

## About the problem of correlation of digital papillary patterns with the phenotypes of ABO blood group systems

*S. Baltova*

*Department of Anatomy and Physiology of Man, University of Plovdiv*

Blood samples of 632 clinically healthy subjects (326 males and 306 females) of Bulgarian origin from South-central and South-eastern regions of Bulgaria aged from 18 to 60 years were used in the study. ABO blood-grouping were done by conventional methods. Dermatoglyphs from both hands of the studied individual were taken according to the typographical method. The data were analyzed by variation and correlation analysis. All phenotypes of ABO blood-group system showed low to high correlation with the digital papillary patterns. A high correlation is observed between blood groups  $A_1B$ ,  $A_2$  and B with loops and phenotype LW for both hands for both sexes. The highest values of  $r$  were recorded in individuals with phenotype  $A_1B$  and  $A_2$  in males and  $A_1B$  and  $A_2B$  in females, while the lowest were found in subjects with blood group  $A_1I$  for both sexes. The phenotypes L, W and ALW in each of the cases correlate significantly and highly with blood group AB.

*Key words:* blood-group systems ABO, digital papillary patterns.

### Introduction

There have been multiple attempts to trace correlations between ABO phenotypes (including MN, Rh, etc.) and various systems of characteristics – morphological, dermatoglyphic included, functional biochemical and even psychological [3, 8, 9].

Dermatoglyphic patterns are genetically immutable, do not alter with age or with diagnostically sensitive characteristics, which in most cases vary independently of each other. There are few studies available in literature on correlations between them and certain dermatoglyphic indices and ABO phenotypes [1, 4, 7].

The review of available literature suggested that the subject in question had not been sufficiently investigated and authors seem to hold contradictory views. Most reports refer to digital papillary patterns.

## Material and Methods

Blood samples of 632 clinically healthy subjects (326 males and 306 females) of Bulgarian origin from South-central and South-eastern regions of Bulgaria aged from 18 to 60 years were used in the study.

ABO blood-grouping was done by the conventional methods.

Dermatoglyphs from both hands of the studied individuals were taken according to the typographical method. Digital papillary patterns were interpreted according to [2]. In the correlation analysis aiming to assess separate digital papillary patterns, the sum of the radial and ulnar loops as well as all types of whorls were used. In accordance with the various types of patterns present on all fingers the following phenotypes were established: AL – presence of arches and loops, LW – presence of loops and whorls, and ALW – presence of arches, loops and whorls.

The data were analyzed by variation and correlation analysis.

## Results and Discussion

The study of blood samples from 632 subjects showed 6 phenotype combinations of blood groups according to the erythrocyte factors ABO:  $A_1$ ,  $A_2$ , O, B,  $A_1B$ ,  $A_2B$  (Table 1). The revealed genes frequencies are for  $p_1=0.2873$ ,  $p_2=0.0504$ ,  $q=0.1391$  and  $r=0.5232$ .

The co-ordination between the observed and the expected values is very good and according to Hardy-Weinberg's law it is evident that the studied population is in a genetic equilibrium regarding the blood group under the ABO system. Therefore, the given results about the percentage distribution of phenotypes and gene frequencies for the studied blood group systems are close to those for the Bulgarian population as compared to literary sources [10].

In all groups studied dactyloscopy was performed separately for both sexes, and on both hands. The analysis of frequency of digital patterns showed that in both sexes for both hands ulnar loops [U] were most common, followed by whorls [W]. In both sexes the least common were radial loops [R]. Of all types the most common were ulnar whorls [Wu] followed by symmetric whorls [Ws] in males, and radial whorls [Wr] in females (Table 2). The formula for the papillary patterns frequency on both hands for both sexes is:  $U > W > A > R$ .

The bilateral comparison in males indicated higher frequency of W on the right hand and U on the left hand. In females A and R prevailed on the left hand, and U prevailed on the right. Whorls –  $W_s$ ,  $W_u$  were more common on the right hand, while  $W_r$  and A dominated on the left hand in both males and females. The given results about the frequencies of finger prints for the studied persons are close to those for the Bulgarian population as compared to literati sources of other authors [5, 6, 11]. It is evident that in the present study for males the frequency for A is slightly elevated, and for R is smaller, which is probably due to the different extent of the observation.

The study of the per cent phenotype distribution of papillary patterns according to the blood group affiliation revealed the highest frequency in blood group A, followed by O and B, with the lowest frequency in AB for both sexes (Table 3). The bilateral comparison showed the following higher frequencies: A, L on left hand and W on right hand in blood group A males; A, L, W on right hand in males and on left hand in females with O; A, L, W on right hand for AB males and females; A, L in males and L, W on right hand in females with B.

The data from the statistical analysis of the correlations of separate for both sexes are given in Table 4.



Table 2. Per cent frequencies of digital patterns in males and females

Pheno- type	Side	Males		Females		♂	+ ♀	
		n	%	n	%			
A	L	104	3,43	136	4,48	240	3,96	
	R	88	2,90	100	3,29	188	3,10	
	L + R	192	6,33	236	7,77	428	7,06	
L	U	L	882	29,07	860	28,35	1742	28,71
		R	830	27,36	940	30,98	1770	29,17
		L + R	1712	56,43	1800	59,33	3512	57,88
	R	L	74	2,44	72	2,37	146	2,41
		R	62	2,04	46	1,52	108	1,78
		L + R	136	4,48	118	3,89	254	4,19
W	r	L	282	9,29	310	10,22	592	9,76
		R	140	4,61	96	3,16	236	3,89
		L + R	422	13,91	406	13,38	828	13,65
	s	L	118	3,89	76	2,50	194	3,20
		R	172	5,67	152	5,01	324	5,34
		L + R	290	9,56	228	7,51	518	8,54
	u	L	58	1,91	64	2,11	122	2,01
		R	224	7,38	182	5,99	406	6,69
		L + R	282	9,29	246	8,10	528	8,70
A + L + W	L	1518	50,03	1518	50,03	3036	50,03	
	R	1516	49,97	1516	49,97	3032	49,97	
	L + R	3034	100,00	3034	100,00	6068	100,00	

Table 4 shows that in males the correlation coefficient ( $r$ ) for L varies, which is evidence of significant and high correlation between the given trait and the ABO. For the rest of the blood groups the level of correlation is significant at  $p > 0.95$ . In correlative relationships between ABO phenotypes and W again there is a significant correlation with  $A_1B$  and  $A_2$  at a level of confidence  $p > 0.95$ . In B a moderate correlation for the left and right hands was recorded. For the rest of the blood groups (0 and  $A_1$ ) the correlation is low. A low correlation was established between  $A_2$ ,  $A_1B$ ,  $A_1$  and the arches of patterns on the left hand. A low correlation was also observed in  $A_1$ ,  $A_1B$ ,  $A_2$  for the right hand, while in B for both hands and 0 no correlation was established. The results from the correlative analysis indicate that the phenotype AL correlates moderately with  $A_2$ ,  $A_1B$ , B and poorly with the other blood group for both hands. In phenotype LW there is high correlation with B for the left hand, and with  $A_1B$  for the right hand. In  $A_1B$  and  $A_2$  for the left hand and B and  $A_2$  for the right hand there is a significant correlation, but for the other blood groups it is moderate. The correlation between  $A_1B$ ,  $A_2$  and B and the phenotype ALW is moderate for both hands and low for the rest of the blood groups.

Table 4 presents the correlative relationships in females.

Here the correlation tends to increase from moderate to significant for L of the left and right hands. In  $A_1B$ ,  $A_2$  and B it is significant. There is a significant correlation in 0 and  $A_1$  both for the left and right hands. For  $A_2B$  the level of correlation is moderate. In W for the left and right hands there is a significant correlation with  $A_2B$ ,  $A_1B$  and  $A_2$  at  $p > 0.95$ .

Low correlation was established for A in blood groups  $A_2B$ ,  $A_1$ ,  $A_1B$ ,  $A_2$  and 0 for both hands. No correlative relationship was found in B for both hands. Phenotype AL correlates significantly with  $A_2B$  at  $p > 0.95$ . In  $A_1B$ ,  $A_2$  and B a moderate correlation was observed, while in the other two blood groups (0 and  $A_1$ ) the correlation was low. In

Table 4. Correlation between phenotypes of ABO blood groups and digital papillary patterns

Phenotype		Males (n = 326)				Females (n = 306)			
		left		right		left		right	
		r	$\chi^2$	r	$\chi^2$	r	$\chi^2$	r	$\chi^2$
1	2	3	4	5	6	7	8	9	10
L	A <sub>1</sub>	-0.5614	51.37*	-0.5565	50.48*	-0.5450	45.44*	-0.5357	43.91*
	A <sub>2</sub>	-0.8642	121.74**	-0.8593	120.36**	-0.8694	115.65**	-0.8662	114.80**
	B	-0.7703	96.72**	-0.7679	96.12**	-0.7497	85.99**	-0.7458	85.10**
	A <sub>1</sub> B	-0.8889	128.79**	-0.8839	127.34**	-0.8760	117.41**	-0.8729	116.58**
	A <sub>2</sub> B					-0.3448	18.33	-0.3268	15.31
	O	-0.6609	71.20*	-0.6559	70.12*	-0.6332	61.34*	-0.6284	60.42*
W	A <sub>1</sub>	-0.1711	4.77	-0.1382	3.11	-0.2124	6.90	-0.2175	7.24
	A <sub>2</sub>	-0.5431	48.08*	-0.6090	60.45*	-0.6097	56.88*	-0.6010	55.26*
	B	-0.4267	29.68	-0.4983	40.47	-0.4502	31.01	-0.4545	31.61
	A <sub>1</sub> B	-0.5741	53.72*	-0.6387	79.93*	-0.6053	56.06*	-0.6093	56.80*
	A <sub>2</sub> B					-0.6628	67.21*	-0.6697	68.62
	O	-0.2944	14.13	-0.3814	23.71	-0.3113	14.83	-0.3163	15.31*
A	A <sub>1</sub>	0.2189	7.81	0.2492	10.12	-0.2642	9.89	-0.2595	10.30
	A <sub>2</sub>	-0.2841	13.16	-0.1651	4.44	-0.1761	4.74	-0.1855	5.26
	B	-0.0473	0.36	-0.0154	0.039	0.0170	0.0442	0.0096	0.014
	A <sub>1</sub> B	-0.2393	8.92	-0.2105	7.22	-0.1903	5.54	-0.1955	5.85
	A <sub>2</sub> B					-0.2929	13.13	-0.2969	13.49
	O	0.0985	1.58	0.1299	2.75	0.1677	4.30	0.1608	3.96
AL	A <sub>1</sub>	-0.1569	4.01	-0.1458	3.46	-0.1452	3.23	-0.1363	2.84
	A <sub>2</sub>	-0.4847	38.29	-0.4742	36.65	-0.4919	37.02	-0.4819	35.53
	B	-0.3535	20.37	-0.3751	29.93	-0.3655	20.44	-0.3577	19.58
	A <sub>1</sub> B	-0.4815	37.79	-0.4995	40.67	-0.4988	38.07	-0.4911	36.90
	A <sub>2</sub> B					-0.5484	46.01*	-0.6584	66.32*
	O	-0.2302	8.64	-0.2561	10.69	-0.2384	8.70	-0.2305	8.13

Table 4 – Continued

1	2	3	4	5	6	7	8	9	10
LW	A <sub>1</sub>	-0.3389	18.72	-0.3836	23.99	-0.3596	19.78	-0.3625	20.11
	A <sub>2</sub>	-0.5375	47.09*	-0.5859	55.95*	-0.6823	71.23*	-0.6763	69.98*
	B	-0.7502	93.21**	-0.5947	57.65*	-0.5643	48.72	-0.5675	49.27*
	A <sub>1</sub> B	-0.6656	72.21*	-0.7033	80.62**	-0.6834	71.56*	-0.6852	71.83*
	A <sub>2</sub> B					-0.7240	80.20**	-0.7275	80.98**
	O	-0.4442	32.16	-0.4867	38.61	-0.4478	30.68	-0.4508	31.09
ALW	A <sub>1</sub>	-0.1467	3.51	-0.1641	4.39	-0.1461	3.27	-0.1472	3.32
	A <sub>2</sub>	-0.4402	31.59	-0.4554	33.80	-0.3933	23.67	-0.4570	31.95
	B	-0.3539	20.41	-0.3697	22.28	-0.3018	13.94	-0.3461	18.33
	A <sub>1</sub> B	-0.4940	39.78	-0.4786	37.34	-0.4660	33.22	-0.4621	32.67
	A <sub>2</sub> B					-0.5074	39.39*	-0.5035	38.79*
	O	-0.2474	9.98	-0.2641	11.37	-0.2361	8.53	-0.2322	8.25

\*  $p > 0.95$ ; \*\* $p > 0.99$

all blood groups there was a consistent tendency towards an increase in the correlative relationship with phenotype LW for both hands. In A<sub>2</sub>B there are significant correlations for the studied index and moderate in the rest of the 0 and A<sub>1</sub>. Blood group A<sub>2</sub>B correlates significantly with the phenotype ALW at  $p > 0.95$ , while A<sub>1</sub>B, A<sub>2</sub> and B correlates moderately and poorly in 0 and A<sub>1</sub> for left and right hands.

The obtained results give grounds to conclude that all phenotypes of the ABO have correlative relationships with the digital patterns. A high correlation is observed between A<sub>1</sub>B, A<sub>2</sub> and B with L and phenotype LW for both hands for both sexes. Significant correlations were established between: blood groups 0, A<sub>1</sub> with L for both hands in both sexes. The same is also true for A<sub>1</sub>B and A<sub>2</sub> with W and phenotypes LW for both hands in both sexes; A<sub>2</sub>B with W with phenotypes AL and ALW for both hands in females; B with phenotype LW for both hands in females and with LW for the right hand in males. For B and 0 individuals a moderate correlation with the whorls on both hands in both sexes was established. A<sub>1</sub>B, A<sub>2</sub> and B with phenotypes AL and ALW for both hands and both sexes, and 0 and A<sub>1</sub> with phenotype LW. A low correlation of A<sub>1</sub> and 0 with phenotypes AL, ALW was observed; A<sub>1</sub>B, A<sub>2</sub> and A<sub>1</sub> with L and A<sub>1</sub> with W for both hands in both sexes; in A<sub>2</sub>B and 0 with arches for both hands in females.

The correlation analysis revealed absence of correlation between B with arches in both hands in both sexes, and between 0 and A<sub>1</sub> with arches for the left hand in males. The highest values of  $r$  were recorded in individuals with A<sub>1</sub>B and A<sub>2</sub> in males and A<sub>1</sub>B and A<sub>2</sub>B in females, while the lowest were found in subjects with A<sub>1</sub> for both sexes.

It is suggested that the correlative relationships between digital patterns and the phenotypes of the ABO blood group system observed in this study could be explained with the presence of genetic relations between them. Perhaps in their determination there are common factors that vary in a mutually dependent way. Further and more extensive investigations would verify and determine the stability of correlations in different groups by recording typical frequencies of dermatoglyphic traits and ABO blood groups.

## Conclusions

1. The dermatoglyphic analysis revealed presence of slight bilateral and intersexual differences.
2. Correlations vary from low to significant without distinct bilateral and intersexual differences.
3. The phenotypes L, W and ALW in each of the cases correlate significantly and highly with blood group AB.

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