

## Supplementary appendix

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### **Data identification, access, and inclusion**

Our main source of data was the WHO Vitamin and Mineral Nutrition Information System (VMINS) database. Data are identified via periodic MEDLINE searches and through an international network of collaborators and country contacts. Studies are included in the WHO database if there is a defined population-based sampling frame; a probabilistic sampling procedure is used; and if sample size is at least 100 individuals. We also provided a list of data sources in the WHO VMINS to WHO country offices and to WHO's network of international collaborators, and sought additional data that were not in VMINS. We manually identified and removed duplicate data by checking all data sources from the same country and year. Our last data update was in the first quarter of 2015.

As described in the main text, we used only data that measured vitamin A deficiency in terms of serum retinol concentration. We accessed data that reported mean serum retinol, the prevalence of serum retinol  $< 0.35 \mu\text{mol/l}$ , the prevalence of serum retinol  $< 0.7 \mu\text{mol/l}$ , or prevalence of serum retinol  $< 1.05 \mu\text{mol/l}$ . We screened the VMINS data and included data sources if:

- serum retinol was measured for children under seven years of age;
- a probabilistic sampling method with a defined sampling frame was used, and data were representative of at least a first administrative unit within a country;
- the sample size of the survey or study was at least 75 individuals;
- data were collected in or after 1990; and
- data were from the 138 countries and territories listed in Appendix Table 1.

Our age group of interest was 6-59 months of age because this is the age range for which randomised trials have found effects on mortality and because it was the most commonly

reported age range in population-based surveys. We included data from studies that had included children younger than 7 years of age in order to make use of a number of additional surveys.

Consistent with our inclusion and exclusion criteria, we excluded VMNIS data sources if (Appendix Figure 1):

- serum retinol was not measured, or another measure such as retinol in cord blood serum or breast milk, retinol-binding protein, or signs of xerophthalmia were reported;
- data were collected prior to 1990 or in a country or territory not listed in Appendix Table 1;
- data were not representative of the general population (e.g., from a sample of refugees), non-random sampling methods were used, or sampling methods were not adequately described;
- data were from a facility-based surveillance system;
- the study was representative of an area smaller than a first administrative unit within a country;
- the study did not collect data on children under age 7;
- data for children under seven years of age were reported together with those for children older than seven years of age without reporting summary statistics in smaller age bands; or
- data were collected immediately following a Vitamin A supplementation campaign.

### **Conversion among serum retinol metrics**

Our primary definition of vitamin A deficiency was serum retinol < 0.70 µmol/L. Some data sources reported serum retinol < 0.35 µmol/L, serum retinol < 1.05 µmol/L, and/or mean serum retinol (Webtable 2). We used data sources that had reported the prevalence of serum retinol < 0.70 µmol/L as well as the other three metrics to develop regression models to estimate the former. We fitted the following three ordinary least squares regressions:

$$\text{Logit}(P_{0.70}) \sim \text{logit}(P_{0.35})$$

$$\text{Logit}(P_{0.70}) \sim \text{logit}(P_{1.05})$$

$$\text{Logit}(P_{0.70}) \sim \text{mean\_retinol}$$

where  $P_x$  is the prevalence of serum retinol <  $x$  µmol/l. The regression coefficients are given in Appendix Table 4.

### **References**

1. World Health Organization. Serum retinol concentrations for determining the prevalence of vitamin A deficiency in populations. Geneva: World Health Organization, 2011.
2. World Health Organization. Global prevalence of vitamin A deficiency in populations at risk 1995-2005. Geneva: World Health Organization; 2009.

**Appendix table 1: Countries and territories in analysis regions.**

<b>Region</b>	<b>Countries</b>
East and Southeast Asia	Cambodia, China, Democratic People’s Republic of Korea, Indonesia, Lao People’s Democratic Republic, Malaysia, Maldives, Myanmar, Philippines, Sri Lanka, Taiwan, Thailand, Timor-Leste, Viet Nam
Oceania	Fiji, Kiribati, Marshall Islands, Micronesia (Federated States of), Papua New Guinea, Samoa, Solomon Islands, Tonga, Vanuatu
South Asia	Afghanistan, Bangladesh, Bhutan, India, Nepal, Pakistan
Central Asia, Middle East, and North Africa	Algeria, Armenia, Azerbaijan, Bahrain, Egypt, Georgia, Iran (Islamic Republic of), Iraq, Jordan, Kazakhstan, Kuwait, Kyrgyzstan, Lebanon, Libyan Arab Jamahiriya, Mongolia, Morocco, Occupied Palestinian Territory, Oman, Qatar, Saudi Arabia, Syrian Arab Republic, Tajikistan, Tunisia, Turkey, Turkmenistan, United Arab Emirates, Uzbekistan, Yemen
Sub-Saharan Africa	Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Côte d’Ivoire, Democratic Republic of the Congo, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Sudan, Swaziland, São Tomé and Príncipe, Togo, Uganda, United Republic of Tanzania, Zambia, Zimbabwe
Andean and Central Latin America and Caribbean	Antigua and Barbuda, Bahamas, Barbados, Belize, Bermuda, Bolivia, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Peru, Puerto Rico, Saint Lucia, Saint Vincent and the Grenadines, Suriname, Trinidad and Tobago, Venezuela (Bolivarian Republic of)
Southern and Tropical Latin America	Argentina, Brazil, Chile, Paraguay, Uruguay

Appendix table 2: Characteristics of included data sources.

Country	Year	Age	Coverage	Sample size	Notes	Reference
Afghanistan	2013	.5-4.99	National	728	1, 2	National Nutrition Survey
Angola	1998-1999	0-5.07	National	765	2, 3, 4	Ministry of Health, National Program of Nutrition, UNICEF. Assessing vitamin A and iron deficiency anaemia, nutritional anaemia among children aged 0-60 months in the Republic of Angola [technical report]. 2000.
Antigua and Barbuda	1996-1997	1-4.99	National	92	1, 4	Micronutrient Working Group. Iron and vitamin A status in five Caribbean countries. <i>Cajanus</i> , 2002, 35:4-34
Argentina	1998	.5-2.07	1st admin or above	414	1, 2, 3, 4	Morasso M del C, Molero J, Vinocur P, Acosta L, Paccussi N, Raselli S, Falivene G, Viteri FE. Deficiencias de hierro y de vitamina A y prevalencia de anemia en niños y niñas de 6 a 24 meses de edad en Chaco, Argentina [Iron and vitamin A deficiencies and prevalence of anemia in boys and girls between 6 to 24 months of age in Chaco, Argentina]. <i>Archivos Latinoamericanos de Nutrición</i> , 2003, 53:21-27
Argentina	2004-2005	2-5.99	National	7200	2, 4	Ministerio de Salud, Plan Federal de Salud. Encuesta Nacional de Nutrición y Salud (ENNyS). Argentina, Ministerio de Salud, 2007.
Armenia	1998	0-4.99	National	2341	2, 4	Branca F, Napolitano A, Coclite D, Rossi L. The health and nutritional status of children and women in Armenia. Rome, National Institute of Nutrition, 1998.
Bangladesh	1997-1998	.5-4.99	1st admin or above (rural)	1136	1, 2, 3, 4	Helen Keller International [Bangladesh], Institute of Public Health Nutrition. Vitamin A status throughout the lifecycle in rural Bangladesh: National Vitamin A Survey 1997-98. Dhaka, Helen Keller International, 1999.
Bangladesh	2011-2012	.5-4.99	National	873	1, 2, 3	National Micronutrients Status Survey
Belize	2011-2012	.5-4.99	National	937	2	Report on prevalence of anemia and deficiency of ferritin, retinol, serum folate, red blood cell folate, and vitamin B12 in women of childbearing age (15-49 years of age) and children 6-59 months of age, Belize 2011-2012
Benin	1999	1-5.99	1st admin or above	1491	2	Republique du Benin, Ministère de la Santé Publique, Direction de la Santé Familiale, UNICEF, USAID. Enquête nationale sur la carence en vitamine A et la disponibilité en sel iode dans les ménages. rapport de l'enquête familiale. Republique du Benin, 2000.
Bhutan	1999	1-4.99	1st admin or above	910	1, 4	Pem N, Gyeltshen K, Tenzin N. Report of a survey for vitamin A deficiency in children under Five and pregnant women in Bhutan. 2000.
Botswana	1994	.5-5.99	National	243	1, 2, 3, 4	Ministry of Health [Botswana], UNICEF. Micronutrient malnutrition in Botswana. A national survey to assess the status of iodine, iron, and vitamin A. Gaborone, Ministry of Health, 1996.
Brazil	1992	0-4.99	1st admin or above	1032	1, 2, 3, 4	Diniz AS. Aspecto clínicos, sub-clínicos e epidemiológicos da hipovitaminose A no estado da Paraíba [thesis]. Pernambuco, Universidade Federal de Pernambuco, 1997.
Brazil	1997	0-4.99	1st admin or above	669	1, 2	Instituto Nacional de Alimentação e Nutrição, Instituto Materno Infantil de Pernambuco, Departamento de Nutrição. II Pesquisa estadual de saúde e nutrição. Brazil, Instituto Nacional de Alimentação e Nutrição, 1998.
Brazil	1998	.5-5.07	1st admin or above	607	1, 2, 4	Martins MC, Santos LMP, Assis AMO. Prevalence of hypovitaminosis A among preschool children from northeastern Brazil, 1998. <i>Revista de Saúde Pública</i> , 2004, 38:537-542
Brazil	2006	.5-4.99	National	3499	2	Pesquisa Nacional de Demografia e Saude da Crianca e da Mulher
Burundi	2005	.5-4.99	National	714	2	Ministere de la Sante Publique, Programme de Lutte Contre les Maladies Transmissibles es Carentielles. Rapport de l'enquete nationale de nutrition de la population, 2005. Bujumbura, Burundi, Ministère de la Santé Publique, 2006.
Cabo Verde	1996	.5-5.99	National	299	2, 3	Caracterizao deficiencia de vitamina A e da anemia em crianças pré-escolares de Cabo Verde. Cape Verde, Ministério da Saúde e Promoção Social, 1997.
Cambodia	2000	.5-4.99	National	359	1, 2	Hix J, Rasca P, Morgan J, Denna S, Panagides D, Tam M, Shankar AH. Validation of a rapid enzyme immunoassay for the quantitation of retinol-binding protein to assess vitamin A status within populations. <i>European Journal of Clinical Nutrition</i> , 2006, 60:1299-1303
Cameroon	1992	0-5.99	1st admin or above	147	2	Wilson MR, Mansour M, Atud AE, Casey R, Fobi G, Moukouri E, Alemayehu W, Martone JF, Ross-Degnan D. A population-based study of xerophthalmia in the extreme north Province of Cameroon, West Africa. <i>Archives of Ophthalmology</i> , 1996, 114:464-468

Cameroon	2000	1-5.99	National	2375	1, 2, 4	MSP, UNICEF, Hellen Keller Worldwide, Sight and Life, WHO. Cameroun Enquête Nationale sur la Carence en Vitamine A et l'Anémie. 2001.
Cameroon	2009	1-4.99	National	83	2	National Survey of Micronutrient Status and Consumption of Fortifiable Foods
Central African Republic	1998-1999	.5-3.07	National	882	1, 2, 3, 4	Ministere Delegue a l'Economie au Plan et a la Cooperation Internationale, Ministere de la Sante et de la Population, UNICEF. Enquête nationale sur l'avitaminose A, la carence en fer et la consommation du sel iode [rapport final]. Republique Centrafricaine, 2000.
China	1999-2000	0-6.07	National	7826	2, 3, 4	Jingxiong J, Toschke AM, von Kries R, Koletzko B, Liangming L. Vitamin A status among children in China. Public Health Nutrition, 2006, 9:955-960
China	2001	0-4.99	1st admin or above	187	4	Hu W, Tong S, Oldenburg B, Feng X. Serum vitamin A concentrations and growth in children and adolescents in Gansu Province, China. Asia Pacific Journal of Clinical Nutrition, 2001, 10:63-66
China	2001	0-5.99	1st admin or above	1257	2, 3, 4	Mi J, Lin L, Ma G, Gu X, Liu M, Cheng H, Hou D, Tan Z, Liu C.. Prevalence of vitamin A deficiency in children under six years of age in Tibet, China [in Chinese]. Zhonghua Yu Fang Yi Xue Za Zhi [Chinese Journal of Preventive Medicine], 2003, 37:419-422
China	2006	0-5	National	18554	2, 3	Zhao, L., et al., [Analysis of health selective survey result of children and pregnant/Lying-in women in China in 2006]. Wei Sheng Yan Jiu, 2008. 37(1): p. 65-7.
Colombia	2005	42095	National	4406	1, 2, 3, 4	Encuesta Nacional de la Situacion Nutricional (ENSIN)
Colombia	2010	1-4.99	National	488	2, 4	Encuesta Nacional de la Situacion Nutricional (ENSIN)
Congo	1998-1999	.5-6.99	1st admin or above	299	1, 2, 4	Samba C, Tchibindat F, Houze P, Gourmel B, Malvy D. Prevalence of infant Vitamin A deficiency and undernutrition in the Republic of Congo. Acta Tropica, 2006, 97:270-283
Costa Rica	1996	1-6.99	National	567	1, 2, 3, 4	Carvajal Fernandez D, Alfaro Calvo T, Monge-Rojas R. Deficiencia de vitamina A en niños preescolares: un problema reemergente en Costa Rica? [Vitamin A deficiency among preschool children: a re-emerging problem in Costa Rica?]. Archivos Latinoamericanos de Nutrición, 2003, 53:267-270
Costa Rica	2008-2009	1-6.99	National	378	2, 3, 4	Encuesta Nacional de Nutricion
Cote d'Ivoire	1996	2-5.99	1st admin or above	282	1, 2	Asobayire FS Development of a food fortification strategy to combat iron deficiency in the Ivory Coast [thesis] Zurich, Swiss Federal Institute of Technology, 2000.
Cuba	1999-2000	.5-2.07	1st admin or above (urban)	2371	1, 2, 4	Matos CM, Rodríguez GP, Gutiérrez PM, Jiménez EA, Ramos Mesa MA. Estado nutricional de la vitamina A en niños Cubanos de 6 a 24 meses de edad. 2002.
DR Congo	1998-1999	.5-3.07	National	601	1, 2	Ministère de la Santé, Bureau National TDCI, UNICEF, CEPLANUT. Importance de la carence en vitamine A en République Democratique du Congo. Kinshasa, DRC, 2000.
Dominica	1996-1997	1-4.99	National	160	1	Micronutrient Working Group. Iron and vitamin A status in five Caribbean countries. Cajuanus, 2002, 35:4-34
Dominican Republic	1991	1-5.99	1st admin or above	505	1, 2, 3	Centro Nacional de Investigaciones en Salud Materno Infantil. Deficiencia de vitamina A en la región del sudoeste de la República Dominicana. Santa Domingo, 1991.
Dominican Republic	2009	.5-4.99	National	918	2	Encuesta Nacional de Micronutrientes
Ecuador	1993-1994	1-4.99	1st admin or above	1232	1, 2, 3, 4	Ministerio de Salud Publica [Ecuador]. Deficiencia de vitamina A en provincias de pobreza critica del Ecuador. Quito, 1994.
Ecuador	2011-2013	.5-4.99	National	2044	2	Encuesta Nacional de Salud y Nutricion ENSANUT-ECU
Egypt	1997	.5-5.99	1st admin or above	2587	2, 4	Alexandria University, High Institute of Public Health, UNICEF. Assessment of protein energy malnutrition, iron deficiency anaemia and vitamin A deficiency in Menia, Assiut and Sohag Governorates. Alexandria, Alexandria University, High Institute of Public Health, 1997.
Egypt	1999	.5-5.99	1st admin or above	1040	2, 4	El Sayed N, Zeid HA, Ismail H, Nofal L, Mahfouz A, Gad A. Assessment of vitamin A deficiency (VAD) among preschool children in Alexandria Governorate: Community-Based Study. Bulletin of the High Institute of Public Health, 1999, 29:389-398
El Salvador	2009	1-4.99	National	587	2, 4	Estudio de retinol sérico en niños y niñas de 12 a 59 mese de edad y en mujeres de 15 a 49 años
Ethiopia	1996	.5-5.99	1st admin or above	634	2	Haidar J, Demisse T. Malnutrition and xerophthalmia in rural communities of Ethiopia. East African Medical Journal, 1999, 76:590-593
Ethiopia	1997	.5-5.99	1st admin or above	1087	1, 2	Synder R, MacDonald C. World Vision Ethiopia MICA Program. Final Evaluation Report. Ethiopia, World Vision Ethiopia, 2006.



Gambia	1999	1-5.99	National	405	1, 2, 4	Bah A, Semega-Janneh I, Prentice A, Bates C. Nationwide survey on the prevalence of vitamin A and iron deficiency in women and children in the Gambia. Banjul, National Nutrition Agency, 2001.
Ghana	1997	.5-4.99	1st admin or above	1050	1, 2	Quarshie K, Amoafu E. Proceedings of the workshop on dissemination of findings of vitamin A and anaemia prevalence surveys; 1998 Nov 24-25; Accra, Ghana. 1998
Guatemala	1995	1-4.99	National	1576	1, 2, 3	Ministerio de Salud Pública y Asistencia Social. Encuesta Nacional de Micronutrientes. Guatemala City, Ministerio de Salud Pública y Asistencia Social, 1996.
Guatemala	2009-2010	.5-4.99	National	1198	2, 3	Encuesta Nacional de Micronutrientes (ENMICRON)
Guyana	1996-1997	1-4.99	National	141	1	Micronutrient Working Group. Iron and vitamin A status in five Caribbean countries. <i>Cajanus</i> , 2002, 35:4-34
Haiti	2004-2005	.5-4.99	National	780	1, 2	Ministere de la Sante Publique et de la Population, Fonds des Nations Unies pour l'Enfance. Enquete sur la prevalence de la carence en vitamine A et de la deficiencia end iode end Haiti. L'institut Haitien de l'Enfance, 2005.
Honduras	1996	1-5.99	National	1618	2, 3, 4	Ministerio de Salud Pública, Secretaria de Salud, Fundación Internacional de Ojos, Opportunities for Micronutrient Interventions, USAID. Encuesta Nacional de Micronutrientes Honduras, 1996. Tegucigalpa, Secretaria de Salud, Ministerio de Salud Pública, 1997.
India	2000	1-3.99	1st admin or above	618	1, 2, 4	State Government of Orissa, WHO, National Institute of Nutrition [India], UNICEF, Micronutrient Initiative. Impact of vitamin A supplementation delivered with oral polio vaccine as part of immunization campaign in Orissa, India [draft final report]. Bhubheshwar, State Government of Orissa, 2001.
India	2001-2003	1-4.99	1st admin or above (rural)	3934	2	National Institute of Nutrition, Indian Council of Medical Research. Prevalence of Micronutrient Deficiencies. National Nutrition Monitoring Bureau (NNMB) Technical Report No. 22. Hyderabad, India, National Institute of Nutrition, 2003.
India	2002-2003	42125	1st admin or above	494	2	Arlappa, N., et al., Clinical and sub-clinical vitamin A deficiency among rural pre-school children of Maharashtra, India. <i>Ann Hum Biol</i> , 2008. 35(6): p. 606-14.
Indonesia	1990-1991	.5-5.99	1st admin or above	1869	1, 2, 4	Ross DA, Trowbridge FL. Review of USAID/VITAL-supported vitamin A deficiency surveys. 1994.
Indonesia	1995-1996	1-1.99	1st admin or above	97	4	de Pee S, Bloem MW, Satoto, Yip R, Sukaton A, Tjong R, Shrimpton R, Muhilal, Kodyat B. Impact of a social marketing campaign promoting dark-green leafy vegetables and eggs in central Java, Indonesia. <i>International Journal for Vitamin and Nutrition Research</i> , 1998, 68:389-398
Indonesia	2006	.5-4.99	1st admin or above	3745	2	Susilowati H. Studi masalah gizi mikro de Indonesia: perhatian khusus pada kurang vitamin a (KVA), anemia, den seng [Study on micronutrient problems in Indonesia: special focus on vitamin A deficiency, anaemia and zinc]. <i>Nutrition Research and Development Center, Ministry of Health [Indonesia]</i> , 2007.
Indonesia	2011	2-4.99	National	504	2, 4	Sandjaja, S. et al. Food consumption and nutritional and biochemical status of 0.5-12-year-old Indonesian children: the SEANUTS study. <i>British Journal of Nutrition</i> , 2013, 110:S11-S20.
Iran	2001	1.5-1.99	National	8493	2, 3	The Medical University, The Department of Computer Sciences, UNICEF, The National Reference Laboratories and The Institute of Nutrition and Food Technology. An investigation of under-nutrition in Iran year 1380 (2001). Iran, Ministry of Health, 2001.
Iraq	2011-2012	1-4.99	National	2024	2	Iraq National Micronutrient Deficiencies: Assessment and Response 2011-2012
Jamaica	1998	1-4.99	National	284	1, 4	WHO Pan American Health Organization, Caribbean Food and Nutrition Institute, Ministry of Health, Ministry of Education. Micronutrient study report: an assessment of the vitamin A, E, beta-carotene, and iron status in Jamaica. 1998
Jordan	2002	1-4.99	National	1036	2	Ministry of Health [Jordan], WHO, UNICEF, Centers for Disease Control and Prevention. National baseline survey on iron deficiency anemia and vitamin A deficiency. Amman, Ministry of Health, 2002.
Jordan	2010	1-4.99	National	915	1, 2	National Micronutrient Survey Jordan 2010
Kazakhstan	2002	.5-5.07	1st admin or above	1019	1, 2, 3, 4	Kazakh Academy of Nutrition, UNICEF [Central Asian Republics and Kazakhstan]. Estimation of vitamin A deficiency prevalence in Kazakhstan. Almaty, Kazakhstan, 2002.
Kenya	1994	.5-6.07	National	6425	1, 2, 4	Ngare DK, Muttunga JN, Njonge E. Vitamin A deficiency in pre-school in children in Kenya. <i>East African Medical Journal</i> , 2000, 77:421-424

Kenya	1999	0-5.07	National	945	1, 2	Mwaniki DL, Omwega AM, Muniu EM, Mutunga JN, Akelola R, Shako BR, Gotink MH, Pertet AM. Anaemia and status of iron, vitamin A and zinc in Kenya. The 1999 National Survey. Nairobi, Ministry of Health, 2002.
Lao PDR	2000	0-4.99	National	419	1, 2	Ministry of Health [Lao People's Democratic Republic]. Report on national health survey: health status of the People of LAO PDR. Vientiane, Ministry of Health, 2001.
Lesotho	1993	2-6.99	National	127	1, 2, 4	Wolde-Gebriel Z. National survey on iodine, vitamin A and iron status of women and children in Lesotho. Maseru, Ministry of Health/United Nations Children's Fund, 1994.
Liberia	1999	.5-2.99	National	643	1, 2, 4	Mulder-Sibanda M, Dahn B, Duworko M, Flomo-Hall M, Benson A, Ortiz J. National Micronutrient Survey. A national prevalence study on vitamin A deficiency, iron deficiency anemia, iodine deficiency. Monrovia, Ministry of Health and Social Welfare, Family Health Division, United Nations Children's Fund, 1999.
Madagascar	2000	.5-4.99	National	584	1, 2, 4	Razafiarisoa Berthine. Enquête sur la carence en vitamine A chez les femmes et les enfants en enquête sur l'anémie chez les écoliers de 6 à 14 ans, Madagascar 2000. Washington, DC, United States Agency for International Development Micronutrient Program, 2001.
Malawi	2001	.5-3.07	National	476	1, 2, 3, 4	Ministry of Health, UNICEF. Malawi Micronutrient Survey 2001. Lilongwe, Malawi, Ministry of Health, 2003.
Malaysia	1999-2000	NR-5.99	National	454	2, 4	Ministry of Health [Malaysia]. A study of malnutrition in under five children in Malaysia. Kuala Lumpur, Ministry of Health, Malaysia, 1999.
Maldives	2001	2-2.99	National	640	1, 2, 3, 4	Minister of Health, Republic of Maldives. Multiple Indicator Cluster Survey (MICS 2), Maldives. Malé, Ministry of Health, 2001.
Maldives	2007	.5-4.99	National	1262	2, 4	National Micronutrient Survey
Mali	1997	1-5.5	National	1510	1, 2, 4	Schemann, J.F., et al., National immunisation days and vitamin A distribution in Mali: has the vitamin A status of pre-school children improved? Public Health Nutr, 2003. 6(3): p. 233-44.
Mali	1999	1-5.5	National	1524	1, 2, 4	Schemann, J.F., et al., National immunisation days and vitamin A distribution in Mali: has the vitamin A status of pre-school children improved? Public Health Nutr, 2003. 6(3): p. 233-44.
Marshall Islands	1994-1995	1-5.99	National	919	1, 2, 3, 4	Palafox NA, Gamble MV, Dancheck B, Ricks MO, Briand K, Semba RD. Vitamin A deficiency, iron deficiency, and anemia among preschool children in the Republic of the Marshall Islands. Nutrition, 2003, 19:405-408
Mauritius	1995	3-6.99	National	161	1, 2	Ministry of Health [Mauritius]. A survey of nutrition in Mauritius and Rodrigues (1995) [final report]. Port Louis, Ministry of Health, 1995.
Mexico	1998-1999	0-4.99	National	322	1, 2, 4	Instituto Nacional de Salud Publica. Encuesta Nacional de Nutrición 1999. Mexico City, Instituto Nacional de Salud Publica, 1999.
Micronesia (Federated States of)	1993	2-3.99	1st admin or above	354	1, 2, 4	Auerbach SB. Maternal-Child Health Survey: Pohnpei, Federated States of Micronesia, 1993 [summary table]. 1993
Micronesia (Federated States of)	2000	2-4.99	1st admin or above	486	2, 4	Socorro P, Gonzaga C. Results of vitamin A, anemia and blood lead survey among 2-4 year old children and reproductive-aged women in Yap proper and Kosrae State, Federated States of Micronesia. Atlanta, Centers for Disease Control and Prevention, 2000.
Micronesia (Federated States of)	2002	2-6.99	1st admin or above	242	2, 4	Kim D, Sowell A. Vitamin A deficiency among children and caregivers in Chuuk State, Federated States of Micronesia. Federated States of Micronesia, Centers for Disease Control and Prevention, 2002.
Mongolia	1997-1999	.5-6.07	National	416	2, 4	Erdenechimeg E Physiologic and hygienic assessment of vitamin A deficiency in children, Mongolia [thesis] Mongolia, Public Health Institute, 2000.
Mongolia	2000-2002	.5-4.99	1st admin or above	233	2, 4	vitaminization. First International Congress on School Hygiene, May 12, 2004, Moscow, 2004:1071-1172
Mongolia	2001	.5-4.99	1st admin or above	88	2, 4	Bolormaa N, Byambatogtoch B, Bates J, Serdula MK, Kaufmann R, Woodruff BA, Khan LK, Gillespie C. Final Report of a Survey Assessing the Nutritional consequences of the Dzud in Mongolia. Mongolia, Ministry of Health Ulaan Baatar, Mongolia, 2003.
Mongolia	2006	.5-3	1st admin or above (urban)	203	2, 4	Lander, R.L., et al., Multiple micronutrient deficiencies persist during early childhood in Mongolia. Asia Pac J Clin Nutr, 2008. 17(3): p. 429-40.
Morocco	1996	.5-5.99	National	1453	2, 4	Nasri I, El Bouhali B, Aguenauh H, Mokhtar N. Vitamin A deficiency among Moroccan women and children. African Health Sciences, 2004, 4:3-8

Mozambique	2001-2002	.5-4.99	National	705	1, 2	Ministério da Saúde, Direcção Nacional de Saúde. Inquérito nacional sobre a deficiência de vitamina A, prevalência de anemia e malária em crianças dos 6-59 meses e respectivas mães. Maputo, Instituto Nacional de Saúde, 2003.
Namibia	1992	2-6.99	National	290	1, 2, 4	Ministry of Health and Social Services [Namibia]. Iodine deficiency disorders in Namibia and data in the status of vitamin A and iron. 1992.
Nepal	1997-1998	.5-4.99	National	843	1, 2, 4	Ministry of Health [Nepal], Child Health Division, New ERA, The Micronutrient Initiative, UNICEF [Nepal], WHO. Nepal Micronutrient Status Survey 1998. Kathmandu, Ministry of Health, 1999.
Nicaragua	1993	1-4.99	National	1451	1, 2, 3, 4	Ministerio de Salud, Direccion General de Promocion de la Salud, Direccion de Nutricion. Encuesta nacional sobre deficiencia de micronutrientes en Nicaragua 1993: resumen ejecutivo [National survey of micronutrient deficiencies in Nicaragua 1993: executive summary]. Managua, Ministerio de Salud, 1994.
Nicaragua	2000	.5-4.99	National	2215	1, 2, 3, 4	Ministerio de Salud. Encuesta nacional de micronutrientes (ENM 2000) [National survey of micronutrients (ENM 2000)]. Managua, Ministerio de Salud, 2002.
Nicaragua	2003-2005	.5-4.99	National	1496	2	Ministerio de Salud. Sistema integrado de vigilancia de intervenciones nutricionales (SIVIN) 2003-2005. Managua, Ministerio de Salud, 2006.
Nigeria	1992-1993	0-5.99	1st admin or above	739	2	Federal Government of Nigeria, UNICEF. The nutritional status of women and children in Nigeria. Lagos, 1994.
Nigeria	1993	.5-5.99	National	1331	1, 2, 4	Federal Ministry of Health and Social Services, United States Agency for International Development, Vitamin A Field Support Project, Opportunities for Micronutrient Interventions. Nigeria National Micronutrient Survey, 1993. Nigeria, Federal Ministry of Health and Social Services, 1996.
Nigeria	2001	0-4.99	National	3099	1, 2, 4	International Institute of Tropical Agriculture (IITA), USAID, UNICEF, USDA. Nigeria Food Consumption and Nutrition Survey 2001-2003 [summary]. Nigeria, International Institute of Tropical Agriculture, 2004.
Oman	2004	.5-4.99	National	152	2	Ministry of Health of the Sultanate of Oman, UNICEF Muscat, WHO Eastern Mediterranean Regional Office. National micronutrient status and fortified food coverage survey, Oman, 2004. Muscat, Oman, Department of Nutrition, Ministry of Health of the Sultanate of Oman, 2006.
Pakistan	1997	.5-5.07	1st admin or above	2519	1, 2	Paracha PI, Jamil A, Northrop-Clewes C, Thurnham DI. Interpretation of vitamin A status in apparently healthy Pakistani children by using markers of subclinical infection. American Journal of Clinical Nutrition, 2000, 72:1164-1169
Pakistan	2011	0-4.99	National	8634	2	Pakistan Nutritional Survey 2011
Panama	1992	1-4.99	National	1103	1, 2, 3, 4	Ministerio de Salud, Departamento de Nutricion y Dietetica. Encuesta nacional de vitamina A 1992 [National survey on vitamin A 1992]. Panamá City, Ministerio de Salud, 1992.
Panama	1999	1-4.99	National	924	1, 2, 3, 4	Ministerio de Salud, UNICEF. Encuesta nacional de vitamina A y anemia por deficiencia de hierro [National survey of vitamin A and iron deficiency anemia]. Panama City, Ministerio de Salud, 2000.
Papua New Guinea	1998	.5-5.99	1st admin or above	130	2, 4	Friesen H, Verma N, Lagani W, Billson F, Saweri W, Earl J. Vitamin A status of children in different provinces in Papua New Guinea. In: Abstracts of the 34th Annual Symposium of the Medical Society of Papua New Guinea; 1998 Sept 7-11. 1998:56
Peru	1992-1993	0-3.08	1st admin or above	168	2, 4	Asociación Benéfica Proyectos en Informática Salud Medicina y Agricultura. Encuesta Bioquímica del Estado de Hierro y Vitamina A: regiones Lima y Libertadores-Wari 1992-93 [Biochemical Study of the Iron and Vitamin A Status: regions Lima and Libertadores-Wari 1992-93]. Lima, Asociación Benéfica Proyectos en Informática Salud Medicina y Agricultura/Programa de Alimentación y Nutrición de la Familia en Alto Riesgo, 1993.
Peru	1992-1993	1-4.08	1st admin or above (urban)	225	2, 4	Asociación Benéfica Proyectos en Informática Salud Medicina y Agricultura. Encuesta Bioquímica del Estado de Hierro y Vitamina A: regiones Lima y Libertadores-Wari 1992-93 [Biochemical Study of the Iron and Vitamin A Status: regions Lima and Libertadores-Wari 1992-93]. Lima, Asociación Benéfica Proyectos en Informática Salud Medicina y Agricultura/Programa de Alimentación y Nutrición de la Familia en Alto Riesgo, 1993.

Peru	1997	NR-4.99	National	504	2	Instituto Nacional de Salud, Centro Nacional de Alimentación y Nutrición, Dirección Ejecutiva de Vigilancia Alimentaria y Nutricional. Informe nacional de deficiencia de vitamina A en niños menores de 05 años y mujeres en edad fértil 1997-2001. Lima, Ministerio de Salud, 2001.
Peru	1998	NR-4.99	National	946	2	Instituto Nacional de Salud, Centro Nacional de Alimentación y Nutrición, Dirección Ejecutiva de Vigilancia Alimentaria y Nutricional. Informe nacional de deficiencia de vitamina A en niños menores de 05 años y mujeres en edad fértil 1997-2001. Lima, Ministerio de Salud, 2001.
Peru	1999	NR-4.99	National	882	2	Instituto Nacional de Salud, Centro Nacional de Alimentación y Nutrición, Dirección Ejecutiva de Vigilancia Alimentaria y Nutricional. Informe nacional de deficiencia de vitamina A en niños menores de 05 años y mujeres en edad fértil 1997-2001. Lima, Ministerio de Salud, 2001.
Peru	2000	NR-4.99	National	657	2	Instituto Nacional de Salud, Centro Nacional de Alimentación y Nutrición, Dirección Ejecutiva de Vigilancia Alimentaria y Nutricional. Informe nacional de deficiencia de vitamina A en niños menores de 05 años y mujeres en edad fértil 1997-2001. Lima, Ministerio de Salud, 2001.
Peru	2001	NR-4.99	National	734	2	Instituto Nacional de Salud, Centro Nacional de Alimentación y Nutrición, Dirección Ejecutiva de Vigilancia Alimentaria y Nutricional. Informe nacional de deficiencia de vitamina A en niños menores de 05 años y mujeres en edad fértil 1997-2001. Lima, Ministerio de Salud, 2001.
Philippines	1993	.5-6.99	National	3773	1, 2, 4	Food and Nutrition Research Institute, Department of Science
Philippines	1998	.5-5.99	National	14291	1, 2	Food and Nutrition Research Institute, Department of Science and Technology, UNICEF. Philippine nutrition facts & figures. Manila, Food and Nutrition Research Institute, 2001.
Philippines	2003	.5-4.99	National	3544	1, 2, 4	Pedro MRA, Cerdana CM, Molano WL, Constantine A, Perlas LA, Palafox EF, Patalan L, Chavez M, Madriaga J, Castillo E, Barba CVC. Sixth National Nutrition Surveys. Philippines, Food and Nutrition Research Institute, Department of Science and Technology, 2006.
Philippines	2008	.5-5.99	National	2408	2, 4	7th National Nutrition Survey
Rwanda	1996	0-6.07	National	423	1, 2	Ministère de la Santé, UNICEF, OMS. National Nutrition Survey of Women and Children in Rwanda in 1996 [final report]. Kigali, Ministère de la Santé, 1997.
Saint Vincent and the Grenadines	1996-1997	1-4.99	National	174	1	Micronutrient Working Group. Iron and vitamin A status in five Caribbean countries. Cajanus, 2002, 35:4-34
Senegal	2010	1-4.99	National	1418	2, 3, 4	Senegal Micronutrient Survey
South Africa	1994	.5-5.99	National	4283	1, 2, 4	South African Vitamin A Consultation Group (SAVACG). Children aged 6 to 71 months in South Africa, 1994: their anthropometric, vitamin A, iron and immunisation coverage status. Johannesburg, South African Vitamin A Consultative Group, 1995.
South Africa	2005	1-6.99	National	969	1, 2, 3, 4	National Food Consumption Survey
South Africa	2012	0-4.99	National	438	2, 4	South African National Health and Nutrition Examination Survey SANHANES-1
Sri Lanka	1995-1996	.5-5.99	National	1750	1, 2, 3, 4	Ministry of Health and Indigenous Medicine, Medical Research Institute. Vitamin A deficiency status of children in Sri Lanka 1995/1996 [survey report]. Dehiwela, AJ Prints, 1998.
Tajikistan	2002	.5-5.07	1st admin or above	500	1, 2, 3, 4	Avgonov ZT, Gaibov AG, Tazhibaev ShS, Khairov KhS. [Prevalence of vitamin deficiency in Tajik children]. Voprosy Pitaniia, 2005, 74:14-16
Tanzania	1997	.5-5.99	National	853	1, 2	Ballart A, Mugyabyso JKL, Ruhiye DRM, Ndossi GD, Basheke MM. The National Vitamin A Deficiency Control Programme. A preliminary report on the national vitamin A survey 1997. 1998
Thailand	2011	3-5.99	National	178	2	Rojroongwasinkul, N., et al. SEANUTS: the nutritional status and dietary intakes of 0.5-12-year-old Thai children. British Journal of Nutrition, 2013, 110:S36-S44.
Tunisia	2006	5-6.99	1st admin or above	5591	1, 2, 4	République Tunisienne - Ministère de la Santé Publique, UNICEF. Statut en Vitamine A de L'Enfant Tunisien. Tunisia,
Uganda	2000-2001	.5-4.99	National	859	2	Uganda Bureau of Statistics. Uganda Demographic and Health Survey 2000- 2001. Uganda, 2001.
Uzbekistan	2002	.5-4.99	1st admin or above	633	1, 2	Ministry of Health, Analytical and Information Center [Uzbekistan], Ministry of Macroeconomics and Statistics, State Department of Statistics [Uzbekistan], ORC Macro. Uzbekistan Health Examination Survey 2002. Calverton, MD, ORC Macro, 2004.

Viet Nam	1998	0-4.99	1st admin or above	397	1, 2, 4	Ninh NX, Quyen DT, Thu NN, Hien VT, Nhien NV, Quang T, Khan NC. Sub-clinical vitamin A deficiency and some related risk factors among children and lactating mothers in the Red River Delta Province in 1998. Journal of Preventive Medicine, 2000, 10:31-38
Viet Nam	2005	.5-4.99	1st admin or above	1775	2	National Institute of Nutrition. Report on anemia and sub-clinical vitamin A deficiency in some provinces in Viet Nam, March 2006. Hanoi, National Institute of Nutrition, 2006.
Viet Nam	2009-2010	1-4.99	National	97920	2	General Nutrition Survey
Yemen	1992	1-5.99	1st admin or above	319	1, 2	Rosen DS, Al Sharif Z, Bashir M, Al Shabooti A, Pizzarello LD. Vitamin A deficiency and xerophthalmia in western Yemen. European Journal of Clinical Nutrition, 1996, 50:54-57
Zambia	1997	0-4.99	National	900	1, 2, 4	Luo C, Mwela CM. National Survey on Vitamin A Deficiency in Zambia: a random cluster study for children (0-5 years) and mothers attending national immunization days in August 1997. Lusaka, National Food and Nutrition Commission, 1997.
Zambia	2003	.5-4.99	National	659	1, 2, 4	Micronutrient Operational Strategies and Technologies (MOST), UNICEF, Centers for Disease Control and Prevention, Food and Nutrition Commission of Zambia, University of Zambia. Report of the national survey to evaluate the impact of vitamin A interventions in Zambia, July and November 2003. Zambia, Micronutrient Operational Strategies and Technologies, United States Agency for International Development (USAID) Micronutrient Program, 2003.
Zimbabwe	1999	1-5.99	National	346	1, 2, 4	Ministry of Health and Child Welfare, Nutrition Unit. Zimbabwe National Micronutrient Survey: 1999. Harare, Ministry of Health and Child Welfare, 2001.
For the notes column: 1 = prevalence of serum retinol < 0.35 mmol/L was reported; 2 = prevalence of serum retinol < 0.70 mmol/L was reported; 3= prevalence of serum retinol < 1.05 mmol/L was reported; 4 = mean serum retinol was reported						

**Appendix table 3: Risk ratios for vitamin A deficiency for diarrhea and measles mortality, adjusted for background prevalence of deficiency**

Study	Protective risk ratio (95% CI)	Risk ratio due to absence of supplementation (95% CI)	Prevalence of vitamin A deficiency (%)	Risk ratio due to vitamin A deficiency (95% CI) <sup>†</sup>
<b>Diarrhea mortality</b>				
Rahmathullah (1990)	0.48 (0.23-1.01)	2.08 (0.99-4.37)	37.5	3.89 (0.98-9.98)
West (1991)	0.61 (0.39-0.96)	1.64 (1.04-2.57)	39.9	2.81 (1.13-5.44)
Daulaire (1992)	0.65 (0.38-1.10)	1.54 (0.90-2.62)	39.9	2.52 (0.73-5.57)
Herrera (1992)	1.01 (0.68-1.49)	0.99 (0.67-1.47)	48.9	0.98 (0.28-2.01)
Ghana VAST Study Team (1993)	0.66 (0.46-0.95)	1.52 (1.05-2.18)	57.1	1.94 (1.10-3.14)
Agarwal (1995)	0.78 (0.21-2.94)	1.28 (0.34-4.80)	49.4	1.62 (0.00-9.33)
Chowdhury (2002)	0.34 (0.07-1.65)	2.94 (0.61-14.28)	48.0	5.05 (0.18-28.71)
Venkatarao (1996)	0.20 (0.01-4.30)	5.10 (0.25-105.85)	49.4	10.00 (0.00-231.34)
DEVTA Team (2013)	0.94 (0.83-1.06)	1.06 (0.94-1.20)	56.8	1.11 (0.90-1.36)
<b>Pooled risk ratio*</b>	<b>0.76 (0.62-0.93)</b>	<b>1.32 (1.08-1.61)</b>		<b>1.69 (1.17-2.45)</b>
<b>I<sup>2</sup></b>	<b>37%</b>	<b>37%</b>		<b>39%</b>
<b>Measles mortality</b>				
Daulaire (1992)	0.67 (0.07-6.39)	1.49 (0.16-14.26)	39.9	2.39 (0.00-38.47)
Agarwal (1995)	0.92 (0.18-4.58)	1.09 (0.22-5.48)	49.4	1.19 (0.00-10.84)
Herrera (1992)	0.99 (0.20-4.90)	1.01 (0.20-5.00)	48.9	1.02 (0.00-9.70)
Rahmathullah (1990)	0.58 (0.17-1.95)	1.72 (0.51-5.84)	37.5	2.93 (0.00-13.91)
Ghana VAST Study Team (1993)	0.82 (0.49-1.40)	1.22 (0.72-2.06)	57.1	1.40 (0.49-2.93)
West (1991)	0.24 (0.04-1.36)	4.17 (0.71-24.3)	39.9	9.95 (0.19-66.79)
DEVTA Team (2013)	0.91 (0.69-1.19)	1.10 (0.84-1.44)	56.8	1.17 (0.71-1.78)
<b>Pooled risk ratio*</b>	<b>0.86 (0.68-1.08)</b>	<b>1.17 (0.93-1.47)</b>		<b>1.26 (0.84-1.87)</b>
<b>I<sup>2</sup></b>	<b>&lt;1%</b>	<b>&lt;1%</b>		<b>&lt;1%</b>

\* Risk ratios were calculated using a random-effects model.

<sup>†</sup>The lower bounds of risk ratio due to vitamin A deficiency were truncated to zero if the estimates were below zero after adjusting prevalence of vitamin A deficiency.

**Appendix table 4: Regressions used to convert among serum retinol metrics.**

	Intercept (standard error)	Coefficient (standard error)	N	Adjusted R- squared
from serum retinol < 0.35 $\mu\text{mol/l}$	1.694 (0.167)	0.695 (0.044)	68	0.78
from serum retinol < 1.05 $\mu\text{mol/l}$	-1.984 (0.115)	0.962 (0.078)	32	0.83
from mean serum retinol ( $\mu\text{mol/l}$ )	3.853 (0.262)	-5.306 (0.268)	73	0.84

**Appendix table 5: Prevalence of vitamin A deficiency by World Health Organization (WHO) regions, UNICEF regions, and United Nations subregions in 1991, 2000, and 2013. Numbers in parentheses show 95% credibility intervals. Estimates are for children living in the developing countries listed in Appendix Table 1 only.**

Region	Prevalence in 1991 (%)	Prevalence in 2000 (%)	Prevalence in 2013 (%)
<i>WHO Regions</i>			
African Region	43 (28, 58)	47 (39, 56)	47 (24, 73)
Region of the Americas*	21 (11, 34)	15 (10, 22)	11 (4, 23)
Eastern Mediterranean Region	28 (13, 44)	29 (20, 38)	28 (14, 42)
European Region*	19 (4, 44)	15 (6, 28)	12 (1, 34)
South-East Asian Region	49 (21, 77)	43 (27, 58)	36 (9, 67)
Western Pacific Region	40 (14, 73)	19 (11, 30)	6 (1, 18)
<i>UNICEF Regions</i>			
Central and Eastern Europe/Commonwealth of Independent States*	19 (4, 44)	15 (6, 28)	12 (1, 34)
East Asia and Pacific	42 (19, 71)	21 (14, 30)	6 (1, 17)
East and Southern Africa	46 (30, 62)	49 (39, 58)	47 (23, 75)
Middle East and North Africa	21 (8, 42)	18 (11, 26)	15 (5, 30)
South Asia	47 (14, 78)	46 (28, 62)	44 (13, 78)
Latin America and Caribbean	21 (11, 34)	15 (10, 22)	11 (4, 23)
West and Central Africa	43 (27, 60)	48 (38, 60)	50 (25, 78)
<i>United Nations Subregions</i>			
Caribbean	20 (8, 36)	15 (8, 24)	12 (3, 28)
Central America	23 (8, 49)	14 (6, 28)	10 (1, 33)
Eastern Africa	48 (30, 66)	50 (39, 61)	48 (22, 77)
Eastern Asia	38 (11, 75)	17 (8, 29)	4 (0, 18)
Melanesia	39 (10, 72)	22 (7, 43)	10 (1, 44)
Micronesia	47 (26, 69)	29 (16, 45)	13 (1, 41)
Middle Africa	48 (26, 70)	56 (41, 69)	55 (25, 82)
Northern Africa	23 (10, 44)	21 (13, 30)	18 (5, 39)
Polynesia	32 (8, 64)	16 (5, 36)	6 (0, 25)
South America	21 (10, 34)	15 (9, 23)	11 (3, 24)
South-central Asia	44 (14, 72)	43 (27, 59)	41 (13, 73)
South-eastern Asia	51 (33, 69)	28 (19, 37)	9 (3, 20)
Southern Africa	37 (15, 63)	39 (23, 57)	44 (15, 74)
Western Africa	42 (25, 60)	46 (34, 59)	47 (21, 78)
Western Asia	20 (5, 43)	15 (6, 28)	12 (2, 28)

\*More than 10% of children under age five in this region live in a country for which no estimate was made; estimates represent only children living in countries listed in Appendix Table 1. In the WHO European region, estimates were made for 26% of children under five; in the WHO Region of the Americas, 70% of children under five; in the UNICEF CEESIS region, 51% of children under five.



**Appendix table 6: Number (in thousands) and per cent of child deaths attributable to vitamin A deficiency by World Health Organization (WHO) regions, UNICEF regions, and United Nations subregions in 2000. Numbers in parentheses show 95% credibility intervals. Estimates are for children living in the developing countries listed in Appendix Table 1 only.**

Region	Diarrhoea		Measles		All causes	
	Number	Per cent	Number	Per cent	Number	Per cent
<i>WHO Regions</i>						
African Region	97.6 (65.6, 136.6)	18.9 (14.9, 23.7)	36.9 (12.1, 63.4)	11.3 (4.5, 21.3)	134.5 (90.8, 179.4)	3.3 (2.2, 4.5)
Region of the Americas	2.5 (1.4, 3.8)	7.6 (4.5, 11.7)	0.0 (0.0, 0.0)	*	2.5 (1.4, 3.8)	0.6 (0.4, 1.0)
Eastern Mediterranean Region	25.1 (12.9, 38.2)	15.7 (8.8, 23.4)	5.3 (1.5, 8.7)	11.4 (3.6, 21.7)	30.3 (16.8, 43.7)	2.7 (1.5, 3.9)
European Region	1.3 (0.4, 2.3)	8.9 (3.3, 16.8)	0.0 (0.0, 0.0)	3.1 (0.0, 11.1)	1.3 (0.4, 2.4)	0.9 (0.3, 1.6)
South-East Asian Region	78.4 (32.7, 129.5)	17.9 (7.6, 29.4)	12.0 (1.8, 24.4)	10.4 (1.8, 23.2)	90.4 (40.7, 143.3)	2.9 (1.3, 4.5)
Western Pacific Region	6.6 (3.5, 11.4)	9.2 (5.1, 15.1)	0.7 (0.2, 1.1)	6.5 (2.0, 12.4)	7.3 (3.9, 12.1)	0.9 (0.5, 1.5)
<i>UNICEF Regions</i>						
Central and Eastern Europe/Commonwealth of Independent States	1.3 (0.4, 2.3)	8.9 (3.3, 16.8)	0.0 (0.0, 0.0)	3.1 (0.0, 11.1)	1.3 (0.4, 2.4)	0.9 (0.3, 1.6)
East Asia and Pacific	11.5 (7.1, 17.6)	10.6 (6.7, 15.5)	2.4 (0.5, 4.8)	7.2 (1.9, 16.2)	13.9 (8.5, 20.7)	1.2 (0.7, 1.7)
East and Southern Africa	46.5 (30.0, 63.4)	19.2 (13.9, 24.5)	9.6 (3.5, 15.9)	12.6 (5.4, 21.0)	56.1 (37.9, 73.7)	3.3 (2.2, 4.3)
Middle East and North Africa	5.8 (2.7, 9.2)	11.9 (6.0, 18.8)	1.2 (0.1, 2.2)	8.1 (1.5, 17.2)	6.9 (3.5, 10.4)	1.6 (0.8, 2.4)
South Asia	90.9 (41.0, 143.4)	18.0 (8.4, 28.3)	12.3 (1.9, 24.6)	11.2 (1.9, 24.7)	103.2 (49.1, 156.7)	3.0 (1.4, 4.5)
Latin America and Caribbean	2.5 (1.4, 3.8)	7.6 (4.5, 11.7)	0.0 (0.0, 0.0)	*	2.5 (1.4, 3.8)	0.6 (0.4, 1.0)
West and Central Africa	52.9 (33.0, 83.4)	18.8 (13.1, 25.5)	29.4 (7.6, 56.3)	11.2 (3.4, 23.1)	82.4 (48.7, 120.5)	3.5 (2.1, 5.1)
<i>United Nations Subregions</i>						
Caribbean	0.5 (0.1, 1.1)	9.4 (2.6, 20.4)	0.0 (0.0, 0.0)	*	0.5 (0.1, 1.1)	1.3 (0.4, 2.8)
Central America	0.6 (0.2, 1.2)	6.6 (2.7, 12.7)	0.0 (0.0, 0.0)	*	0.6 (0.2, 1.2)	0.6 (0.2, 1.1)
Eastern Africa	39.7 (25.2, 54.3)	19.2 (13.3, 24.7)	9.4 (3.3, 15.7)	12.6 (5.3, 21.2)	49.0 (31.5, 64.6)	3.3 (2.1, 4.4)
Eastern Asia	3.5 (1.1, 8.1)	7.3 (2.4, 15.6)	0.2 (0.0, 0.5)	4.6 (0.0, 14.4)	3.7 (1.2, 8.1)	0.6 (0.2, 1.2)
Melanesia	0.2 (0.0, 0.4)	10.1 (1.8, 22.7)	0.0 (0.0, 0.1)	5.9 (0.0, 19.8)	0.2 (0.0, 0.5)	1.2 (0.3, 3.1)
Micronesia	0.0 (0.0, 0.0)	11.9 (5.4, 21.9)	0.0 (0.0, 0.0)	8.3 (0.0, 25.4)	0.0 (0.0, 0.0)	1.6 (0.8, 3.0)
Middle Africa	20.9 (11.8, 34.3)	20.7 (12.8, 28.4)	7.5 (0.8, 16.3)	14.2 (2.1, 31.2)	28.5 (15.2, 41.6)	3.9 (2.1, 5.7)
Northern Africa	4.0 (1.5, 6.6)	13.6 (5.6, 23.2)	0.8 (0.0, 1.8)	8.5 (0.6, 20.5)	4.8 (2.0, 7.5)	1.9 (0.8, 3.0)
Polynesia	0.0 (0.0, 0.0)	7.9 (1.7, 18.6)	0.0 (0.0, 0.0)	4.8 (0.0, 18.2)	0.0 (0.0, 0.0)	0.4 (0.1, 1.1)
South America	1.4 (0.6, 2.3)	7.5 (3.8, 12.8)	0.0 (0.0, 0.0)	*	1.4 (0.6, 2.3)	0.6 (0.3, 1.0)
South-central Asia	92.1 (42.1, 144.8)	17.8 (8.4, 27.7)	12.3 (1.9, 24.6)	11.2 (1.9, 24.7)	104.4 (50.5, 157.7)	2.9 (1.4, 4.4)
South-eastern Asia	7.8 (4.7, 12.0)	13.3 (7.9, 19.0)	2.1 (0.4, 4.6)	7.6 (1.5, 18.2)	10.0 (5.7, 15.1)	1.9 (1.1, 2.9)
Southern Africa	1.5 (0.6, 2.7)	16.7 (6.5, 28.0)	0.1 (0.0, 0.2)	9.6 (0.4, 22.2)	1.6 (0.6, 2.7)	1.6 (0.7, 2.9)
Western Africa	37.4 (20.6, 62.2)	18.1 (11.1, 26.6)	22.0 (4.2, 47.8)	10.4 (2.2, 24.7)	59.5 (30.3, 93.7)	3.3 (1.7, 5.3)
Western Asia	1.8 (0.5, 3.5)	9.5 (2.8, 18.8)	0.3 (0.0, 0.8)	6.9 (0.3, 22.6)	2.1 (0.6, 4.0)	1.0 (0.3, 2.0)

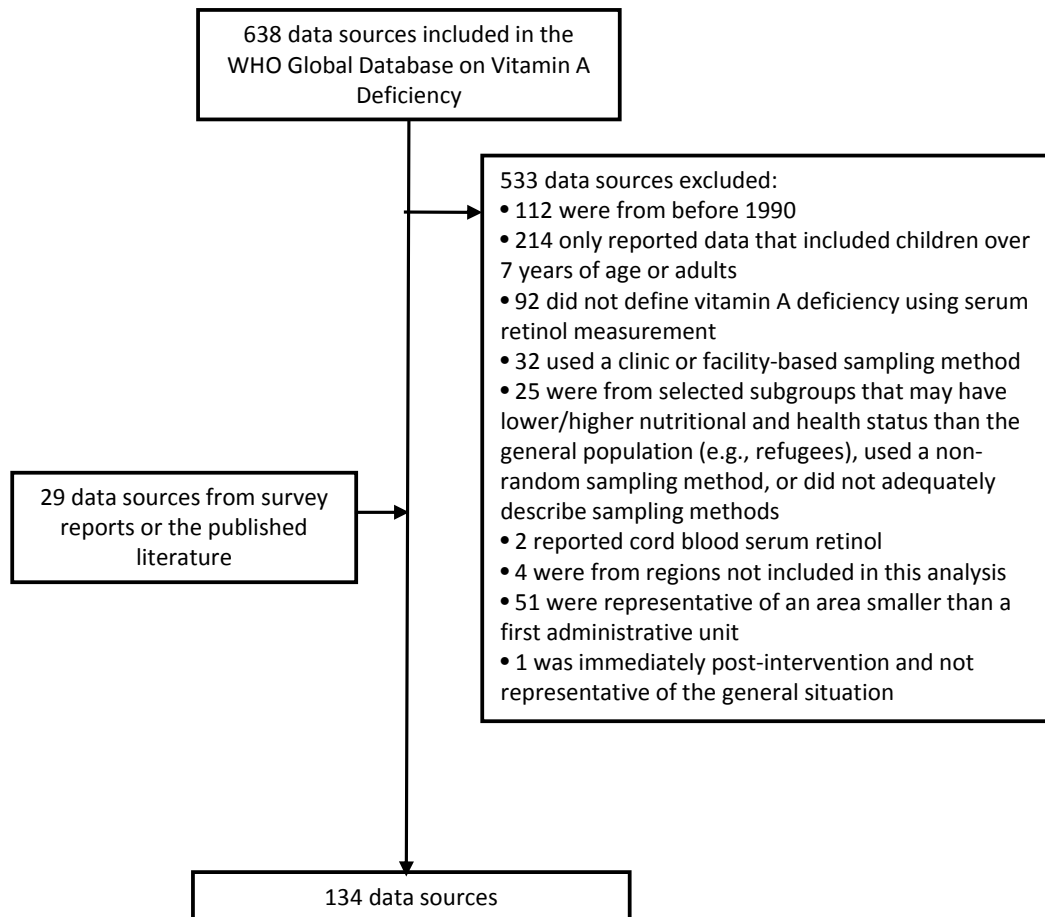
\* No measles deaths occurred in this region during this time period.

**Appendix table 7: Number (in thousands) and per cent of child deaths attributable to vitamin A deficiency by World Health Organization (WHO) regions, UNICEF regions, and United Nations subregions in 2013. Numbers in parentheses show 95% credibility intervals. Estimates are for children living in the developing countries listed in Appendix Table 1 only.**

Region	Diarrhoea		Measles		All causes	
	Number	Per cent	Number	Per cent	Number	Per cent
<i>WHO Regions</i>						
African Region	53.1 (27.4, 94.9)	18.3 (10.3, 26.6)	4.9 (1.6, 9.1)	12.9 (4.3, 24.1)	57.9 (30.0, 100.4)	2.0 (1.0, 3.3)
Region of the Americas	0.5 (0.2, 1.1)	5.9 (1.9, 11.9)	0.0 (0.0, 0.0)	*	0.5 (0.2, 1.1)	0.3 (0.1, 0.5)
Eastern Mediterranean Region	13.9 (6.3, 24.5)	16.5 (8.2, 26.0)	2.1 (0.4, 4.6)	12.2 (2.2, 25.6)	16.0 (7.9, 26.6)	1.9 (0.9, 3.2)
European Region	0.4 (0.0, 1.3)	6.8 (0.8, 19.9)	0.0 (0.0, 0.0)	4.4 (0.0, 17.9)	0.4 (0.0, 1.3)	0.4 (0.0, 1.3)
South-East Asian Region	25.7 (5.0, 50.1)	15.8 (3.2, 31.5)	4.2 (0.1, 12.4)	9.5 (0.3, 28.2)	29.9 (6.1, 57.3)	1.8 (0.4, 3.4)
Western Pacific Region	0.9 (0.2, 2.2)	4.1 (1.1, 10.1)	0.1 (0.0, 0.2)	2.5 (0.3, 8.1)	1.0 (0.2, 2.3)	0.3 (0.1, 0.6)
<i>UNICEF Regions</i>						
Central and Eastern Europe/Commonwealth of Independent States	0.4 (0.0, 1.3)	6.8 (0.8, 19.9)	0.0 (0.0, 0.0)	4.4 (0.0, 17.9)	0.4 (0.0, 1.3)	0.4 (0.0, 1.3)
East Asia and Pacific	1.4 (0.4, 3.2)	4.1 (1.2, 9.0)	0.2 (0.0, 0.6)	2.0 (0.3, 6.0)	1.6 (0.5, 3.6)	0.3 (0.1, 0.6)
East and Southern Africa	19.9 (9.4, 35.7)	18.2 (9.5, 26.8)	2.1 (0.5, 4.6)	12.6 (3.1, 25.8)	22.0 (10.7, 38.9)	2.0 (0.9, 3.3)
Middle East and North Africa	2.6 (0.8, 5.1)	11.2 (3.7, 21.1)	0.1 (0.0, 0.2)	7.1 (0.8, 18.5)	2.7 (0.8, 5.2)	0.9 (0.3, 1.7)
South Asia	34.8 (11.1, 61.7)	17.0 (5.8, 31.0)	5.1 (0.5, 13.6)	11.1 (1.2, 30.1)	39.9 (13.0, 69.2)	2.0 (0.7, 3.5)
Latin America and Caribbean	0.5 (0.2, 1.1)	5.9 (1.9, 11.9)	0.0 (0.0, 0.0)	*	0.5 (0.2, 1.1)	0.3 (0.1, 0.5)
West and Central Africa	34.9 (15.3, 65.9)	18.6 (9.6, 29.1)	3.7 (0.9, 7.9)	13.4 (3.3, 28.2)	38.7 (18.2, 70.3)	2.1 (1.0, 3.7)
<i>United Nations Subregions</i>						
Caribbean	0.2 (0.0, 0.7)	8.6 (1.0, 23.2)	0.0 (0.0, 0.0)	*	0.2 (0.0, 0.7)	0.8 (0.1, 2.4)
Central America	0.1 (0.0, 0.3)	3.9 (0.8, 9.8)	0.0 (0.0, 0.0)	*	0.1 (0.0, 0.3)	0.2 (0.0, 0.4)
Eastern Africa	15.3 (7.3, 25.4)	18.5 (9.9, 26.9)	1.9 (0.4, 4.3)	12.8 (2.5, 27.3)	17.2 (8.5, 29.2)	1.9 (0.9, 3.1)
Eastern Asia	0.2 (0.0, 0.7)	1.9 (0.3, 7.0)	0.0 (0.0, 0.0)	1.1 (0.0, 6.5)	0.2 (0.0, 0.7)	0.1 (0.0, 0.3)
Melanesia	0.1 (0.0, 0.2)	4.7 (0.2, 19.3)	0.0 (0.0, 0.0)	1.9 (0.0, 9.4)	0.1 (0.0, 0.2)	0.4 (0.0, 1.6)
Micronesia	0.0 (0.0, 0.0)	5.5 (0.6, 16.2)	0.0 (0.0, 0.0)	3.8 (0.1, 14.5)	0.0 (0.0, 0.0)	0.5 (0.1, 1.7)
Middle Africa	15.5 (6.7, 31.8)	19.9 (9.1, 30.9)	2.4 (0.0, 6.5)	14.4 (0.2, 38.3)	17.8 (7.9, 34.3)	2.7 (1.2, 4.8)
Northern Africa	2.0 (0.4, 4.2)	13.2 (2.8, 26.3)	0.1 (0.0, 0.2)	7.8 (0.2, 23.2)	2.1 (0.4, 4.3)	1.1 (0.2, 2.3)
Polynesia	0.0 (0.0, 0.0)	3.1 (0.1, 13.1)	0.0 (0.0, 0.0)	1.8 (0.0, 10.0)	0.0 (0.0, 0.0)	0.1 (0.0, 0.4)
South America	0.2 (0.1, 0.4)	5.4 (1.7, 11.5)	0.0 (0.0, 0.0)	*	0.2 (0.1, 0.4)	0.2 (0.1, 0.3)
South-central Asia	35.2 (11.5, 62.5)	16.7 (5.7, 30.5)	5.1 (0.5, 13.6)	11.1 (1.2, 30.1)	40.3 (13.2, 69.9)	1.9 (0.6, 3.4)
South-eastern Asia	1.2 (0.3, 2.7)	5.1 (1.4, 11.1)	0.2 (0.0, 0.6)	2.0 (0.3, 6.3)	1.4 (0.4, 3.1)	0.4 (0.1, 0.9)
Southern Africa	0.8 (0.2, 1.6)	17.3 (5.8, 31.0)	0.1 (0.0, 0.3)	10.9 (0.6, 29.4)	0.9 (0.3, 1.7)	1.5 (0.5, 2.8)
Western Africa	23.3 (9.3, 47.6)	17.7 (7.5, 29.8)	1.5 (0.5, 2.9)	11.8 (3.9, 24.0)	24.8 (10.1, 49.1)	1.8 (0.7, 3.6)
Western Asia	0.5 (0.1, 1.4)	7.4 (1.1, 18.0)	0.0 (0.0, 0.1)	5.4 (0.1, 25.9)	0.6 (0.1, 1.5)	0.4 (0.1, 1.1)

\* No measles deaths occurred in this region during this time period.

**Appendix figure 1: Flowchart of data identification, access, and extraction.**



**Appendix figure 2: Prevalence of Bitot's spots vs. prevalence of serum retinol less than 0.70  $\mu\text{mol/L}$ .  
Data from the WHO Vitamin and Mineral Nutrition Information System.**

