

Proportionate Target Population Estimates Used by National Immunization Programmes in Sub-Saharan Africa and Comparison with Values from an External Source

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Abstract

Background: In order to effectively plan the delivery of immunization services, manage stock and supply levels and target interventions, national immunization programmes (NIP) must have an estimate of the target population they serve. To overcome challenges with target population estimation, some NIPs apply “rule-of-thumb” conversion factors to total population estimates. We compare these proportionate target population values with those from an external source. **Methods:** Using data reported by national immunization programmes in sub-Saharan Africa, we computed the proportionate target population as the number of births, surviving infants and children under 5 years of age, respectively, as a proportion of the total population size. We compared these values with those estimates computed from United Nations Population Division (UNPD) data. We then recomputed NIP target population sizes using the proportionate target population values from the UNPD applied to the total population size reported by NIP. **Results:** Data were available from 47 sub-Saharan Africa countries. Births as a proportion of the total population were greater within reports from NIP (median, 0.0400; IQR: 0.0350 - 0.0437) compared to values from UNPD estimates (median, 0.0364; IQR: 0.0332 - 0.0406). Similar patterns were observed for surviving infants (median: NIP, 0.0360; UNPD, 0.0337) and children under 5 years of age (median: NIP, 0.1735; UNPD, 0.1594). The percent difference in proportionate target population ratios between reports from NIPs and the UNPD was >10% in 23 countries for births, in 18 countries for surviving infants,

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in 15 countries for children under 5 years of age. After re-computing target populations using UNPD proportionate target population values applied to NIP reported total population, recomputed administrative coverage levels for the third dose of DTP containing vaccine were higher in 32 of the 47 countries compared to reported administrative coverage levels. Conclusion: Because childhood immunization-related target populations are among the more difficult ones to accurately estimate and project, immunization programmes in sub-Saharan Africa are encouraged to include a critical assessment of the target population values, in conjunction with their national statistics system, as part of the on-going programme monitoring process.

Keywords

Population, Population Estimates, Target Population, Immunization, Immunization Coverage

1. Introduction

National immunization programmes are responsible for protecting children from vaccine preventable diseases. To effectively plan the delivery of immunization services, manage stock and supply levels and target interventions, programme managers must have an estimate of the target population they serve, which in most instances consists of the number of births, surviving infants and children under 5 years of age. However, accurate estimates for these population groups are extremely difficult to obtain in many settings, particularly in countries where the last census was more than 10 years ago (*i.e.*, Angola, Central African Republic, Comoros, Democratic Republic of Congo, Equatorial Guinea, Eritrea, Madagascar, Somalia, Uganda) [1].

To overcome this challenge, some national immunization programmes apply “rule-of-thumb” conversion factors to total population estimates, which are relatively more accurate than subnational or age-specific estimates, to obtain an estimated number of births, surviving infants and children under 5 years. These rule-of-thumb conversion factors represent proportionate target population values. The proportionate target population is the number of births (or surviving infants or children under 5 years) as a proportion of the total population size. A quick review of proportionate target population values computed from United Nations Population Division (UNPD) estimates and projections for all countries and territories as well as for sub-Saharan Africa highlight differences in magnitude and declines since the beginning of the Expanded Programme on Immunization in 1974 (Figure 1).

In this report we examine and describe proportionate target population values computed from national-level population data for 2013 reported by national immunization programmes in sub-Saharan Africa. We compared the values based on nationally reported data with those computed from UNPD estimates. We also recomputed target population sizes using the national proportionate target population values from the UNPD applied to the total population size reported by national immunization programmes. Finally, we recomputed coverage levels for the third dose of DTP containing vaccine (DTP₃) to examine the impact of differences in the proportionate target population values for sub-Saharan African countries reporting to the World Health Organization (WHO) and United Nations Children’s Fund (UNICEF).

2. Methods

2.1. Immunization Target Population Data and Comparisons with an External Data Source

Each year WHO and UNICEF jointly collect national-level data on the incidence of selected vaccine-preventable diseases, immunization coverage, recommended immunization schedules, vaccine supply and other information on the structure, policies and performance of national immunization systems through the WHO/UNICEF Joint Reporting Form on Immunization (JRF). (Since 2000, more than 95% of WHO Member States have reported annually.) As part of this annual reporting exercise, national authorities also report the estimated number of children vaccinated according to administrative data (*i.e.*, reports from health service providers) and the number of children in the national target population for each antigen in the national immunization schedule.

During 2014, countries from the WHO African Region reported the number of live births, surviving infants,

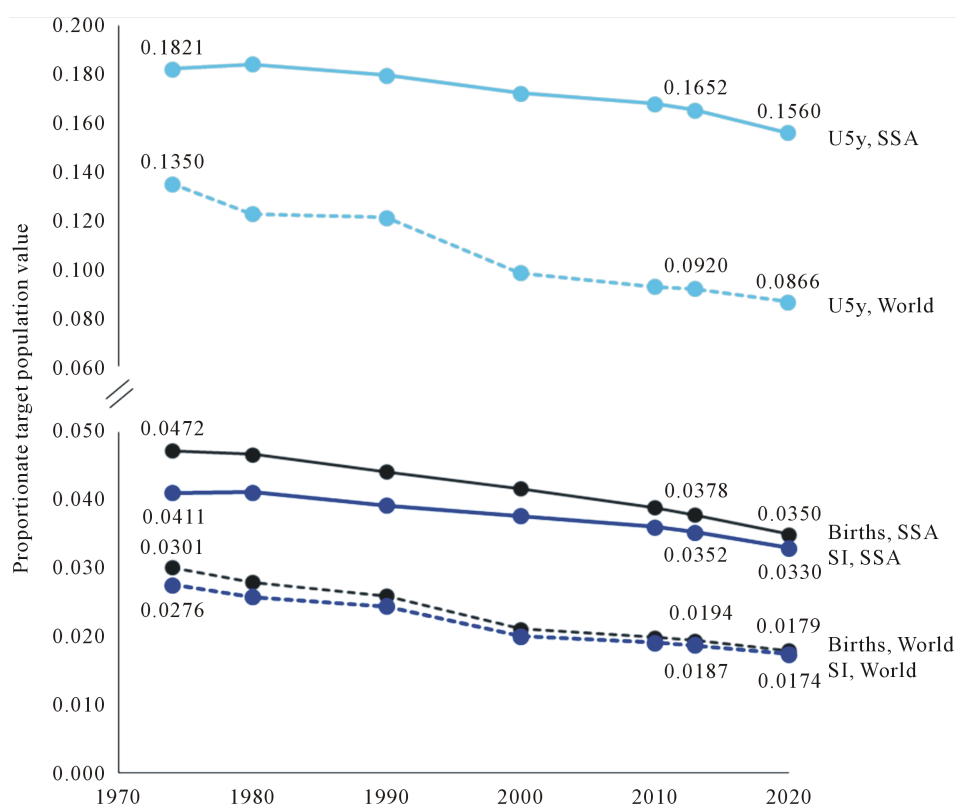


Figure 1. Proportionate target population values for births, surviving infants (SI) and children under 5 years (U5y) computed from UNPD estimates and projections for sub-Saharan Africa (SSA) and all countries, 1974-2020. Data source: United Nations, Department of Economic and Social Affairs, Population Division (2013). *World population prospects: The 2012 Revision*.

children under 5 years of age and total population size used by the national immunization programme during 2013 on the WHO/UNICEF Joint Reporting Form. The appropriate target population for vaccines administered at birth (e.g., Bacille Calmette-Guérin or BCG; Hepatitis B birth dose) is the estimated number of live births in the country. For other vaccines, the target population most often used for computing coverage is the number of surviving infants. (NB. Some countries use the number of live births as the official denominator for computing coverage levels. Historically, countries with high infant mortality have chosen not to use the number of live births as a target population for vaccines administered after birth since an immunization programme's performance might not be accurately reflected in the presence of high infant mortality even if the programme was vaccinating each and every child that survived.) And, vaccination campaigns (e.g., measles) often target children under 5 years of age.

We abstracted the national number of live births, surviving infants, children under 5 years of age and total population size for the 2013 reporting period as well as the national number of children vaccinated with three doses of DTP containing vaccine (DTP₃) obtained from national routine administrative data systems. Administrative data are based on aggregated reports from service providers to local health authorities of the number of vaccinations administered during a given period.

We also abstracted the national number of births, surviving infants, children under 5 years of age and total population size from public use files provided by the UNPD [2]. For both the nationally reported population data and that obtained from the UNPD, we divided the number of births by the total population size to obtain births as a proportion of the total population. We repeated this process for surviving infants and children under 5 years. We then computed the percent difference in the national proportionate target population values for births, surviving infants and children under 5 years between the nationally reported values compared to those computed from UNPD data.

2.2. Application of Proportionate Target Population and Implications for Coverage

To examine changes in coverage if one used the UNPD-based national proportionate target population values, we multiplied the total national population size reported by the national immunization programme by the proportionate target population values from the UNPD to obtain a recomputed national number of births, surviving infants and children under 5 years, respectively, for each country. Using the recomputed number of surviving infants as denominator and the nationally reported number of children vaccinated, we recomputed coverage for DTP₃. We then compared the recomputed coverage level with the administrative coverage reported by national immunization programmes and describe the observed differences.

3. Results

3.1. Total Population

Data were available for 47 countries. Sudan, although geographically located in sub-Saharan Africa, reports to the WHO Regional Office for the Eastern Mediterranean rather than the WHO Regional Office for Africa and therefore total population size and the number of children under 5 years was not reported by the Sudan immunization programme to WHO or UNICEF for this exercise. Somalia, geographically located in sub-Saharan Africa reporting to the WHO Regional Office for the Eastern Mediterranean, was an exception to the annual reporting process and data availability for this exercise as a WHO/UNICEF Joint Reporting Form that provided the total population size and number of children under 5 years was submitted by Somalia through UNICEF.

Relative differences in total population reported by national immunization programmes compared to those estimated by UNPD ranged from 0.2% (Botswana) to 39.7% (Eritrea) with a median percent difference of 5.7% (IQR: 2.7% - 8.2%). The percent difference (absolute value) in total population between the two sources was less than 5% in 22 (47%) of 47 countries and exceeded 15% in five countries (Burundi, 20.7%; Côte d'Ivoire, 17.1%; Democratic Republic of the Congo, 28.1%; Eritrea, 39.7%; Gabon, 20.1%).

3.2. Proportionate Target Population: Births, Surviving Infants, Children under 5 Years

Births as a proportion of the total population based on reports from national immunization programmes ranged from 0.0104 (Mauritius) to 0.0583 (Niger) with a median value of 0.0400 (IQR: 0.0350 - 0.0437) (**Table 1**). Proportionate target population values for births based on UNPD data ranged from 0.0115 (Mauritius) to 0.0499 (Niger) with a median value of 0.0364 (IQR: 0.0332 - 0.0406).

Surviving infants as a proportion of the total population based on reports from national programmes ranged from 0.0179 (Seychelles) to 0.0536 (Niger) with a median value of 0.0360 (IQR: 0.0328 - 0.0402) (**Table 1**). Comoros, Mauritius, Senegal and South Africa reported the number of births for surviving infants rather than a separate value. Surviving infants as a proportion of the total population per UNPD data ranged from 0.0113 (Mauritius) to 0.0473 (Niger) with a median value of 0.0337 (IQR: 0.0312 - 0.0379).

Children under 5 years of age as a proportion of the total population based on reports from national programmes ranged from 0.0567 (Mauritius) to 0.2391 (The Gambia) with a median value of 0.1735 (IQR: 0.1514 - 0.2000) (**Table 1**). In contrast, values based on UNPD data ranged from 0.0564 (Mauritius) to 0.2072 (Niger) with a median value of 0.1594 (IQR: 0.1470 - 0.1759).

The relative (percent) difference between the proportionate target population values, from data reported by the national immunization programmes and those from the UNPD, is shown for each country in **Table 1**. For births, the percent difference (absolute value) in the proportionate target population values ranged from 0.4% (Sao Tome and Principe) to 38.1% (Namibia) with a median value of 9.7% (IQR: 3.2% - 16.9%). The percent difference in proportionate target population for births, comparing values from reported data to those from UNPD estimates, was <10% in 24 (51%) of 47 countries (difference < 0:8 countries; difference > 0:16), 10% - 19.9% in 16 (34%) countries (difference < 0:3; difference > 0:13) and 20% or more in seven (15%) countries (difference < 0:1; difference > 0:6). For surviving infants, the percent difference (absolute value) ranged from 0.4% (United Republic of Tanzania) to 36.2% (Namibia) with a median value of 8.5% (IQR: 2.9% - 13.2%). The percent difference in proportionate target population values for surviving infants was <10% in 29 (62%) of 47 countries (difference < 0:8 countries; difference > 0:21), 10% - 19.9% in 13 (28%) countries (difference < 0:5; difference > 0:8) and 20% or more in five (11%) countries (difference < 0:0; difference > 0:5). Finally for children under 5 years, the percent difference (absolute value) ranged from 0.9% (Rwanda) to 44.6% (Sierra Leone) with

Table 1. Total population estimates and the number of births, surviving infants (SI) and children under 5 years (U5y) as a proportion of total population for 2013 from the United Nations Population Division and national immunization programmes as reported to the World Health Organization and United Nations Children's Fund for 47 sub-Saharan African countries.

Country	UN Population Division (UNPD) Estimates				National Immunization Programme Estimates Reported to WHO and UNICEF				Percent difference in reported proportionate target population estimates compared to UNPD		
	Total pop'n (x1000)	Proportion of total pop'n			Total pop'n (x1000)	Proportion of total pop'n			Births	SI	U5y
		Births	SI	U5y		Births	SI	U5y			
Angola	21,472	0.0442	0.0400	0.1873	22,096	0.0500	0.0425	0.2000	13.1	6.3	6.8
Benin	10,323	0.0365	0.0340	0.1605	9672	0.0412	0.0384	0.1772	13.0	13.2	10.4
Botswana	2021	0.0236	0.0228	0.1146	2025	0.0240	0.0230	0.1216	2.0	0.8	6.1
Burkina Faso	16,935	0.0409	0.0381	0.1761	17,323	0.0437	0.0407	0.1874	6.9	6.8	6.4
Burundi	10,163	0.0448	0.0409	0.1866	8054	0.0529	0.0417	0.2015	18.2	1.8	8.0
Cameroon	22,254	0.0373	0.0346	0.1631	20,896	0.0450	0.0380	0.1690	20.6	9.8	3.6
Cabo Verde	499	0.0202	0.0199	0.0971	512	0.0206	0.0202	0.0981	2.1	1.8	1.1
Central African Republic	4616	0.0342	0.0311	0.1460	4,758	0.0350	0.0304	0.1730	2.2	-2.2	18.5
Chad	12,825	0.0460	0.0416	0.1915	13,770	0.0410	0.0360	0.1820	-10.8	-13.5	-5.0
Comoros	735	0.0352	0.0329	0.1582	764	0.0267	0.0267	0.1600	-24.2	-18.8	1.1
Congo	4448	0.0375	0.0352	0.1660	4413	0.0432	0.0400	0.2000	15.1	13.6	20.5
Côte d'Ivoire	20,316	0.0367	0.0339	0.1573	23,784	0.0362	0.0331	0.1540	-1.2	-2.5	-2.1
Democratic Republic of the Congo	67,514	0.0428	0.0382	0.1764	86,453	0.0400	0.0349	0.1890	-6.5	-8.6	7.2
Equatorial Guinea	757	0.0354	0.0323	0.1517	699	0.0390	0.0354	0.1580	10.1	9.5	4.1
Eritrea	6333	0.0367	0.0352	0.1674	3816	0.0300	0.0287	0.1461	-18.3	-18.7	-12.8
Ethiopia	94,101	0.0331	0.0315	0.1514	86,691	0.0338	0.0316	0.1450	2.2	0.5	-4.2
Gabon	1672	0.0319	0.0305	0.1455	2008	0.0350	0.0329	0.1550	9.7	7.7	6.5
Gambia	1849	0.0428	0.0405	0.1832	1700	0.0481	0.0446	0.2391	12.4	10.1	30.5
Ghana	25,905	0.0309	0.0293	0.1419	26,594	0.0400	0.0380	0.2000	29.6	29.7	40.9
Guinea	11,745	0.0369	0.0343	0.1606	11,814	0.0400	0.0360	0.2000	8.3	5.1	24.5
Guinea-Bissau	1704	0.0375	0.0340	0.1583	1693	0.0370	0.0310	0.1700	-1.4	-8.9	7.4
Kenya	44,354	0.0349	0.0332	0.1589	42,436	0.0381	0.0341	0.1604	9.1	2.8	0.9
Lesotho	2074	0.0275	0.0259	0.1261	1909	0.0283	0.0274	0.1369	2.9	6.1	8.5
Liberia	4294	0.0354	0.0333	0.1598	3857	0.0430	0.0401	0.1700	21.5	20.5	6.4
Madagascar	22,925	0.0348	0.0335	0.1573	23,506	0.0353	0.0333	0.1800	1.6	-0.8	14.4
Malawi	16,363	0.0398	0.0364	0.1754	15,317	0.0437	0.0410	0.1735	9.6	12.5	-1.1
Mali	15,302	0.0473	0.0432	0.1928	16,807	0.0443	0.0401	0.2000	-6.2	-7.2	3.7
Mauritania	3890	0.0341	0.0317	0.1502	3414	0.0440	0.0406	0.1800	29.1	28.3	19.8
Mauritius	1244	0.0115	0.0113	0.0564	1296	0.0104	0.0104	0.0567	-9.0	-7.9	0.6
Mozambique	25,834	0.0389	0.0361	0.1703	24,366	0.0430	0.0402	0.1710	10.5	11.6	0.4
Namibia	2303	0.0261	0.0252	0.1234	2173	0.0360	0.0343	0.1400	38.1	36.2	13.4

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Niger	17,831	0.0499	0.0473	0.2072	16,838	0.0583	0.0536	0.1879	16.9	13.4	-9.3
Nigeria	173,615	0.0413	0.0382	0.1759	175,075	0.0400	0.0376	0.1993	-3.2	-1.6	13.3
Rwanda	11,777	0.0352	0.0335	0.1648	10,811	0.0310	0.0295	0.1650	-11.9	-12.0	0.1
Sao Tome and Principe	193	0.0339	0.0324	0.1591	173	0.0340	0.0330	0.1500	0.4	1.8	-5.7
Senegal	14,133	0.0378	0.0360	0.1683	13,575	0.0390	0.0390	0.1940	3.2	8.5	15.3
Seychelles	93	0.0165	0.0164	0.0769	90	0.0175	0.0179	0.0824	6.0	9.2	7.1
Sierra Leone	6092	0.0366	0.0324	0.1535	6190	0.0400	0.0364	0.2220	9.1	12.4	44.6
Somalia	10,496	0.0439	0.0404	0.1865	9561	0.0400	0.0357	0.2000	-8.9	-11.8	7.3
South Africa	52,776	0.0208	0.0200	0.1030	52,982	0.0205	0.0205	0.0999	-1.6	2.3	-3.0
South Sudan	11,296	0.0360	0.0332	0.1581	11,196	0.0400	0.0359	0.2100	11.2	8.1	32.9
Swaziland	1250	0.0298	0.0279	0.1364	1100	0.0357	0.0288	0.1302	19.6	3.1	-4.5
Togo	6817	0.0364	0.0340	0.1604	6614	0.0450	0.0415	0.2000	23.5	21.9	24.9
Uganda	37,579	0.0433	0.0408	0.1893	35,189	0.0485	0.0430	0.2050	12.1	5.3	8.3
United Republic of Tanzania	49,253	0.0392	0.0373	0.1758	47,163	0.0395	0.0375	0.1761	0.7	0.4	0.2
Zambia	14,539	0.0430	0.0402	0.1827	14,204	0.0500	0.0465	0.2000	16.3	15.6	9.5
Zimbabwe	14,150	0.0315	0.0303	0.1443	13,205	0.0369	0.0328	0.1514	17.0	8.2	4.9

UNPD data obtained from United Nations, Department of Economic and Social Affairs, Population Division (2013). *World Population Prospects: The 2012 Revision*.

a median value of 7.1% (IQR: 3.7% - 13.4%). The percent difference in proportionate target population values for children under 5 years was <10% in 32 (68%) of 47 countries (difference < 0:8 countries; difference > 0:24), 10% - 19.9% in eight (17%) countries (difference < 0:1; difference > 0:7) and 20% or more in seven (15%) countries (difference < 0:0; difference > 0:7). The percent difference in proportionate target population was <10% for births, surviving infants and children under 5 years in 16 of 47 countries.

3.3. Re-Computed Target Population Estimates

We recomputed the estimated number of births, surviving infants and children under 5 years for each country using the proportionate values from the UNPD data and the total population values reported by the national immunization programmes (**Table 2**). We also display the expected directional change (increase or decrease) in coverage levels if coverage were calculated using a recomputed target population values shown in **Table 2** compared to those reported to WHO and UNICEF for a given number of children vaccinated. For example, if a country reported vaccinating 90 children in a target population of 100 children, then the resultant coverage level is 90%. Using the same numerator (e.g., 90 children vaccinated) and re-computing the target population, if the target population size increases compared to the original report, then expected coverage level would decrease and vice versa. **Figure 2** displays a comparison of reported administrative coverage levels for the third dose of DTP containing vaccine with those based on a recomputed target population using the UNPD-based proportionate target population value for surviving infants applied to the national immunization programme reported total population. Keep in mind if there was no difference between the compared coverage levels, data points would fall along the 45-degree diagonal.

3.4. Implications for Immunization Coverage Levels

Reported administrative DTP₃ coverage levels were <50% in 3 countries, 50% - 79% in 9 countries, 80% - 89% in 11 countries, 90% - 99% in 19 countries, and >100% in five countries. The utilization of the recomputed

Table 2. Number of births, surviving infants (SI) and children under 5 years (U5y) recomputed using the respective proportion of total population from the United Nations Population Division applied to the national immunization programme reported total population estimate for 2013 for 47 sub-Saharan African countries.

Country	Recomputed estimates of number of:					
	Births		SI		U5y	
Angola	976,547	↑	883,571	↑	4,137,651	↑
Benin	352,595	↑	328,584	↑	1,552,255	↑
Botswana	47,749	↑	46,268	↑	231,983	↑
Burkina Faso	708,871	↑	660,036	↑	3,051,376	↑
Burundi	360,516	↑	329,418	↑	1,503,115	↑
Cameroon	779,960	↑	723,208	↑	3,408,412	↑
Cabo Verde	10,343	↑	10,170	↑	49,741	↑
Central African Republic	162,894	↑	147,847	↓	694,521	↑
Chad	633,229	↓	573,056	↓	2,637,457	↓
Comoros	26,926	↓	25,131	↓	120,853	↑
Congo	165,618	↑	155,199	↑	732,643	↑
Côte d'Ivoire	872,086	↓	807,265	↓	3,741,484	↓
Democratic Republic of the Congo	3,699,239	↓	3,299,752	↓	15,246,887	↑
Equatorial Guinea	24,764	↑	22,594	↑	106,067	↑
Eritrea	140,177	↓	134,447	↓	638,844	↓
Ethiopia	2,868,335	↑	2,728,725	↑	13,126,992	↓
Gabon	64,089	↑	61,341	↑	292,218	↑
Gambia	72,826	↑	68,825	↑	311,521	↑
Ghana	820,836	↑	779,248	↑	3,774,773	↑
Guinea	436,447	↑	404,749	↑	1,897,234	↑
Guinea-Bissau	63,555	↓	57,635	↓	268,011	↑
Kenya	1,482,514	↑	1,406,939	↑	6,743,230	↑
Lesotho	52,473	↑	49,364	↑	240,833	↑
Liberia	136,567	↑	128,408	↑	616,305	↑
Madagascar	817,059	↑	787,792	↓	3,697,724	↑
Malawi	610,036	↑	558,111	↑	2,686,616	↓
Mali	794,449	↓	726,331	↓	3,240,995	↑
Mauritania	116,391	↑	108,086	↑	512,774	↑
Mauritius	14,855	↓	14,686	↓	73,022	↑
Mozambique	948,366	↑	878,855	↑	4,149,057	↑
Namibia	56,632	↑	54,768	↑	268,170	↑
Niger	840,041	↑	795,971	↑	3,489,604	↓
Nigeria	7,233,313	↓	6,690,486	↓	30,803,031	↑

Continued

Rwanda	380,314	↓	361,911	↓	1,782,207	↑
Sao Tome and Principe	5877	↑	5,624	↑	27,597	↓
Senegal	513,180	↑	488,153	↑	2,285,072	↑
Seychelles	1488	↑	1477	↑	6914	↑
Sierra Leone	226,860	↑	200,640	↑	950,252	↑
Somalia	419,632	↓	386,654	↓	1,782,658	↑
South Africa	1,103,100	↓	1,061,102	↑	5,458,027	↓
South Sudan	402,827	↑	371,891	↑	1,769,703	↑
Swaziland	32,808	↑	30,710	↑	150,022	↓
Togo	240,947	↑	225,090	↑	1,061,007	↑
Uganda	1,522,289	↑	1,436,760	↑	6,662,578	↑
United Republic of Tanzania	1,849,077	↑	1,760,365	↑	8,289,549	↑
Zambia	610,528	↑	571,206	↑	2,595,214	↑
Zimbabwe	415,798	↑	400,479	↑	1,906,029	↑

Arrows indicate the expected directional change, either increase (↑) or decrease (↓), in coverage levels for a given number of children vaccinated due to a change in the target population size based on the application of the proportionate population size from the UNPD estimates applied to the total population reported by the national immunization programme as compared to the estimated target population size reported by national immunization programmes.

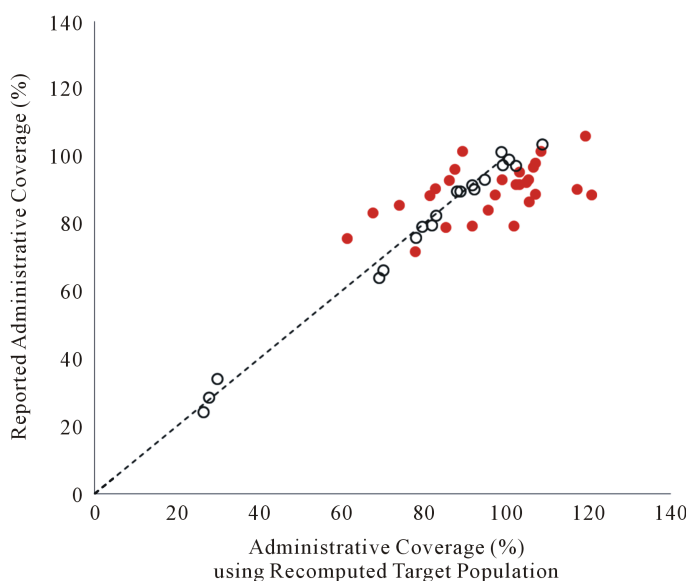


Figure 2. Comparison of administrative coverage for the third dose of DTP containing vaccine based on a recomputed target population using the proportionate target population value from the UNPD applied to the national immunization programme reported total population with reported administrative coverage in 47 sub-Saharan Africa countries for 2013.

target population of surviving infants resulted in lower coverage levels in 13 countries while coverage levels increased in 33 countries, with 17 countries having coverage levels >100%. Coverage did not meaningfully change in one country. The difference between the reported administrative coverage and the recomputed cover-

age exceeded 5% points in 28 of 47 countries (shown in red in **Figure 2**).

4. Discussion

National estimates of births, surviving infants and children under 5 years of age as a proportion of the total national population vary widely across sub-Saharan African countries. We are unaware of any prior work that has described and compared proportionate target population estimates used by immunization programmes to an external source. At the beginning of the Expanded Programme on Immunization in 1974, births and surviving infants as a proportion of the total population in sub-Saharan Africa countries averaged 4.72% and 4.11%, respectively. By 2013, these values declined to 3.78% and 3.52% for sub-Saharan African countries. The national immunization programme in several countries (appear to) continue to use fixed proportionate target population values (e.g., births = 4% of total population in DRC, Ghana, Guinea, Nigeria, Sierra Leone, Somalia and South Sudan; births = 5% of total population in Angola and Zambia; children under 5 years = 20% of total population in Angola, Congo, Ghana, Guinea, Mali, Somalia, South Sudan, Togo, Zambia). Not only can the use of constant proportionate target population values over time present challenges for immunization programme monitoring [3], but inaccuracies in the magnitude of the proportionate target population used may create problems for programme planning.

Comparisons of target proportionate population size based on data reported by national immunization programmes to WHO and UNICEF with values computed from UNPD estimates observed a tendency for immunization programme estimates to be larger than UNPD estimates. Among the five largest countries (based on total population), differences in reported number of births and surviving infants compared to values based on multiplying proportionate population values from the UNPD to nationally reported total population were <10%. Although the application of the proportionate target population values from the UNPD to the national immunization programme reported national total population reduces the variance to that observed between the nationally reported total population and the UNPD total population, the implication for many countries if they were to use these values would be an implausible immunization coverage level that exceeds 100%. Only three of the 17 countries with recomputed administrative coverage levels >100% shown in **Figure 2** actually reported a coverage value >100%. This may suggest problems with numerator data and highlight the need for equally appropriate attention to critically assessing the accuracy of the number of children vaccinated.

The availability of external sources of population data, such as that from the United Nations Population Division, does not represent a solution for inaccuracies that may exist in the national population estimates available to immunization programmes, but they can serve as a useful tool for assessing those inaccuracies and provide useful information for establishing operational envelopes or signals for further investigation. Ideally, immunization programme staff work closely with their technical counterparts in the national statistics system to make use of the latest census data and population projections in order to obtain estimates of births and surviving infants that are more appropriate than using a constant proportionate target population value over time. Anecdotally we know that this is often not the case.

Given the dramatic changes in fertility and in neonatal infant and under-5 mortality since the beginning of the Expanded Programme on Immunization, as well as expected changes between now and mid-century, national immunization programmes confront an on-going challenge to effectively plan the delivery of immunization services, manage stock and supply levels and target interventions. This is particularly so for the programmes in sub-Saharan Africa, which will account for one in every three children born by 2050 [4]. Because childhood immunization-related target populations are among the more difficult ones to accurately estimate, immunization programmes in sub-Saharan Africa are encouraged to include a critical assessment of target population values, in conjunction with the national statistics system, as part of the on-going programme monitoring process. In addition, consideration may be given to include training exercises in such assessments within mid-level programme manager continuing education workshops. Further work is needed to describe different approaches that have proved successful in fostering technical collaborations between national immunization programmes and their counterparts in national statistical systems.

Disclaimer

The findings and opinions expressed here are those of the authors alone and do not reflect those of their respective institutions.

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