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## The relationship between the leucocyte count, the “Shift to the left” and the incidence of drumsticks in mongolism

This paper deals with three abnormalities which have been found in the leucocytes of mongols.

Just over ten years ago, Turpin and Bernyer (1947) showed that the average number of lobes in the nuclei of the polymorphonuclear neutrophils of mongols was different from that found in their normal relatives and the general population. The authors found that the neutrophil cells of mongols had fewer lobes than those of normal people, i.e. that the polymorphonuclear count of mongols showed a “shift to the left”. This finding was confirmed by Shapiro (1949) in England and by Lüers and Lüers (1954) in Germany.

The present investigation concerns the shift to the left and related problems of the leucocytes of mongols. The patients selected for this study were fifty mongol children between the ages of three and fourteen years, and these were compared with fifty non-mongol mentally defective children who were matched with the mongols for age and sex. All the children were patients of the Fountain Hospital, London. Blood specimens from mongols and their controls were always taken at the same time, and in this way it was hoped to keep the conditions between the two groups as nearly comparable as possible. Peripheral blood was used, and stained films and total white cell counts were obtained from all patients.

The polymorphonuclear count was arrived at by classifying 500 nuclei of neutrophils according to whether they had one to five lobes and taking the average. Since the decision as to how many lobes a nucleus contains must in many cases be

subjective, all these counts were performed without knowledge of the origin of the slide.

The results of the lobe counts are shown in the first slide (Fig. 1). The distribution of the counts from mongols is shown on top and it will be seen that it is clearly shifted to the left of the control distribution below. The average count for all mon-

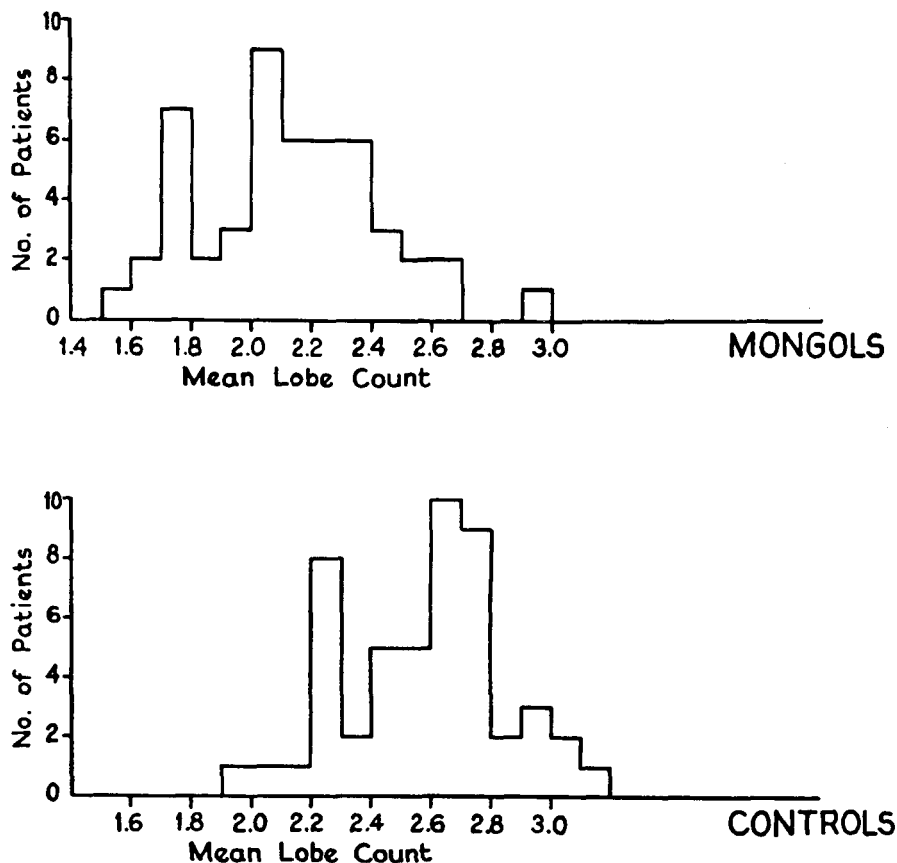


Fig. 1. Frequency distributions of mean lobe counts in 50 mongols and 50 controls.

gols was found to be 2.12 lobes per nucleus and that for the controls 2.57 lobes per nucleus. The difference between the two distributions is statistically significant: the value of tris 4.08, which has a probability of 1 in 200,000.

The main results of the total white cell count are shown in the second slide (Table 1). It was found that there was no significant difference in the total white cell counts between the two groups, but that the differential count showed significant differences. The mongols had more neutrophils than the controls, and this excess

Table 1 - Mean Leucocyte Counts in 50 Mongols and 50 Controls

	Mongols.	Controls.	t	P
Total Leucocytes	8,254	7,965	0.53	0.6.
Neutrophils.	5,184	4,048	2.84	0.01.
Lymphocytes	2,102	2,888	3.36	0.01

was compensated by a shortage of lymphocytes. It was thought that the greater number of neutrophils in the mongols might lead to greater immaturity of the circulating cells and thus be connected with the shift to the left. In order to test this possibility, the relationship between the lobe count and the total white cell count, and the relationship between the mean lobe count and the neutrophil count were investigated.

The relationship between the mean lobe count and the total white cell count are shown in the third slide (Fig. 2). Each point on these graphs represents the mean of the ten consecutive values.

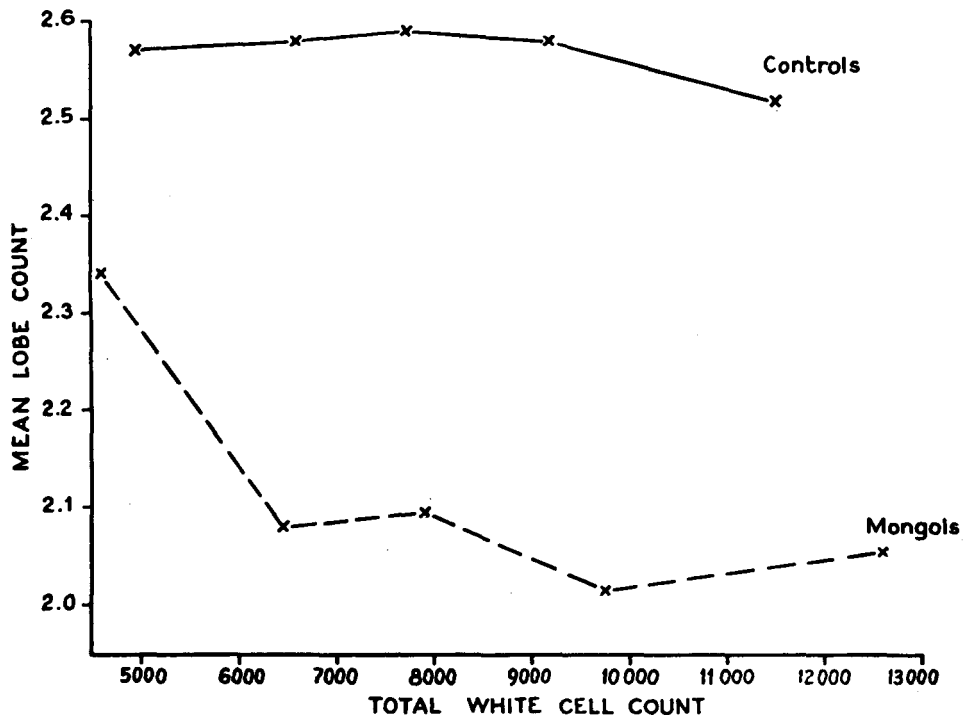


Fig. 2

The main point which emerges from these two graphs is that they do not intersect at any point but are quite separate. This means that for each given white cell count the mongols have a lower lobe count than the controls. In addition, the shape of the graphs seems to be different. In the mongols, the mean lobe count is highest

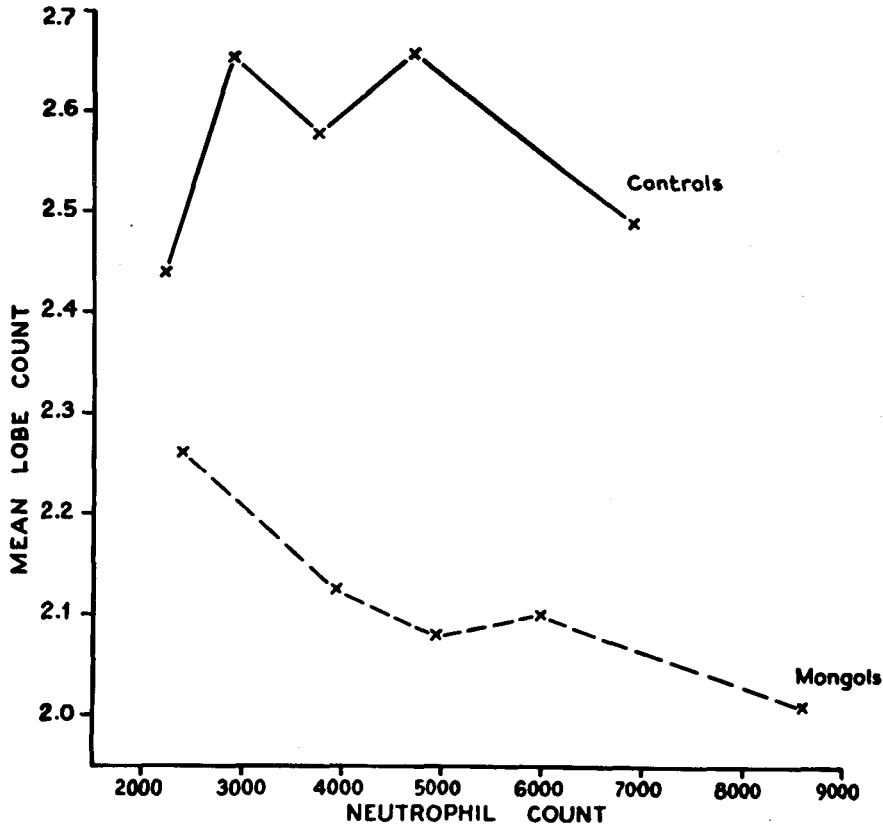


Fig. 3

when the total white cell count is very low, i.e. about 5000 cells per cmm., and thereafter the mean lobe count drops. In the controls, on the other hand, the mean lobe count appears to be fairly steady until the average white cell count reaches a figure of about 10,000 cells per cmm.; after this, a slight drop is noticed.

The relationship between the mean lobe count and the neutrophil count is shown in the fourth slide (Fig. 3). It will be seen once again that the graphs for the mongols and the controls are quite distinct, and that for each neutrophil count the mean lobe

count of the mongols is lower than that of the controls. This proves that the increased number of neutrophils, which was observed in the mongols, cannot be responsible for the lower lobe count.

At the same time as the lobe counts were recorded, a note was also made of the presence of any drumsticks, and in this way the number of drumsticks present in 500

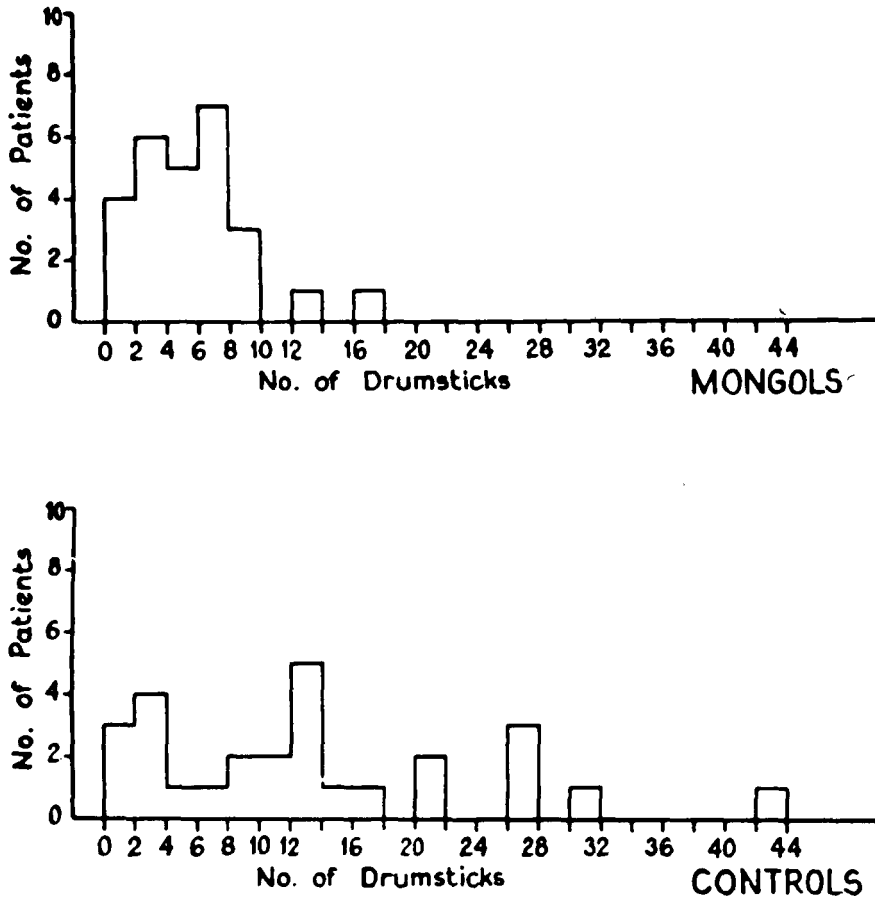


Fig. 4. Frequency distributions of the incidence of drumsticks per 500 neutrophils in 27 mongol and 27 control females.

neutrophils was obtained. The incidence of drumsticks in the females is shown in the fifth slide (Fig. 4). It will be seen that the mongols have fewer drumsticks than the controls. In fact the mean number of drumsticks per 500 neutrophils was 12.7 in the controls, but only 5.3 in the mongols. Thus the incidence of drumsticks in the

control group is quite normal, but the mongols have fewer drumsticks than normal females. The difference between the two distributions is statistically highly significant ( $t = 13.5$ ;  $P$  is very small).

Davidson and his collaborators (1954, 1958) have shown that the incidence of drumsticks is affected by the lobe count, and the question therefore arises whether the low number of drumsticks in the mongols can be accounted for by the lower lobe count, or whether it is at least partly due to some other factor.

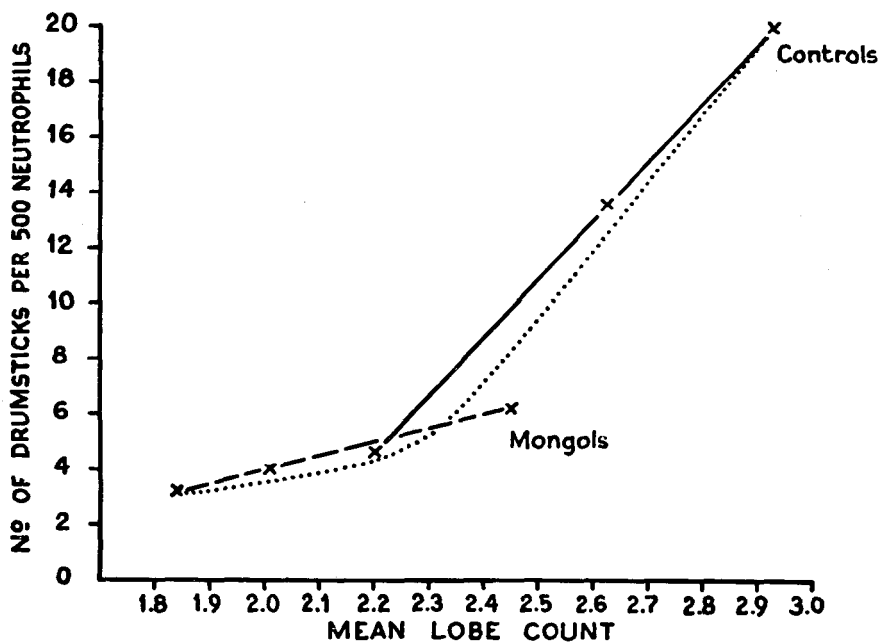


Fig. 5

The relationship between the incidence of drumsticks and the mean lobe count is shown in the sixth slide (Fig. 5). Each point on the graph represents the mean of nine cases. It will be seen that the numbers of drumsticks in both mongols and controls increase with increasing lobe counts and, moreover, that the increase in both groups appears to be linear. The two lines intersect, however, which proves that the low incidence of drumsticks of the mongols is at least partly due to the lowered lobe count. It seems very likely that the real line relating the number of drumsticks with the lobe count curves somewhere between the two lines. These data suggest therefore that in spite of the fact that mongols have fewer drumsticks than normal females, no sexual abnormality need be invoked.

### Conclusion

It is concluded that the "shift to the left" of the neutrophil nuclei of mongols cannot be accounted for either by an increase in the total number of white cells or by an increase in neutrophils and that some other cause must be sought to explain this phenomenon; on the other hand, the low incidence of drumsticks observed in mongols can be regarded as the result of the lowered lobe count, and no sexual abnormality need be invoked.

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### RIASSUNTO

Si fa un confronto fra 50 mongoloidi e 50 deficienti mentali di altri tipi con riguardo al numero medio di lobi nucleari dei granulociti neutrofili, al numero totale di leucociti ed all'incidenza dei « drumsticks ».

Si conclude che il numero basso dei lobi nucleari neutrofilici dei mongoloidi non può essere una conseguenza di un aumento del numero totale dei leucociti o dei neutrofili e che si deve cercare un'altra causa per spiegare questo fenomeno. Dall'altra parte, l'incidenza bassa di « drumsticks » osservata nelle mongoloidi può considerarsi come risultato del numero ridotto dei lobi e non occorre supporre che esista una anomalia sessuale.

### RÉSUMÉ

On a comparé 50 mongoliens à 50 déficients mentaux d'autres types par rapport à la segmentation nucléaire des granulocytes neutrophiles, le nombre total de leucocytes et l'incidence de « drumsticks ».

On conclut qu'on ne peut pas expliquer le nombre réduit des lobules nucléaires des granulocytes des mongoliens par une augmentation dans le nombre total de leucocytes ou de neutrophiles et qu'il faut chercher une autre cause pour expliquer ce phénomène. D'autre part, l'incidence basse des « drumsticks » observée dans les mongoliens femelles peut être expliquée comme résultat du nombre réduit des lobules et il ne faut pas supposer aucune existence d'une anomalie sexuelle.

### ZUSAMMENFASSUNG

Eine vergleichende Untersuchung wurde unternommen zwischen 50 mongoloiden Kindern und 50 schwachsinnigen nicht-mongoloiden Kindern mit Bezug auf die Segmentierung der neutrophilen Granulozyten, der totalen Leukozytenzahl und der Häufigkeit des Vorkommens von « drumsticks ».

Es wurde gezeigt dass die schwächere Segmentierung der Granulozytenkerne in Mongoloiden nicht durch eine erhöhte Zahl der Leukozyten oder der Neutrophilen zu erklären ist, und dass eine andere Ursache für diese Erscheinung gefunden werden muss. Andererseits kann die niedrige Zahl der « drumsticks », die in weiblichen Mongoloiden gefunden wurde, durchaus als das Resultat der schwächeren Segmentierung der Neutrophilenkerne betrachtet werden, so dass in dieser Hinsicht eine Abnormalität der Geschlechts nicht erwogen werden muss.