

## Announcement of Population Data

## Allele frequencies of 15 short tandem repeats (STRs) in three Egyptian populations of different ethnic groups

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**Abstract**

DNA typing of 15 short tandem repeat (STR) loci included in the AmpF/STR Identifiler<sup>TM</sup> PCR amplification kit (Applied Biosystems), was carried out in three Egyptian populations of different ethnic groups: the Berbers from the Siwa oasis (in the North-Western Egyptian desert), the Muslims and the Copts from Adaima (Upper Egypt). A total of 297 individuals were typed. After Bonferroni's correction, no deviations from the Hardy–Weinberg equilibrium were observed for all samples at the 15 STR loci. All loci are highly polymorphic and population differentiation tests showed that 7, 10 and 8 out of 15 loci have significant differences between the Berbers and the Muslim samples, between the Berbers and the Copts, and between the two samples from Adaima, respectively. Comparative analyses between our population data and other geographically related populations gathered from the literature were performed.

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**Keywords:** STR; Egypt; AmpF/STR Identifiler<sup>TM</sup>; Population data

**Population:** We studied 297 unrelated and healthy donors from three different Egyptian ethnic groups (Fig. 1): 98 Berbers from the Siwa oasis, 99 Muslims and 100 Copts from Adaima village. The people were subjected to an interview in order to make sure of their ethnic origins and to obtain their informed consent. All the individuals and their families have been living in the area for at least three generations.

The Siwa oasis is located in the western Egyptian desert region. The inhabitants are Muslims speaking Siwi, a particular dialect related to Berber language. In the context of North African settlement, the ancestors of the present day Berbers are considered as the oldest inhabitants of North Africa (since the Neolithic). The historical period is marked by successive invasions and conquests (Persians, Arabs...) that caused significant cultural and religious changes on Berber groups. However, the Berbers from the Siwa oasis always tried to preserve their culture and their identity in spite of the successive invasions.

Muslims and Copts are neighbouring cultural groups living in Adaima village (Upper Egypt) 8 km from the South of Esna, on the western bank of the Nile. The Copts represent the native Christian minority of Egypt. The Copts is the Egyptian part which has not been converted to Islam since the Muslim invasion. The Coptic language, now extinct, is the form of the ancient Egyptian language spoken in early Christian times. Note that the “Muslims” term used in this article only refers to the Muslims from Adaima, and not to the Muslim Berbers from Siwa.

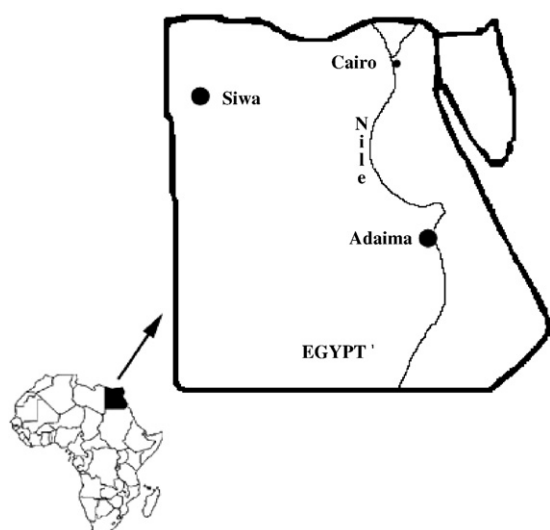
**DNA extraction:** For Siwa, genomic DNA was isolated from blood samples using the NucleoSpin<sup>®</sup> Blood Mini Kit (BD Biosciences Clontech). For Adaima, genomic DNA was isolated from buccal swabs using the DNA extraction Clean Mix kit (Talent).

**PCR:** Only 1 ng target DNA was amplified in a GeneAmp 2700 thermal cycler (Applied Biosystems) following the manufacturer's instructions for the AmpF/STR Identifiler<sup>TM</sup> PCR Amplification Kit (Applied Biosystems). The samples were amplified in single reactions for all 15 loci using fluorescently labelled primers.

**Typing:** Separation was made by capillary electrophoresis in an ABI PRISM 310 Genetic Analyzer using the separation medium Performance Optimized Polymer (POP) 4 and 47 cm

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capillaries (Applied Biosystems). The LIZ labelled ladder (GeneScan 500 LIZ) was used for sizing the determinations of the amplified fragments in combination with GeneScan software (vs.3.7, Applied Biosystems). Numerical allele designations of the profiles were obtained by comparison to the allelic ladder using Genotyper software (vs.3.7, Applied Biosystems).

**Analysis of data:** The frequency of each allele for each locus and the observed heterozygosity ( $H_o$ ) were calculated from the number of observed genotypes in the sample (direct gene counting). Expected heterozygosity ( $H_e$ ) was estimated as  $1 - \sum_i p_i^2$  where  $p_i$  is the frequency of the  $i$ th allele in the locus. The Hardy–Weinberg equilibrium exact test (dememorization value 10,000, and 5000 iterations per batch) was assessed by means of GENEPOP (1.2) statistical package [1]. The Bonferroni correction was applied on loci showing a departure from Hardy–Weinberg equilibrium [2]. In order to assess the relationship between the populations analysed, the

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Table 1 (Continued)

Allele	D3S1358	D21S11	D18S51	D5S818	D13S317	D7S820	D16S539	CSF1PO	D8S1179	FGA	TH01	VWA	TPOX	D19S433	D2S1338
$H_o$	0.755	0.908	0.847	0.786	0.745	0.816	0.765	0.816	0.776	0.847	0.745	0.806	0.724	0.796	0.847
$H_e$	0.749	0.834	0.865	0.753	0.769	0.796	0.786	0.766	0.800	0.871	0.756	0.805	0.695	0.841	0.829
PD	0.888	0.937	0.961	0.888	0.912	0.918	0.920	0.898	0.925	0.958	0.908	0.929	0.866	0.956	0.940
PIC	0.706	0.814	0.850	0.716	0.736	0.765	0.754	0.727	0.774	0.857	0.720	0.777	0.657	0.823	0.810
PE	0.519	0.812	0.689	0.573	0.501	0.630	0.536	0.630	0.554	0.689	0.501	0.610	0.467	0.591	0.689
$P$	0.521	0.117	0.538	0.276	0.876	0.384	0.865	0.457	0.051	0.119	0.863	0.880	0.888	0.719	0.447

$H_o$ : observed heterozygosity;  $H_e$ : expected heterozygosity; PIC: polymorphism information content; PD: power of discrimination; PE: power of exclusion;  $P$ :  $p$ -values of the exact test for Hardy–Weinberg equilibrium (with a 5% significance level).

Table 2

Allelic frequencies and forensic parameters of 15 STR loci in 99 Egyptian Muslims from Adaima

Allele	D3S1358	D21S11	D18S51	D5S818	D13S317	D7S820	D16S539	CSF1PO	D8S1179	FGA	TH01	VWA	TPOX	D19S433	D2S1338
6	–	–	–	–	–	–	–	–	–	–	0.237	–	0.020	–	–
7	–	–	–	–	–	0.010	–	–	–	–	0.268	–	–	–	–
8	–	–	–	0.061	0.071	0.136	0.030	0.005	–	–	0.071	–	0.424	–	–
9	–	–	–	0.111	0.061	0.086	0.121	0.035	–	–	0.343	–	0.187	0.005	–
9.3	–	–	–	–	–	–	–	–	–	–	0.071	–	–	–	–
10	–	–	–	0.091	0.066	0.409	0.116	0.318	0.086	–	0.010	–	0.061	–	–
10.2	–	–	–	–	–	–	–	0.005	–	–	–	–	–	–	–
11	–	–	0.010	0.318	0.273	0.197	0.278	0.222	0.076	–	–	–	0.258	0.045	–
12	–	–	0.101	0.268	0.369	0.126	0.263	0.323	0.081	–	–	–	0.051	0.096	–
13	0.051	–	0.096	0.146	0.121	0.035	0.172	0.086	0.247	–	–	–	–	0.247	–
13.2	–	–	–	–	–	–	–	–	–	–	–	–	–	0.045	–
14	0.106	–	0.141	0.005	0.040	–	0.015	0.005	0.182	–	–	0.056	–	0.197	–
14.2	–	–	–	–	–	–	–	–	–	–	–	–	–	0.076	–
15	0.172	–	0.056	–	–	–	0.005	–	0.227	–	–	0.136	–	0.101	–
15.2	–	–	0.005	–	–	–	–	–	–	–	–	–	–	0.066	–
16	0.247	–	0.081	–	–	–	–	–	0.071	–	–	0.242	–	0.081	0.025
16.2	–	–	–	–	–	–	–	–	–	–	–	–	–	0.035	–
17	0.293	–	0.111	–	–	–	–	–	0.030	–	–	0.328	–	–	0.106
17.2	–	–	–	–	–	–	–	–	–	–	–	–	–	0.005	–
18	0.121	–	0.121	–	–	–	–	–	–	0.020	–	0.131	–	–	0.157
18.2	–	–	0.005	–	–	–	–	–	–	–	–	–	–	–	–
19	0.010	–	0.066	–	–	–	–	–	–	0.076	–	0.076	–	–	0.106
20	–	–	0.167	–	–	–	–	–	–	0.051	–	0.030	–	–	0.126
21	–	–	0.040	–	–	–	–	–	–	0.157	–	–	–	–	0.086
22	–	–	–	–	–	–	–	–	–	0.131	–	–	–	–	0.101
23	–	–	–	–	–	–	–	–	–	0.182	–	–	–	–	0.116
23.2	–	–	–	–	–	–	–	–	–	0.005	–	–	–	–	–
24	–	–	–	–	–	–	–	–	–	0.121	–	–	–	–	0.116
25	–	–	–	–	–	–	–	–	–	0.101	–	–	–	–	0.061
26	–	0.005	–	–	–	–	–	–	–	0.051	–	–	–	–	–
27	–	0.005	–	–	–	–	–	–	–	0.020	–	–	–	–	–
28	–	0.121	–	–	–	–	–	–	–	0.081	–	–	–	–	–
28.2	–	0.010	–	–	–	–	–	–	–	–	–	–	–	–	–
29	–	0.359	–	–	–	–	–	–	–	0.005	–	–	–	–	–
30	–	0.207	–	–	–	–	–	–	–	–	–	–	–	–	–
30.2	–	0.015	–	–	–	–	–	–	–	–	–	–	–	–	–
31	–	0.020	–	–	–	–	–	–	–	–	–	–	–	–	–
31.2	–	0.106	–	–	–	–	–	–	–	–	–	–	–	–	–
32.2	–	0.081	–	–	–	–	–	–	–	–	–	–	–	–	–
33.2	–	0.020	–	–	–	–	–	–	–	–	–	–	–	–	–
36	–	0.035	–	–	–	–	–	–	–	–	–	–	–	–	–
37	–	0.015	–	–	–	–	–	–	–	–	–	–	–	–	–
$H_o$	0.808	0.788	0.828	0.859	0.768	0.747	0.798	0.717	0.758	0.909	0.717	0.737	0.747	0.848	0.808
$H_e$	0.795	0.793	0.918	0.803	0.760	0.751	0.795	0.736	0.828	0.882	0.744	0.788	0.712	0.860	0.888
PD	0.917	0.933	0.967	0.905	0.905	0.899	0.925	0.886	0.948	0.966	0.886	0.922	0.866	0.957	0.968
PIC	0.765	0.769	0.880	0.750	0.727	0.719	0.765	0.690	0.807	0.871	0.701	0.759	0.667	0.844	0.877
PE	0.614	0.577	0.653	0.712	0.540	0.505	0.595	0.455	0.523	0.814	0.455	0.488	0.505	0.692	0.614
$P$	0.337	0.760	0.005 <sup>a</sup>	0.528	0.351	0.697	0.572	0.779	0.725	0.659	0.050 <sup>a</sup>	0.059	0.638	0.374	0.047 <sup>a</sup>

$H_o$ : observed heterozygosity;  $H_e$ : expected heterozygosity; PIC: polymorphism information content; PD: power of discrimination; PE: power of exclusion;  $P$ :  $p$ -values of the exact test for Hardy–Weinberg equilibrium (with a 5% significance level).

<sup>a</sup> Bonferroni's correction (0.05/15 = 0.0033).

Table 3

Allelic frequencies and forensic parameters of 15 STR loci in 100 Egyptian Copts from Adaima

Allele	D3S1358	D21S11	D18S51	D5S818	D13S317	D7S820	D16S539	CSF1PO	D8S1179	FGA	TH01	VWA	TPOX	D19S433	D2S1338
6	–	–	–	–	–	–	–	–	–	–	0.275	–	0.005	–	–
7	–	–	–	–	–	0.040	–	–	–	–	0.190	–	–	–	–
8	–	–	–	0.030	0.105	0.140	0.020	0.010	0.010	–	0.065	–	0.520	–	–
9	–	–	–	0.045	0.035	0.115	0.195	0.040	–	–	0.270	–	0.135	–	–
9.3	–	–	–	–	–	–	–	–	–	–	0.140	–	–	–	–
10	–	–	–	0.070	0.045	0.325	0.130	0.365	0.035	–	0.060	–	0.045	–	–
11	–	–	0.005	0.265	0.155	0.220	0.225	0.175	0.095	–	–	–	0.295	0.020	–
12	–	–	0.140	0.445	0.515	0.140	0.185	0.385	0.120	–	–	–	–	0.100	–
13	0.030	–	0.130	0.140	0.140	0.020	0.215	0.020	0.395	–	–	–	–	0.235	–
13.2	–	–	–	–	–	–	–	–	–	–	–	–	–	0.030	–
14	0.120	–	0.235	0.005	0.005	–	0.030	–	0.070	–	–	0.175	–	0.310	–
14.2	–	–	–	–	–	–	–	–	–	–	–	–	–	0.050	–
15	0.150	–	0.070	–	–	–	–	0.005	0.190	–	–	0.115	–	0.115	–
15.2	–	–	–	–	–	–	–	–	–	–	–	–	–	0.050	–
16	0.195	–	0.070	–	–	–	–	–	0.060	–	–	0.205	–	0.060	–
16.2	–	–	0.015	–	–	–	–	–	–	–	–	–	–	0.020	–
17	0.275	–	0.050	–	–	–	–	–	0.025	–	–	0.310	–	0.010	0.255
17.2	–	–	0.005	–	–	–	–	–	–	–	–	–	–	–	–
18	0.180	–	0.265	–	–	–	–	–	–	–	–	0.140	–	–	0.090
19	0.035	–	0.010	–	–	–	–	–	–	0.070	–	0.040	–	–	0.150
20	0.015	–	–	–	–	–	–	–	–	0.055	–	0.015	–	–	0.115
21	–	–	0.005	–	–	–	–	–	–	0.075	–	–	–	–	0.050
22	–	–	–	–	–	–	–	–	–	0.215	–	–	–	–	0.025
23	–	–	–	–	–	–	–	–	–	0.160	–	–	–	–	0.105
24	–	–	–	–	–	–	–	–	–	0.125	–	–	–	–	0.060
25	–	–	–	–	–	–	–	–	–	0.050	–	–	–	–	0.145
26	–	–	–	–	–	–	–	–	–	0.060	–	–	–	–	0.005
27	–	0.010	–	–	–	–	–	–	–	0.060	–	–	–	–	–
28	–	0.155	–	–	–	–	–	–	–	0.075	–	–	–	–	–
29	–	0.235	–	–	–	–	–	–	–	0.055	–	–	–	–	–
30	–	0.225	–	–	–	–	–	–	–	–	–	–	–	–	–
31	–	0.050	–	–	–	–	–	–	–	–	–	–	–	–	–
31.2	–	0.120	–	–	–	–	–	–	–	–	–	–	–	–	–
32.2	–	0.190	–	–	–	–	–	–	–	–	–	–	–	–	–
33.2	–	0.015	–	–	–	–	–	–	–	–	–	–	–	–	–
$H_o$	0.720	0.790	0.870	0.680	0.640	0.710	0.790	0.680	0.830	0.770	0.760	0.760	0.660	0.830	0.850
$H_e$	0.815	0.817	0.825	0.704	0.677	0.792	0.813	0.686	0.774	0.881	0.788	0.797	0.622	0.815	0.852
PD	0.935	0.933	0.939	0.872	0.858	0.927	0.932	0.842	0.900	0.966	0.917	0.927	0.782	0.933	0.957
PIC	0.789	0.791	0.804	0.661	0.644	0.763	0.785	0.628	0.749	0.870	0.756	0.768	0.561	0.793	0.836
PE	0.460	0.581	0.735	0.398	0.342	0.444	0.581	0.398	0.656	0.527	0.527	0.527	0.369	0.656	0.695
$P$	0.022 <sup>a</sup>	0.089	0.743	0.825	0.289	0.267	0.472	0.909	0.034 <sup>a</sup>	0.013 <sup>a</sup>	0.093	0.463	0.460	0.217	0.840

$H_o$ : observed heterozygosity;  $H_e$ : expected heterozygosity; PIC: polymorphism information content; PD: power of discrimination; PE: power of exclusion;  $P$ :  $p$ -values of the exact test for Hardy–Weinberg equilibrium (with a 5% significance level).

<sup>a</sup> Bonferroni's correction (0.05/15 = 0.0033).

$F_{ST}$  genetic distances [3] were calculated, locus-by-locus, using the Arlequin program package [4]. Population differentiation was tested for each locus by exact tests [5] as implemented in the Arlequin program [4]. Forensic parameters (polymorphism information content, PIC; power of discrimination, PD; and power of exclusion, PE) were calculated using Microsoft Excel-PowerStats program [6] downloaded from Promega corporation website at <http://www.promega.com/geneticidtools/powerstats/>.

**Access to the data:** Complete data can be obtained from the authors on request to: [dugoujon@cict.fr](mailto:dugoujon@cict.fr).

**Other remarks:** Population data for the 15 STRs are shown in Tables 1–3 for the Siwan Berbers, the Muslims and the Copts from Adaima, respectively. Based on the results of the exact tests, no deviations from the Hardy–Weinberg equilibrium were

observed for Siwa at the 15 STRs while three departures are observed for each group from Adaima: at the D18S51, TH01 and D2S1338 loci for the Muslims and at the D3S1358, D8S1179 and FGA loci for the Copts. When using the Bonferroni correction for the number of loci analysed, the six deviations are not significant. So we can say that all the STR loci analysed in this study met the Hardy–Weinberg equilibrium. The observed heterozygosity ( $H_o$ ) ranges from 0.724 (TPOX) to 0.908 (D21S11) for the Berbers, from 0.717 (CSF1PO and TH01) to 0.909 (FGA) for the Muslims and from 0.640 (D13S317) to 0.870 (D18S51) for the Copts. The most polymorphic genetic marker was FGA in the Berber and the Copt samples (PIC value of 0.857 and 0.870, respectively) and D18S51 in the Muslims (PIC value of 0.880). The least polymorphic marker was TPOX (PIC of 0.657, 0.667 and 0.561

Table 4  
Genetic distances ( $F_{ST}$ ) between the three populations studied

STR	Berbers vs. Muslims		Berbers vs. Copts		Muslims vs. Copts	
	$F_{ST}$	$p$ -value	$F_{ST}$	$p$ -value	$F_{ST}$	$p$ -value
D3S1358	0.01296	<b>0.00586</b>	0.02370	<b>0.00000*</b>	0.00021	<b>0.37305</b>
D21S11	0.02045	<b>0.00098*</b>	0.00214	0.22168	0.01437	<b>0.00391</b>
D18S51	0.03163	<b>0.00000*</b>	0.04716	<b>0.00000*</b>	0.03234	<b>0.00000*</b>
D5S818	0.00512	0.09961	0.00081	0.31152	0.02134	<b>0.00098*</b>
D13S317	0.00485	0.07812	0.02186	<b>0.00195*</b>	0.02160	<b>0.00000*</b>
D7S820	0.02206	<b>0.00000*</b>	0.00955	<b>0.01953</b>	0.00128	<b>0.28320</b>
D16S539	0.00116	0.27832	0.01167	<b>0.00977</b>	0.00526	0.08203
CSF1PO	0.00445	0.12402	0.02662	<b>0.00000*</b>	0.00354	0.16797
D8S1179	0.00185	0.21875	0.01771	<b>0.00293*</b>	0.01966	<b>0.00000*</b>
FGA	0.00530	<b>0.04004</b>	0.00796	<b>0.00977</b>	0.00716	<b>0.01074</b>
TH01	0.01091	<b>0.02539</b>	0.02753	<b>0.00098*</b>	0.00801	<b>0.03906</b>
VWA	0.01078	<b>0.01367</b>	0.01510	<b>0.00195*</b>	0.00627	<b>0.04590</b>
TPOX	0.00195	0.23926	0.00413	0.13867	0.00707	0.06934
D19S433	0.00117	0.30566	0.00301	0.18262	0.00169	0.25879
D2S1338	0.03740	<b>0.00000*</b>	0.01682	<b>0.00098*</b>	0.02127	<b>0.00000*</b>

In bold: significant  $F_{ST}$   $p$ -values.

\* The  $p$ -values that remains significant after Bonferroni's correction.

for the Berbers, the Muslims and the Copts, respectively) in the three population samples. In the Berbers from Siwa, the power of discrimination (PD) varies between 0.866 (TPOX) and 0.961 (D18S51) and the probability of exclusion (PE) varies between 0.467 (TPOX) and 0.812 (D21S11). For the 15 loci, the combined power of discrimination and the combined probability of exclusion are  $1.373 \times 10^{-17}$  and 0.9999993, respectively. In the Muslims from Adaima, the power of discrimination (PD) varies between 0.866 (TPOX) and 0.968 (D2S1338) and the probability of exclusion (PE) varies between 0.455 (CSF1PO and TH01) and 0.814 (FGA). For the 15 loci, the combined power of discrimination and the combined probability of exclusion are  $4.146 \times 10^{-18}$  and 0.9999988, respectively. In the Copt samples, the power of discrimination (PD) varies between 0.782 (TPOX) and 0.966 (FGA) and the probability of exclusion (PE) varies

between 0.342 (D13S317) and 0.735 (D18S51). For the 15 loci, the combined power of discrimination and the combined probability of exclusion are  $4.867 \times 10^{-17}$  and 0.9999912, respectively.

Then, the three Egyptian populations were compared (Tables 4 and 5). After Bonferroni's correction, four  $F_{ST}$  genetic distances remain significant between the Berbers and the Muslims (D21S11, D18S51, D7S820 and D2S1338), eight between the Berbers and the Copts (D3S1358, D18S51, D13S317, CSF1PO, D8S1179, TH01, VWA and D2S1338) and five between the two samples from Adaima (D18S51, D5S818, D13S317, D8S1179 and D2S1338) (Table 4). The exact tests of population differentiation reveal that 7 out of 15 loci (D3S1358, D21S11, D18S51, D7S820, CSF1PO, FGA and D2S1338) have statistically significant differences between the Berbers and the Muslim samples, 10 out of 15 loci (D3S1358, D18S51, D13S317, CSF1PO, D8S1179, FGA, TH01, VWA, TPOX and D2S1338) between the Berbers and the Copts, and 8 out of 15 loci (D21S11, D18S51, D5S818, D13S317, D8S1179, FGA, TPOX, D2S1338) between the two samples from Adaima (Table 5).

Present analysis of the three different ethnic groups was made in order to complete STR database for Egyptian populations. Three works were previously published [7–9] on Egyptian population (Arabic-speakers) but this is the first study of D19S433 and D2S1338 allele frequency distribution in Egypt.

We have compared our data with other published data [7–10] on geographically related population samples (from Egypt and Saudi Arabia), using the available sets of loci (Table 6). After Bonferroni's correction, population differentiation tests showed that the Berbers from Siwa had significant differences with the general population of Egyptian Muslims [7] in 6 out of 13 loci (D18S51, CSF1PO, D8S1179, FGA, TH01 and TPOX), with Saudi Arabians [10] in 5 out of 13 loci (D18S51, D13S317, D16S539, CSF1PO and TH01), with Egyptians from El Minia

Table 5  
Population differentiation tests between the three Egyptian samples

STR	Non-differentiation exact $p$ -values		
	Berbers vs. Muslims	Berbers vs. Copts	Muslims vs. Copts
D3S1358	<b>0.00000</b>	<b>0.00000</b>	0.13550
D21S11	<b>0.00000</b>	0.27765	<b>0.00000</b>
D18S51	<b>0.00000</b>	<b>0.00000</b>	<b>0.00000</b>
D5S818	0.16680	0.68705	<b>0.00090</b>
D13S317	0.03755	<b>0.00000</b>	<b>0.00245</b>
D7S820	<b>0.00090</b>	0.00335	0.29715
D16S539	0.31255	0.01245	0.11380
CSF1PO	<b>0.00145</b>	<b>0.00000</b>	0.04125
D8S1179	0.02445	<b>0.00000</b>	<b>0.00000</b>
FGA	<b>0.00000</b>	<b>0.00000</b>	<b>0.00005</b>
TH01	0.00375	<b>0.00000</b>	0.00360
VWA	0.00435	<b>0.00000</b>	0.00465
TPOX	0.02405	<b>0.00290</b>	<b>0.00110</b>
D19S433	0.08675	0.02215	0.40160
D2S1338	<b>0.00000</b>	<b>0.00000</b>	<b>0.00000</b>

In bold:  $p$ -values that remain significant after Bonferroni's correction.

city [8] in 5 out of 10 loci (D13S317, D7S820, CSF1PO, TH01 and TPOX), and with Egyptians from the Cairo [9] area in 3 out of 9 loci (D18S51, D7S820 and FGA). About the Muslims from Adaima, they had significant differences with the general population of Egyptian Muslims in 6 out of 13 loci (D3S1358, D21S11, D18S51, D5S818, D8S1179 and FGA), with Saudi Arabians in 4 out of 13 loci (D18S51, FGA, TH01 and TPOX), with Egyptians from El Minia city in 2 out of 10 loci (D3S1358 and D5S818), and with Egyptians from the Cairo area in 4 out of 9 loci (D3S1358, D18S51, D5S818 and FGA). About the Muslims from Adaima, they had significant differences with the general population of Egyptian Muslims in 6 out of 13 loci (D3S1358, D18S51, D13S317, D8S1179, FGA and TH01), with Saudi Arabians in 8 out of 13 loci (D3S1358, D18S51, D13S317, D16S539, D8S1179, FGA, TH01 and VWA), with Egyptians from El Minia city in 6 out of 10 loci (D3S1358, D5S820, D13S317, D16S539, CSF1PO and FGA), and with Egyptians from the Cairo area in 7 out of 9 loci (D3S1358, D21S11, D18S51, D5S818, D13S317, D8S1179 and FGA).

This paper follows the guidelines for publication of population data requested by the journal [11].

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