

BLOOD GROUPS AND SECRETION OF BLOOD GROUP SUBSTANCES

Comparison of Allergic With Nonallergic Persons in a Pacific Northwest College Population

Paul P. VanArsdel, Jr., M.D., and Arno G. Motulsky, M.D., Seattle, Wash.

With the technical assistance of Gabrielle Bouchard and Sue Stevens

SEVERAL associations have emerged from the many studies concerning the distribution of human blood groups in disease. The predominance of group O in patients with peptic ulcer has been repeatedly confirmed, and the association of group A with gastric carcinoma is also well established. These associations have been well discussed by Fraser Roberts¹ in a recent critical review of blood groups and disease. Another remarkable correlation is that reported to occur between group A and salivary tumors.² The significance of such relationships is as yet obscure, but their occurrence has stimulated an extensive search for other disease-blood group correlations.

Many studies of blood groups in disease can be criticized because of their dependence on small numbers and on control data from separate populations (such as blood donors). The several defects in blood group studies were well outlined by Fraser Roberts¹ and re-emphasized by Manuila.³ These pitfalls need to be considered seriously in outlining any new study of blood group associations. Special attention was therefore given to the establishment of adequate controls in the present study of blood group distribution in persons with asthma and hay fever.

The tendency to develop these allergic disorders is heritable, and their occurrence in an unselected population is common enough to permit a large number of persons to be evaluated. These features allowed us to determine the blood group distribution and secretor status in a relatively homogeneous college student population containing both the "normal" and "allergic" groups.

MATERIALS AND METHODS

All students who registered for the first time at the University of Washington in Seattle between December, 1956, and October, 1957, answered a detailed questionnaire concerning the presence or absence of a history of asthma or hay fever. Twelve per cent reported hay fever only, 2.7 per cent reported asthma and hay fever, and 2.0 per cent reported asthma alone; a total of 16.7

From the Department of Medicine, University of Washington School of Medicine.

Assisted by grants from Ciba Pharmaceutical Products, Inc., the Washington State Heart Association, and the National Institutes of Health.

Received for publication Feb. 26, 1959.

per cent indicated a history of one or both of these allergic disorders. Further details will be reported elsewhere.⁴ Negro and Oriental students, who would be expected to show somewhat different blood group frequencies, were excluded.

Blood was obtained by venipuncture from all subjects and allowed to clot. Within six hours of collection, we performed ABO grouping on the blood specimens, using high-potency antiserum.* From July to October, 1957 (representing the largest registration group), almost all samples (4,387) were tested in addition with anti-D serum,* and 1,125 of 1,922 group A bloods were separated into A₁ and A₂ subgroups by a combined approach involving absorbed anti-A serum and plant lectins which has been reported previously.⁵

Finally, starting in July, 1957, salivas were collected from all students with positive allergic histories and from 2,355 nonallergic students. A total of 3,144 salivas were tested for presence of blood group substance by the use of an extract of *Ulex europaeus* seeds in a hemagglutination inhibition technique described by Boyd and Shapleigh⁶ and modified for large-scale use.⁵

RESULTS AND DISCUSSION

The ABO grouping of 5,657 persons is presented in Table I. The over-all incidence of group O was 42.4 per cent and of group A, 43.4 per cent. There was no significant difference between the allergic and nonallergic groups ($\chi^2 = 0.77$, $p > 0.3$). The reason for the difference in A and O blood group frequencies between male and female subjects in the nonallergic group ($\chi^2 = 6.7$, $p = 0.01$) is not clear. The difference was not found within the allergic group.

TABLE I. INCIDENCE OF BLOOD GROUPS IN ALLERGIC AND NONALLERGIC STUDENTS

	O		A		B		AB		TOTAL
	NUMBER	PER CENT	NUMBER	PER CENT	NUMBER	PER CENT	NUMBER	PER CENT	
Allergic									
Males	261	41.9	277	44.5	59	9.5	26	4.2	623
Females	122	40.3	139	45.9	36	11.9	6	2.0	303
Total	383	41.4	416	44.9	95	10.3	32	3.5	926
Nonallergic									
Males	1,484	43.8	1,427	42.1	361	10.6	120	3.5	3,392
Females	532	39.7	615	45.9	143	10.7	49	3.7	1,339
Total	2,016	42.5	2,042	43.3	504	10.6	169	3.6	4,731
Total group									
Males	1,745	43.4	1,704	42.4	420	10.4	146	3.6	4,015
Females	654	39.8	754	45.9	179	10.9	55	3.3	1,642
Grand total	2,399	42.4	2,458	43.4	599	10.6	201	3.6	5,657

The slight excess of blood group A₂ in the allergic population (Table II) is not significant ($\chi^2 = 1.6$, $p > 0.2$). Also, typing with anti-D serum did not reveal any significant abnormalities in the allergic group (Table III). However, the fraction of d (Rh-negative) was higher in female subjects of both allergic and nonallergic groups than in males; this difference was statistically significant ($\chi^2 = 6.7$, $p = 0.01$).

*Obtained from the Ortho Pharmaceutical Corporation, Raritan, New Jersey.

TABLE II. A₁-A₂ DISTRIBUTION, ALLERGIC VERSUS NONALLERGIC STUDENTS

	A ₁	A ₂	A ₁ B	A ₂ B	TOTAL	PER CENT A ₁ OR A ₁ B
Allergic						
Males	143	43	10	6	202	75.7
Females	71	19	2	2	94	77.7
Total	214	62	12	8	296	76.4
Nonallergic						
Males	418	111	36	12	577	78.7
Females	187	37	21	7	252	82.5
Total	605	148	57	19	829	79.9
Total group						
Males	561	154	46	18	779	77.9
Females	258	56	23	9	346	81.3
Grand total	819	210	69	27	1,125	79.0

TABLE III. DISTRIBUTION OF D AND d BLOOD TYPES AMONG ALLERGIC AND NONALLERGIC GROUPS

	O			A			B			AB			TOTAL		
	D	d	% D	D	d	% D	D	d	% D	D	d	% D	D	d	% D
Allergic															
Males	165	38	81.3	175	30	85.4	34	10	77.3	15	5	75.0	389	83	82.4
Females	85	18	82.5	83	25	76.8	25	4	86.2	5	0	100.0	198	47	80.8
Both	250	56	81.7	258	55	82.4	59	14	80.8	20	5	80.0	587	130	81.9
Nonallergic															
Males	971	183	84.0	902	172	83.9	249	60	80.6	89	11	89.0	2,211	426	83.9
Females	309	94	76.8	383	88	81.3	105	15	87.5	32	7	82.0	829	204	80.1
Both	1,280	277	82.3	1,285	260	83.2	354	75	82.5	121	18	87.1	3,040	630	82.8

Distribution of the above-mentioned factors was also calculated separately for the 212 persons within the allergic population with a history of asthma. Since the results were practically identical with the data already presented for the total population, they were not tabulated separately.

The number and percentage of secretors of H substance is presented in Table IV, according to blood groups and allergic history. There are fewer nonsecretors among the allergic persons than among the remainder (21.5 per

TABLE IV. SECRETOR STATUS OF ALLERGIC AND NONALLERGIC GROUPS

	O		A		B		AB		TOTAL		BOTH	% s
	S	s	S	s	S	s	S	s	S	s		
Allergic												
Males	166	39	186	45	31	20	16	5	399	109	508	21.4
Females	89	30	99	25	28	5	4	1	220	61	281	21.7
Both	255	69	285	70	59	25	20	6	619	170	789	21.5
Nonallergic												
Males	523	162	520	168	136	45	39	11	1,218	386	1,604	24.4
Females	255	83	231	85	44	28	20	5	550	201	751	26.8
Both	778	245	751	253	180	73	59	16	1,768	587	2,355	24.9
Total												
Males	689	201	706	213	167	65	55	16	1,617	495	2,112	23.4
Females	344	113	330	110	72	33	24	6	770	262	1,032	25.4
Both	1,033	314	1,036	323	239	98	79	22	2,387	757	3,144	24.1

S = Secretor.

s = Nonsecretor.

cent versus 24.9 per cent, $\chi^2 = 3.71$, $p = 0.055$). In the 181 asthmatic persons tested, the incidence was identical (Table V). A similar trend was first noted by McConnell and Sheppard⁷ in 250 persons with active asthma, but the

TABLE V. SECRETOR STATUS OF ASTHMATIC GROUP

	S	s	TOTAL	% S
Males	97	29	126	23.0
Females	45	10	55	18.2
Both	142	39	181	21.5

S = Secretor.

s = Nonsecretor.

variability in their data (particularly between males and females) rendered statistical evaluation difficult. In our study, the level of significance of this association, although not at all conclusive, suggests that further studies might be worth while.

SUMMARY

The blood group distribution of 5,657 mixed-white college students from the Pacific Northwest was found to be 42.4 per cent O, 43.4 per cent A, 10.6 per cent B, and 3.6 per cent AB. Seventy-nine per cent of 1,125 group A persons were A₁. Eighty-three per cent of 4,387 students were Rh-positive, and 24.1 per cent of 3,144 were nonsecretors of blood group substance.

There were no significant differences in such distributions within this population between allergic (hay fever and asthma) and nonallergic persons.

The cooperation of Gordon G. Bergy, M.D., Director of the Hall Health Center, University of Washington, and his staff is gratefully acknowledged.

REFERENCES

1. Fraser Roberts, J. A.: Blood Groups and Susceptibility to Disease: A Review, Brit. J. Prev. & Social Med. 11: 107-125, 1957.
2. Cameron, J. M.: Blood-Groups in Tumours of Salivary Tissue, Lancet 1: 239-240, 1958.
3. Manuila, A.: Blood Groups and Disease—Hard Facts and Delusions, J. A. M. A. 167: 2047-2053, 1958.
4. VanArsdel, P. P., Jr., and Motulsky, A. G.: Frequency and Heritability of Asthma and Allergic Rhinitis in College Students, Acta genetica et statistica medica (in press).
5. VanArsdel, P. P., Jr.: The Usefulness of the Plant-Lectin, *Ulex Europaeus*, in a Large-Scale Blood-Group Study, Vox Sanguinis 3: 448-455, 1958.
6. Boyd, W. C., and Shapleigh, E.: Separation of Individuals of Any Blood Group Into Secretors and Non-Secretors by Use of a Plant Agglutinin (Lectin), Blood 9: 1194-1198, 1954.
7. McConnell, R. B., and Sheppard, P. M.: The Secretor Character and Disease, Proc. First International Congress of Human Genetics, Part III (T. Kemp, editor), Basel, 1957, S. Karger, pp. 574-579.