Variation in Secretor and Lewis Type Frequencies within the British Isles

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A study of the ABO groups and secretor status of alcoholic patients which included individuals of English, Irish, and Scottish origin necessitated a comparison with appropriate normal controls (Camps, Dodd, and Lincoln, 1969).

Although the figures most quoted for secretor/non-secretor frequencies in the British Isles are those of McConnell (Race and Sanger, 1968), which show a non-secretor frequency of 22.7%, other figures quoted by Mourant (1954) from some otherwise unpublished observations of Ikin *et al* (1952) strongly suggested that this general figure of 22.7% might not hold for the Irish and Scottish. The fact that these ethnic groups probably have higher non-secretor frequencies can be derived from the frequencies Ikin *et al* found for Le(a+b-) since among 527 Scottish individuals and 106 Irish, 28.46% and 31.13% respectively were of this type. The corresponding saliva samples were apparently not tested but it may be assumed that all the Le(a+b-) individuals were non-secretors. In addition, a small number of non-secretors would be found in the Le(a-b-) phenotype. A series of 531 salivas from school children in Belfast showed a non-secretor frequency of 26.55% (Dodge, 1967). These various results suggested that it was important to carry out a survey of the ABO groups and secretor status of an adequate number of individuals from various parts of the British Isles.

A search of the literature reveals but few secretor/non-secretor frequencies showing such a high percentage of non-secretors as those of Ikin for the Irish and Scottish based on Lewis types.

Van Arsdel (1958) in testing a series of 3144 students from the University of Washington, found the proportion of non-secretors to be 24.11%. Nerell (1964) has collected together the figures of 12 investigated populations as far flung as Egypt and Canada with frequencies of non-secretors ranging from 11.1% to 25.4%. Several series from India show higher non-secretor frequencies than have

been found generally in Europe. Pradhan *et al* (1970) found 28.17% non-secretors among medical students at Kanpur.

Donors and Methods

Our series included 284 individuals from the staff of the North and South London Regional Transfusion centres and the London Hospital, 550 blood donors from Aberdeen, 644 from Belfast, and 597 from Dublin.

The ABO groups of the London donors were randomly selected but the selection from the Blood Transfusion Centres was made according to the requirements of the blood banks.

It was not possible to obtain both red cells and saliva from every individual included in the series. Not all the Irish and Scottish blood donors contributed samples of saliva; from Aberdeen, Belfast, and Dublin there were respectively 43, 112, and 145 fewer saliva than blood samples obtained.

The London series, however, included saliva samples from 71 individuals whose ABO groups were known but whose red cells were not tested with anti-Le^a and anti-Le^b sera. One of us (P.J.L.) carried out the Lewis typing of the red cells at each individual centre, but saliva samples were frozen within a few hours of collection and tested in our own laboratory.

ABO grouping was carried out by a standard tube technique examining red cells and serum independently.

The Lewis types were determined by a similar tube technique, but the tests were incubated in a water bath at 15°C for 2 hours. The anti-Le^a and anti-Le^b sera were well established reagents kindly supplied by the South London Regional Blood Transfusion Centre.

Saliva samples diluted 1 in 2 in saline were subjected to boiling in a water bath for 15 minutes followed by centrifugation before being examined for the presence of A, B, and H substances. A screening inhibition technique was devised and each sample was tested against suitably diluted anti-A, anti-B and anti-H reagents. The anti-A and anti-B sera were of human origin while the anti-H was the plant lectin *Ulex europaeus*.

Results and Discussion

A comparison between the frequencies of secretors and non-secretors at each centre is shown in Table I.

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TABLE I
FREQUENCIES OF SECRETORS AND NON-SECRETORS AT
EACH CENTRE

Centre	Total Tested	Secretors	Non-secretors	Gene Frequencies	
				se	Se(1 - se)
London	284	215 (75.7%)	69 (24.29%)	0.4929	0.5071
Aberdeen	507	358 (70.61%)	149 (29.38%)	0.5424	0.4576
Belfast	532	372 (69.92%)	160 (30.07%)	0.5484	0.4516
Dublin	452	304 (67.25%)	148 (32.74%)	0.5673	0.4327

The secretor/non-secretor frequencies obtained for the London series are not significantly different from those of McConnell (Race and Sanger, 1968) for Liverpool, which are usually taken as standard for England. Their values for these gene frequencies are 0.4767 for se and 0.5233 for Se.

However, the Scottish and Irish values are strikingly different and are among the highest frequencies of non-secretors on record. The observed numbers of secretors and non-secretors at the Dublin and Belfast Centres were amalgamated to give a figure for the Irish group. Our London series was added to the large English series reported by Horwich *et al* (1966), in which 2435 people were tested of whom 590 (24.23%) were non-secretors. The English and Irish figures were then compared by means of 2×2 tables. A chi-squared of 21 was obtained. $p < 0.001$ for 1 degree of freedom.

Comparing the Aberdeen figures with the English figure in the same way gives a chi-squared of 7.4, $0.001 < p < 0.01$ for 1 df. Frequencies similar to the Irish and Scottish obtain in Iceland (see the article on p. 46).

Table II summarizes the Lewis types of the red cells of all individuals from whom red cell samples were obtained irrespective of whether or not there was a corresponding saliva sample with each. There is a close correlation with the findings of Ikin (Mourant, 1954).

TABLE II
LEWIS TYPES OF RED CELLS

Centre	Total Tested	Le(a+b-)	Le(a-b+)	Le(a-b-)
London	213	49 (23.00%)	134 (62.91%)	30 (14.08%)
Aberdeen	550	154 (28.00%)	361 (65.63%)	35 (6.36%)
Belfast	644	173 (26.86%)	421 (65.37%)	50 (7.76%)
Dublin	597	165 (27.63%)	385 (64.48%)	47 (7.87%)

The Le(a-b-) type was sometimes difficult to distinguish. Some examples of group A₁ secretors possessing Le^b may have been scored as Le(a-b-) because of the well known inability of some anti-Le^b sera to disclose the presence of Le^b when accompanied by A₁. However, the anti-Le^b we used

gave at least weak reactions with the red cells of most group A₁ secretors. One of the chief interests in correlating the secretor status with Lewis types centres upon the secretor/non-secretor frequency among the Le(a-b-) population (Table III).

TABLE III
SECRETOR/NON-SECRETOR
FREQUENCIES IN THE Le(a-b-)
PHENOTYPE

Centre	Le(a-b-)	
	Non-Secretor	Secretor
London	2	28
Aberdeen	6	23
Belfast	10	29
Dublin	12	13

If the Le, le and Se, se genes segregate independently this secretor/non-secretor ratio should reflect that of the rest of the population. Taking all the centres together we have 93 Le(a-b-) secretors and 30 Le(a-b-) non-secretors. We expect 86.5 secretors and 36.5 non-secretors. These expected figures are based on the frequencies of secretors and non-secretors found in the Le(a+b-) and Le(a-b+) phenotypes. The observed figures do not differ significantly from the expected ($\chi^2 = 1.65$ $p = 0.2$). Thus our secretor/non-secretor frequencies in the Le(a-b-) phenotype supports the independent inheritance of the Lewis and secretor genes.

In conclusion, since the secretor genes have been implicated in a number of blood group and disease associations, it is important that the significant variation in frequency of these genes between different parts of the British Isles is noted, and the appropriate controls selected for comparison when blood group secretion studies in relation to certain diseases are carried out.

Summary

Blood and saliva samples from individuals in Aberdeen, Belfast, Dublin, and London have been tested for Lewis type and secretor status. The results show a significant difference from the generally accepted figure for the Lewis and secretor

frequencies of the English population. This has relevance to the selection of controls when associating the secretion of blood group substances to certain diseases.

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