DISTRIBUTION OF AB0 AND RHESUS BLOOD GROUPS IN G6PD DEFICIENT CHINESE AND MALAY NEWBORNS

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The distribution of AB0 blood groups was studied in 459 Chinese and 65 Malay newborns with deficiency of G6PD, and in 1181 Chinese and 535 Malay newborns with normal levels of the enzyme. Similarly, the distribution of Rhesus blood groups was studied in 248 G6PD deficient Chinese newborns and in 255 normal subjects. No association between the AB0 blood groups and G6PD deficiency was observed in either Chinese or Malays. For the Rhesus system there was found to be a statistically significant decrease in the frequency of genotypes containing the complex R_1 *in G6PD deficient subjects compared with that in normal subjects.*

INTRODUCTION

It now seems certain that predisposition to certain pathological conditions may be influenced by specific blood groups. A condition for which there has been some controversy regarding its possible blood group association is deficiency of erythrocyte glucose-6-phosphate dehydrogenase (G6PD). This X-chromosome-linked condition may manifest itself as neonatal jaundice or, in later life, as occasional hemolytic episodes and occurs in subjects of diverse ethnic background who are indigenous to areas in which malaria is, or has been, endemic (WHO 1967).

Tarlov et al. (1962) did not detect any significant association between G6PD deficiency and the AB0 blood groups in American Negro males, but in contrast found a highly significant decrease in the frequency of gene *E* of the Rhesus system in deficient subjects compared with that in unaffected subjects. Adam et al. (1963) reported an apparent association between blood group B and G6PD deficiency in Kurdish Jews, and, in Singapore, Saha and Banerjee (1971*a*) made a similar observation in Malays but not in Chinese. Saha and Banerjee (1971*b*) have also noted a similar trend to exist in populations of South and North India, but the samples were too small to permit any conclusions to be drawn.

In a preliminary study, Saha and Wong (1971) investigated the AB0 blood group distribution in 322 G6PD deficient and in 551 unaffected Chinese newborns. The observed increase in the frequency of blood group B in the enzyme deficient subjects was found to be statistically significant at the 5% level. Furthermore, a decrease in the frequency of gene *E* of the Rhesus system was observed in a subsample of 97 enzyme deficient subjects compared with that in 68 of the normal subjects.

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In an attempt to investigate further the possible association of blood groups and G6PD deficiency, the AB0 distribution of a series of G6PD deficient newborn Chinese and Malays has been compared with that in an unselected series of Chinese and Malay newborns in Singapore, and the Rhesus groups of G6PD deficient Chinese newborns have been compared with those of healthy Chinese adults.

MATERIAL AND METHODS

All of the cord-blood samples used in the investigation had been submitted for routine screening for G6PD deficiency to the Department of Pediatrics, University of Singapore from Kandang Kerbau Hospital in which 75% of births in the Republic of Singapore occur. Samples found to be deficient of the enzyme by the screening test of Motulsky and Campbell-Kraut (1961) were collected from 459 consecutive Chinese newborns and from 65 consecutive Malay newborns. The samples for AB0 blood group comparisons were obtained subsequently from 1181 consecutive Chinese newborns and from 535 consecutive Malay newborns with normal levels of G6PD. For the Rhesus blood group comparisons, the Rhesus groups of 248 G6PD deficient Chinese newborns were determined and compared with those of 255 healthy adult Chinese who had attended hospital for routine medical examinations. In view of the small number of enzyme deficient Malay newborns available, a similar comparison was not performed for this ethnic group.

The AB0 groups were determined by standard tile technique using anti-A and anti-B sera purchased from Biotest Serum Institut, Germany, and the Rhesus groups were determined by use of anti-D, anti-C, anti-E, anti-c, and anti-e sera purchased from the same source.

Maximum likelihood estimates of the respective gene frequencies were obtained using a program written by Dr. W. J. Schull for the IBM 360 at the Australian National University. The gene frequencies obtained for the G6PD deficient subjects and for the comparison subjects in each ethnic group were compared by chi-square analysis. In addition, the following phenotype comparisons were made using the method of Woolf (1955): A : 0, (A + B) : 0, (A + B + AB) : 0, (A + AB) : (0 + B), A : (0 + B + AB), 0 : B, 0 : (B + AB). For the Rhesus system the observed number of genotypes containing the complex R_1 was compared by chi-square analysis with the number not containing R_1 (i.e., R_1 : not-R_1). Similarly the genotypic comparisons R_2 : not-R_2 and R_0 : not-R_0, were performed, as were the phenotypic comparisons E : not-E, e : not-e, C : not-C, and c : not-c.

RESULTS

The observed number of AB0 and Rhesus phenotypes in the respective groups of samples are shown in Table 1. The gene frequency estimates from these figures are shown in Table 2. In neither Chinese nor Malays did the chi-square value approach the 5% level of statistical significance when AB0 gene frequencies and phenotype frequencies were compared in G6PD deficient subjects and in normal subjects. The Rhesus system was studied only in the Chinese subjects. The only comparison between G6PD deficient and normal subjects for which statistical significance was indicated was the genotypic comparison R_1 : not-R_1 in which the result $\chi^2_1 = 6.19$ corresponds to a level of significance of 1.2%.

DISCUSSION

A total of 459 Chinese, and 65 Malay consecutive G6PD deficient newborns may be expected to represent reasonably well the population of G6PD deficient subjects as a whole in these two ethnic groups. Similarly, the blood group distribution in 1181 consecutive Chinese and in 535 consecutive Malay births may be expected to represent equally well the blood group

TABLE 1

AB0 BLOOD GROUPS IN CHINESE AND MALAYS WITH G6PD DEFICIENCY

	Chinese				Malays			
	G6PD deficients		Controls		G6PD deficients		Controls	
	N	%	N	%	N	%	N	%
Phenotypes 0	210	45.75	505	42.76	27	41.54	212	39.63
A	122	26.58	311	26.33	11	16.92	119	22.24
B	107	23.31	276	23.37	24	36.92	169	31.59
AB	20	4.36	89	7.54	3	4.62	35	6.54
Total	459	100.00	1181	100.00	65	100.00	535	100.00
Gene frequencies								
0	0.6807		0.6461		0.6494		0.6303	
A	0.1694		0.1859		0.1146		0.1562	
B	0.1499		0.1680		0.2361		0.2135	

TABLE 2

RHESUS GROUPS IN G6PD DEFICIENT CHINESE

Phenotypes	Probable genotypes	G6PD deficient		Controls	
		N	%	N	%
CCDEE	R_zR_z	0	0	1	0.39
CCDEe	R_1R_z	3	1.21	6	2.35
CCDee	R_1R_1	123	49.60	126	49.41
CcDEE	R_2R_z	10	4.03	3	1.18
CcDEe	R_1R_2	69	27.82	84	32.94
CcDee	R_1R_o	20	8.06	22	8.63
ccDEE	R_2R_2	9	3.63	8	3.14
ccDEe	R_2R_o	11	4.44	5	1.96
ccDee	R_oR_o	3	1.21	0	0
Total		248	100.00	255	100.00
Gene frequencies	R_1 (*CDe*)	0.6794		0.7124	
	R_2 (*cDE*)	0.2157		0.2104	
	R_z (*CDE*)	0.0282		0.0229	
	R_o (*cDe*)	0.0766		0.0543	

distribution in the Chinese and Malay populations as a whole in Singapore. A comparison of the blood group distribution in the G6PD deficient subjects with that in the normal subjects for each of the two ethnic groups should, therefore, give an accurate indication of any blood group association which may exist for G6PD deficiency. Thus, the failure of the present investigation to demonstrate any association between the AB0 blood groups and G6PD deficiency, when these comparisons were performed, appears to suggest strongly that no

such association exists. This finding is consistent with those of Tarlov et al. (1962), but conflicts with those of Adam et al. (1963) and of Saha and Banerjee (1971*a*, 1971*b*). No explanation for the disagreement with the findings of Adam et al. is immediately apparent, although it should be emphasised that blood group association was noted by these workers only in the case of the Kurdish community. The survey of Saha and Banerjee (1971*a*) found evidence for blood group association only in the case of Malays in Singapore of whom only 28 subjects were enzyme deficient. Similarly, the survey of Saha and Banerjee (1971*b*) found only a trend towards blood group association in a relatively small group of enzyme deficient Asiatic Indians. Thus, the evidence for blood group association in the two latter surveys may have been the result of inadequate sample size. The observations of Saha and Wong (1971) of an excess frequency of blood group B in G6PD deficient newborns was not confirmed in the present series of larger numbers thus suggesting that no such association exists.

The only previous references to the possible association of the Rhesus blood group system with G6PD deficiency are those of Tarlov et al. (1962) and of Saha and Wong (1971). In both cases a decrease in the frequency of gene E was found in the enzyme deficient subjects compared with that in the normal subjects, but both surveys used relatively small samples. In the present investigation involving a larger sample, the finding of a significant decrease in the frequency of genotypes containing the complex R_1 in deficient subjects compared with that in normal subjects, conflicts with the findings of the two earlier studies. However, the failure of the present series to demonstrate differences between the frequencies of homozygous R_1R_1 in the deficient and healthy subjects gives reason to suspect that the observed dissimilarity represents an error of sampling rather than a genuine blood group association. Further work should clarify this point.

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RIASSUNTO

Distribuzione dei Gruppi Sanguigni ABO e Rh in Neonati Cinesi e Malesi G6PD Deficienti

È stata studiata la distribuzione dei gruppi sanguigni ABO in 459 neonati cinesi e in 65 neonati malesi con deficienza di G6PD, ed in 1181 neonati cinesi e 535 malesi con livelli normali di tale enzima. Analogamente è stata studiata la distribuzione dei gruppi sanguigni Rh in 248 neonati cinesi G6PD deficienti e in 255 normali. Nei cinesi come nei malesi non è stata osservata alcuna associazione fra i gruppi ABO e deficienza di G6PD, mentre per il sistema Rh è stata riscontrata una diminuzione significativa nella frequenza dei genotipi contenenti il complesso R_1 nei soggetti G6PD deficienti.

RÉSUMÉ

Distribution des Groupes Sanguins ABO et Rh chez des Nouveaux-nés Chinois et Malais G6PD Déficients

L'on a étudié la distribution des groupes sanguins ABO chez 459 nouveaux-nés chinois et 65 nouveaux-nés malais atteints de déficience G6PD, et chez 1181 nouveaux-nés chinois et 535 malais avec niveaux normaux de cet enzyme. De même, la distribution des groupes sanguins a été étudiée chez 248 nouveaux-nés chinois G6PD déficients et 255 normaux. Chez les chinois, comme chez les malais, nous n'avons observé aucune association entre les groupes ABO et déficience de G6PD, alors que pour le système Rh nous avons trouvé une diminution significative dans la fréquence des génotypes contenant le groupe R_1 chez les sujets G6PD déficients.

ZUSAMMENFASSUNG

Distribution der ABO- und Rh-Blutgruppen bei chinesischen und malaiischen Neugeborenen mit G6PD-Mangel

Bei 459 chinesischen und 65 malaiischen Neugeborenen mit G6PD-Mangel und bei 1181 chinesischen und 535 malaiischen Neugeborenen mit normalen Werten für dieses Enzym, wurde die Distribution der *ABO*-Blutgruppen untersucht. Eine ähnliche Untersuchung erfolgte für die Rh-Blutgruppen bei 248 chinesischen Neugeborenen mit G6PD-Mangel und bei 255 normalen chinesischen Neugeborenen. Weder bei den chinesischen noch bei den malaiischen Babies liess sich eine Verbindung zwischen ABO-Blutgruppen und G6PD-Mangel feststellen, während für das Rh-System bei den Kindern mit G6PD-Mangel eine bedeutsame Verminderung im Vorkommen der Genotypen mit R_1-Komplex bemerkt wurde.

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