

Blood Groupings in Marshallese

*Abstract.* The absence of the Diego blood factor, the extremely low incidence of the *M* gene, and the unusually high *R'* gene frequency of the Marshallese more nearly resemble the blood groupings of the people of the western islands of Indonesia than the blood groupings of the Amerindians.

During March 1958, the annual medical survey of the Marshallese people of Rongelap Island was carried out, 4 years after they were accidentally exposed to radioactive fallout (March 1954) (1). These annual surveys are carried out by Brookhaven National Laboratory under the direction of R. A. Conard and are sponsored by the Atomic Energy Commission with the collaboration of the Department of Defense. During the course of these studies it became of interest to determine the blood groupings in the Marshallese people as an index of their origin and homogeneity. Blood samples were obtained by the survey team for this purpose.

The frequent movement of the Marshallese people among the various islands of Micronesia and, to a lesser extent, of Melanesia and other adjacent areas precludes any such concept as "pure" Marshallese. However, these people have lived for an estimated 2000 years on these islands with fewer outside contacts, perhaps, than most other groups. The findings presented consist of the

Table 1. Results of blood grouping of 129 Marshallese.

Group	No.	Percentage	Gene frequency*
<i>ABO system</i>			
O	75	58.1	.762 ( $r_c = .789$ )
A <sub>1</sub>	24	18.6	.114 ( $p_c = .116$ )
A <sub>2</sub>	0	0	
B	19	15.0	.093 ( $q_c = .095$ )
A <sub>1</sub> B	10	7.4	
A <sub>2</sub> B	1	0.8	
<i>M-N system</i>			
M	8	6.2	.14
MN	20	15.5	
N	101	78.3	.86
<i>Rh-Hr system</i>			
Rh <sub>1</sub> Rh <sub>1</sub>	126	97.7	.985
Rh,rh	3	2.3	

\*  $r_c$ ,  $p_c$ , and  $q_c$  = corrected gene frequency for genes O, A, and B.

Table 2. Blood group frequencies among Marshallese and Polynesians.

Item	Marshallese		Polyne- sians Sim- mons and Gray- don's report (N = 138)
	This report (N = 129)	Sim- mons' report (N = 678)	
<i>ABO system</i>			
Group (%)			
O	58.1	52.2	39.1
A	18.6	21.4	60.9
B	15.0	21.1	0
AB	8.2	5.3	0
Gene frequency			
$r_c$	.789	.723	.626
$p_c$	.116	.135	.374
$q_c$	.095	.134	0
<i>Rh-Hr system</i>			
Phenotype (%)			
Rh <sub>1</sub> Rh <sub>1</sub>	97.7	90.6	19.6
Rh,rh	2.3	.7	.7
Rh <sub>2</sub>	0	.3	29.7
Rh <sub>1</sub> Rh <sub>2</sub>	0	8.0	50.0
Gene frequency			
$R^1$	.985	.951	.449
$R^2$	0	.04	.543
$R^0$	.015	.006	.007
<i>M-N system</i>			
Type (%)			
M	6.2	10*	19.6
MN	15.5	19*	47.8
N	78.3	71*	32.6
Gene frequency			
<i>m</i>	.14	.22	.435
<i>n</i>	.86	.78	.565
<i>Duffy system</i>			
Fy <sup>a</sup> + (%)	89.2	100	74.6
<i>Kell system</i>			
K + (%)	0		0
<i>Diego system</i>			
Di <sup>a</sup> + (%)	0		0

\* These values were calculated from published data.

blood groupings and gene distribution of 129 Marshallese and cannot be considered as characteristic of any special group, but rather a sampling of the gene distribution in the area. The results, by the ABO, M-N, and Rh-Hr systems, are shown in Table 1 and are compared with the results of other studies in Table 2.

*ABO system.* In the ABO system the high frequency of the B group which almost equals that of the A group is in

sharp contrast to the absence of B or AB among the Polynesians. An unusual finding was one Marshallese of group A<sub>2</sub>B. This was verified by testing with several absorbed B antisera, as well as with the lectin from *Dolichos biflorans* (2). The total absence of A<sub>2</sub> genes in Eastern Asia, Australia, and Indonesia has been repeatedly noted (3). Inquiry into the family background of the single A<sub>2</sub>B native failed to reveal any significant information to lead one to suspect admixture.

*M-N system.* The low frequency of the *M* gene has been noted in this area by many investigators (4). The frequencies obtained in this study are among the lowest encountered and are in sharp contrast to the figures obtained among the Polynesians.

*Rh-Hr system.* A most unusual distribution was noted in the Rh-Hr system. Tests were performed with anti Rh<sub>0</sub>(D), rh'(C), rh''(E), hr'(c), and hr''(e) sera.

A completely different set of results from those reported for Polynesians was obtained. In particular, the latter were reported as being of group Rh<sub>1</sub>Rh<sub>2</sub> in 50 percent of the persons tested, whereas not a single individual of this grouping was found among the Marshallese. The gene frequency of 98.5 percent for  $R^1$  is the highest reported for any ethnic group. The complete absence of any rh negative persons in these and related series makes one suspect that the true genotype of the bloods giving a positive reaction with anti-hr'(c) serum is most probably  $R^1R^0$ . The occasional finding of an Rh<sub>0</sub> person by Simmons *et al.* (4) supports this interpretation. In the present series of 125 samples there were no bloods that reacted with rh''(E) antiserum.

*Duffy system.* In the Duffy system there were found 89.2 percent Duffy (Fy<sup>a</sup>) positive bloods. A previous report of 100 percent Duffy (Fy<sup>a</sup>) positive reactions (4) (performed on 30 specimens that had been stored for 16 months) indicates a need for verification and clarification.

*Other systems.* Kell tests were 100 percent negative, as was previously reported. Diego tests were 100 percent negative (5).

The failure to demonstrate the Diego factor in any of the studies conducted in this area of the world is noteworthy. To date its absence in Polynesians (6),

Maoris (7), and now in Marshallese becomes a significant finding in view of its occurrence in Mongoloids, Eskimos, and Amerindians (8), to whom Heyerdahl (9) credits the population of Polynesia.

The present findings (12) indicate a rather homogenous population of the Marshall Islands with extremes of gene frequencies. With some reservations, because of the relatively small sample, the following facts are of interest in the blood groupings of the Marshallese: (i) the extremely high frequency of the *O* gene (78.9 per cent); (ii) the extremely low frequency of the *M* gene (14 percent); (iii) the highest incidence of the *R*<sup>1</sup> gene yet reported (98.5 percent); (iv) the presence of 10.8 percent of Duffy (Fy<sup>a</sup>) negatives; (v) the absence of the Kell and Diego blood factors; (vi) a single example of A<sub>2</sub>B.

The investigations of numerous authors, compiled and summarized by Mourant, relate these blood groupings most nearly to those found in Southeast Asia and Indonesia, where relatively frequent *B* genes, a high *N* frequency, and a similarly high frequency of the *R*<sup>1</sup> gene are found.

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#### References and Notes

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5. We are indebted to Dr. Philip Levine, who supplied the anti-Di<sup>a</sup> serum, and to Dr. Miguel Layrisse, who supplied the Di<sup>a</sup>-positive cells for control.
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10. We acknowledge the technical assistance of Hannah Pretshold.

5 August 1958