

# Modell's

Haemoglobinopathologist's

# Almanac

## Epidemiological Estimates for Haemoglobin Disorders: WHO American Region by Country

Comprising the following charts and tables:

- Chart 1: Population
- Chart 2: Annual births
- Chart 3: Crude birth rate and infant mortality rate
- Chart 4: Per cent of pregnant women carrying alpha globin gene variants, by variant
- Chart 5: Per cent of pregnant women carrying beta globin gene variants, by variant
- Chart 6: Per cent of pregnant women carrying any haemoglobin gene variant
- Chart 7: Conceptions/1000 with combinations of significant variants
- Chart 8: Annual pregnant carriers of significant variants
- Chart 9: Annual pregnancies where both parents carry a significant variant
- Chart 10: Annual conceptions with combinations of significant gene variants

Charts and tables compiled showing conservative estimates based on best available data presented on the World Wide Web in May 2007 by Professor Bernadette Modell (b.modell@pcps.ucl.ac.uk) and Matthew Darlison (m.darlison@ucl.ac.uk), UCL Centre for Health Informatics and Multiprofessional Education (CHIME) and World Health Organisation Collaborating Centre for the Community Control of Hereditary Disorders.

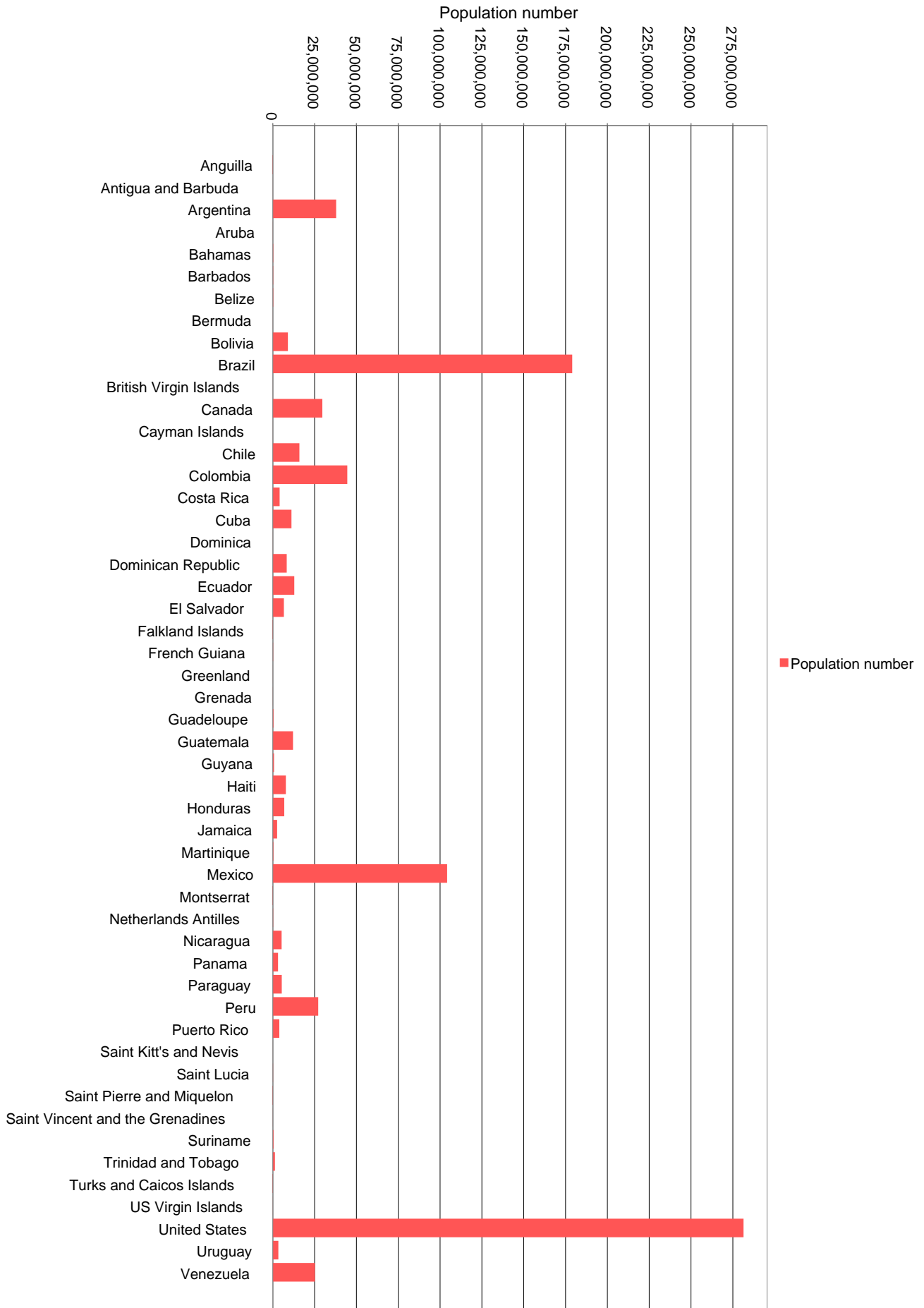
### Definitions used

In terms of alpha globin genotypes, we define as pathological homozygous alpha zero thalassaemia (causes hydrops fetalis) and the combination of alpha zero and alpha plus thalassaemia (causes haemoglobin H disease). Homozygous alpha plus thalassaemia is not considered to cause pathology. In terms of beta globin genotypes, we define as pathological haemoglobin S/C, homozygous haemoglobin S (SS), haemoglobin S/beta thalassaemia, homozygous beta thalassaemia, haemoglobin E/beta thalassaemia and some rare combinations. We define as harmless homozygous haemoglobin C (CC), haemoglobin C/beta thalassaemia, homozygous haemoglobin E (EE), homozygous haemoglobin D (DD), haemoglobin D/beta thalassaemia, and some other rare combinations.

WHO Regions are constituted as follows:

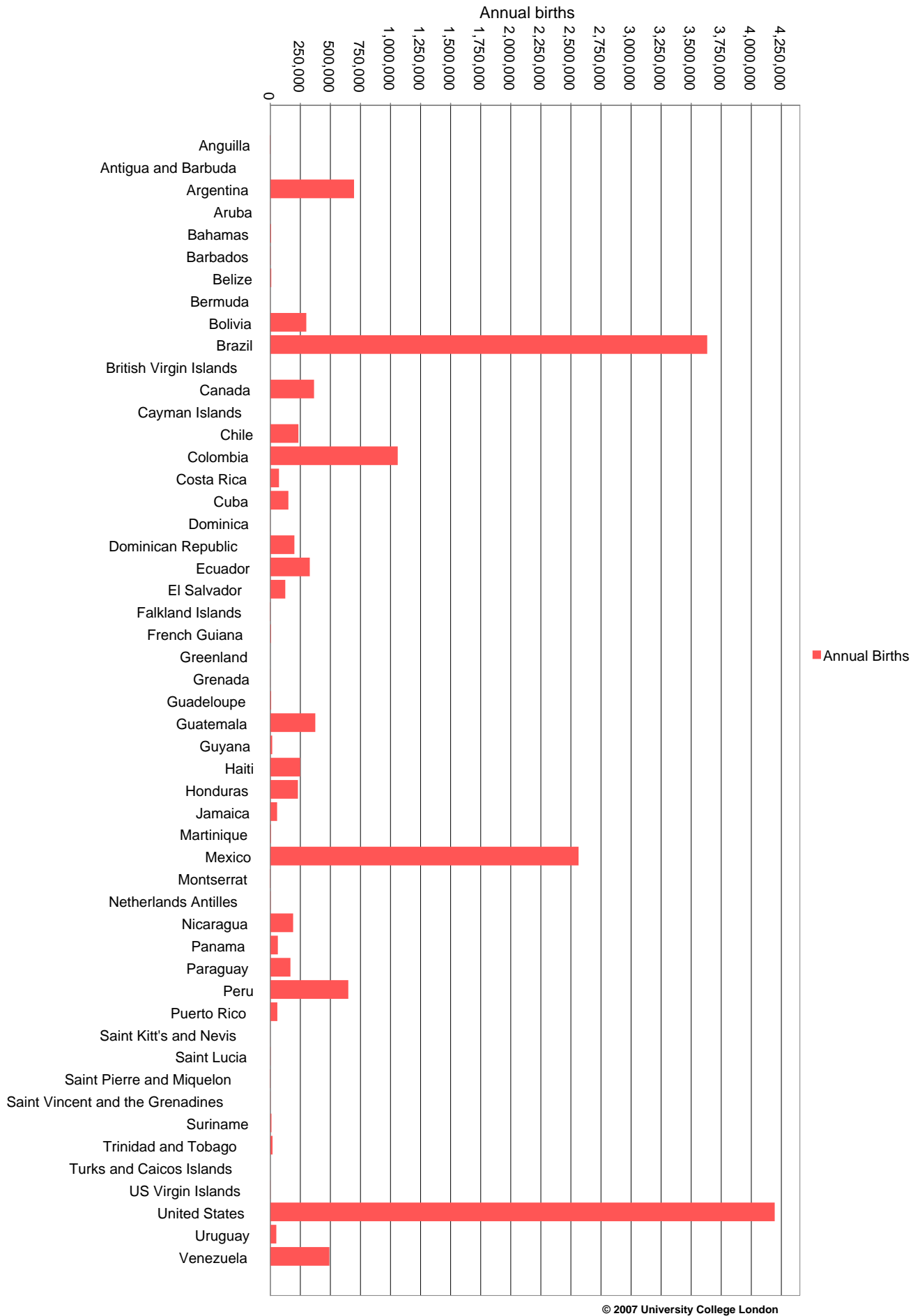
African Region (AFR)	American Region (AMR)	Eastern Mediterranean Region (EMR)	European Region (EUR)	South East Asian Region (SEAR)	Western Pacific Region (WPR)
<p><b>Northern Africa:</b> Algeria</p> <p><b>Western Africa:</b> Benin, Burkina Faso, Cote d'Ivoire, Cape Verde, Gambia, Guinea-Bissau, Ghana, Guinea, Liberia, Mali, Mauritania, Niger, Nigeria, Sierra Leone, Saint Helena, Senegal, Togo</p> <p><b>Middle Africa:</b> Angola, Central African Republic, Cameroon, Chad, Congo, Democratic Republic of the Congo (formerly Zaire), Equatorial Guinea, Gabon, Sao Tome and Principe</p> <p><b>Eastern Africa:</b> Burundi, Comoros, Kenya, Madagascar, Malawi, Mauritius, Mayotte, Mozambique, Reunion, Rwanda, Seychelles, United Republic of Tanzania, Uganda, Zambia, Zimbabwe</p> <p><b>Southern Africa:</b> Botswana, Lesotho, Namibia, South Africa, Swaziland</p>	<p><b>Northern America:</b> Bermuda, Canada, Greenland, Saint Pierre and Miquelon, United States</p> <p><b>Central America:</b> Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama</p> <p><b>Caribbean:</b> Anguilla, Antigua and Barbuda, Aruba, Bahamas, Barbados, British Virgin Islands, Cayman Islands, Cuba, Dominica, Dominican Republic, Grenada, Guadeloupe, Haiti, Jamaica, Martinique, Montserrat, Netherlands Antilles, Puerto Rico, Saint Kitt's and Nevis, Saint Vincent and the Grenadines, Saint Lucia, Trinidad and Tobago, Turks and Caicos Islands, US Virgin Islands</p> <p><b>South America:</b> Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Falkland Islands, French Guiana, Guyana, Paraguay, Peru, Suriname, Uruguay, Venezuela</p>	<p><b>Northern Africa:</b> Libyan Arab Jamahiriya, Morocco, Sudan, Tunisia, Western Sahara</p> <p><b>Eastern Africa:</b> Djibouti, Egypt, Eritrea, Ethiopia, Somalia</p> <p><b>Western Asia:</b> Bahrain, Cyprus, Iraq, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syrian Arab Republic, United Arab Emirates, Yemen</p> <p><b>South Central Asia:</b> Afghanistan, Iran, Islamic Republic of, Pakistan, Occupied Palestinian territory</p>	<p><b>Northern Europe:</b> Channel Islands, Denmark, Estonia, Faroe Islands, Finland, Isle of Man, Iceland, Ireland, Latvia, Lithuania, Norway, Sweden, United Kingdom</p> <p><b>Western Europe:</b> Austria, Belgium, France, Germany, Liechtenstein, Luxembourg, Monaco, Netherlands, Switzerland</p> <p><b>Southern Europe:</b> Albania, Andorra, Bosnia and Herzegovina, Croatia, Gibraltar, Greece, Italy, The former Yugoslav Republic of Macedonia, Malta, Portugal, San Marino, Slovenia, Spain, Yugoslavia</p> <p><b>Eastern Europe:</b> Belarus, Bulgaria, Czech Republic, Hungary, Republic of Moldova, Poland, Romania, Russian Federation, Slovakia, Ukraine</p> <p><b>South Central Asia:</b> Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan</p> <p><b>Western Asia:</b> Armenia, Azerbaijan, Georgia, Israel, Turkey</p>	<p><b>South Central Asia:</b> Bangladesh, Bhutan, India, Maldives, Nepal, Sri Lanka</p> <p><b>South Eastern Asia:</b> East Timor, Indonesia, Myanmar, Thailand</p>	<p><b>Eastern Asia:</b> China, China - Hong Kong, Japan, Korea, Democratic Peoples' Republic of Korea, Republic of, China - Macau, Mongolia, Taiwan, Province of China</p> <p><b>South Eastern Asia:</b> Brunei Darussalam, Cambodia, Heard Island and McDonald Islands, Lao Peoples' Democratic Republic, Malaysia, Philippines, Singapore, Vietnam</p> <p><b>Melanesia, Micronesia, Polynesia:</b> American Samoa, Cook Islands, Fiji, French Polynesia, Guam, Kiribati, Marshall Islands, Micronesia, Federated States of New Caledonia, Northern Mariana Islands, Nauru, Niue, Palau, Pitcairn, Papua New Guinea, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuatu, Wallis and Futuna Islands</p> <p><b>Australia and New Zealand:</b> Australia, New Zealand</p>

Chart 1: Population



<i>Country</i>	<i>Population number</i>
Anguilla	13,000
Antigua and Barbuda	67,000
Argentina	37,870,000
Aruba	94,000
Bahamas	301,000
Barbados	267,000
Belize	274,000
Bermuda	62,000
Bolivia	9,025,000
Brazil	178,985,000
British Virgin Islands	21,000
Canada	29,615,615
Cayman Islands	37,000
Chile	15,919,000
Colombia	44,531,000
Costa Rica	4,089,000
Cuba	11,160,000
Dominica	71,000
Dominican Republic	8,325,000
Ecuador	12,843,000
El Salvador	6,638,000
Falkland Islands	2,000
French Guiana	181,000
Greenland	57,000
Grenada	93,000
Guadeloupe	450,000
Guatemala	12,084,000
Guyana	746,000
Haiti	7,803,000
Honduras	6,861,000
Jamaica	2,590,000
Martinique	381,000
Mexico	104,214,000
Montserrat	11,000
Netherlands Antilles	215,000
Nicaragua	5,268,000
Panama	3,116,000
Paraguay	5,356,000
Peru	27,148,000
Puerto Rico	3,890,000
Saint Kitt's and Nevis	39,000
Saint Lucia	152,000
Saint Pierre and Miquelon	7,000
Saint Vincent and the Grenadines	112,000
Suriname	481,000
Trinidad and Tobago	1,289,000
Turks and Caicos Islands	16,000
US Virgin Islands	94,000
United States	281,381,143
Uruguay	3,304,000
Venezuela	25,220,000
WHO American Region population total	852,768,758

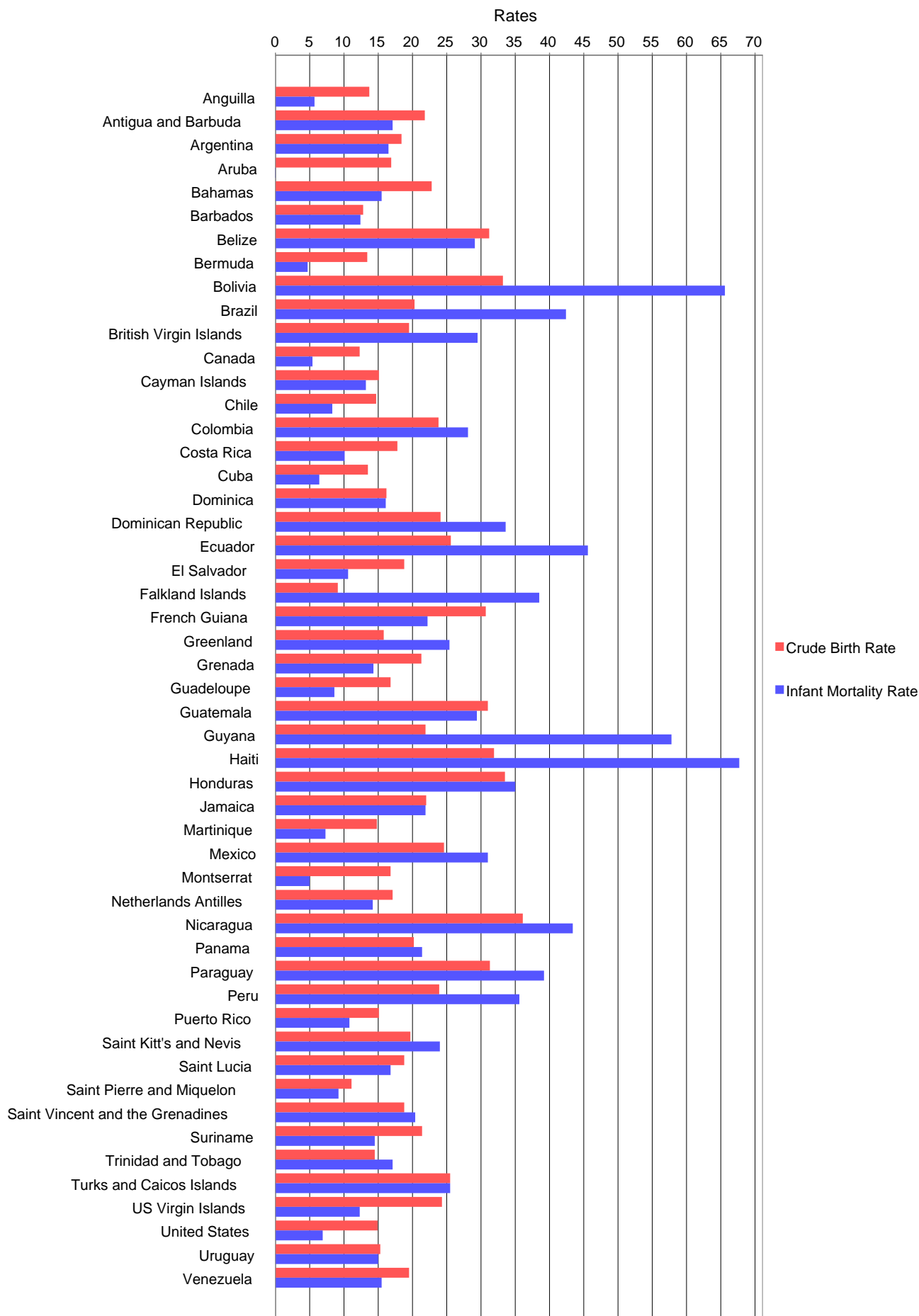
Chart 2: Annual births



Indicates requirement for carrier screening during pregnancy. The annual number of people marrying (not shown) is the indicator for pre-marital or pre-pregnancy screening.

<i>Country</i>	<i>Annual Births</i>
Anguilla	178
Antigua and Barbuda	1,460
Argentina	696,807
Aruba	1,588
Bahamas	6,862
Barbados	3,417
Belize	8,548
Bermuda	830
Bolivia	299,630
Brazil	3,633,395
British Virgin Islands	409
Canada	364,092
Cayman Islands	558
Chile	234,009
Colombia	1,059,837
Costa Rica	72,784
Cuba	150,660
Dominica	1,150
Dominican Republic	200,632
Ecuador	328,780
El Salvador	124,794
Falkland Islands	18
French Guiana	5,556
Greenland	900
Grenada	1,980
Guadeloupe	7,560
Guatemala	374,604
Guyana	16,337
Haiti	248,915
Honduras	229,843
Jamaica	56,980
Martinique	5,638
Mexico	2,563,664
Montserrat	184
Netherlands Antilles	3,676
Nicaragua	190,174
Panama	62,943
Paraguay	167,642
Peru	648,837
Puerto Rico	58,739
Saint Kitt's and Nevis	768
Saint Lucia	2,857
Saint Pierre and Miquelon	77
Saint Vincent and the Grenadines	2,105
Suriname	10,293
Trinidad and Tobago	18,690
Turks and Caicos Islands	408
US Virgin Islands	2,284
United States	4,194,487
Uruguay	50,551
Venezuela	491,790
WHO American Region total births	16,608,920

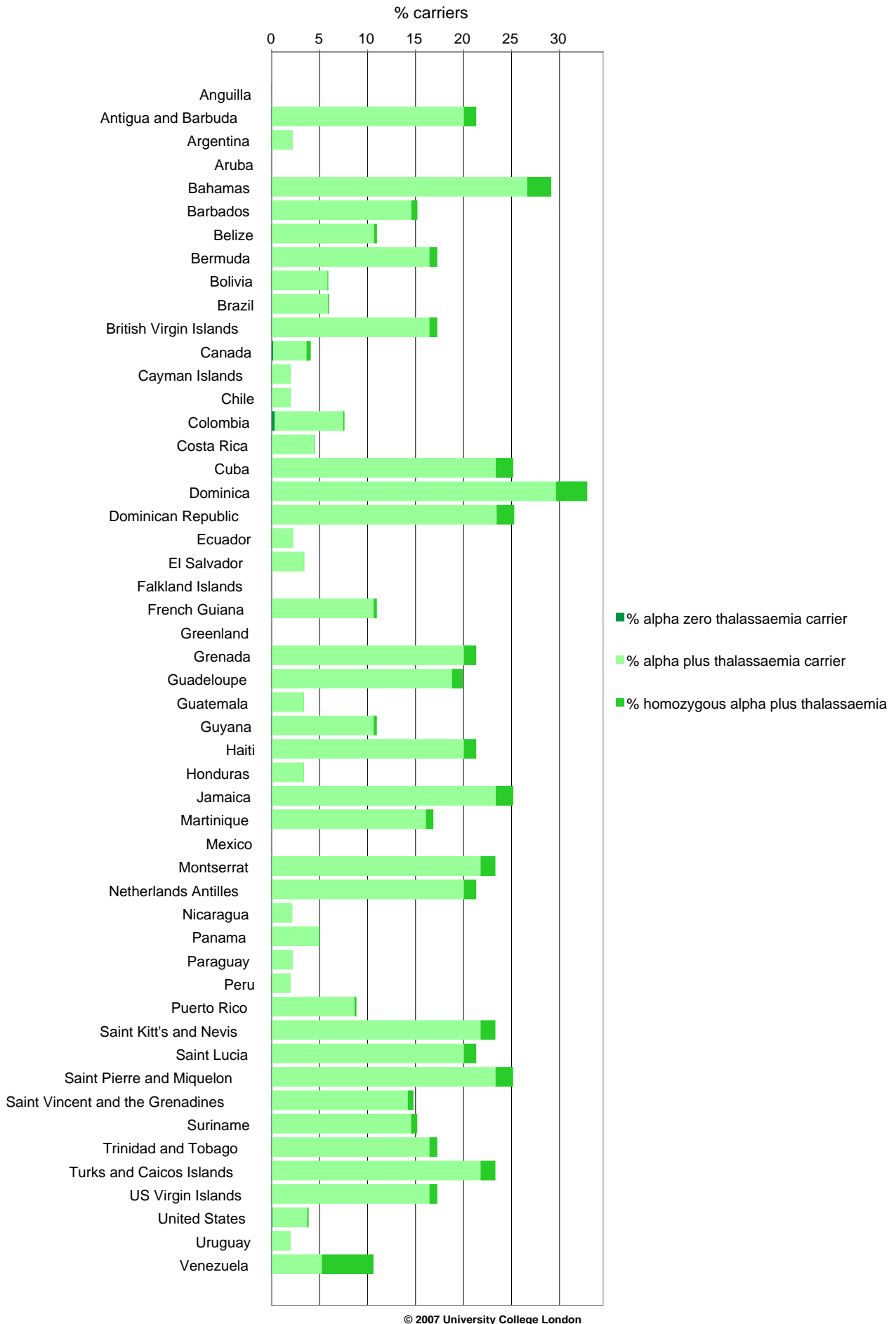
Chart 3: Crude birth rate and infant mortality rate



Crude birth rate (CBR) = live births per 1000 population per year; infant mortality rate (IMR) = deaths under 1 year, per 1,000 live births.

<i>Country</i>	<i>Crude Birth Rate</i>	<i>Infant Mortality Rate</i>
Anguilla	13.7	5.7
Antigua and Barbuda	21.8	17.1
Argentina	18.4	16.5
Aruba	16.9	0
Bahamas	22.8	15.5
Barbados	12.8	12.4
Belize	31.2	29.1
Bermuda	13.4	4.7
Bolivia	33.2	65.6
Brazil	20.3	42.4
British Virgin Islands	19.5	29.5
Canada	12.294	5.4
Cayman Islands	15.1	13.2
Chile	14.7	8.3
Colombia	23.8	28.1
Costa Rica	17.8	10.1
Cuba	13.5	6.4
Dominica	16.2	16.1
Dominican Republic	24.1	33.6
Ecuador	25.6	45.6
El Salvador	18.8	10.6
Falkland Islands	9.1	38.5
French Guiana	30.7	22.2
Greenland	15.8	25.4
Grenada	21.3	14.3
Guadeloupe	16.8	8.6
Guatemala	31	29.4
Guyana	21.9	57.8
Haiti	31.9	67.7
Honduras	33.5	35
Jamaica	22	21.9
Martinique	14.8	7.3
Mexico	24.6	31
Montserrat	16.8	5
Netherlands Antilles	17.1	14.2
Nicaragua	36.1	43.4
Panama	20.2	21.4
Paraguay	31.3	39.2
Peru	23.9	35.6
Puerto Rico	15.1	10.8
Saint Kitt's and Nevis	19.7	24
Saint Lucia	18.8	16.8
Saint Pierre and Miquelon	11.1	9.2
Saint Vincent and the Grenadines	18.8	20.4
Suriname	21.4	14.5
Trinidad and Tobago	14.5	17.1
Turks and Caicos Islands	25.5	25.5
US Virgin Islands	24.3	12.3
United States	14.9	6.9
Uruguay	15.3	15
Venezuela	19.5	15.5
WHO American Region aggregate rates	19	26

Chart 4: Per cent of pregnant women carrying alpha globin gene variants, by variant

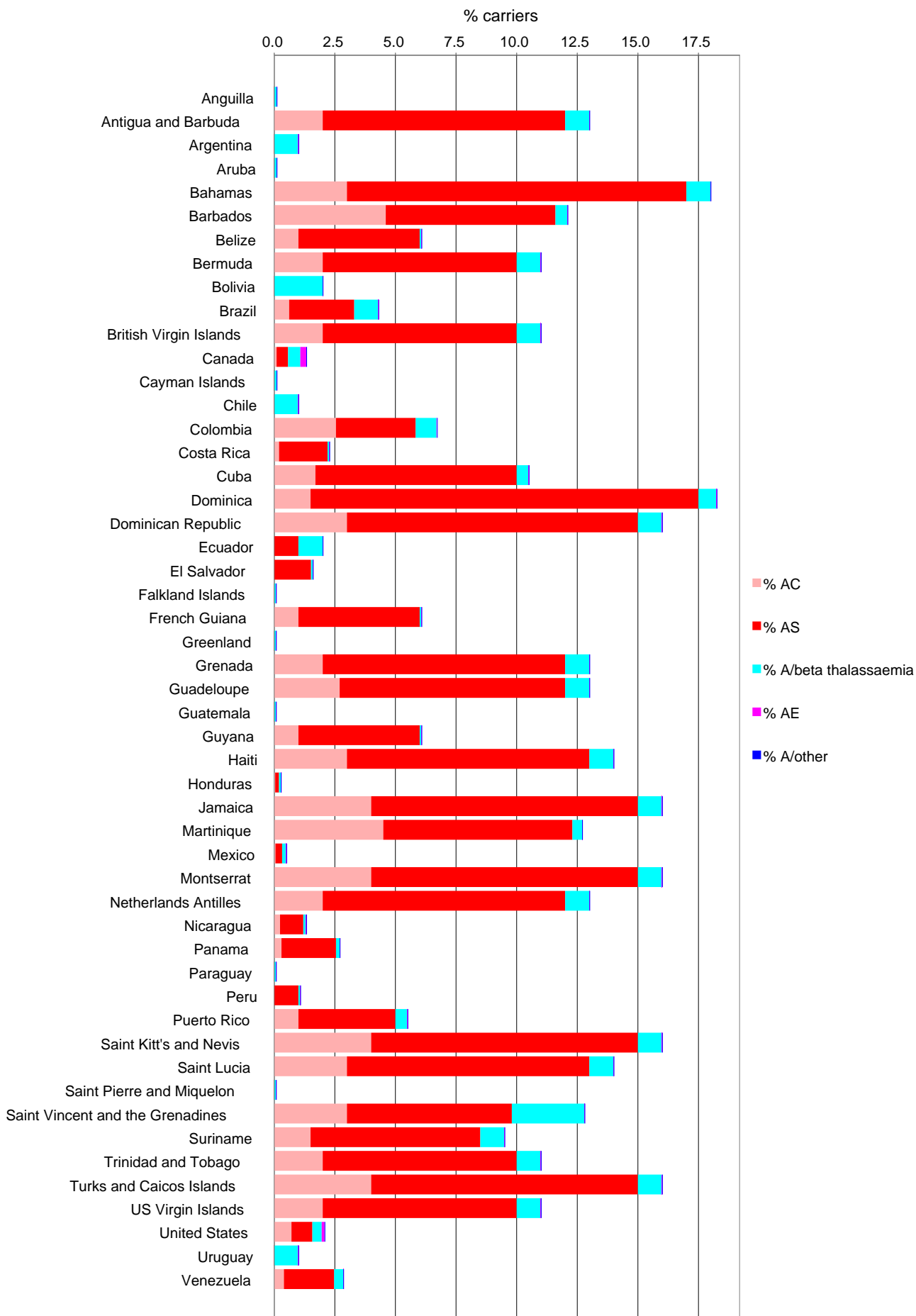


Data is for deletional alpha globin gene variants. Homozygous alpha plus thalassaemia is included as it is common and harmless.



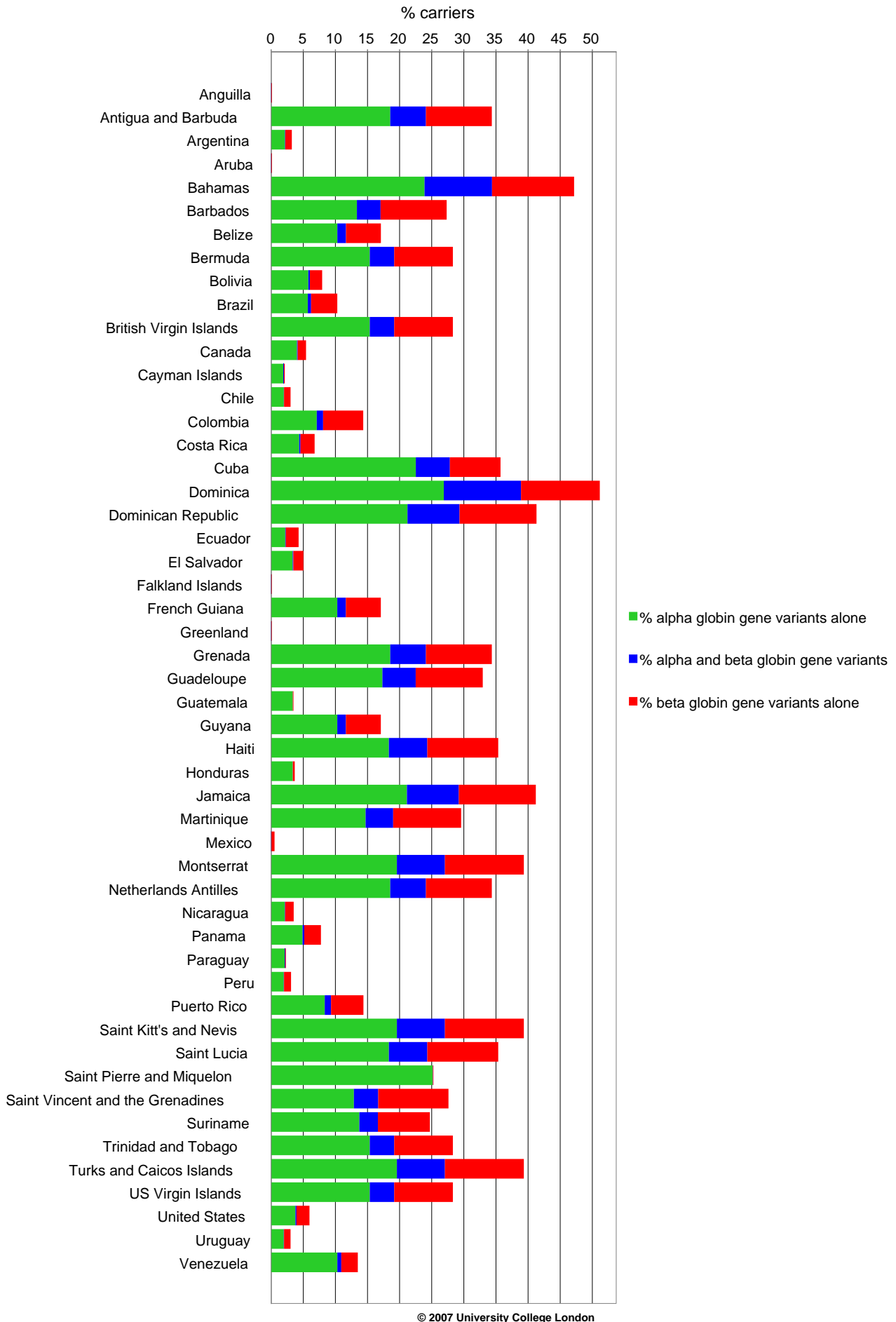
Country	% alpha zero thalassaemia carrier	% alpha plus thalassaemia carrier	% homozygous alpha plus thalassaemia
Anguilla	0	0	0
Antigua and Barbuda	0	20.046	1.277
Argentina	0	2.175	0.012
Aruba	0	0	0
Bahamas	0	26.635	2.503
Barbados	0	14.569	0.626
Belize	0	10.662	0.319
Bermuda	0	16.446	0.817
Bolivia	0	5.818	0.091
Brazil	0	5.868	0.099
British Virgin Islands	0	16.446	0.817
Canada	0.175	3.463	0.444
Cayman Islands	0	1.98	0.01
Chile	0	1.979	0.011
Colombia	0.311	7.145	0.138
Costa Rica	0	4.413	0.054
Cuba	0	23.355	1.822
Dominica	0	29.622	3.269
Dominican Republic	0	23.443	1.839
Ecuador	0	2.229	0.015
El Salvador	0	3.372	0.031
Falkland Islands	0	0	0
French Guiana	0	10.637	0.331
Greenland	0	0	0
Grenada	0	20.046	1.277
Guadeloupe	0	18.809	1.104
Guatemala	0	3.339	0.031
Guyana	0	10.637	0.331
Haiti	0	20.046	1.277
Honduras	0	3.339	0.031
Jamaica	0	23.355	1.822
Martinique	0	16.074	0.777
Mexico	0	0	0
Montserrat	0	21.77	1.545
Netherlands Antilles	0	20.046	1.277
Nicaragua	0	2.146	0.012
Panama	0	4.956	0.065
Paraguay	0	2.176	0.012
Peru	0	1.975	0.013
Puerto Rico	0	8.631	0.204
Saint Kitt's and Nevis	0	21.77	1.545
Saint Lucia	0	20.046	1.277
Saint Pierre and Miquelon	0	23.329	1.835
Saint Vincent and the Grenadines	0	14.187	0.59
Suriname	0	14.535	0.642
Trinidad and Tobago	0	16.446	0.817
Turks and Caicos Islands	0	21.77	1.545
US Virgin Islands	0	16.446	0.817
United States	0.085	3.619	0.159
Uruguay	0	1.976	0.012
Venezuela	0	5.23	5.387
WHO American Region aggregate carrier rates	0.045	4.47	0.315

Chart 5: Per cent of pregnant women carrying beta globin gene variants, by variant



Country	% AC	% AS	% A/beta thalassaemia	% AE	% A/other
Anguilla	0	0	0.1	0	0.03
Antigua and Barbuda	2	10	1	0	0.03
Argentina	0	0	1	0	0.03
Aruba	0	0	0.1	0	0.03
Bahamas	3	14	1	0	0.03
Barbados	4.6	7	0.5	0	0.03
Belize	1	5	0.075	0	0.03
Bermuda	2	8	1	0	0.03
Bolivia	0	0	2	0	0.03
Brazil	0.616	2.684	1	0	0.03
British Virgin Islands	2	8	1	0	0.03
Canada	0.097	0.476	0.503	0.247	0.03
Cayman Islands	0	0	0.1	0	0.03
Chile	0	0	1	0	0.03
Colombia	2.546	3.289	0.86	0.019	0.03
Costa Rica	0.2	2	0.075	0	0.03
Cuba	1.7	8.3	0.5	0	0.03
Dominica	1.5	16	0.75	0	0.03
Dominican Republic	3	12	1	0	0.03
Ecuador	0	1	1	0	0.03
El Salvador	0	1.52	0.075	0	0.03
Falkland Islands	0	0	0.075	0	0.03
French Guiana	1	5	0.075	0	0.03
Greenland	0	0	0.075	0	0.03
Grenada	2	10	1	0	0.03
Guadeloupe	2.7	9.3	1	0	0.03
Guatemala	0	0	0.075	0	0.03
Guyana	1	5	0.075	0	0.03
Haiti	3	10	1	0	0.03
Honduras	0.04	0.16	0.075	0	0.03
Jamaica	4	11	1	0	0.03
Martinique	4.5	7.8	0.4	0	0.03
Mexico	0.05	0.277	0.175	0	0.03
Montserrat	4	11	1	0	0.03
Netherlands Antilles	2	10	1	0	0.03
Nicaragua	0.24	0.96	0.12	0	0.03
Panama	0.3	2.25	0.15	0	0.03
Paraguay	0	0	0.075	0	0.03
Peru	0	1	0.075	0	0.03
Puerto Rico	1	4	0.5	0	0.03
Saint Kitt's and Nevis	4	11	1	0	0.03
Saint Lucia	3	10	1	0	0.03
Saint Pierre and Miquelon	0	0	0.075	0	0.03
Saint Vincent and the Grenadines	3	6.8	3	0	0.03
Suriname	1.5	7	1	0	0.03
Trinidad and Tobago	2	8	1	0	0.03
Turks and Caicos Islands	4	11	1	0	0.03
US Virgin Islands	2	8	1	0	0.03
United States	0.712	0.862	0.385	0.118	0.03
Uruguay	0	0	1	0	0.03
Venezuela	0.401	2.072	0.377	0	0.03
WHO American Region aggregate carrier rates	0.631	1.699	0.585	0.036	0.03

Chart 6: Per cent of pregnant women carrying any haemoglobin gene variant

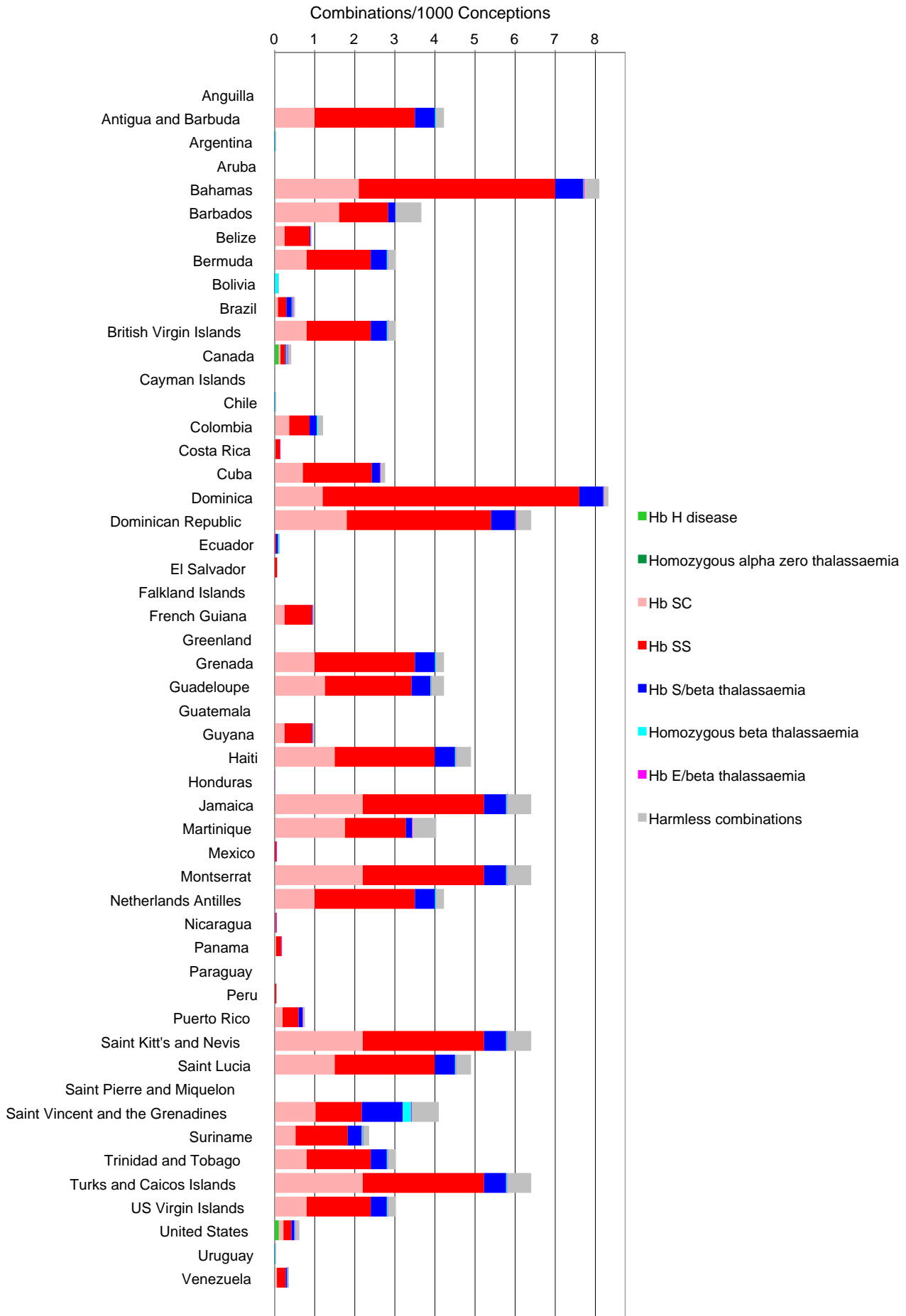


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Alpha and beta globin gene variants are inherited independently and do not interact to cause disease: many people carry both alpha and beta variants.

<i>Country</i>	<i>% carriers of alpha globin gene variants alone</i>	<i>% carriers of both alpha and beta globin gene variants</i>	<i>% carriers of beta globin gene variants alone</i>	<i>Total % carriers</i>
Anguilla	0	0	0.13	0.13
Antigua and Barbuda	18.545	5.557	10.252	34.353
Argentina	2.165	0.045	1.007	3.218
Aruba	0	0	0.13	0.13
Bahamas	23.884	10.507	12.777	47.167
Barbados	13.351	3.686	10.287	27.324
Belize	10.31	1.341	5.435	17.086
Bermuda	15.359	3.808	9.126	28.293
Bolivia	5.789	0.24	1.91	7.939
Brazil	5.709	0.517	4.072	10.297
British Virgin Islands	15.359	3.808	9.126	28.293
Canada	4.029	0.106	1.299	5.434
Cayman Islands	1.987	0.005	0.127	2.12
Chile	1.969	0.041	1.01	3.019
Colombia	7.103	0.982	6.253	14.339
Costa Rica	4.364	0.206	2.202	6.771
Cuba	22.526	5.302	7.879	35.707
Dominica	26.879	12.025	12.268	51.171
Dominican Republic	21.229	8.105	11.977	41.311
Ecuador	2.199	0.091	1.984	4.275
El Salvador	3.349	0.111	1.57	5.029
Falkland Islands	0	0	0.105	0.105
French Guiana	10.299	1.339	5.435	17.074
Greenland	0	0	0.105	0.105
Grenada	18.545	5.557	10.252	34.353
Guadeloupe	17.319	5.189	10.435	32.944
Guatemala	3.366	0.007	0.101	3.474
Guyana	10.299	1.339	5.435	17.074
Haiti	18.331	5.983	11.038	35.353
Honduras	3.359	0.021	0.295	3.674
Jamaica	21.142	8.072	11.994	41.208
Martinique	14.706	4.29	10.585	29.581
Mexico	0	0	0.532	0.532
Montserrat	19.578	7.475	12.293	39.345
Netherlands Antilles	18.545	5.557	10.252	34.353
Nicaragua	2.129	0.058	1.321	3.508
Panama	4.883	0.274	2.593	7.75
Paraguay	2.186	0.005	0.103	2.293
Peru	1.965	0.044	1.083	3.092
Puerto Rico	8.347	0.977	5.041	14.366
Saint Kitt's and Nevis	19.578	7.475	12.293	39.345
Saint Lucia	18.331	5.983	11.038	35.353
Saint Pierre and Miquelon	25.138	0.053	0.079	25.27
Saint Vincent and the Grenadines	12.882	3.792	10.934	27.608
Suriname	13.731	2.893	8.084	24.708
Trinidad and Tobago	15.359	3.808	9.126	28.293
Turks and Caicos Islands	19.578	7.475	12.293	39.345
US Virgin Islands	15.359	3.808	9.126	28.293
United States	3.784	0.159	2.027	5.97
Uruguay	1.968	0.041	1.01	3.018
Venezuela	10.312	0.612	2.574	13.497
WHO American Region aggregate carrier rates	4.56	0.541	2.711	7.812

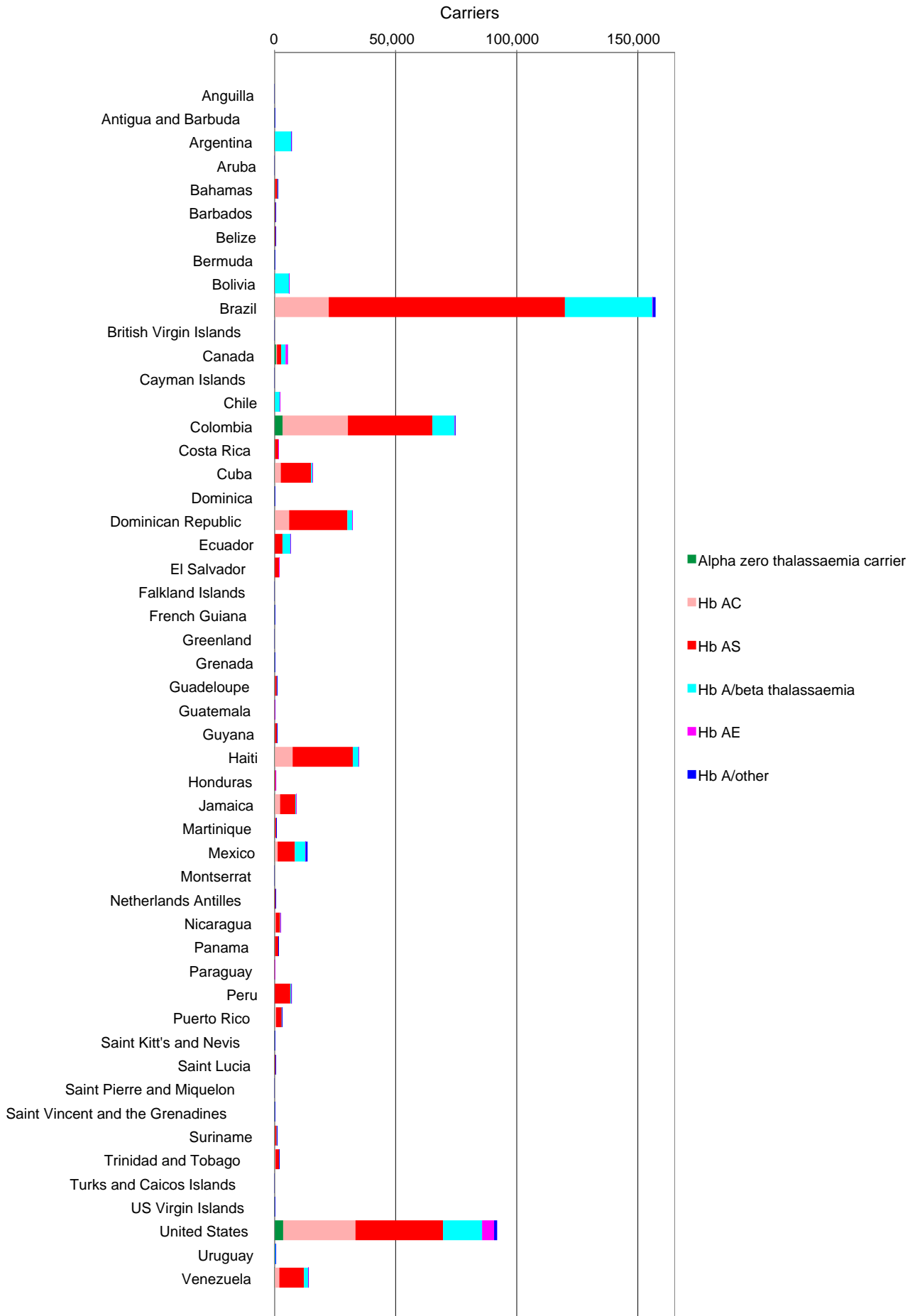
Chart 7: Conceptions/1000 with combinations of significant variants



Pathological combinations are shown individually. Harmless combinations are grouped together. For details see definitions.

Country	Hb H disease	Homozygous alpha zero thalassaemia	Hb SC	Hb SS	Hb S/beta thalassaemia	Homozygous beta thalassaemia	Hb E/beta thalassaemia	Harmless combinations	Total affected conceptions	Total conceptions
Anguilla	0	0	0	0	0	0	0	0	0	0
Antigua and Barbuda	0	0	1	2.5	0.5	0.025	0	0.2	4.025	4.225
Argentina	0	0	0	0	0	0.026	0	0	0.026	0.026
Aruba	0	0	0	0	0	0	0	0	0	0
Bahamas	0	0	2.1	4.9	0.7	0.025	0	0.375	7.725	8.1
Barbados	0	0	1.61	1.225	0.175	0.006	0	0.644	3.016	3.66
Belize	0	0	0.25	0.625	0.019	0	0	0.029	0.894	0.923
Bermuda	0	0	0.8	1.6	0.4	0.025	0	0.2	2.825	3.025
Bolivia	0	0	0	0	0	0.103	0	0	0.103	0.103
Brazil	0	0	0.083	0.21	0.134	0.036	0	0.047	0.463	0.51
British Virgin Islands	0	0	0.8	1.6	0.4	0.025	0	0.2	2.825	3.025
Canada	0.094	0.009	0.044	0.119	0.018	0.033	0.022	0.075	0.339	0.414
Cayman Islands	0	0	0	0	0	0	0	0	0	0
Chile	0	0	0	0	0	0.028	0	0	0.028	0.029
Colombia	0.012	0	0.354	0.507	0.18	0.03	0.001	0.123	1.084	1.207
Costa Rica	0	0	0.02	0.111	0.007	0.001	0	0.003	0.139	0.142
Cuba	0	0	0.706	1.722	0.208	0.006	0	0.115	2.642	2.756
Dominica	0	0	1.2	6.4	0.6	0.014	0	0.113	8.214	8.327
Dominican Republic	0	0	1.8	3.6	0.6	0.025	0	0.375	6.025	6.4
Ecuador	0	0	0	0.036	0.05	0.036	0	0	0.123	0.123
El Salvador	0	0	0	0.066	0.006	0.001	0	0	0.072	0.072
Falkland Islands	0	0	0	0	0	0	0	0	0	0
French Guiana	0	0	0.249	0.681	0.019	0.001	0	0.04	0.95	0.99
Greenland	0	0	0	0	0	0.001	0	0	0.001	0.001
Grenada	0	0	1	2.5	0.5	0.025	0	0.2	4.025	4.225
Guadeloupe	0	0	1.256	2.162	0.465	0.025	0	0.317	3.908	4.225
Guatemala	0	0	0	0	0	0.001	0	0	0.001	0.001
Guyana	0	0	0.249	0.681	0.019	0.001	0	0.04	0.95	0.99
Haiti	0	0	1.5	2.5	0.5	0.025	0	0.375	4.525	4.9
Honduras	0	0	0	0.002	0.001	0.001	0	0	0.003	0.003
Jamaica	0	0	2.2	3.025	0.55	0.025	0	0.6	5.8	6.4
Martinique	0	0	1.755	1.521	0.156	0.004	0	0.596	3.436	4.032
Mexico	0	0	0.005	0.041	0.004	0.001	0	0.001	0.051	0.052
Montserrat	0	0	2.2	3.025	0.55	0.025	0	0.6	5.8	6.4
Netherlands Antilles	0	0	1	2.5	0.5	0.025	0	0.2	4.025	4.225
Nicaragua	0	0	0.012	0.023	0.006	0	0	0.003	0.041	0.044
Panama	0	0	0.034	0.127	0.017	0.001	0	0.005	0.178	0.182
Paraguay	0	0	0	0	0	0	0	0	0	0
Peru	0	0	0	0.038	0.004	0.001	0	0	0.043	0.043
Puerto Rico	0	0	0.2	0.4	0.1	0.006	0	0.05	0.706	0.756
Saint Kitt's and Nevis	0	0	2.2	3.025	0.55	0.025	0	0.6	5.8	6.4
Saint Lucia	0	0	1.5	2.5	0.5	0.025	0	0.375	4.525	4.9
Saint Pierre and Miquelon	0	0	0	0	0	0.001	0	0	0.001	0.001
Saint Vincent and the Grenadines	0	0	1.02	1.156	1.02	0.225	0	0.675	3.421	4.096
Suriname	0	0	0.524	1.302	0.349	0.036	0	0.148	2.211	2.358
Trinidad and Tobago	0	0	0.8	1.6	0.4	0.025	0	0.2	2.825	3.025
Turks and Caicos Islands	0	0	2.2	3.025	0.55	0.025	0	0.6	5.8	6.4
US Virgin Islands	0	0	0.8	1.6	0.4	0.025	0	0.2	2.825	3.025
United States	0.104	0.003	0.114	0.2	0.073	0.017	0.016	0.091	0.526	0.617
Uruguay	0	0	0	0	0	0.034	0	0	0.034	0.034
Venezuela	0	0	0.059	0.219	0.029	0.028	0	0.014	0.335	0.349
WHO American Region aggregate rates	0.029	0.001	0.136	0.265	0.083	0.021	0.005	0.058	0.54	0.597

Chart 8: Annual pregnant carriers of significant variants

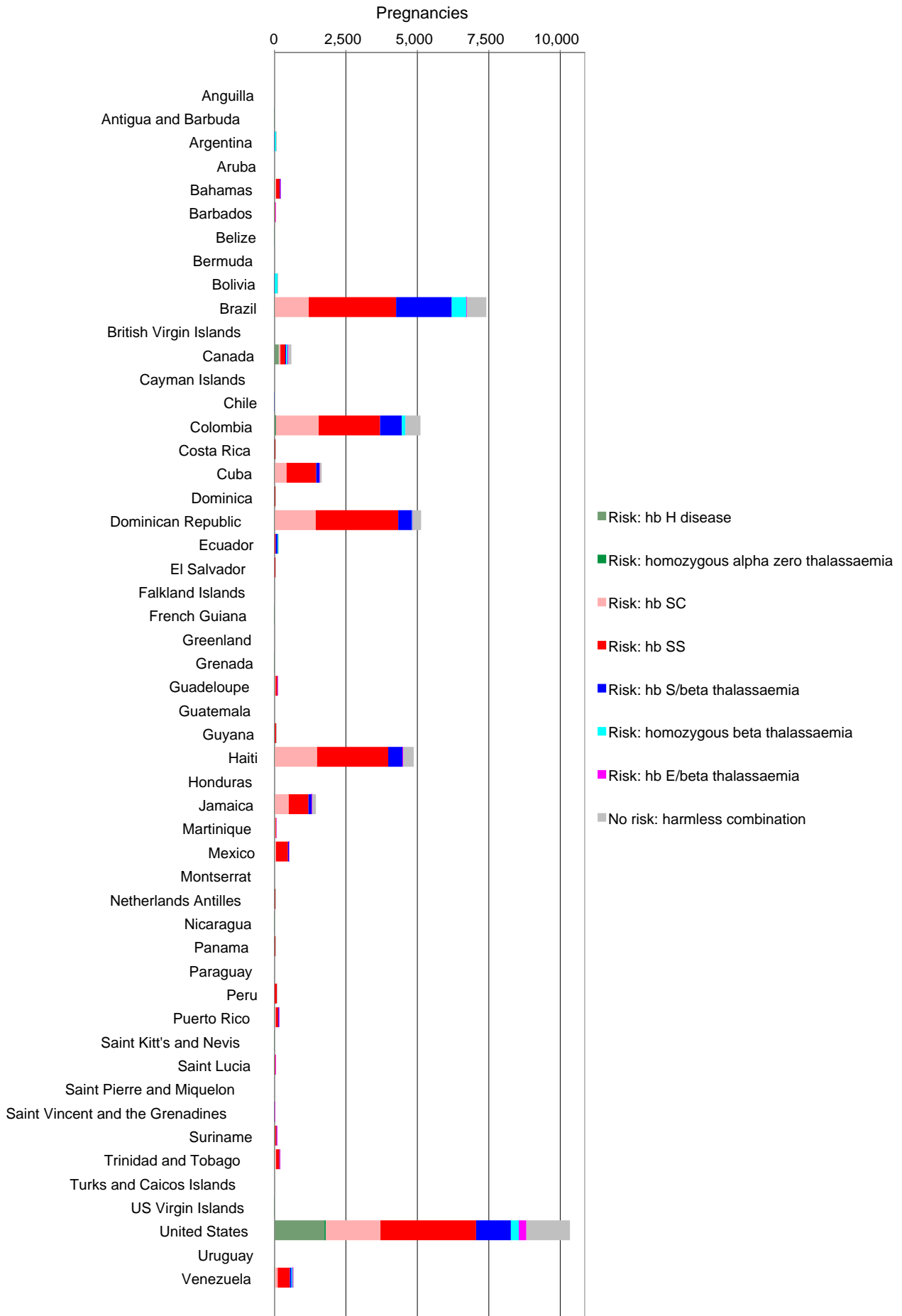


Indicates requirement for information for carriers, and the offer of partner testing. Also indicates annual carriers detectable by neonatal screening.



<i>Country</i>	<i>Alpha zero thalassaemia carrier</i>	<i>Hb AC</i>	<i>Hb AS</i>	<i>Beta thalassaemia carrier</i>	<i>Hb AE</i>	<i>Hb A/other</i>	<i>Total carriers</i>
Anguilla	0	0	0	0	0	0	0
Antigua and Barbuda	0	29	146	14	0	0	189
Argentina	0	0	0	6,968	0	209	7,177
Aruba	0	0	0	1	0	0	1
Bahamas	0	205	960	68	0	2	1,235
Barbados	0	157	239	17	0	1	414
Belize	0	85	427	6	0	2	520
Bermuda	0	16	66	8	0	0	90
Bolivia	0	0	0	5,992	0	89	6,081
Brazil	0	22,381	97,520	36,333	0	1,090	157,324
British Virgin Islands	0	8	32	4	0	0	44
Canada	637	353	1,731	1,831	897	109	5,558
Cayman Islands	0	0	0	0	0	0	0
Chile	0	0	0	2,340	0	70	2,410
Colombia	3,294	26,988	34,858	9,115	198	317	74,770
Costa Rica	0	145	1,455	54	0	21	1,675
Cuba	0	2,561	12,504	753	0	45	15,863
Dominica	0	17	184	8	0	0	209
Dominican Republic	0	6,018	24,075	2,006	0	60	32,159
Ecuador	0	0	3,287	3,287	0	98	6,672
El Salvador	0	0	1,896	93	0	37	2,026
Falkland Islands	0	0	0	0	0	0	0
French Guiana	0	55	277	4	0	1	337
Greenland	0	0	0	0	0	0	0
Grenada	0	39	198	19	0	0	256
Guadeloupe	0	204	703	75	0	2	984
Guatemala	0	0	0	280	0	112	392
Guyana	0	163	816	12	0	4	995
Haiti	0	7,467	24,891	2,489	0	74	34,921
Honduras	0	91	367	172	0	68	698
Jamaica	0	2,279	6,267	569	0	17	9,132
Martinique	0	253	439	22	0	1	715
Mexico	0	1,294	7,101	4,486	0	769	13,650
Montserrat	0	7	20	1	0	0	28
Netherlands Antilles	0	73	367	36	0	1	477
Nicaragua	0	456	1,825	228	0	57	2,566
Panama	0	188	1,416	94	0	18	1,716
Paraguay	0	0	0	125	0	50	175
Peru	0	0	6,488	486	0	194	7,168
Puerto Rico	0	587	2,349	293	0	17	3,246
Saint Kitt's and Nevis	0	30	84	7	0	0	121
Saint Lucia	0	85	285	28	0	0	398
Saint Pierre and Miquelon	0	0	0	0	0	0	0
Saint Vincent and the Grenadines	0	63	143	63	0	0	269
Suriname	0	154	720	102	0	3	979
Trinidad and Tobago	0	373	1,495	186	0	5	2,059
Turks and Caicos Islands	0	16	44	4	0	0	64
US Virgin Islands	0	45	182	22	0	0	249
United States	3,558	29,862	36,147	16,134	4,962	1,258	91,921
Uruguay	0	0	0	505	0	15	520
Venezuela	0	1,970	10,189	1,854	0	147	14,160
WHO American Region total pregnant carriers	7,489	104,717	282,193	97,194	6,057	4,963	502,613

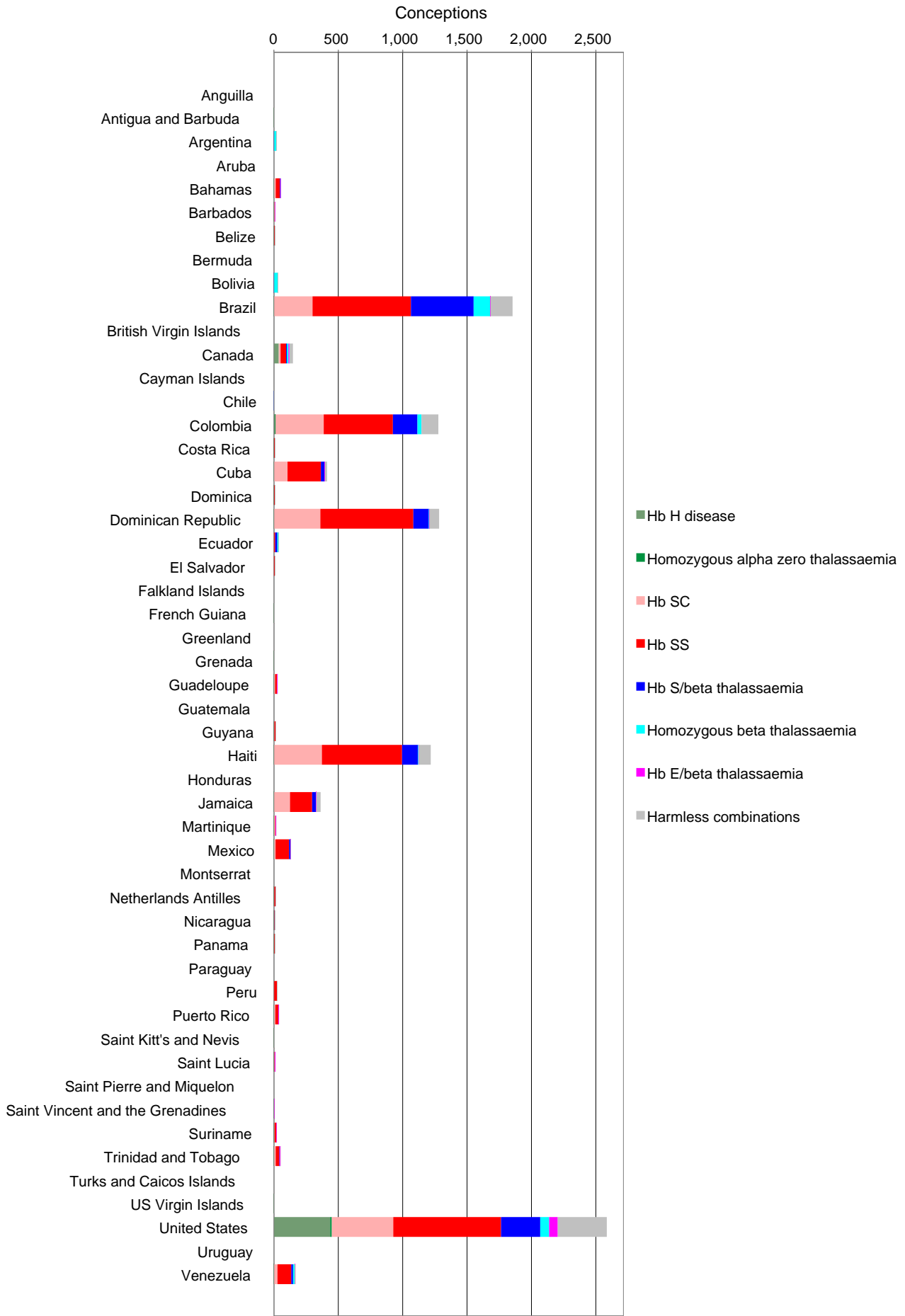
Chart 9: Annual pregnancies where both parents carry a significant variant



Indicates requirement for expert risk assessment, genetic counselling and the offer of prenatal diagnosis.

Country	Risk: hb H disease	Risk: homozygous alpha zero thalassaemia	Risk: hb SC	Risk: hb SS	Risk: hb S/beta thalassaemia	Risk: homozygous beta thalassaemia	Risk: hb E/beta thalassaemia	No risk: harmless combination	Total at-risk pregnancies	Total pregnancies requiring risk assessment
Anguilla	0	0	0	0	0	0	0	0	0	0
Antigua and Barbuda	0	0	4	12	0	0	0	0	16	16
Argentina	0	0	0	0	0	72	0	0	72	72
Aruba	0	0	0	0	0	0	0	0	0	0
Bahamas	0	0	56	132	16	0	0	8	204	212
Barbados	0	0	20	16	0	0	0	8	36	44
Belize	0	0	8	20	0	0	0	0	28	28
Bermuda	0	0	0	4	0	0	0	0	4	4
Bolivia	0	0	0	0	0	120	0	0	120	120
Brazil	0	0	1,200	3,056	1,948	524	0	684	6,728	7,412
British Virgin Islands	0	0	0	0	0	0	0	0	0	0
Canada	136	12	60	172	24	48	32	108	484	592
Cayman Islands	0	0	0	0	0	0	0	0	0	0
Chile	0	0	0	0	0	24	0	0	24	24
Colombia	48	0	1,500	2,148	764	124	4	520	4,588	5,108
Costa Rica	0	0	4	32	0	0	0	0	36	36
Cuba	0	0	424	1,036	124	0	0	68	1,584	1,652
Dominica	0	0	4	28	0	0	0	0	32	32
Dominican Republic	0	0	1,444	2,888	480	20	0	300	4,832	5,132
Ecuador	0	0	0	44	64	44	0	0	152	152
El Salvador	0	0	0	32	0	0	0	0	32	32
Falkland Islands	0	0	0	0	0	0	0	0	0	0
French Guiana	0	0	4	12	0	0	0	0	16	16
Greenland	0	0	0	0	0	0	0	0	0	0
Grenada	0	0	4	16	0	0	0	0	20	20
Guadeloupe	0	0	36	64	12	0	0	8	112	120
Guatemala	0	0	0	0	0	0	0	0	0	0
Guyana	0	0	16	44	0	0	0	0	60	60
Haiti	0	0	1,492	2,488	496	24	0	372	4,500	4,872
Honduras	0	0	0	0	0	0	0	0	0	0
Jamaica	0	0	500	688	124	4	0	136	1,316	1,452
Martinique	0	0	36	32	0	0	0	12	68	80
Mexico	0	0	52	420	40	4	0	12	516	528
Montserrat	0	0	0	0	0	0	0	0	0	0
Netherlands Antilles	0	0	12	36	4	0	0	0	52	52
Nicaragua	0	0	8	16	4	0	0	0	28	28
Panama	0	0	8	28	4	0	0	0	40	40
Paraguay	0	0	0	0	0	0	0	0	0	0
Peru	0	0	0	96	8	0	0	0	104	104
Puerto Rico	0	0	44	92	20	0	0	8	156	164
Saint Kitt's and Nevis	0	0	4	8	0	0	0	0	12	12
Saint Lucia	0	0	16	28	4	0	0	4	48	52
Saint Pierre and Miquelon	0	0	0	0	0	0	0	0	0	0
Saint Vincent and the Grenadines	0	0	8	8	8	0	0	4	24	28
Suriname	0	0	20	52	12	0	0	4	84	88
Trinidad and Tobago	0	0	56	116	28	0	0	12	200	212
Turks and Caicos Islands	0	0	0	4	0	0	0	0	4	4
US Virgin Islands	0	0	4	12	0	0	0	0	16	16
United States	1,748	52	1,908	3,348	1,216	276	268	1,524	8,816	10,340
Uruguay	0	0	0	0	0	4	0	0	4	4
Venezuela	0	0	112	428	56	52	0	28	648	676
WHO American Region total pregnancies	1,932	64	9,064	17,656	5,456	1,340	304	3,820	35,816	39,636

Chart 10: Annual conceptions with combinations of significant gene variants



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Indicates (potential) annual affected births, and annual increase in requirements for patient care. Baseline for assessing effects of prevention.

Country	Hb H disease	Homozygous alpha zero thalassaemia	Hb SC	Hb SS	Hb S/beta thalassaemia	Homozygous beta thalassaemia	Hb E/beta thalassaemia	Harmless combinations	Total affected conceptions	Total conceptions with combinations
Anguilla	0	0	0	0	0	0	0	0	0	0
Antigua and Barbuda	0	0	1	3	0	0	0	0	4	4
Argentina	0	0	0	0	0	18	0	0	18	18
Aruba	0	0	0	0	0	0	0	0	0	0
Bahamas	0	0	14	33	4	0	0	2	51	53
Barbados	0	0	5	4	0	0	0	2	9	11
Belize	0	0	2	5	0	0	0	0	7	7
Bermuda	0	0	0	1	0	0	0	0	1	1
Bolivia	0	0	0	0	0	30	0	0	30	30
Brazil	0	0	300	764	487	131	0	171	1,682	1,853
British Virgin Islands	0	0	0	0	0	0	0	0	0	0
Canada	34	3	15	43	6	12	8	27	121	148
Cayman Islands	0	0	0	0	0	0	0	0	0	0
Chile	0	0	0	0	0	6	0	0	6	6
Colombia	12	0	375	537	191	31	1	130	1,147	1,277
Costa Rica	0	0	1	8	0	0	0	0	9	9
Cuba	0	0	106	259	31	0	0	17	396	413
Dominica	0	0	1	7	0	0	0	0	8	8
Dominican Republic	0	0	361	722	120	5	0	75	1,208	1,283
Ecuador	0	0	0	11	16	11	0	0	38	38
El Salvador	0	0	0	8	0	0	0	0	8	8
Falkland Islands	0	0	0	0	0	0	0	0	0	0
French Guiana	0	0	1	3	0	0	0	0	4	4
Greenland	0	0	0	0	0	0	0	0	0	0
Grenada	0	0	1	4	0	0	0	0	5	5
Guadeloupe	0	0	9	16	3	0	0	2	28	30
Guatemala	0	0	0	0	0	0	0	0	0	0
Guyana	0	0	4	11	0	0	0	0	15	15
Haiti	0	0	373	622	124	6	0	93	1,125	1,218
Honduras	0	0	0	0	0	0	0	0	0	0
Jamaica	0	0	125	172	31	1	0	34	329	363
Martinique	0	0	9	8	0	0	0	3	17	20
Mexico	0	0	13	105	10	1	0	3	129	132
Montserrat	0	0	0	0	0	0	0	0	0	0
Netherlands Antilles	0	0	3	9	1	0	0	0	13	13
Nicaragua	0	0	2	4	1	0	0	0	7	7
Panama	0	0	2	7	1	0	0	0	10	10
Paraguay	0	0	0	0	0	0	0	0	0	0
Peru	0	0	0	24	2	0	0	0	26	26
Puerto Rico	0	0	11	23	5	0	0	2	39	41
Saint Kitt's and Nevis	0	0	1	2	0	0	0	0	3	3
Saint Lucia	0	0	4	7	1	0	0	1	12	13
Saint Pierre and Miquelon	0	0	0	0	0	0	0	0	0	0
Saint Vincent and the Grenadines	0	0	2	2	2	0	0	1	6	7
Suriname	0	0	5	13	3	0	0	1	21	22
Trinidad and Tobago	0	0	14	29	7	0	0	3	50	53
Turks and Caicos Islands	0	0	0	1	0	0	0	0	1	1
US Virgin Islands	0	0	1	3	0	0	0	0	4	4
United States	437	13	477	837	304	69	67	381	2,204	2,585
Uruguay	0	0	0	0	0	1	0	0	1	1
Venezuela	0	0	28	107	14	13	0	7	162	169
WHO American Region total pregnancies	483	16	2,266	4,414	1,364	335	76	955	8,954	9,909