TECHNICAL NOTE

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Population Data of Casework in West Virginia on Six Genetic Marker Systems

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ABSTRACT: Blood specimens and stains submitted from all geographic regions of West Virginia were analyzed for six genetic markers: International ABO, phosphoglucomutase (PGM), esterase D (ESD), erythrocyte acid phosphatase (EAP), adenylate kinase (AK), and adenosine deaminase (ADA). The four-year study indicates that markers identified were distributed in Hardy-Weinberg equilibrium and are consistent with population data previously reported.

KEYWORDS: criminalistics, demography, genetic typing, population data, phosphoglucomutase, ABO, esterase D, erythrocyte acid phosphatase, adenylate kinase, adenosine deaminase

Genetic marker frequency data on blood have become increasingly important in forensic science casework. Repeatedly, the crime laboratory serologist is required to testify concerning the significance and probability of identifying various genetic markers from blood taken from crime scenes and victims. An important aspect of testimony is based upon the genetic marker distribution found in the population of the serologist's geographical area. Noting that no such distribution analysis has been performed specifically for the general population of West Virginia, the authors undertook this study.

Using electrophoretic and isoelectric focusing techniques, which make reliable and sensitive typing of genetic markers from forensic science casework an easy and routine endeavor, we examined a combination of 1000 different whole bloods and bloodstains received between 1982 and 1985, inclusive, for specific genetic markers. Of the numerous marker systems available for typing, 6 were selected for this study: International ABO, phosphoglucomatose (PGM), esterase-D (ESD), erythrocyte acid phosphatase (EAP), adenylate kinase (AK), and adenosine deaminase (ADA).

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Materials and Methods

Whole blood ABOs were typed using the standard slide method. The Howard-Martin absorption elution technique was used to obtain ABO markers from bloodstains. The enzyme systems were analyzed using Wraxall et al.'s Group I and II electrophoretic methods and by various techniques of isoelectric focusing [*1-5*]. Statistical data were based on Hardy-Weinberg equilibrium and verified using the chi-square statistic.

Results

The results obtained from the whole bloods and stains were similar to population data presented in studies from other geographic regions [*6-9*]. Figures concerning the ABO systems obtained from the state office of the American Red Cross indicate that the ABO decimal fractions illustrated in Table 1 are acceptable for the state.

Tables 2 through 6 illustrate the number of observed phenotypes and the decimal fractions

TABLE 1—*ABO phenotypes.*[a]

Type	Observed Number	Observed Frequency
A	388	0.388
B	109	0.109
O	463	0.463
AB	40	0.040

[a]Sigma $\chi^2 = 0.25$, d.f. = 1, $0.50 < P < 0.70$.
Based on Hardy-Weinberg equilibrium.

TABLE 2—*PGM phenotypes.*[a]

Type	Observed Number	Observed Frequency
1+	393	0.410
1+1−	146	0.152
1−	18	0.018
2+1+	251	0.262
2+1−	38	0.039
2−1+	43	0.044
2−1−	10	0.010
2+	43	0.044
2+2−	14	0.014
2−	2	0.002

[a]Sigma $\chi^2 = 4.71$, d.f. = 6, $0.50 < P < 0.70$.
Based on Hardy-Weinberg equilibrium.

TABLE 3—*ESD phenotypes.*[a]

Type	Observed Number	Observed Frequency
1	715	0.805
2−1	161	0.181
2	12	0.013

[a]Sigma $\chi^2 = 0.72$, d.f. = 1, $0.30 < P < 0.50$.
Based on Hardy-Weinberg equilibrium.

TABLE 4—*EAP phenotypes.*[a]

Type	Observed Number	Observed Frequency
A	87	0.091
B	437	0.457
C	2	0.002
BA	377	0.394
CA	19	0.019
CB	33	0.034

[a]Sigma $\chi^2 = 2.79$, d.f. = 3, $0.70 < P < 0.90$.
Based on Hardy-Weinberg equilibrium.

TABLE 5—*AK phenotypes.*[a]

Type	Observed Number	Observed Frequency
1	908	0.947
2−1	49	0.051
2	1	0.001

[a]Sigma $\chi^2 = 0.16$, d.f. = 1, $0.50 < P < 0.70$.
Based on Hardy-Weinberg equilibrium.

TABLE 6—*ADA phenotypes.*[a]

Type	Observed Number	Observed Frequency
1	852	0.896
2−1	97	0.102
2	1	0.001

[a]Sigma $\chi^2 = 1.07$, d.f. = 1, $0.20 < P < 0.30$.
Based on Hardy-Weinberg equilibrium.

for the PGM, ESD, EAP, AK, and ADA systems. The phenotypic frequencies and the chi-square statistics for all systems are within the acceptable ranges that Hardy-Weinberg Equilibrium would propose.

The results of this study indicate that there is no substantial difference in the phenotypic frequencies obtained for these six systems in West Virginia and the frequencies obtained from populations in other geographic regions.

Discussion

This study clearly demonstrates that the population frequencies that occur in West Virginia are consistent with frequencies that occur in other populations for the ABO, PGM, ESD, EAP, AK, and ADA bloodgroup systems. There is no indication from any data collected that the general population of West Virginia are in anyway uncharacteristic in regard to these six genetic markers.

Note that this study was purposely undertaken without consideration for racial differences in these enzyme systems. Current census data for West Virginia indicate that the population of the state is 96% Caucasian. The influence of any variation in data, as a result of non-Caucasian origin, was assumed to be minimal and insignificant.

The American Red Cross in this region lists the following percentages for ABO blood types: O—46.1, A—38.8, B—11.1, and AB—3.9.

A point of interest in this study is that all markers were obtained solely from forensic science casework. Whole bloods were used when they were included in routine casework, but as a rule, typing was performed from stains. Given the consistency between the data of this study and previous studies, it is evident that forensic science casework results are an extremely valuable source for reliable blood-marker data.

In conclusion, it is safe to say on the basis of this study that the population of West Virginia falls well within established gene-frequency distributions for the ABO, PGM, ESD, EAP, AK, and ADA blood group markers.

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