Supplementary Material Hardy-Weinberg Equilibrium

Briefly, in the case of a single locus with two alleles (A and S) where p is the allele frequency of the dominant allele, q is the frequency of the recessive allele (HbA and HbS respectively in the present study) and $p+q=1$, genotype frequencies assuming HWE are equivalent to p^2 for homozygous dominants (AA), $2pq$ for heterozygotes (AS), q^2 for homozygous recessives (SS) and $p^2+2pq+q^2=1$ (Equation 1). Considering a three-allele case (for example HbA, HbS and HbC), the corresponding equation is $p^2+2pq+q^2+2pr+r^2+2qr=1$ (Equation 2) where r is the third allele (i.e. r^2, $2pr$ and $2qr$ are CC, AC and SC proportions respectively).

Equation 1: $p^2 + 2pq + q^2 = 1$

where p and q are the proportions of the two alleles (e.g. HbA and HbS).

Equation 2: $p^2 + 2pq + q^2 + 2pr + r^2 + 2qr = 1$

where p, q and r are the proportions of the three alleles (HbA, HbS and HbC).

For each study population, we calculated the expected genotype frequencies based on these equations (Table 1). Radar charts, created with a slightly modified version of the radarchart function included in the "fmsb" package in *R* (see code in the Supplementary Information), are used to illustrate the relative differences between observed and expected genotype counts for selected studies (Figure 2).

Supplementary Table 1

ID	Bibliographic citation	Source
1	Aebischer ML, Martorana MC, Costa F, et al. Evaluation of the sensitivity of microfilter paper assays in an anthropological study: results of samples from Cameroon and Tanzania. *Anthropologischer Anzeiger* . 1990;48(1):15-23.	Pubmed
2	Agasa B, Bosunga K, Opara A, et al. Prevalence of sickle cell disease in a northeastern region of the Democratic Republic of Congo: what impact on transfusion policy? *Transfusion Medicine* . 2010;20(1):62-65.	Pubmed
3	Al Arrayed S. Campaign to control genetic blood diseases in Bahrain. *Community Genetics* . 2005;8(1):52-55.	Pubmed
4	Al Arrayed S, Al Hajeri A. Newborn screening services in Bahrain between 1985 and 2010. *Advances in Hematology* . 2012:903219.	Pubmed
5	Al Hosani H, Salah M, Osman HM, Farag HM, Anvery SM. Incidence of haemoglobinopathies detected through neonatal screening in the United Arab Emirates. *Eastern Mediterranean Health Journal* . 2005;11(3):300-307.	Pubmed
6	Al Hosani H, Salah M, Osman HM, et al. Expanding the comprehensive national neonatal screening programme in the United Arab Emirates from 1995 to 2011. *Eastern Mediterranean Health Journal* . 2014;20(1):17-23.	Pubmed
7	Al-Awamy BH, Al-Muzan M, Al-Turki M, Serjeant GR. Neonatal screening for sickle cell disease in the Eastern Province of Saudi Arabia. *Transactions of the Royal Society of Tropical Medicine and Hygiene* . 1984;78(6):792-794.	Pubmed
8	Alkindi S, Al Zadjali S, Al Madhani A, et al. Forecasting hemoglobinopathy burden through neonatal screening in Omani neonates. *Hemoglobin* . 2010;34(2):135-144.	Pubmed
9	Al-Nood H, Al-Ismail S, King L, May A. Prevalence of the sickle cell gene in Yemen: a pilot study. *Hemoglobin* . 2004;28(4):305-315.	Pubmed
10	Diallo DA. Sickle cell disease in Africa: current situation and strategies for improving the quality and duration of survival. *Bulletin of the Académie Nationale de Médecine* . 2008;7:1361-1373. Complemented by *Personal Communication* .	Preliminary studies
11	Fattoum S. [Hemoglobinopathies in Tunisia. An updated review of the epidemiologic and molecular data]. *Tunisie Medicale* . 2006;84(11):687-696.	Pubmed
12	Hajer S, Neila T, Sondess HF, et al. A lower-cost protocol for sickle cell disease neonatal screening in Tunisia. *Annals of Saudi Medicine* . 2012;32(1):49-52.	Pubmed
13	Kafando E, Sawadogo M, Cotton F, Vertongen F, Gulbis B. Neonatal screening for sickle cell disorders in Ouagadougou, Burkina Faso: a pilot study. *Journal of Medical Screening* . 2005;12(3):112-114.	Pubmed
14	Khoriaty E, Halaby R, Berro M, Sweid A, Abbas HA, Inati A. Incidence of sickle cell disease and other hemoglobin variants in 10,095 lebanese neonates. *Public Library of Science One* . 2014;9(9):e105109.	Pubmed
15	Kulkarni AG, Jekeme SD. Cord blood screening for haemoglobinopathies in northern Nigeria. *Annals of Tropical Medicine and Parasitology* . 1986;80(5):549-551.	Pubmed
16	Lallemant M, Galacteros F, Lallemant-Lecoeur S, et al. Hemoglobin abnormalities. An evaluation on new-born infants and their mothers in a maternity unit close to Brazzaville (P.R. Congo). *Human Genetics* . 1986;74(1):54-58.	Preliminary studies
17	Le Hesran JY, Personne I, Personne P, et al. Longitudinal study of Plasmodium falciparum infection and immune responses in infants with or without the sickle cell trait. *International Journal of Epidemiology* . 1999;28(4):793-798.	Preliminary studies
18	Mbodj M, Ndoye O, Diarra M, et al. [Sickle cell disease neonatal screening. First evaluation]. *Dakar Medical* . 2003;48(3):202-205.	Pubmed
19	McGann PT, Ferris MG, Ramamurthy U, et al. A prospective newborn screening and treatment program for sickle cell anemia in Luanda, Angola. *American Journal of Hematology* . 2013;88(12):984-989.	Pubmed
20	Mohammed AM, Al-Hilli F, Nadkarni KV, Bhagwat GP, Bapat JP. Hemoglobinopathies and glucose-6-phosphate dehydrogenase deficiency in hospital births in Bahrain. *Annals of Saudi Medicine* . 1992;12(6):536-539.	Pubmed

21	Moreno JL, Baribwira C. The epidemiology of neonatal sickle-cell-anemia in Bujumbura (Burundi). *Annales de Pédiatrie* . 1994;41(4):215-218.	Preliminary studies
22	Munyanganizi R, Cotton F, Vertongen F, Gulbis B. Red blood cell disorders in Rwandese neonates: screening for sickle cell disease and glucose-6-phosphate dehydrogenase deficiency. *Journal of Medical Screening* . 2006;13(3):129-131.	Pubmed
23	Mutesa L, Boemer F, Ngendahayo L, et al. Neonatal screening for sickle cell disease in Central Africa: a study of 1825 newborns with a new enzyme-linked immunosorbent assay test. *Journal of Medical Screening* . 2007;14(3):113-116.	Pubmed
24	Nasserullah Z, Alshammari A, Abbas MA, et al. Regional experience with newborn screening for sickle cell disease, other hemoglobinopathies and G6PD deficiency. *Annals of Saudi Medicine* . 2003;23(6):354-357.	Pubmed
25	North ML, Piffaut MC, Duwig I, Locoh-Donou AG, Locoh-Donou AM. Detection of haemoglobinopathies at birth in Togo. *Nouvelle Revue Française d'Hématologie* . 1988;30(4):237-241.	Pubmed
26	Odunvbun ME, Okolo AA, Rahimy CM. Newborn screening for sickle cell disease in a Nigerian hospital. *Public Health* . 2008;122(10):1111-1116.	Pubmed
27	Ohene-Frempong K, Oduro J, Tetteh H, Nkrumah F. Screening newborns for sickle cell disease in Ghana. *Pediatrics* . 2008;121(Supplement 2):S120-S121. Complemented by *Personal Communication* .	Pubmed
28	Oudart JL, Diadhiou F, Sarrat H, Satge P. [Hemoglobin of the African newborn infant. Results of an investigation in Senegal]. *Annales de Pédiatrie.* 1968;15(12):773-781.	Pubmed
29	Richard-Lenoble D, Toublanc JE, Zinsou RD, Kombila M, Carme B. [Results of a systematic study of drepanocytosis in 1,500 Gabonese using hemoglobin electrophoresis]. *Bulletin de la Société de Pathologie Exotique et de Ses Filiales* . 1980;73(2):200-206.	Pubmed
30	Segbena AY, Kueviakoe I, Messie AK, Napo-Koura IG, Vovor A, David M. [Hemoglobin anomalies at the university hospital center in Lome, Togo]. *Médecine Tropicale* . 2002;62(1):51-54.	Pubmed
31	Talafih K, Hunaiti AA, Gharaibeh N, Gharaibeh M, Jaradat S. The prevalence of hemoglobin S and glucose-6-phosphate dehydrogenase deficiency in Jordanian newborn. *Journal of Obstetrics and Gynaecology Research* . 1996;22(5):417-420.	Pubmed
32	Tchamago CJ. Dépistage néonatal de la drépanocytose au Sénégal. Etude préliminaire au de de deux maternités de Dakar.: Faculté de Médecine, de Pharmacie et d'Odonto-Stomatologie, Université Cheikh Anta Diop; 2006.	Preliminary studies
33	Tshilolo L, Aissi LM, Lukusa D, et al. Neonatal screening for sickle cell anaemia in the Democratic Republic of the Congo: experience from a pioneer project on 31 204 newborns. *Journal of Clinical Pathology* . 2009;62(1):35-38.	Pubmed
34	Tshilolo L, Kafando E, Sawadogo M, et al. Neonatal screening and clinical care programmes for sickle cell disorders in sub-Saharan Africa: lessons from pilot studies. *Public Health* . 2008;122(9):933-941.	Pubmed
35	Van Baelen H, Vandepitte J, Cornu G, Eeckels R. Routine detection of sickle-cell anaemia and haemoglobin Bart's in Congolese neonates. *Tropical and Geographical Medicine* . 1969;21(4):412-426.	Pubmed
36	Williams TN, Uyoga S, Macharia A, et al. Bacteraemia in Kenyan children with sickle-cell anaemia: a retrospective cohort and case-control study. *Lancet.* 2009;374(9698):1364-1370. Complemented by *Personal Communication* .	Preliminary studies

Supplementary Table 2

ID	First Author	Year	Country	N	Diagnostic method	Genotype counts						Allele frequency		
						AA	AS	SS	AC	SC	CC	A	S	C
Sub-Saharan Africa														
1	McGann	2013	Angola	36,453	IEF	28,209	7,666	550	21	7	0	0.879	0.120	0.0004
2	Kafando	2005	Burkina Faso	2,341	IEF	1,702	171	14	395	27	32	0.848	0.048	0.1038
3	Moreno	1994	Burundi	260	IEF	238	22	0	/	/	/	0.958	0.042	/
4	Moreno	1994	Burundi	82	IEF	60	20	2	/	/	/	0.854	0.146	/
5	Moreno	1994	Burundi	40	IEF	32	8	0	/	/	/	0.900	0.100	/
	Moreno	**1994**	**Burundi**	**382**	**IEF**	**330**	**50**	**2**	**/**	**/**	**/**	**0.929**	**0.071**	**/**
6	Mutesa	2007	Burundi	637	ELISA	608	28	1	0	0	0	0.976	0.024	0.0000
7	Le Hesran	1999	Cameroon	156	Electrophoresis	118	34	4	/	/	/	0.865	0.135	/
8	Diallo	2008	Congo	1,186	IEF	952	225	9	/	/	/	0.898	0.102	/
9	Van Baelen	1969	DRC	500	Electrophoresis	367	120	13	/	/	/	0.854	0.146	/
10	Lallemant	1986	DRC	146	IEF	118	27	1	/	/	/	0.901	0.099	/
11	Mutesa	2007	DRC	84	ELISA	78	4	0	2	0	0	0.964	0.024	0.0119
12	Tshilolo	2008	DRC	4,116	IEF	3,182	838	96	0	0	0	0.875	0.125	0.0000
13	Tshilolo	2009	DRC	70	IEF	64	6	0	0	0	0	0.957	0.043	0.0000
14	Tshilolo	2009	DRC	579	IEF	473	100	6	0	0	0	0.903	0.097	0.0000
15	Tshilolo	2009	DRC	717	IEF	609	102	6	0	0	0	0.921	0.079	0.0000
16	Tshilolo	2009	DRC	559	IEF	440	110	9	0	0	0	0.886	0.114	0.0000
17	Tshilolo	2009	DRC	932	IEF	791	130	11	0	0	0	0.918	0.082	0.0000
18	Tshilolo	2009	DRC	1,016	IEF	819	179	18	0	0	0	0.894	0.106	0.0000
19	Tshilolo	2009	DRC	3,069	IEF	2,491	527	51	0	0	0	0.898	0.102	0.0000
20	Tshilolo	2009	DRC	4,217	IEF	3,449	713	55	0	0	0	0.902	0.098	0.0000
21	Tshilolo	2009	DRC	10,445	IEF	8,554	1,756	135	0	0	0	0.903	0.097	0.0000
22	Tshilolo	2009	DRC	9,600	IEF	7,810	1,653	137	0	0	0	0.900	0.100	0.0000
	Tshilolo$^{\Sigma}$	**2009**	**DRC**	**31,204**	**IEF**	**25,500**	**5,276**	**428**	**0**	**0**	**0**	**0.902**	**0.098**	**0.0000**
23	Agasa	2010	DRC	520	IEF	394	121	5	/	/	/	0.874	0.126	/
24	Richard-Lenoble	1980	Gabon	96	Electrophoresis	86	8	2	/	/	/	0.938	0.063	/
25	Ohene-Frempong	Pers.com.	Ghana	343,355	IEF	259,660	45,812	3,186	30,253	2,807	1,637	0.867	0.080	0.0529
26	Williams	Pers.com.	Kenya	15,444	PCR	12,984	2,335	125	/	/	/	0.916	0.084	/
27	Diallo	2008	Mali	1,029	IEF	807	102	4	105	4	7	0.885	0.055	0.0598
28	Kulkarni	1986	Nigeria	700	Electrophoresis	526	138	20	15	0	1	0.861	0.127	0.0121
29	Odunvbun	2008	Nigeria	644	IEF	485	133	18	7	1	0	0.862	0.132	0.0062
30	Munyanganizi	2006	Rwanda	987	IEF	960	27	0	0	0	0	0.986	0.014	0.0000
31	Mutesa	2007	Rwanda	1,104	ELISA	1,073	28	1	2	0	0	0.986	0.014	0.0009
32	Oudart	1968	Senegal	345	Electrophoresis	313	25	1	4	2	0	0.949	0.042	0.0087
33	Mbodji	2003	Senegal	479	IEF	426	38	9	5	1	0	0.934	0.059	0.0063
34	Tchamago	2006	Senegal	944	IEF	839	90	4	9	0	0	0.941	0.052	0.0048
35	Diallo	2008	Senegal	1,000	IEF	910	85	5	0	0	0	0.953	0.048	0.0000
36	Aebischer	1990	Tanzania	92	Electrophoresis	82	10	0	/	/	/	0.946	0.054	/
37	Aebischer	1990	Tanzania	101	Electrophoresis	87	13	1	/	/	/	0.926	0.074	/
38	Aebischer	1990	Tanzania	30	Electrophoresis	29	1	0	/	/	/	0.983	0.017	/
	Aebischer$^{\Sigma}$	**1990**	**Tanzania**	**223**	**Electrophoresis**	**198**	**24**	**1**	**/**	**/**	**/**	**0.942**	**0.058**	**/**
39	North	1988	Togo		IEF	269	72	4	34	5	1	0.836	0.110	0.0532
40	Segbena	2002	Togo	171	IEF	110	28	2	27	4	0	0.804	0.105	0.0906
North Africa														
41	Diallo	2008	Tunisia	1,329	IEF	1,309	20	0	0	0	0	0.992	0.008	0.0000
42	Fattoum	2006	Tunisia	2,029	IEF	1,968	44	0	17	0	0	0.985	0.011	0.0042
43	Fattoum	2006	Tunisia	335	IEF	332	2	0	1	0	0	0.996	0.003	0.0015
44	Fattoum	2006	Tunisia	264	IEF	249	15	0	0	0	0	0.972	0.028	0.0000
	Fattoum$^{\Sigma}$	**2006**	**Tunisia**	**2,628**	**IEF**	**2,549**	**61**	**0**	**18**	**0**	**0**	**0.985**	**0.012**	**0.0034**
45	Hajer	2012	Tunisia	9,148	IEF	8,935	176	0	34	1	2	0.988	0.010	0.0021
Middle East														
46	Mohammed	1992	Bahrain	10,327	Electrophoresis	8,954	1,157	217	0	0	0	0.923	0.077	0.0000
47	Al Arrayed	2005	Bahrain	1,995	HPLC	1,652	325	18	/	/	/	0.910	0.090	/
48	Al Arrayed	2012	Bahrain	38,940	HPLC	33,512	5,247	228	/	/	/	0.928	0.073	/
49	Talafih	1996	Jordan	181	Electrophoresis	172	9	0	/	/	/	0.975	0.025	/
50	Khoriaty	2014	Lebanon	10,095	HPLC	9,911	168	10	5	1	0	0.990	0.009	0.0003
51	Alkindi	2010	Oman	7,837	HPLC	7,406	409	22	/	/	/	0.971	0.029	/
52	Al-Awamy	1984	Saudi Arabia	1,697	Electrophoresis	1,612	75	10	/	/	/	0.972	0.028	/
53	Al-Awamy	1984	Saudi Arabia	2,800	Electrophoresis	2,597	188	15	/	/	/	0.961	0.039	/
54	Al-Awamy	1984	Saudi Arabia	1,124	Electrophoresis	900	202	22	/	/	/	0.891	0.109	/
	Al-Awamy$^{\Sigma}$	**1984**	**Saudi Arabia**	**5,621**	**Electrophoresis**	**5,109**	**465**	**47**	**/**	**/**	**/**	**0.950**	**0.050**	**/**

ID	First Author	Year	Country	N	Diagnostic method	Genotype counts						Allele frequency		
						AA	AS	SS	AC	SC	CC	A	S	C
55	Nasserullah	2003	Saudi Arabia	2,149	Electrophoresis	2,096	51	2	/	/	/	0.987	0.013	/
56	Nasserullah	2003	Saudi Arabia	21,829	Electrophoresis	16,645	4,621	563	/	/	/	0.868	0.132	/
	Nasserullah$^{\Sigma}$	**2003**	**Saudi Arabia**	**23,978**	**Electrophoresis**	**18,741**	**4,672**	**565**	**/**	**/**	**/**	**0.879**	**0.121**	**/**
57	Al Hosani	2005	UAE	9,165	HPLC	9,019	137	6	3	0	0	0.992	0.008	0.0002
58	Al Hosani	2005	UAE	13,035	HPLC	12,920	103	3	8	0	1	0.995	0.004	0.0004
	Al Hosani$^{\Sigma}$	**2005**	**UAE**	**22,200**	**HPLC**	**21,939**	**240**	**9**	**11**	**0**	**1**	**0.994**	**0.006**	**0.0003**
59	Al Hosani	2014	UAE	542,286	HPLC	537,494	4,509	203	69	0	11	0.995	0.005	0.0001
60	Al-Nood	2004	Yemen	1,500	HPLC	1,467	33	0	0	0	0	0.989	0.011	0.0000

Supplementary Table 3

ID	Reference	Study period	Country	N	Observed						Expected (HWE)						Exact test	F_{IS} (%)
					%AA	%AS	%SS	%AC	%SC	%CC	%AA	%AS	%SS	%AC	%SC	%CC		
Sub-Saharan Africa																		
1	McGann et al, 2013	Jul 2011 - Jun 2013	Angola	36,453	77.4	21.0	1.5	0.1	0.0	0.0	77.3	21.2	1.4	0.1	0.0	0.0	0.103	0.6
2	Kafando et al, 2005	2000, 2003, 2004	Burkina Faso	2,341	72.7	7.3	0.6	16.9	1.2	1.4	71.9	8.2	0.2	17.6	1.0	1.1	0.002 *	5.5
3	Moreno et al, 1994	Not specified	Burundi	260	91.5	8.5	0.0	/	/	/	91.7	8.1	0.2	/	/	/	0.696	-4.4
4	Moreno et al, 1994	Not specified	Burundi	82	73.2	24.4	2.4	/	/	/	72.9	25.0	2.1	/	/	/	1.000	2.4
5	Moreno et al, 1994	Not specified	Burundi	40	80.0	20.0	0.0	/	/	/	81.0	18.0	1.0	/	/	/	0.712	-11.1
	Moreno et al, 1994	**Not specified**	**Burundi**	**382**	**86.4**	**13.1**	**0.5**	**/**	**/**	**/**	**86.4**	**13.1**	**0.5**	**/**	**/**	**/**	**1.000**	**0.4**
6	Mutesa et al, 2007	Jul 2004 - Jul 2006	Burundi	637	95.4	4.4	0.2	0.0	0.0	0.0	95.3	4.6	0.1	0.0	0.0	0.0	0.295	4.4
7	Le Hesran et al, 1999	Jan 1993 - Dec 1995	Cameroon	156	75.6	21.8	2.6	/	/	/	74.9	23.3	1.8	/	/	/	0.484	6.5
8	Diallo et al, 2008	Feb 2005 - Mar 2005	Congo	1,186	80.3	19.0	0.8	/	/	/	80.6	18.4	1.0	/	/	/	0.281	-3.2
9	Van Baelen et al, 1969	Nov 1964 - Apr 1965	DRC	500	73.4	24.0	2.6	/	/	/	72.9	24.9	2.1	/	/	/	0.471	3.8
10	Lallemant et al, 1986	Not specified	DRC	146	80.8	18.5	0.7	/	/	/	81.1	17.9	1.0	/	/	/	1.000	-3.4
11	Mutesa et al, 2007	Jul 2004 - Jul 2006	DRC	84	92.9	4.8	0.0	2.4	0.0	0.0	93.0	4.6	0.1	2.3	0.1	0.0	1.000	-2.9
12	Tshilolo et al, 2008	Oct 2000 - Aug 2002	DRC	4,116	77.3	20.4	2.3	0.0	0.0	0.0	76.5	21.9	1.6	0.0	0.0	0.0	0.000 *	7.0
13	Tshilolo et al, 2009	Jan 2006 - ?	DRC	70	91.4	8.6	0.0	0.0	0.0	0.0	91.6	8.2	0.2	0.0	0.0	0.0	1.000	-4.5
14	Tshilolo et al, 2009	Jan 2006 - ?	DRC	579	81.7	17.3	1.0	0.0	0.0	0.0	81.6	17.5	0.9	0.0	0.0	0.0	0.810	1.2
15	Tshilolo et al, 2009	Jan 2006 - ?	DRC	717	84.9	14.2	0.8	0.0	0.0	0.0	84.7	14.6	0.6	0.0	0.0	0.0	0.610	2.8
16	Tshilolo et al, 2009	Jan 2006 - ?	DRC	559	78.7	19.7	1.6	0.0	0.0	0.0	78.4	20.3	1.3	0.0	0.0	0.0	0.528	3.0
17	Tshilolo et al, 2009	Jan 2006 - ?	DRC	932	84.9	13.9	1.2	0.0	0.0	0.0	84.4	15.0	0.7	0.0	0.0	0.0	0.078	6.9
18	Tshilolo et al, 2009	Jan 2006 - ?	DRC	1,016	80.6	17.6	1.8	0.0	0.0	0.0	80.0	18.9	1.1	0.0	0.0	0.0	0.044 *	6.9
19	Tshilolo et al, 2009	Jan 2006 - ?	DRC	3,069	81.2	17.2	1.7	0.0	0.0	0.0	80.6	18.4	1.1	0.0	0.0	0.0	0.001 *	6.7
20	Tshilolo et al, 2009	Jan 2006 - ?	DRC	4,217	81.8	16.9	1.3	0.0	0.0	0.0	81.4	17.6	1.0	0.0	0.0	0.0	0.014 *	4.0
21	Tshilolo et al, 2009	Jan 2006 - ?	DRC	10,445	81.9	16.8	1.3	0.0	0.0	0.0	81.5	17.5	0.9	0.0	0.0	0.0	0.000 *	4.0
22	Tshilolo et al, 2009	Jan 2006 - ?	DRC	9,600	81.4	17.2	1.4	0.0	0.0	0.0	80.9	18.1	1.0	0.0	0.0	0.0	0.000 *	4.6
	Tshilolo et al, 2009	**Jan 2006 - ?**	**DRC**	**31,204**	**81.7**	**16.9**	**1.4**	**0.0**	**0.0**	**0.0**	**81.3**	**17.7**	**1.0**	**0.0**	**0.0**	**0.0**	**0.000 ***	**4.6**
23	Agasa et al, 2010	Dec 2006 - Feb 2007	DRC	520	75.8	23.3	1.0	/	/	/	76.4	22.0	1.6	/	/	/	0.236	-5.7
24	Richard-Lenoble et al, 1980	Not specified	Gabon	96	89.6	8.3	2.1	/	/	/	87.9	11.7	0.4	/	/	/	0.037 *	28.9
25	Ohene-Frempong (Pers.com.)	Feb 1995 - Dec 2011	Ghana	343,355	75.6	13.3	0.9	8.8	0.8	0.5	75.2	13.9	0.6	9.2	0.8	0.3	0.000 *	3.9
26	Williams (Pers. Com.)	May 2006 - May 2014	Kenya	15,444	84.1	15.1	0.8	/	/	/	84.0	15.3	0.7	/	/	/	0.093	1.4
27	Diallo et al, 2008	Feb 2005 - Apr 2005	Mali	1,029	78.4	9.9	0.4	10.2	0.4	0.7	78.3	9.8	0.3	10.6	0.7	0.4	0.263	2.5
28	Kulkarni et al, 1986	Not specified	Nigeria	700	75.1	19.7	2.9	2.1	0.0	0.1	74.1	21.9	1.6	2.1	0.3	0.0	0.001 *	10.0
29	Odunvbun et al, 2008	Jun 2000 - Sep 2000	Nigeria	644	75.3	20.7	2.8	1.1	0.2	0.0	74.3	22.7	1.7	1.1	0.2	0.0	0.094	8.7
30	Munyanganizi et al, 2006	2005	Rwanda	987	97.3	2.7	0.0	0.0	0.0	0.0	97.3	2.7	0.0	0.0	0.0	0.0	1.000	-1.4
31	Mutesa et al, 2007	July 2004 - July 2006	Rwanda	1,104	97.2	2.5	0.1	0.2	0.0	0.0	97.1	2.7	0.0	0.2	0.0	0.0	0.204	5.0
32	Oudart et al, 1968	Not specified	Senegal	345	90.7	7.2	0.3	1.2	0.6	0.0	90.1	8.0	0.2	1.7	0.1	0.0	0.061	7.4

ID	Reference	Study period	Country	N	Observed						Expected (HWE)						Exact test	F_{IS} (%)
					%AA	%AS	%SS	%AC	%SC	%CC	%AA	%AS	%SS	%AC	%SC	%CC		
33	Mbodji et al, 2003	Oct 1996 - Jun 1997	Senegal	479	88.9	7.9	1.9	1.0	0.2	0.0	87.3	11.1	0.4	1.2	0.1	0.0	0.000 *	25.7
34	Tchamago et al, 2006	Mar 2005 - Aug 2005	Senegal	944	88.9	9.5	0.4	1.0	0.0	0.0	88.6	9.8	0.3	0.9	0.0	0.0	0.513	5.9
35	Diallo et al, 2008	Not specified	Senegal	1,000	91.0	8.5	0.5	0.0	0.0	0.0	90.7	9.0	0.2	0.0	0.0	0.0	0.163	6.1
36	Aebischer et al, 1990	Not specified	Tanzania	92	89.1	10.9	0.0	/	/	/	89.4	10.3	0.3	/	/	/	1.000	-5.7
37	Aebischer et al, 1990	Not specified	Tanzania	101	86.1	12.9	1.0	/	/	/	85.7	13.7	0.6	/	/	/	1.000	6.4
38	Aebischer et al, 1990	Not specified	Tanzania	30	96.7	3.3	0.0	/	/	/	96.7	3.3	0.0	/	/	/	1.000	-1.7
	Aebischer et al, 1990	**Not specified**	**Tanzania**	**223**	**88.8**	**10.8**	**0.4**	**/**	**/**	**/**	**88.7**	**11.0**	**0.3**	**/**	**/**	**/**	**1.000**	**2.0**
39	North et al, 1988	Not specified	Togo	385	69.9	18.7	1.0	8.8	1.3	0.3	70.0	18.5	1.2	8.9	1.2	0.3	0.970	-1.0
40	Segbena et al, 2002	Not specified	Togo	171	64.3	16.4	1.2	15.8	2.3	0.0	64.7	16.9	1.1	14.6	1.9	0.8	0.485	-3.3
North Africa																		
41	Diallo et al, 2005	Not specified	Tunisia	1,329	98.5	1.5	0.0	0.0	0.0	0.0	98.5	1.5	0.0	0.0	0.0	0.0	1.000	-0.8
42	Fattoum et al, 2006	Not specified	Tunisia	2,029	97.0	2.2	0.0	0.8	0.0	0.0	97.0	2.1	0.0	0.8	0.0	0.0	1.000	-1.2
43	Fattoum et al, 2006	Not specified	Tunisia	335	99.1	0.6	0.0	0.3	0.0	0.0	99.1	0.6	0.0	0.3	0.0	0.0	1.000	-0.3
44	Fattoum et al, 2006	Not specified	Tunisia	264	94.3	5.7	0.0	0.0	0.0	0.0	94.4	5.5	0.1	0.0	0.0	0.0	1.000	-2.9
	Fattoum et al, 2006	**Not specified**	**Tunisia**	**2,628**	**97.0**	**2.3**	**0.0**	**0.7**	**0.0**	**0.0**	**97.0**	**2.3**	**0.0**	**0.7**	**0.0**	**0.0**	**1.000**	**-1.3**
45	Hajer et al, 2012	Not specified	Tunisia	9,148	97.7	1.9	0.0	0.4	0.0	0.0	97.7	1.9	0.0	0.4	0.0	0.0	0.000 *	1.3
Middle East																		
46	Mohammed et al, 1992	Oct 1984 - Dec 1985	Bahrain	10,327	86.7	11.2	2.1	0.0	0.0	0.0	85.2	14.2	0.6	0.0	0.0	0.0	0.000 *	21.2
47	Al Arrayed et al, 2005	Feb 2002 - April 2002	Bahrain	1,995	82.8	16.3	0.9	/	/	/	82.7	16.5	0.8	/	/	/	0.682	1.0
48	Al Arrayed et al, 2012	Jan 2008 - Dec 2010	Bahrain	38,940	86.1	13.5	0.6	/	/	/	86.1	13.6	0.5	/	/	/	0.156	-0.9
49	Talafih et al, 1996	Not specified	Jordan	181	95.0	5.0	0.0	/	/	/	95.1	4.8	0.1	/	/	/	1.000	-2.5
50	Khoriaty et al, 2014	Dec 2010 - Mar 2013	Lebanon	10,095	98.2	1.7	0.1	0.0	0.0	0.0	98.1	1.9	0.0	0.1	0.0	0.0	0.000 *	9.9
51	Alkindi et al, 2010	Apr 2005 - Mar 2007	Oman	7,837	94.5	5.2	0.3	/	/	/	94.3	5.6	0.1	/	/	/	0.000 *	7.0
52	Al-Awamy et al, 1984	Dec 1981 - Apr 1983	Saudi Arabia	1,697	95.0	4.4	0.6	/	/	/	94.5	5.4	0.1	/	/	/	0.000 *	18.8
53	Al-Awamy et al, 1984	Dec 1981 - Apr 1983	Saudi Arabia	2,800	92.8	6.7	0.5	/	/	/	92.4	7.5	0.2	/	/	/	0.000 *	10.3
54	Al-Awamy et al, 1984	Mar 1982 - Apr	Saudi Arabia	1,124	80.1	18.0	2.0	/	/	/	79.3	19.5	1.2	/	/	/	0.021 *	7.8
	Al-Awamy et al, 1984	**Dec 1981 - Apr 1983**	**Saudi Arabia**	**5,621**	**90.9**	**8.3**	**0.8**	**/**	**/**	**/**	**90.3**	**9.5**	**0.2**	**/**	**/**	**/**	**0.000 ***	**12.5**
55	Nasserullah et al, 2003	Dec 1992 - Dec 2001	Saudi Arabia	2,149	97.5	2.4	0.1	/	/	/	97.5	2.5	0.0	/	/	/	0.046 *	6.1
56	Nasserullah et al, 2003	Dec 1992 - Dec 2001	Saudi Arabia	21,829	76.3	21.2	2.6	/	/	/	75.4	22.9	1.7	/	/	/	0.000 *	7.4
	Nasserullah et al, 2003	**Dec 1992 - Dec 2001**	**Saudi Arabia**	**23,978**	**78.2**	**19.5**	**2.4**	**/**	**/**	**/**	**77.3**	**21.3**	**1.5**	**/**	**/**	**/**	0.000 *	8.4
57	Al Hosani et al, 2005	Jan 2002 - Dec 2002	UAE	9,165	98.4	1.5	0.1	0.0	0.0	0.0	98.3	1.6	0.0	0.0	0.0	0.0	0.000 *	7.1
58	Al Hosani et al, 2005	Jan 2002 - Dec 2002	UAE	13,035	99.1	0.8	0.0	0.1	0.0	0.0	99.1	0.8	0.0	0.1	0.0	0.0	0.000 *	6.3
	Al Hosani et al, 2005	**Jan 2002 - Dec 2002**	**UAE**	**22,200**	**98.8**	**1.1**	**0.0**	**0.0**	**0.0**	**0.0**	**98.8**	**1.2**	**0.0**	**0.1**	**0.0**	**0.0**	**0.000 ***	**6.8**
59	Al Hosani et al, 2014	Jan 2002 - Dec 2011	UAE	542,286	99.1	0.8	0.0	0.0	0.0	0.0	99.1	0.9	0.0	0.0	0.0	0.0	0.000 *	8.1
60	Al-Nood et al, 2004	July 2001 - Dec 2001	Yemen	1,500	97.8	2.2	0.0	0.0	0.0	0.0	97.8	2.2	0.0	0.0	0.0	0.0	1.000	-1.1

Supplementary Table 4

ID	First Author	Year	Country	N	Survey location	Population	Source	CBR (2012)	HbS allele frequency	HbC allele frequency	F_{IS} (%)	HbCC newborn estimate			HbSC newborn estimate		
												HWE (1)	HWE+F_{IS} (2)	Ratio (2)/(1)	HWE (1)	HWE+F_{IS} (2)	Ratio (2)/(1)
Sub-Saharan Africa																	
1	McGann	2013	Angola	36,453	Luanda	1,822,407	UN	44.3	0.120	0.0004	0.62	0	0	/	7	7	1.0
2	Kafando	2005	Burkina Faso	2,341	Ouagadougou	1,475,223	UN	41.1	0.048	0.1038	5.45	653	961	1.5	608	574	0.9
10	Mutesa	2007	DRC	84	Goma	1,000,000	Wikipedia	42.9	0.024	0.0119	-2.86	6	-8	-1.3	24	25	1.0
25	Ohene-Frempong	*Pers.com.*	Ghana	343,355	Kumasi	1,922,130	UN	31.1	0.080	0.0529	3.92	167	285	1.7	507	487	1.0
27	Diallo	2008	Mali	1,025	Bamako	2,037,000	CIA	47.3	0.055	0.0598	2.55	344	482	1.4	638	622	1.0
28	Kulkarni	1986	Nigeria	700	Kaduna	1,524,000	CIA	41.5	0.127	0.0121	10.00	9	85	9.4	195	176	0.9
29	Odunvbun	2008	Nigeria	644	Benin City	1,147,188	UN	41.5	0.132	0.0062	8.71	2	27	/	78	71	0.9
31	Mutesa	2007	Rwanda	1,104	Kigali & Butare	740,383	UN	35.4	0.014	0.0009	4.95	0	1	/	1	1	1.0
32	Oudart	1968	Senegal	345	Dakar	1,056,009	UN	38.1	0.042	0.0087	7.40	3	29	9.7	29	27	0.9
33	Mbodji	2003	Senegal	479	Dakar	1,056,009	Census	38.1	0.059	0.0063	25.69	2	66	33.0	30	22	0.7
34	Tchamago	2006	Senegal	944	Dakar (CHAN & HPD)	1,056,009	UN	38.1	0.052	0.0048	5.87	1	12	12.0	20	19	1.0
39	North	1988	Togo	385	Lomé	1,524,000	CIA	36.7	0.110	0.0532	-0.99	159	131	0.8	658	664	1.0
40	Segbena	2002	Togo	171	Lomé	1,524,000	CIA	36.7	0.105	0.0906	-3.26	460	309	0.7	1067	1,102	1.0
North Africa																	
42	Fattoum	2006	Tunisia	2,029	Tunis	702,330	UN	17.3	0.011	0.0042	-1.22	0	0	/	1	1	/
43	Fattoum	2006	Tunisia	335	Nabeul	56,387	Wikipedia	17.3	0.003	0.0015	-0.35	0	0	/	0	0	/
	Fattoum$^{\Sigma}$	**2006**	**Tunisia**	**2,628**	**Tunis + Nabeul + Béja**	**865,158**	**Sum**	**17.3**	**0.012**	**0.0034**	**-1.25**	**0**	**0**	**/**	**1**	**1**	**/**
45	Hajer	2012	Tunisia	9,148	Tunis	702,330	UN	17.3	0.010	0.0021	1.32	0	0	/	1	0	0.0
Middle East																	
50	Khoriaty	2014	Lebanon	10,095	Countrywide	5,882,562	CIA	13.5	0.009	0.0003	9.93	0	2	**/**	0	0	/
57	Al Hosani	2005	UAE	9,165	UAE (citizens)	1,400,000	Wikipedia	14.8	0.008	0.0002	7.14	0	0	/	0	0	/
58	Al Hosani	2005	UAE	13,035	UAE (non-citizens)	7,800,000	Wikipedia	14.8	0.004	0.0004	6.33	0	3	**/**	0	0	/
	Al Hosani$^{\Sigma}$	**2005**	**UAE**	**22,200**	**UAE**	**9,200,000**	**Wikipedia**	**14.8**	**0.006**	**0.0003**	**6.84**	**0**	**3**	**/**	**0**	**0**	**/**
59	Al Hosani	2014	UAE	542,286	UAE	9,200,000	Wikipedia	14.8	0.005	0.0001	8.13	0	1	**/**	0	0	/

Supplementary Code

```
library(fmsb)
library(calibrate)

# Radarchartcentre function (adapted from the radarchart function in the fmsb package)

#################################################################
radarchartcentre <- function (df, axistype = 0, seg = 4, pty = 16, pcol = 1:8, plty = 1:6,
                        plwd = 1, pdensity = NULL, pfcol = NA, cglty = 3, cglwd = 1,
                        cglcol = "navy", axislabcol = "blue", title = "", subtitle = "", size = "", maxmin = TRUE,
                        na.itp = TRUE, ...)
{
  if (!is.data.frame(df)) {
    cat("The data must be given as dataframe.\n")
    return()
  }
  if ((n <- length(df)) < 3)
    return()
  if (maxmin == FALSE) {
    dfmax <- apply(df, 2, max)
    dfmin <- apply(df, 2, min)
    df <- rbind(dfmax, dfmin, df)
  }
  plot(c(-1.2, 1.2), c(-1.2, 1.2), type = "n", frame.plot = FALSE,
       axes = FALSE, xlab = "", ylab = "", main = title, asp = 1)
  mtext(subtitle, side=3, cex=0.5, font=3)
  legend(-1.5, 1.4,c("Obs.","Exp."), lty=c(1,1), lwd=c(2,2), col=c("#ff000099","#0000ff70"), cex=0.8, bty ="n")
  legend(0.1, 1.4,paste("n=",size), cex=0.9, bty="n")

  theta <- seq(90, 450, length = n + 1) * pi/180
  theta <- theta[1:n]
  xx <- cos(theta)
  yy <- sin(theta)
  points(0,0, pch=20, cex=0.5, pty = cglty, col = cglcol)
  for (i in 0:seg) {
    polygon(xx * (i + 1)/(seg + 1), yy * (i + 1)/(seg + 1), lty = cglty, lwd = cglwd, border = cglcol)

    if (axistype == 1 | axistype == 3)
      text(-0.05, (i + 1)/(seg + 1), paste(i/seg * 100, "(%)"), col = axislabcol)

    if (axistype == 4 | axistype == 5)
      text(-0.05, (i + 1)/(seg + 1), sprintf("%3.2f", i/seg), col = axislabcol)
  }

  arrows(0, 0, xx*1, yy * 1, lwd = cglwd, lty = cglty, length = 0, col = cglcol)
  if (axistype == 2 | axistype == 3 | axistype == 5) {
    text(xx[1:n], yy[1:n], df[1, 1:n], col = axislabcol)
  }
  text(xx * 1.2, yy * 1.2, colnames(df), cex=0.85)
  series <- length(df[[1]])
  if (length(pty) < (series - 2)) {
    ptys <- rep(pty, series - 2)
    pcols <- rep(pcol, series - 2)
    pltys <- rep(plty, series - 2)
    plwds <- rep(plwd, series - 2)
```

```
  pdensities <- rep(pdensity, series - 2)
  pfcols <- rep(pfcol, series - 2)
 }
 else {
  ptys <- pty
  pcols <- pcol
  pltys <- plty
  plwds <- plwd
  pdensities <- pdensity
  pfcols <- pfcol
 }
 for (i in 3:series) {
  xxs <- xx
  yys <- yy
  scale <- (df[i, ] - df[2, ])/(df[1, ] - df[2, ])

  if (sum(!is.na(df[i, ])) < 3) {
   cat(sprintf("[DATA NOT ENOUGH] at %d\n%g\n", i, df[i,
                                          ]))
  }
  else {
   for (j in 1:n) {
    if (is.na(df[i, j])) {
     if (na.itp) {
      left <- ifelse(j > 1, j - 1, n)
      while (is.na(df[i, left])) {
       left <- ifelse(left > 1, left - 1, n)
      }
      right <- ifelse(j < n, j + 1, 1)
      while (is.na(df[i, right])) {
       right <- ifelse(right < n, right + 1, 1)
      }
      xxleft <- xx[left] + (df[i,left] - df[2, left])/(df[1, left] - df[2,left])
      yyleft <- yy[left] + (df[i,left] - df[2, left])/(df[1, left] - df[2,left])
      xxright <- xx[right] + (df[i,right] - df[2, right])/(df[1, right] - df[2, right])
      yyright <- yy[right] + (df[i,right] - df[2, right])/(df[1, right] - df[2, right])



      if (xxleft > xxright) {
       xxtmp <- xxleft
       yytmp <- yyleft
       xxleft <- xxright
       yyleft <- yyright
       xxright <- xxtmp
       yyright <- yytmp
      }
      xxs[j] <- xx[j] * (yyleft * xxright - yyright * xxleft)/(yy[j]*(xxright - xxleft) - xx[j] * (yyright - yyleft))
      yys[j] <- (yy[j]/xx[j]) * xxs[j]
     }
     else {
      xxs[j] <- 0
      yys[j] <- 0
     }
    }
    else {
     xxs[j] <- xx[j] * ((df[i, j] - df[2, j])/(df[1, j] - df[2, j]))
```

```
        yys[j] <- yy[j] * ((df[i, j] - df[2, j])/(df[1, j] - df[2, j]))
      }
    }
    polygon(xxs, yys, lty = pltys[i - 2], lwd = plwds[i - 2], border = pcols[i - 2], density = pdensities[i - 2], col = pfcols[i - 2])
    points(xx * scale, yy * scale, pch = ptys[i - 2],col = pcols[i - 2])
   }
  }
}

################################################################

# Import and prepare data

mydata <- read.csv("Filename.csv", header = T)

myrownames <- mydata[,1]

mysize <- mydata$N

myyear <- mydata$Year

myauthor <- mydata$Author

mydata <- mydata[,2:7]

mydata <- data.frame(round(mydata))

# Create plots

pdf("Filename.pdf", paper="a4", onefile=T, height=10.5, width=8)

par(mfrow=c(6,5), mar=c(0.1,0.1,3,0.1))

for (i in c(1:(nrow(mydata)/2))){
  maxmin <- data.frame(
    AA = c(max(mydata[i,1], mydata[i+(nrow(mydata)/2),1]), 0),
    AS = c(max(mydata[i,2], mydata[i+(nrow(mydata)/2),2]), 0),
    SS = c(max(mydata[i,3], mydata[i+(nrow(mydata)/2),3]), 0),
    AC = c(max(mydata[i,4], mydata[i+(nrow(mydata)/2),4]), 0),
    SC = c(max(mydata[i,5], mydata[i+(nrow(mydata)/2),5]), 0),
    CC = c(max(mydata[i,6], mydata[i+(nrow(mydata)/2),6]), 0))
  colnames(mydata) <- c("AA", "AS", "SS", "AC", "SC", "CC")
  myinput <- rbind(maxmin, mydata[i,1:6], mydata[i+(nrow(mydata)/2),1:6])
    radarchartcentre(myinput, maxmin=T, seg = 3, title=myrownames[i], subtitle= paste(myauthor[i],"(",myyear[i],")"),
size=mysize[i], mar=c(0,0,0,0),
          pty=32, pcol=c("#ff000099","#0000ff70"), plwd=2, plty=1,
          cglcol="light grey", cglty=1)
}

dev.off()
```