
	Somalia	829649	548578	281071
	Sudan	3218465	1715814	1502651
	Yemen	780106	616693	163413
South-East Asia	Bangladesh	7545	22467	-14922
	Bhutan	22	3	19
	North Korea	1819	2932	-1113
	India	4148253	7939413	-3791160
	Indonesia	784854	998407	-213553
	Myanmar	82434	153037	-70603
	Nepal	245	1610	-1365
	Thailand	3007	6033	-3026
Western Pacific	Cambodia	69136	157150	-88014
	Laos	5674	23676	-18002
	Papua New Guinea	1470120	1125364	344756
	Philippines	43023	11135	31888
	South Korea	356	328	28
	Solomon Islands	114019	45545	68474
	Vanuatu	910	1223	-313
	Viet Nam	1657	3317	-1660

APPENDIX 2

Table: Number of reported and estimated deaths of malaria and their differences

Region	Location	Reported Number of deaths in 2020	Estimated Number of deaths in 2020	Difference
Africa	Nigeria	151000	121168	29832
	DR Congo	53300	36909	16391
	Tanzania	23100	17142	5958
	Uganda	16500	10716	5784
	Mozambique	16100	12344	3756
	Angola	9990	6454	3536
	Cameroon	12300	9612	2688
	Mali	15000	12407	2593
	Cote d'Ivoire	12200	9897	2303
	Kenya	11400	9418	1982
	Zambia	7820	5885	1935
	Burundi	4730	3297	1433
	South Sudan	4370	2987	1383
	Burkina Faso	14300	13057	1243
	Malawi	6150	5170	980
	Senegal	4270	3404	866
	Rwanda	2840	2187	653
	Guinea	7760	7147	613
	Congo	1920	1483	437
	Ghana	11200	10855	345
	Madagascar	300	139	161
	Central African Republic	2940	2796	144
	Gambia	560	474	86
	Mauritania	1350	1277	73
	Chad	9340	9288	52
	Gabon	330	289	41
	Zimbabwe	79	56	23
	Eritrea	13	7	6
	Namibia	1	0	1
	Botswana	0	0	0
	Comoros	0	0	0
	Equatorial Guinea	0	0	0
	Guinea-Bissau	0	0	0
	Liberia	0	0	0
	South Africa	0	0	0
	Togo	0	0	0
	Ethiopia	380	384	-4
	Benin	8420	8601	-181
	Sierra Leone	6190	6437	-247
	Niger	10800	12009	-1209

APPENDIX 2

Table: (continued)

Region	Location	Reported Number of deaths in 2020	Estimated Number of deaths in 2020	Difference
Americas	Bolivia	2	1	1
	Haiti	2	1	1
	Brazil	0	0	0
	Colombia	0	0	0
	Dominican Republic	0	0	0
	Ecuador	0	0	0
	Guyana	2	2	0
	Peru	4	6	-2
	Venezuela	37	60	-23
Eastern Mediterranean	Sudan	260	140	120
	Somalia	57	38	19
	Yemen	63	50	13
	Djibouti	9	2	7
	Afghanistan	41	45	-4
	Pakistan	91	154	-63
South-East Asia	Bangladesh	0	0	0
	Thailand	0	0	0
	Indonesia	98	122	-24
	Myanmar	12	39	-27
	India	510	907	-397
Western Pacific	Papua New Guinea	160	126	34
	Solomon Islands	17	8	9
	Philippines	3	1	2
	Laos	0	0	0
	Viet Nam	0	0	0
	Cambodia	10	42	-32

METHODS

DATA COLLECTION

Malaria incidence and mortality data were obtained in the WHO Global Health Observatory Dataset. [16] We extracted annual malaria incidence and mortality data by countries with their 95% Uncertainty Intervals (UIs) from 2000 to 2020.

The general methodological approaches to estimate the malaria burden were described elsewhere. [2] Briefly, different methods were used to estimate countries with different malaria transmission status. For the estimation of malaria cases, three different methods were used in the following conditions: 1) countries and areas outside the WHO African Region, and low transmission countries and areas in the African Region; 2) high transmission countries in the WHO African Region, and countries in the WHO Eastern Mediterranean Region in which the quality of surveillance data did not permit a robust estimate from the number of reported cases; and 3) elimination countries and countries at the stage of prevention of reintroduction. For the estimation of malaria deaths, three different methods were also used in the following conditions: 1) low transmission countries and areas, both within and outside Africa; 2) countries in the WHO African Region with a high proportion of deaths due to malaria; and 3) the number of indigenous malaria deaths registered by national malaria programs is reported without further adjustments. [2]

STATISTICAL ANALYSES

Estimated annual percentage change (EAPC) was widely used to quantify the rate trend over a specific interval. A regression line was fitted to the natural logarithm of the rates ($y = \alpha + \beta x + \varepsilon$, where $y = \ln(\text{rate})$ and $x = \text{calendar year}$). EAPC was calculated as $100 \times (e^{\beta} - 1)$, with 95% confidence intervals (CIs) obtained from the linear regression model. In this study, overall EAPC was calculated by the annual incidence and mortality rates of malaria in malaria-endemic countries. We calculated the EAPCs using malaria incidence and mortality rates from 2000 to 2019.

We fitted the calendar year 2020 into the regression lines, and predicted the malaria incidence and mortality rates in 2020. Incidence rate ratio (IRR) and mortality rate ratio (MRR) were calculated by the formula:
$$\frac{\text{Incidence (Mortality) rates in 2020 reported by WHO}}{\text{Predicted incidence (Mortality) rates in 2020}}$$
. We estimated the predicted malaria cases and deaths in 2020 by the formula:
$$\frac{\text{Cases or Deaths in 2020 reported by WHO}}{\text{IRR or MRR}}$$
. Then we compared the predicted malaria data with actual malaria data reported by WHO to see the indirect malaria consequences of the COVID-19 pandemic.

All the statistical analyses were performed using the R program (version 4.4.1).

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