

TECHNICAL NOTE

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Population Frequencies of Carbonic Anhydrase II and Esterase D in the Pittsburgh Metropolitan Area

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ABSTRACT: Population frequencies of the genetic markers esterase D and carbonic anhydrase were determined in blacks and whites using starch gel electrophoresis. Previously published data are compared.

KEY WORDS: pathology and biology, genetic typing, carbonic anhydrase, esterase D

Forensic serologists rely on the frequencies of particular genetic markers in the general population to calculate the rarity of a body fluid or bloodstain sample. The red blood cell isoenzymes esterase D (EsD) and carbonic anhydrase II (CA II) have genetically inherited forms that can be identified in the human population [1-3]. EsD has common variant forms in most populations [1] but CA II is polymorphic almost exclusively in the black population [2].

This communication describes the frequencies of these polymorphic systems in the Pittsburgh metropolitan area and compares them with previously reported frequencies from other populations. A total of 697 EsD phenotypes from 545 whites and 152 blacks as well as 646 CA II phenotypes from blacks only were determined.

Materials and Methods

The Central Blood Bank of Pittsburgh and the Allegheny County Jail supplied whole blood anticoagulated with ethylenediaminetetraacetic acid. Each sample was classified at the time of collection as to name, age, race, and date of collection.

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TABLE 1.—Population frequencies of *esterase D*.

Population	Phenotypes			Total, <i>n</i>	Gene Frequency			Reference
	EsD 1	EsD 2-1	EsD 2		EsD 1	EsD 2	EsD 2	
European								
<i>n</i> observed	2470	617	39	3126	0.8688	0.1112	0.1112	8
<i>n</i> expected	2469.2	618.0	38.8	3126	...	...	...	...
% observed	79.09	19.74	1.25	...	...	...	...	...
% expected	78.99	19.77	1.24	...	...	...	...	...
California white								
% observed	79.5	19.0	1.2	5377	0.892	0.108	0.108	4
California black								
% observed	83.6	16.0	0.4	937	0.916	0.084	0.084	4
Chicano/Amerindian								
% observed	73.9	23.8	2.3	1580	0.858	0.142	0.142	4
Minnesota white								
<i>n</i> observed	422	78	6	506	0.9111	0.0889	0.0889	9
<i>n</i> expected	420.03	81.97	4.00	506.00	...	...	...	...
% observed	83.40	15.41	1.19	...	...	...	...	...
% expected	83.10	16.20	0.79	...	...	...	...	...
Miami white								
% observed	79.3	19.8	0.8	348	0.892	0.108	0.108	5
Detroit white								
% observed	78.1	20.9	1.0	396	0.885	0.115	0.115	5
Los Angeles white								
% observed	71.8	26.9	1.4	216	0.852	0.148	0.148	5
Miami black								
% observed	83.8	15.2	0.9	328	0.914	0.086	0.086	5
Detroit black								
% observed	84.0	15.2	0.8	505	0.916	0.084	0.084	5
Los Angeles black								
% observed	77.4	20.4	2.2	26	0.876	0.124	0.124	5
Western Pennsylvania white								
<i>n</i> observed	429	108	8	545	0.8862	0.1138	0.1138	...
<i>n</i> expected	428.02	109.92	7.06	...	...	...	...	...
% observed	78.7	19.8	1.5	...	...	...	...	...
% expected	78.5	20.2	1.3	...	...	...	...	...
Western Pennsylvania black								
<i>n</i> observed	116	36	0	152	0.8816	0.1184	0.1184	...
<i>n</i> expected	118.14	31.73	2.13	...	...	...	...	...
% observed	76.3	23.7	0	...	...	...	...	...
% expected	77.7	20.9	1.4	...	...	...	...	...

TABLE 2—Population frequencies of carbonic anhydrase II.

Population	Phenotypes			Total, <i>n</i>	Gene Frequency		Reference
	CA 1	CA 2-1	CA 2		CA ¹	CA ²	
Gambia, West Africa							
<i>n</i> observed	497	107	10	614	0.897	0.103	7
<i>n</i> expected	493.6	113.8	6.6	...	...	...	...
% observed	80.9	17.4	1.7	...	...	...	...
% expected	80.4	18.5	1.1	...	...	...	...
United States, black							
<i>n</i> observed	180	39	3	222	0.8986	0.1014	6
<i>n</i> expected	179.27	40.45	2.29	...	...	...	...
% observed	81.08	17.57	1.35	...	...	...	...
% expected	80.75	18.22	1.03	...	...	...	...
Western Pennsylvania, black							
<i>n</i> observed	526	114	6	646	0.9025	0.0975	...
<i>n</i> expected	526.17	113.69	6.14	...	...	...	...
% observed	81.42	17.65	0.93	...	...	...	...
% expected	81.45	17.60	0.95	...	...	...	...

The procedure developed by Hopkinson et al [1] and modified by Parkin and Adams [3] was used for EsD. The method of Hopkinson et al [2] was employed for CA II.

Results and Discussion

The results of random sampling of 697 individuals in the western Pennsylvania region for EsD phenotypes are shown in Table 1. White gene frequencies for EsD¹ and EsD² (0.8862, 0.1138) are nearly the same as black gene frequencies (0.8816, 0.1184). These data closely fit the values expected by the Hardy-Weinberg equilibrium.

CA II phenotypes and gene frequencies of 646 western Pennsylvania blacks (Table 2) also fit the Hardy-Weinberg equilibrium test.

Comparisons with previously published population data are shown in both tables so that the bench analyst may decide how well the data may be extrapolated to other populations. For example, the percentage of occurrence of EsD 1 in the United States may vary from 71.8 to 84.0%. The lower range values were reported in California Chicano/Amerindians [4] and Los Angeles whites [5]. CA II occurs in nearly the same frequencies among the two groups of U.S. blacks [6] as were observed in Gambia, West Africa [7] (Table 2).

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