Global, regional and national epidemiology and prevalence of child stunting, wasting and underweight in low- and middle- income countries, 2006-18

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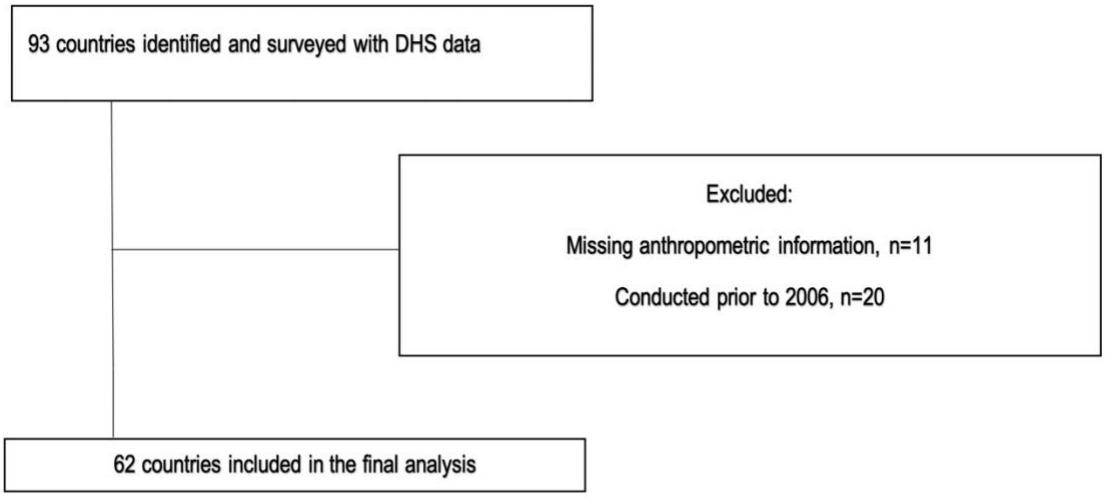
Country	Years of survey	Length/height-for-age N (% Stunted)	Weight-for-length/height N (%Wasted)	Weight-for-age N (% underweight)
sub-Saharan Africa				
Angola	2015-16	7388 (37.6)	7510 (4.8)	7468 (18.5)
Benin	2017-18	12777 (32.2)	13260 (4.9)	12832 (16.6)
Burkina Faso	2010	6994 (34.6)	6994 (15.5)	6994 (25.7)
Burundi	2016-17	6444 (55.9)	6453 (5)	6464 (29.2)
Cameroon	2011	5860 (32.5)	5860 (5.6)	5860 (14.6)
Chad	2014-15	10854 (39.9)	10854 (13)	10854 (28.8)
Comoros	2012	1804 (30.1)	1804 (11.1)	1804 (15.3)
Republic of Congo	2011-12	4591 (24.4)	4591 (5.9)	4591 (11.6)
Democratic Republic of the Congo	2013-14	9030 (42.7)	9030 (7.9)	9030 (22.6)
Equatorial Guinea	2011	1094 (26.2)	1094 (3.1)	1094 (3.8)
Ivory Coast	2011-12	3581 (29.8)	3581 (7.5)	3581 (14.9)
Swaziland	2006-07	2940 (28.9)	2940 (2.5)	2940 (5.4)
Ethiopia	2016	10376 (38.4)	10412 (9.8)	10552 (23.3)
Gabon	2012	3856 (16.5)	3856 (3.3)	3856 (6)
Gambia	2013	3372 (24.5)	3372 (11.5)	3372 (16.2)
Ghana	2014	2895 (18.8)	2895 (4.7)	2895 (11)
Guinea	2012	3531 (31.2)	3531 (9.6)	3531 (18)
Kenya	2014	18986 (26)	18986 (4)	18986 (11)
Lesotho	2014	1869 (33.2)	1869 (2.8)	1869 (10.3)
Liberia	2013	3520 (31.6)	3520 (6)	3520 (15)
Madagascar	2008-2009	5436 (50.1)	5436 (-)	5436 (-)
Malawi	2015-2016	5707 (37.1)	5764 (2.7)	5786 (11.4)
Mali	2012-13	4857 (38.3)	4857 (12.7)	4857 (25.5)
Mozambique	2011	10313 (42.6)	10313 (5.9)	10313 (14.9)
Namibia	2013	2287 (23.7)	2287 (6.2)	2287 (13.3)
Niger	2012	5481 (43.9)	5481 (18)	5481(36.4)
Nigeria	2013	26190 (36.8)	26190 (18)	26190)

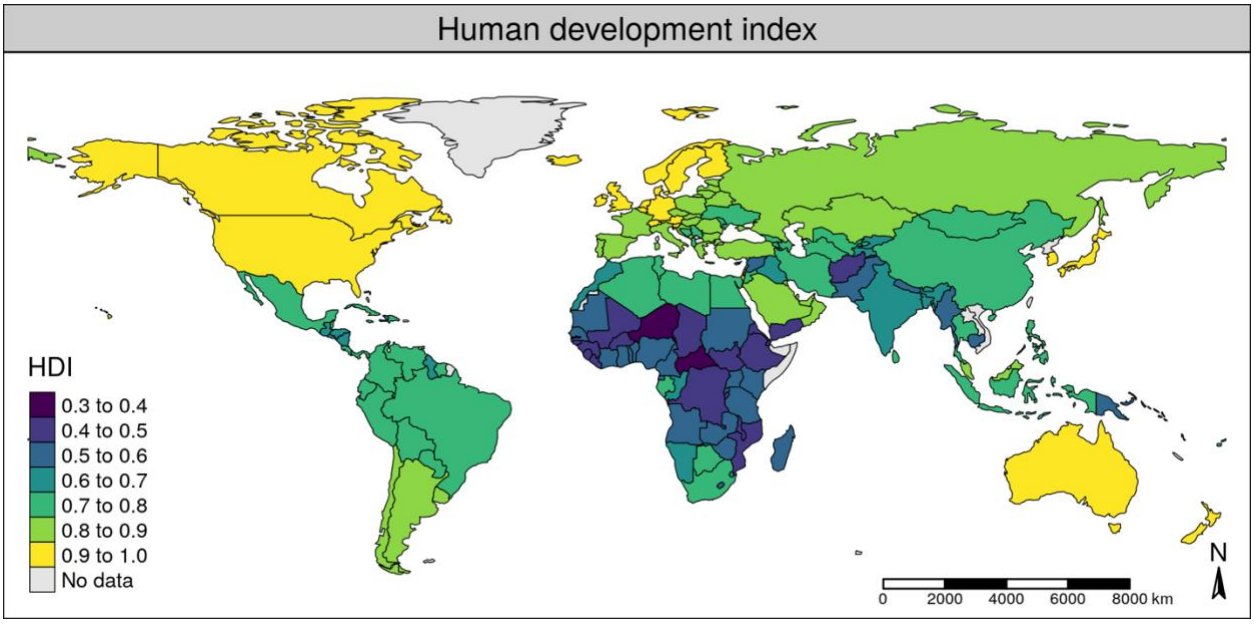
Rwanda	2014-2015	3813 (37.9)	3813 (2.2)	3813 (9.3)
Sao Tome and Principe	2008-09	1544 (29.3)	1544 (10.5)	1544 (13.1)
Senegal	2017	10864 (16.5)	10980 (8.9)	10910 (14.3)
Sierra Leone	2013	5094 (37.9)	5094 (9.3)	5094 (16.4)
South Africa	2016	1404 (27.4)	1384 (2.4)	1416 (5.8)
Tanzania	2015-2016	9846 (34.4)	9811 (4.4)	9886 (13.5)
Togo	2013-14	3282 (27.5)	3282 (6.5)	3282 (16)
Uganda	2016	5117 (28.9)	5191 (3.4)	5136 (10.3)
Zambia	2013-2014	12328 (40.1)	12328 (6)	12328)
Zimbabwe	2015	6305 (26.8)	6255 (3.1)	6352 (8.2)
North Africa				
Egypt	2014	13601 (21.4)	13601 (8.4)	13601 (5.5)
Southern Europe				
Albania	2017-18	2322 (11.3)	2299 (1.5)	2367 (1.4)
Western Asia				
Armenia	2015-16	1573 (9.4)	1555 (4)	1609 (2.4)
Turkey	2013	2519 (9.5)	2519 (10.9)	2519 (5.2)
Yemen	2013	13823 (46.5)	13823 (16.3)	13823 (39)
Azerbaijan	2006	1979 (25.1)	1979 (6.8)	1979 (7.7)
Central Asia				
Kyrgyz Republic	2012	4337 (17.7)	4337 (2.7)	4337 (3.4)
Tajikistan	2017	6694 (17.5)	6684 (5.5)	6716 (7.5)
East Asia/South Asia/Southeast Asia				
Bangladesh	2014	7318 (36.1)	7318 (14.3)	7318 (32.6)
Cambodia	2014	4893 (32.4)	4893 (9.6)	4893 (23.9)
India	2015-16	219796 (38.4)	219796 (21)	219796 (35.7)
Maldives	2016-17	2246 (15.3)	2260 (9)	2327 (14.7)
Myanmar	2015-16	4089 (29.2)	4076 (6.9)	4100 (18.9)
Nepal	2016	2421 (35.8)	2417 (9.6)	2428 (27)
Pakistan	2017-18	3522 (37.6)	3547 (6.9)	3622 (22.3)
Timor-Leste	2016	6714 (45.6)	6476 (22.6)	7206 (39.9)
Oceania				
Samoa	2008	8422 (27.1)	8422 (1.4)	8422 (4.3)

Latin America and Caribbean				
Bolivia	2008	8422 (27.1)	8422 (1.4)	8422 (4.3)
Colombia	2010	15702 (13.2)	15702 (0.9)	15702 (3.4)
Dominican Republic	2013	3619 (6.9)	3619 (2)	3619 (3.8)
Guatemala	2014-15	12567 (46.5)	12567 (0.7)	12567 (12.6)
Guyana	2009	1522 (18.2)	1522 (5.3)	1522 (10.5)
Haiti	2016-17	6618 (21.9)	6589 (3.6)	6646 (9.4)
Honduras	2011-12	10167 (22.6)	10167 (1.4)	10167 (7)
Peru	2012	9168 (18.1)	9168 (0.6)	9168 (3.4)

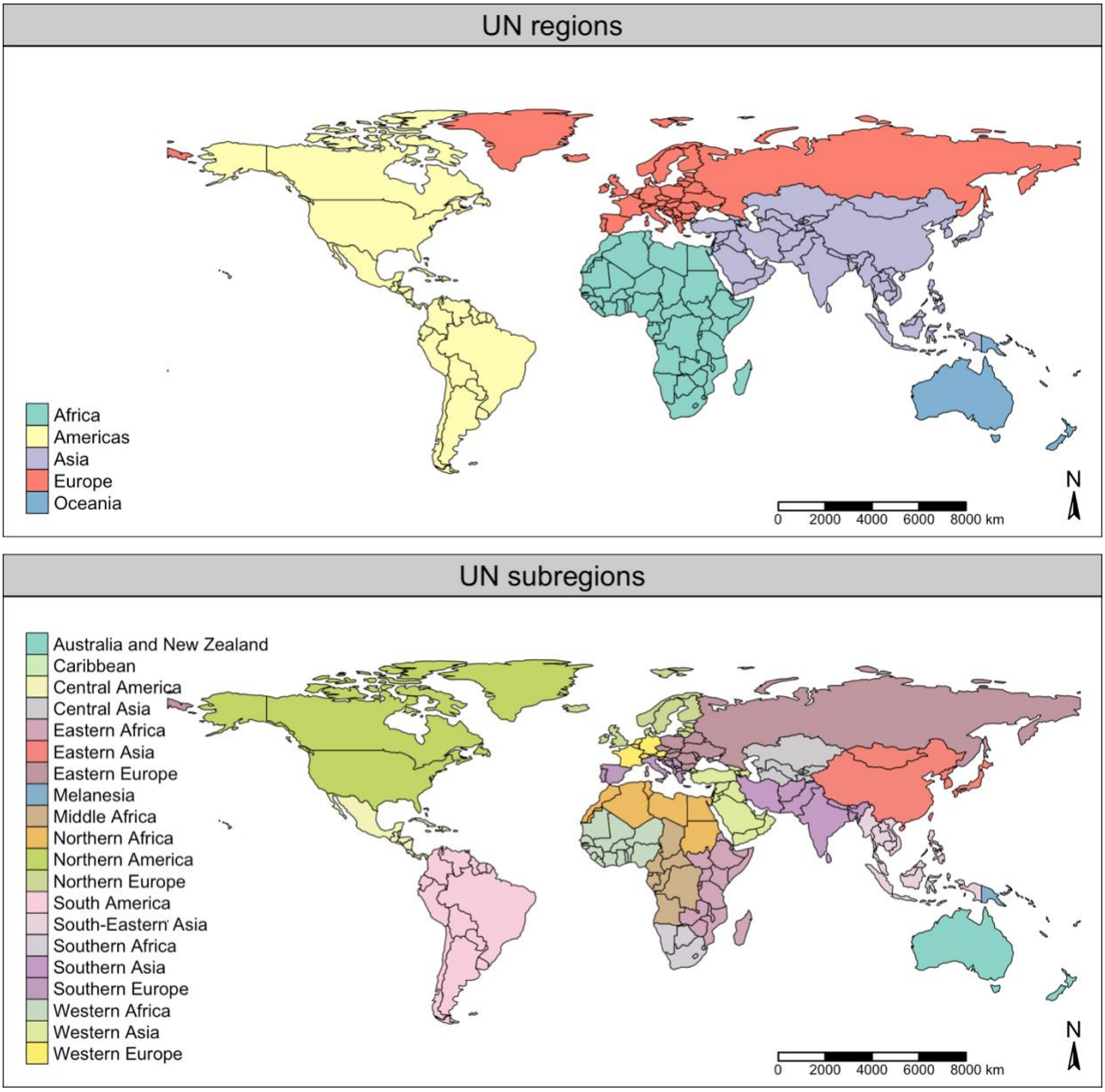
Supplementary Table S1: Anthropometric measurements: Country-specific anthropometric indices showing number of children with anthropometric measurements.



Supplementary Figure S1: Flow chart for country selection. In this study, nationally representative DHS data between 2006 and 2018 including anthropometric indices for each country was extracted. Surveys without anthropometric data were excluded from the analysis.

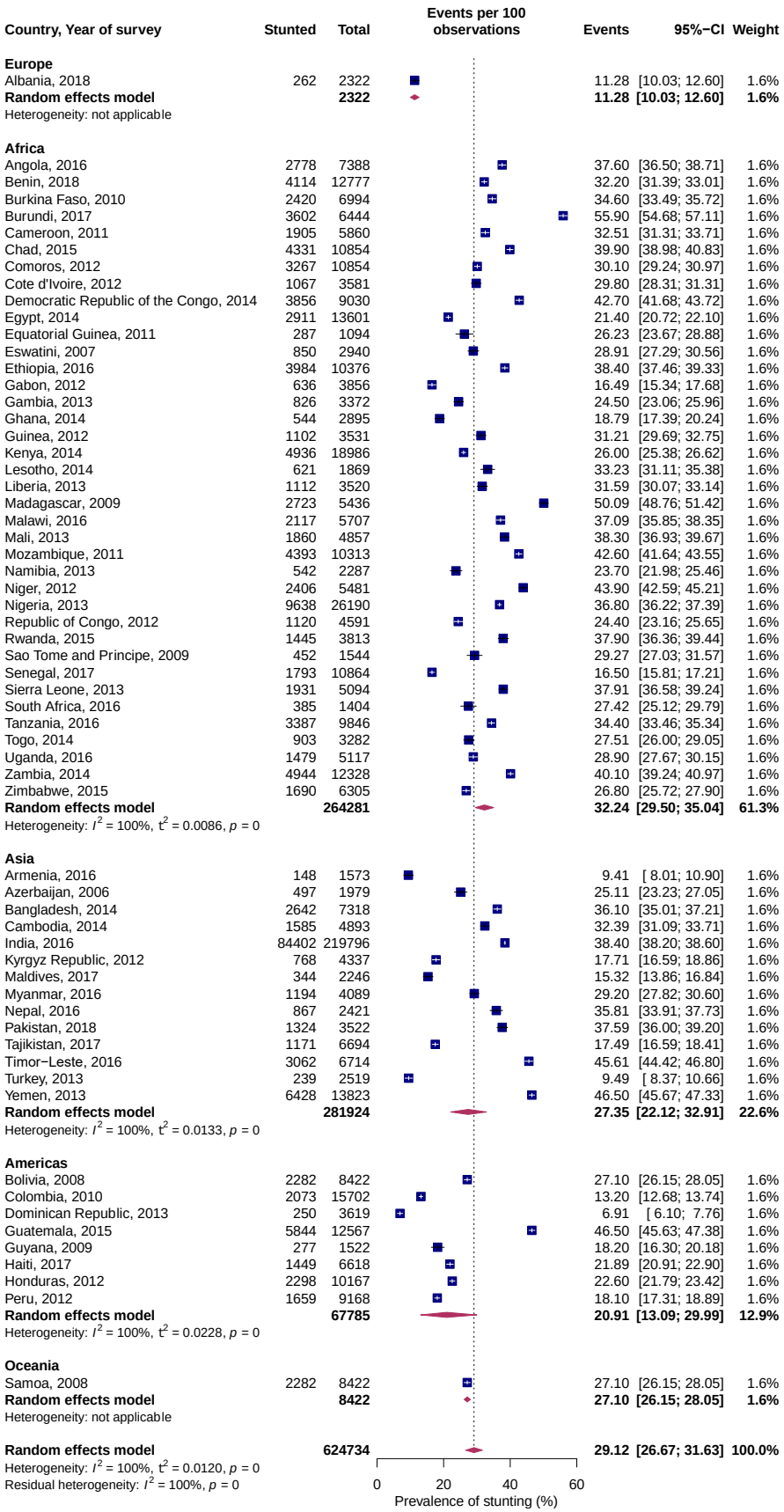


Supplemental Figure S2: Maps of covariates. Human development index data were extracted from the United Nations[1]. All the maps were produced with the R software for statistical computing version 3.6.3. The world shapefile was retrieved from the **spData** package (version 0.3.0, https://CRAN.R-project.org/package=spData) and the maps created with the **tmap** package (version 3.2.2, https://CRAN.R-project.org/package=tmap).

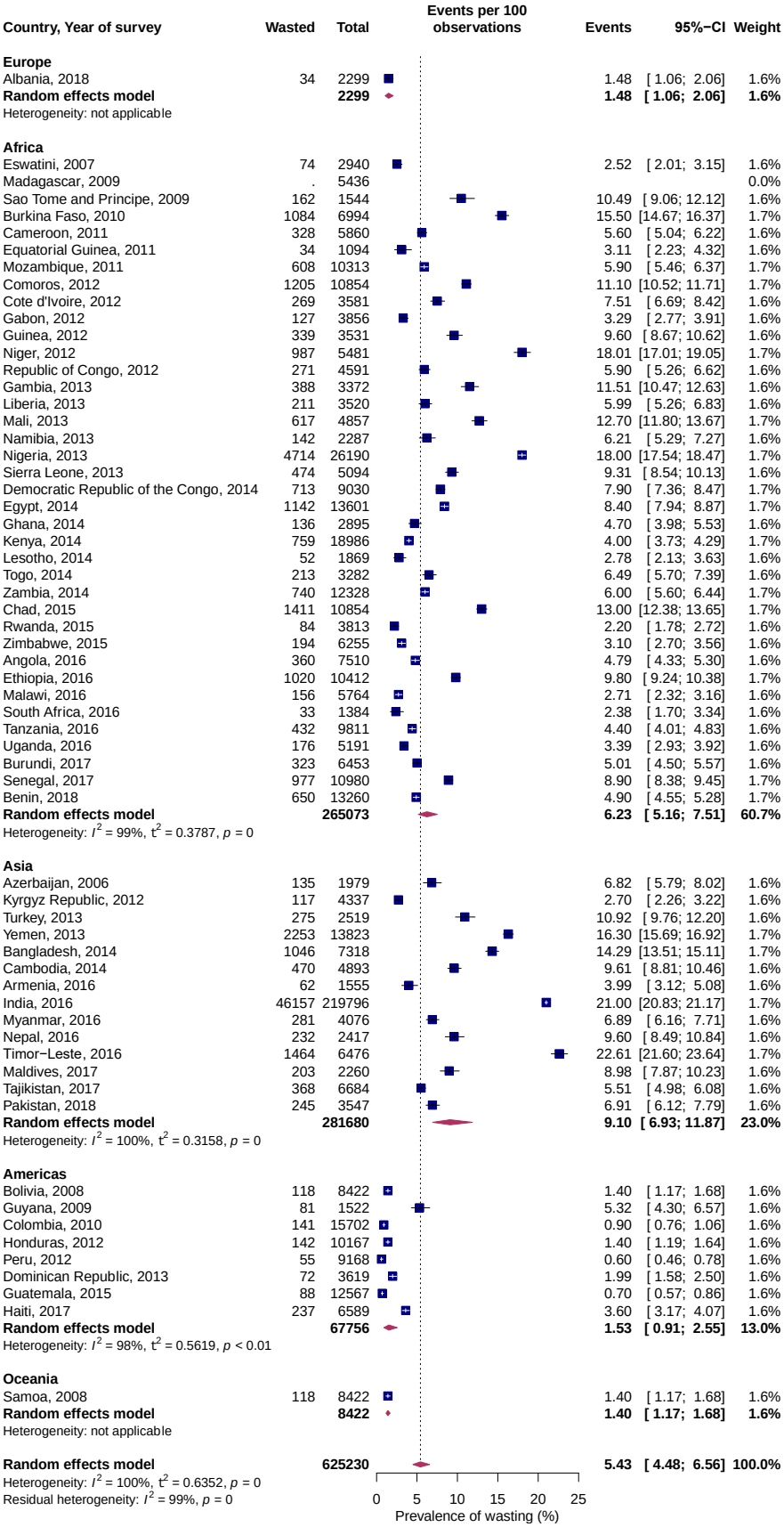


Supplemental Figure S3: Maps of covariates. UN regions (top panel) and Un subregions (bottom panel) used for aggregating data analysis in the current analysis[2]. All the maps were produced with the R software for statistical computing version 3.6.3. The world shapefile was retrieved from the **spData** package (version 0.3.0, https://CRAN.R-project.org/package=spData) and the maps created with the **tmap** package (version 3.2.2, https://CRAN.R-project.org/package=tmap).

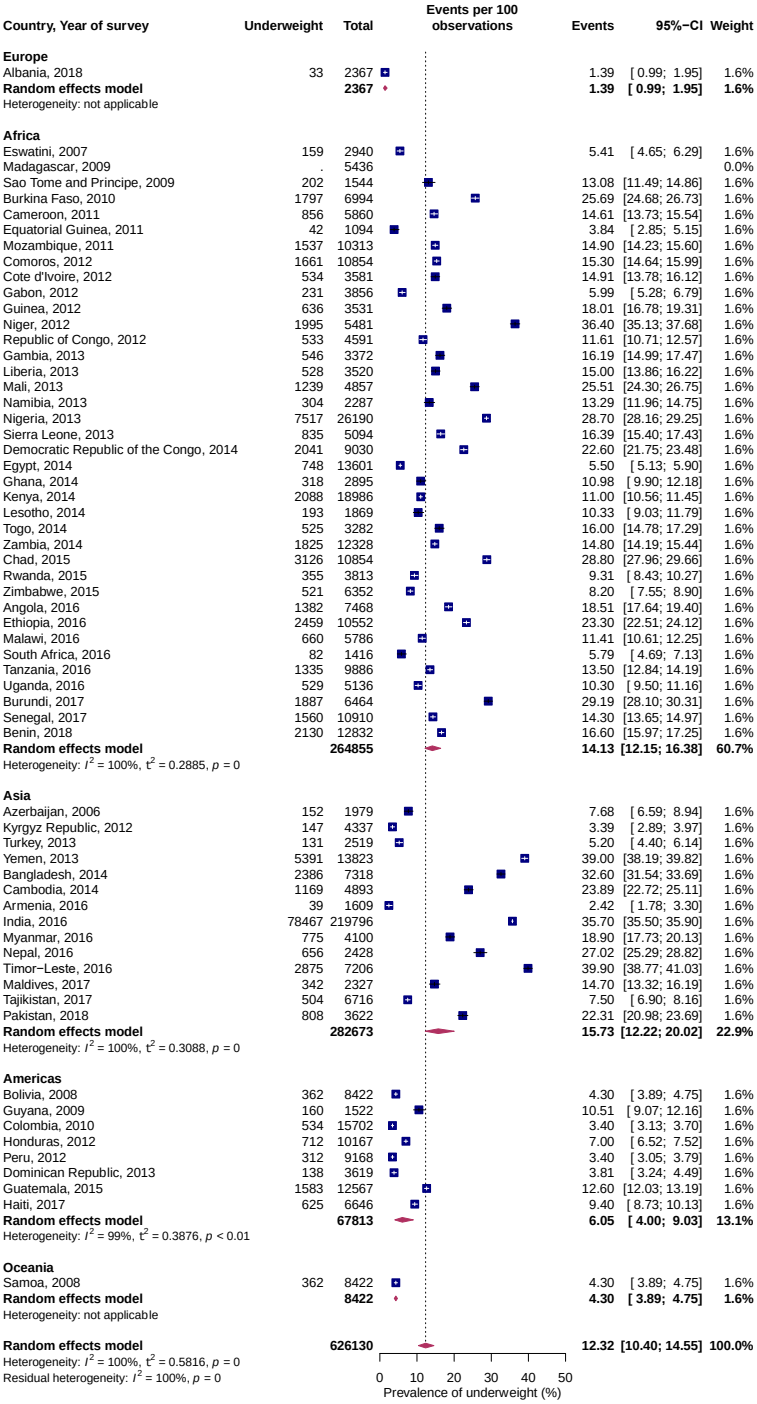
Supplemental Figure S4: Forest plot of stunting prevalence by UN region of LMICs.
Events values represent the number of cases of stunting expressed as a percentage. Blue squares and their corresponding lines are the point estimates and 95% confidence intervals (95% CI). Maroon diamonds represent the pooled estimate of the prevalence for each subgroup (width denotes 95% CI). Weights are from the random-effects analysis using the method of DerSimonian and Laird[3]. Heterogeneity by UN region: Africa (I^2 = 100%); Americas-Latin and Caribbean (I^2 = 100%); Europe (I^2 = not applicable); Asia (I^2 = 100%); and Oceania (I^2 = not applicable); p for interaction comparing the different subgroups < 0.0001.)


Country, Year of survey
Stunted
Total
Events per 100 observations
Events
95%−CI
Weight
Europe
Albania, 2018 262 2322 11.28 [10.03; 12.60] 1.6%
Random effects model 2322 11.28 [10.03; 12.60] 1.6%
Heterogeneity: not applicable
Africa
Angola, 2016 2778 7388 37.60 [36.50; 38.71] 1.6%
Benin, 2018 4114 12777 32.20 [31.39; 33.01] 1.6%
Burkina Faso, 2010 2420 6994 34.60 [33.49; 35.72] 1.6%
Burundi, 2017 3602 6444 55.90 [54.68; 57.11] 1.6%
Cameroon, 2011 1905 5860 32.51 [31.31; 33.71] 1.6%
Chad, 2015 4331 10854 39.90 [38.98; 40.83] 1.6%
Comoros, 2012 3267 10854 30.10 [29.24; 30.97] 1.6%
Cote d'Ivoire, 2012 1067 3581 29.80 [28.31; 31.31] 1.6%
Democratic Republic of the Congo, 2014 3856 9030 42.70 [41.68; 43.72] 1.6%
Egypt, 2014 2911 13601 21.40 [20.72; 22.10] 1.6%
Equatorial Guinea, 2011 287 1094 26.23 [23.67; 28.88] 1.6%
Eswatini, 2007 850 2940 28.91 [27.29; 30.56] 1.6%
Ethiopia, 2016 3984 10376 38.40 [37.46; 39.33] 1.6%
Gabon, 2012 636 3856 16.49 [15.34; 17.68] 1.6%
Gambia, 2013 826 3372 24.50 [23.06; 25.96] 1.6%
Ghana, 2014 544 2895 18.79 [17.39; 20.24] 1.6%
Guinea, 2012 1102 3531 31.21 [29.69; 32.75] 1.6%
Kenya, 2014 4936 18986 26.00 [25.38; 26.62] 1.6%
Lesotho, 2014 621 1869 33.23 [31.11; 35.38] 1.6%
Liberia, 2013 1112 3520 31.59 [30.07; 33.14] 1.6%
Madagascar, 2009 2723 5436 50.09 [48.76; 51.42] 1.6%
Malawi, 2016 2117 5707 37.09 [35.85; 38.35] 1.6%
Mali, 2013 1860 4857 38.30 [36.93; 39.67] 1.6%
Mozambique, 2011 4393 10313 42.60 [41.64; 43.55] 1.6%
Namibia, 2013 542 2287 23.70 [21.98; 25.46] 1.6%
Niger, 2012 2406 5481 43.90 [42.59; 45.21] 1.6%
Nigeria, 2013 9638 26190 36.80 [36.22; 37.39] 1.6%
Republic of Congo, 2012 1120 4591 24.40 [23.16; 25.65] 1.6%
Rwanda, 2015 1445 3813 37.90 [36.36; 39.44] 1.6%
Sao Tome and Principe, 2009 452 1544 29.27 [27.03; 31.57] 1.6%
Senegal, 2017 1793 10864 16.50 [15.81; 17.21] 1.6%
Sierra Leone, 2013 1931 5094 37.91 [36.58; 39.24] 1.6%
South Africa, 2016 385 1404 27.42 [25.12; 29.79] 1.6%
Tanzania, 2016 3387 9846 34.40 [33.46; 35.34] 1.6%
Togo, 2014 903 3282 27.51 [26.00; 29.05] 1.6%
Uganda, 2016 1479 5117 28.90 [27.67; 30.15] 1.6%
Zambia, 2014 4944 12328 40.10 [39.24; 40.97] 1.6%
Zimbabwe, 2015 1690 6305 26.80 [25.72; 27.90] 1.6%
Random effects model 264281 32.24 [29.50; 35.04] 61.3%
Heterogeneity: I^2 = 100%, t^2 = 0.0086, p = 0
Asia
Armenia, 2016 148 1573 9.41 [8.01; 10.90] 1.6%
Azerbaijan, 2006 497 1979 25.11 [23.23; 27.05] 1.6%
Bangladesh, 2014 2642 7318 36.10 [35.01; 37.21] 1.6%
Cambodia, 2014 1585 4893 32.39 [31.09; 33.71] 1.6%
India, 2016 84402 219796 38.40 [38.20; 38.60] 1.6%
Kyrgyz Republic, 2012 768 4337 17.71 [16.59; 18.86] 1.6%
Maldives, 2017 344 2246 15.32 [13.86; 16.84] 1.6%
Myanmar, 2016 1194 4089 29.20 [27.82; 30.60] 1.6%
Nepal, 2016 867 2421 35.81 [33.91; 37.73] 1.6%
Pakistan, 2018 1324 3522 37.59 [36.00; 39.20] 1.6%
Tajikistan, 2017 1171 6694 17.49 [16.59; 18.41] 1.6%
Timor−Leste, 2016 3062 6714 45.61 [44.42; 46.80] 1.6%
Turkey, 2013 239 2519 9.49 [8.37; 10.66] 1.6%
Yemen, 2013 6428 13823 46.50 [45.67; 47.33] 1.6%
Random effects model 281924 27.35 [22.12; 32.91] 22.6%
Heterogeneity: I^2 = 100%, t^2 = 0.0133, p = 0
Americas
Bolivia, 2008 2282 8422 27.10 [26.15; 28.05] 1.6%
Colombia, 2010 2073 15702 13.20 [12.68; 13.74] 1.6%
Dominican Republic, 2013 250 3619 6.91 [6.10; 7.76] 1.6%
Guatemala, 2015 5844 12567 46.50 [45.63; 47.38] 1.6%
Guyana, 2009 277 1522 18.20 [16.30; 20.18] 1.6%
Haiti, 2017 1449 6618 21.89 [20.91; 22.90] 1.6%
Honduras, 2012 2298 10167 22.60 [21.79; 23.42] 1.6%
Peru, 2012 1659 9168 18.10 [17.31; 18.89] 1.6%
Random effects model 67785 20.91 [13.09; 29.99] 12.9%
Heterogeneity: I^2 = 100%, t^2 = 0.0228, p = 0
Oceania
Samoa, 2008 2282 8422 27.10 [26.15; 28.05] 1.6%
Random effects model 8422 27.10 [26.15; 28.05] 1.6%
Heterogeneity: not applicable
Random effects model 624734 29.12 [26.67; 31.63] 100.0%
Heterogeneity: I^2 = 100%, t^2 = 0.0120, p = 0
Residual heterogeneity: I^2 = 100%, p = 0
0
20
40
60
Prevalence of stunting (%)

Supplemental Figure S5: Forest plot of wasting prevalence by UN region of LMICs. Events values represent the number of cases of wasting expressed as a percentage. Blue squares and their corresponding lines are the point estimates and 95% confidence intervals (95% CI). Maroon diamonds represent the pooled estimate of the prevalence for each subgroup (width denotes 95% CI). Weights are from the random-effects analysis using the method of DerSimonian and Laird[3]. Heterogeneity by UN region: Africa (I^2 = 99%); Americas-Latin and Caribbean (I^2 = 98%); Europe (I^2 = not applicable); Asia (I^2 = 100%); and Oceania (I^2 = not applicable); p for interaction comparing the different subgroups < 0.0001.)


Country, Year of survey
Wasted
Total
Events per 100 observations
Events
95%−CI
Weight
Europe
Albania, 2018 34 2299 1.48 [1.06; 2.06] 1.6%
Random effects model 2299 1.48 [1.06; 2.06] 1.6%
Heterogeneity: not applicable
Africa
Eswatini, 2007 74 2940 2.52 [2.01; 3.15] 1.6%
Madagascar, 2009 . 5436 0.0%
Sao Tome and Principe, 2009 162 1544 10.49 [9.06; 12.12] 1.6%
Burkina Faso, 2010 1084 6994 15.50 [14.67; 16.37] 1.7%
Cameroon, 2011 328 5860 5.60 [5.04; 6.22] 1.6%
Equatorial Guinea, 2011 34 1094 3.11 [2.23; 4.32] 1.6%
Mozambique, 2011 608 10313 5.90 [5.46; 6.37] 1.7%
Comoros, 2012 1205 10854 11.10 [10.52; 11.71] 1.7%
Cote d'Ivoire, 2012 269 3581 7.51 [6.69; 8.42] 1.6%
Gabon, 2012 127 3856 3.29 [2.77; 3.91] 1.6%
Guinea, 2012 339 3531 9.60 [8.67; 10.62] 1.6%
Niger, 2012 987 5481 18.01 [17.01; 19.05] 1.7%
Republic of Congo, 2012 271 4591 5.90 [5.26; 6.62] 1.6%
Gambia, 2013 388 3372 11.51 [10.47; 12.63] 1.6%
Liberia, 2013 211 3520 5.99 [5.26; 6.83] 1.6%
Mali, 2013 617 4857 12.70 [11.80; 13.67] 1.7%
Namibia, 2013 142 2287 6.21 [5.29; 7.27] 1.6%
Nigeria, 2013 4714 26190 18.00 [17.54; 18.47] 1.7%
Sierra Leone, 2013 474 5094 9.31 [8.54; 10.13] 1.6%
Democratic Republic of the Congo, 2014 713 9030 7.90 [7.36; 8.47] 1.7%
Egypt, 2014 1142 13601 8.40 [7.94; 8.87] 1.7%
Ghana, 2014 136 2895 4.70 [3.98; 5.53] 1.6%
Kenya, 2014 759 18986 4.00 [3.73; 4.29] 1.7%
Lesotho, 2014 52 1869 2.78 [2.13; 3.63] 1.6%
Togo, 2014 213 3282 6.49 [5.70; 7.39] 1.6%
Zambia, 2014 740 12328 6.00 [5.60; 6.44] 1.7%
Chad, 2015 1411 10854 13.00 [12.38; 13.65] 1.7%
Rwanda, 2015 84 3813 2.20 [1.78; 2.72] 1.6%
Zimbabwe, 2015 194 6255 3.10 [2.70; 3.56] 1.6%
Angola, 2016 360 7510 4.79 [4.33; 5.30] 1.6%
Ethiopia, 2016 1020 10412 9.80 [9.24; 10.38] 1.7%
Malawi, 2016 156 5764 2.71 [2.32; 3.16] 1.6%
South Africa, 2016 33 1384 2.38 [1.70; 3.34] 1.6%
Tanzania, 2016 432 9811 4.40 [4.01; 4.83] 1.6%
Uganda, 2016 176 5191 3.39 [2.93; 3.92] 1.6%
Burundi, 2017 323 6453 5.01 [4.50; 5.57] 1.6%
Senegal, 2017 977 10980 8.90 [8.38; 9.45] 1.7%
Benin, 2018 650 13260 4.90 [4.55; 5.28] 1.7%
Random effects model 265073 6.23 [5.16; 7.51] 60.7%
Heterogeneity: I^2 = 99%, t^2 = 0.3787, p = 0
Asia
Azerbaijan, 2006 135 1979 6.82 [5.79; 8.02] 1.6%
Kyrgyz Republic, 2012 117 4337 2.70 [2.26; 3.22] 1.6%
Turkey, 2013 275 2519 10.92 [9.76; 12.20] 1.6%
Yemen, 2013 2253 13823 16.30 [15.69; 16.92] 1.7%
Bangladesh, 2014 1046 7318 14.29 [13.51; 15.11] 1.7%
Cambodia, 2014 470 4893 9.61 [8.81; 10.46] 1.6%
Armenia, 2016 62 1555 3.99 [3.12; 5.08] 1.6%
India, 2016 46157 219796 21.00 [20.83; 21.17] 1.7%
Myanmar, 2016 281 4076 6.89 [6.16; 7.71] 1.6%
Nepal, 2016 232 2417 9.60 [8.49; 10.84] 1.6%
Timor−Leste, 2016 1464 6476 22.61 [21.60; 23.64] 1.7%
Maldives, 2017 203 2260 8.98 [7.87; 10.23] 1.6%
Tajikistan, 2017 368 6684 5.51 [4.98; 6.08] 1.6%
Pakistan, 2018 245 3547 6.91 [6.12; 7.79] 1.6%
Random effects model 281680 9.10 [6.93; 11.87] 23.0%
Heterogeneity: I^2 = 100%, t^2 = 0.3158, p = 0
Americas
Bolivia, 2008 118 8422 1.40 [1.17; 1.68] 1.6%
Guyana, 2009 81 1522 5.32 [4.30; 6.57] 1.6%
Colombia, 2010 141 15702 0.90 [0.76; 1.06] 1.6%
Honduras, 2012 142 10167 1.40 [1.19; 1.64] 1.6%
Peru, 2012 55 9168 0.60 [0.46; 0.78] 1.6%
Dominican Republic, 2013 72 3619 1.99 [1.58; 2.50] 1.6%
Guatemala, 2015 88 12567 0.70 [0.57; 0.86] 1.6%
Haiti, 2017 237 6589 3.60 [3.17; 4.07] 1.6%
Random effects model 67756 1.53 [0.91; 2.55] 13.0%
Heterogeneity: I^2 = 98%, t^2 = 0.5619, p < 0.01
Oceania
Samoa, 2008 118 8422 1.40 [1.17; 1.68] 1.6%
Random effects model 8422 1.40 [1.17; 1.68] 1.6%
Heterogeneity: not applicable
Random effects model 625230 5.43 [4.48; 6.56] 100.0%
Heterogeneity: I^2 = 100%, t^2 = 0.6352, p = 0
Residual heterogeneity: I^2 = 99%, p = 0
0
5
10
15
20
25
Prevalence of wasting (%)

Supplemental Figure S6: Forest plot of underweight prevalence by UN region of LMICs. Events values represent the number of cases of underweight expressed as a percentage. Blue squares and their corresponding lines are the point estimates and 95% confidence intervals (95% CI). Maroon diamonds represent the pooled estimate of the prevalence for each subgroup (width denotes 95% CI). Weights are from the random-effects analysis using the method of DerSimonian and Laird[3]. Heterogeneity by UN region: Africa (I^2 = 100%); Americas-Latin and Caribbean (I^2 = 99%); Europe (I^2 = not applicable); Asia (I^2 = 100%); and Oceania (I^2 = not applicable); p for interaction comparing the different subgroups < 0.0001.)


Country, Year of survey
Underweight
Total
Events per 100 observations
Events
95%−CI
Weight
Europe
Albania, 2018 33 2367 1.39 [0.99; 1.95] 1.6%
Random effects model 2367 1.39 [0.99; 1.95] 1.6%
Heterogeneity: not applicable
Africa
Eswatini, 2007 159 2940 5.41 [4.65; 6.29] 1.6%
Madagascar, 2009 . 5436 0.0%
Sao Tome and Principe, 2009 202 1544 13.08 [11.49; 14.86] 1.6%
Burkina Faso, 2010 1797 6994 25.69 [24.68; 26.73] 1.6%
Cameroon, 2011 856 5860 14.61 [13.73; 15.54] 1.6%
Equatorial Guinea, 2011 42 1094 3.84 [2.85; 5.15] 1.6%
Mozambique, 2011 1537 10313 14.90 [14.23; 15.60] 1.6%
Comoros, 2012 1661 10854 15.30 [14.64; 15.99] 1.6%
Cote d'Ivoire, 2012 534 3581 14.91 [13.78; 16.12] 1.6%
Gabon, 2012 231 3856 5.99 [5.28; 6.79] 1.6%
Guinea, 2012 636 3531 18.01 [16.78; 19.31] 1.6%
Niger, 2012 1995 5481 36.40 [35.13; 37.68] 1.6%
Republic of Congo, 2012 533 4591 11.61 [10.71; 12.57] 1.6%
Gambia, 2013 546 3372 16.19 [14.99; 17.47] 1.6%
Liberia, 2013 528 3520 15.00 [13.86; 16.22] 1.6%
Mali, 2013 1239 4857 25.51 [24.30; 26.75] 1.6%
Namibia, 2013 304 2287 13.29 [11.96; 14.75] 1.6%
Nigeria, 2013 7517 26190 28.70 [28.16; 29.25] 1.6%
Sierra Leone, 2013 835 5094 16.39 [15.40; 17.43] 1.6%
Democratic Republic of the Congo, 2014 2041 9030 22.60 [21.75; 23.48] 1.6%
Egypt, 2014 748 13601 5.50 [5.13; 5.90] 1.6%
Ghana, 2014 318 2895 10.98 [9.90; 12.18] 1.6%
Kenya, 2014 2088 18986 11.00 [10.56; 11.45] 1.6%
Lesotho, 2014 193 1869 10.33 [9.03; 11.79] 1.6%
Togo, 2014 525 3282 16.00 [14.78; 17.29] 1.6%
Zambia, 2014 1825 12328 14.80 [14.19; 15.44] 1.6%
Chad, 2015 3126 10854 28.80 [27.96; 29.66] 1.6%
Rwanda, 2015 355 3813 9.31 [8.43; 10.27] 1.6%
Zimbabwe, 2015 521 6352 8.20 [7.55; 8.90] 1.6%
Angola, 2016 1382 7468 18.51 [17.64; 19.40] 1.6%
Ethiopia, 2016 2459 10552 23.30 [22.51; 24.12] 1.6%
Malawi, 2016 660 5786 11.41 [10.61; 12.25] 1.6%
South Africa, 2016 82 1416 5.79 [4.69; 7.13] 1.6%
Tanzania, 2016 1335 9886 13.50 [12.84; 14.19] 1.6%
Uganda, 2016 529 5136 10.30 [9.50; 11.16] 1.6%
Burundi, 2017 1887 6464 29.19 [28.10; 30.31] 1.6%
Senegal, 2017 1560 10910 14.30 [13.65; 14.97] 1.6%
Benin, 2018 2130 12832 16.60 [15.97; 17.25] 1.6%
Random effects model 264855 14.13 [12.15; 16.38] 60.7%
Heterogeneity: I^2 = 100%, τ^2 = 0.2885, p = 0
Asia
Azerbaijan, 2006 152 1979 7.68 [6.59; 8.94] 1.6%
Kyrgyz Republic, 2012 147 4337 3.39 [2.89; 3.97] 1.6%
Turkey, 2013 131 2519 5.20 [4.40; 6.14] 1.6%
Yemen, 2013 5391 13823 39.00 [38.19; 39.82] 1.6%
Bangladesh, 2014 2386 7318 32.60 [31.54; 33.69] 1.6%
Cambodia, 2014 1169 4893 23.89 [22.72; 25.11] 1.6%
Armenia, 2016 39 1609 2.42 [1.78; 3.30] 1.6%
India, 2016 78467 219796 35.70 [35.50; 35.90] 1.6%
Myanmar, 2016 775 4100 18.90 [17.73; 20.13] 1.6%
Nepal, 2016 656 2428 27.02 [25.29; 28.82] 1.6%
Timor−Leste, 2016 2875 7206 39.90 [38.77; 41.03] 1.6%
Maldives, 2017 342 2327 14.70 [13.32; 16.19] 1.6%
Tajikistan, 2017 504 6716 7.50 [6.90; 8.16] 1.6%
Pakistan, 2018 808 3622 22.31 [20.98; 23.69] 1.6%
Random effects model 282673 15.73 [12.22; 20.02] 22.9%
Heterogeneity: I^2 = 100%, τ^2 = 0.3088, p = 0
Americas
Bolivia, 2008 362 8422 4.30 [3.89; 4.75] 1.6%
Guyana, 2009 160 1522 10.51 [9.07; 12.16] 1.6%
Colombia, 2010 534 15702 3.40 [3.13; 3.70] 1.6%
Honduras, 2012 712 10167 7.00 [6.52; 7.52] 1.6%
Peru, 2012 312 9168 3.40 [3.05; 3.79] 1.6%
Dominican Republic, 2013 138 3619 3.81 [3.24; 4.49] 1.6%
Guatemala, 2015 1583 12567 12.60 [12.03; 13.19] 1.6%
Haiti, 2017 625 6646 9.40 [8.73; 10.13] 1.6%
Random effects model 67813 6.05 [4.00; 9.03] 13.1%
Heterogeneity: I^2 = 99%, τ^2 = 0.3876, p < 0.01
Oceania
Samoa, 2008 362 8422 4.30 [3.89; 4.75] 1.6%
Random effects model 8422 4.30 [3.89; 4.75] 1.6%
Heterogeneity: not applicable
Random effects model 626130 12.32 [10.40; 14.55] 100.0%
Heterogeneity: I^2 = 100%, τ^2 = 0.5816, p = 0
Residual heterogeneity: I^2 = 100%, p = 0
0
10
20
30
40
50
Prevalence of underweight (%)

Equation for random-effects analysis using the method of DerSimonian and Laird[3]

Suppose that there are K studies/surveys. The estimated treatment effect for a binary response variable (logarithm of the odds ratio) in the k^{th} study, $k = 1,2, \dots, K$, is Y_k. The estimated variance of Y_k in the k^{th} study is S_k^2. The weight for the estimated treatment effect in the k^{th} study in the fixed-effects model is $w_k = 1/S_k^2$. The overall weighted treatment effect in the mixed-effects model is

$$Y_k = \theta + u_k + e_k$$

where

1. Y_k is the observed effect in the k^{th} study
2. θ is the pooled population parameter of interest (natural logarithm of the population odds ratio)
3. e_k is the random error term for the k^{th} study
4. u_k is a random effect for the k^{th} study, $k = 1,2, \dots, K$.

It is assumed that $e_1, e_2, \dots, e_K$ are independent random variables with $e_k \sim N(0, \sigma_k^2), k = 1,2, \dots, K$. The variance term σ_k^2 reflects intra-study variability and its estimate is S_k^2. Usually, Y_k and S_k^2 (or S_k) are provided as descriptive statistics in the k^{th} study report. The overall weighted treatment effect in the mixed -effects model is

$$Y = \left(\sum_{k=1}^{K} w_k Y_k\right) / \left(\sum_{k=1}^{K} w_k\right)$$

where $w_k = 1/\left(S_k^2 + \widehat{\omega}^2\right), k = 1,2, \dots, K.$

the variance of Y in the random-effects model is

$$S^2 = 1 \Big/ \left(\sum_{k=1}^{K} w_k\right)$$

The statistic for testing H_0: $study\ homogeneity$ is

$$Q = \sum_{k=1}^{K} w_k (Y_k - Y)^2 \sim \chi_{K-1}^2$$

References

1 United Nations Development Programme. Human development index (HDI). doi:http://hdr.undp.org/en/data (2020).

2 United Nations. *Definition of Regions*, <https://population.un.org/wpp/DefinitionOfRegions/> (2019).

3 DerSimonian, R. & Laird, N. Meta-analysis in clinical trials. *Controlled Clinical Trials* **7**, 177-188, doi:https://doi.org/10.1016/0197-2456(86)90046-2 (1986).