DERMATOGLYPHICS IN CHILDHOOD LEUKAEMIA: A GUIDE TO PROGNOSIS AND AETIOLOGY?

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Summary.—The results of analysis of the dermatoglyphics of 152 children with acute lymphoblastic leukaemia (ALL) (and the first-degree relatives of 54 of them) contrast with those of 31 children with acute myeloblastic leukaemia (AML) (and the first-degree relatives of 25 of them).

In ALL our findings suggest that neither genetic susceptibility nor an environmental factor, effective during the early antenatal period, is of aetiological importance; but the response to treatment, assessed as length of first remission, was found to be related to the amount of fingertip pattern. This may have clinical application.

In AML there is evidence of a genetically determined factor carrying a high risk of the development of the disease, in that a member of each of 5 different families of the 25 studied bore a rare hypothenar pattern, compared with none in 75 control families. No dermatoglyphic features were of prognostic significance in AML.

THE NUMBER and arrangement of dermal ridges on human hands and feet provide a permanent record of events during the first 4 months of foetal life, during which time the early development of the thymus and immune system also occur.

These features are mainly genetically determined, but may also be affected by other factors (such as exposure to teratogens or maternal infections) which interfere with foetal development during that period. The possibility that environmental influences during early foetal life, in addition to a possible genetic immunodeficiency, might be of aetiological importance in childhood leukaemia, prompted the study of dermatoglyphics in patients with this disease.

The conclusions of the 3 largest published series confined to acute lymphoblastic leukaemia (ALL) in children are conflicting. Berka *et al.* (1971) found no dermatolglyphic features to distinguish a series of 50 patients from controls;

Purvis-Smith and Menser (1973*a*) found evidence of predisposing genetic factors only, in a series of 135 patients and their relatives, whereas Wertelecki *et al.* (1973) who published material from 76 patients and their relatives, suggested that in addition to a genetic factor there also appeared to be some antenatal environmental influence distinguishing male patients from their brothers.

The distinction between genetic and environmental antenatal influence is of importance aetiologically and requires clarification.

SUBJECTS AND METHODS

Dermatoglyphic prints were obtained by the Faurot technique from hands and feet of 152 Caucasian children (87 boys, 65 girls) under the age of 15 years in whom a diagnosis of acute lymphoblastic leukaemia (ALL) was made at the Hospitals for Sick Children between 18 May 1972 and 31 December 1976.

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Patients previously treated or referred for advice before starting treatment elsewhere, were not included. There was no case of Down's syndrome. In total only 17 patients (10 boys, 7 girls) presenting during this $4\frac{1}{2}$ years, were not printed, thus the series includes 90% of Caucasian patients newly diagnosed as ALL during this period. Fourteen of those not printed died within 2 years of diagnosis, 5 of them without remitting. Three are still alive: one is living abroad, one is too young to print satisfactorily and one has gross congenital deformities of the hands and feet. The first-degree relatives of the last of these are, however, included in the series. Amongst the children included in the series were 11 (10 boys and one girl) whose blast cells form E rosettes: 9 of these were classified as T-cell ALL and 2, who presented with mediastinal mass and pleural effusion but without overt leukaemia, as T-cell lymphoma. Blast cells with T-cell markers were plentiful in the pleural fluid of these 2 patients, but neither had subsequent involvement of the blood or marrow. One other patient had B-cell leukaemia.

All the patients remitted. The majority were treated according to one of the Medical Research Council's trial schedules; all received similar induction protocols followed by a course of radiotherapy to the central nervous system soon after remission was established. Maintenance schedules varied with the trial, the more intensive regimes being reserved for those presenting with high leucocyte counts or T-cell ALL leukaemia, but all received essentially continuous maintenance therapy with multiple drugs at maximum tolerated doses. Treatment was stopped, according to schedule, in patients who were still in first remission, either at 2 years or 3 years after diagnosis.

Prints were also obtained from first-degree relatives of 54 of the patients who presented during 1974 and 1975. These were families of 49 consecutive new patients with ALL (5 with T-cell ALL) where both parents were available and willing to take part in the investigation, together with 5 additional families of patients who presented subsequently with T-cell ALL. In these 54 families there were 73 (35 male, 38 female) siblings of the patients; but only 18 male and 5 female patients had like-sexed siblings. Each family provided a "control" family, usually friends of theirs, matched as nearly as possible for age of the parents and including a child of similar age to the patient.

The dermatoglyphics of 31 Caucasian children (19 boys, 12 girls) with acute myeloblastic leukaemia (AML) were also studied together with the parents and siblings (16 male, 12 female) of 25 of them. These constitute two-thirds of such patients who presented at the Hospitals for Sick Children between 18 May 1972 and 31 December 1976, and are cytologically a heterogeneous group: 23 were myeloblastic, 5 myelomonocytic, 2 monocytic and one erythroblastic. Control families were matched for only 21 of these and, together with those matching the 54 ALL families, included 145 children (68 male, 77 female).

Interpretation of all areas of the prints (excluding toes) was carried out using the nomenclature for loops on palms and soles described by Penrose and Loesch (1969, 1970).

Standard measurements were made, which included total ridge count (TRC), a–b count and maximal atd angle. Pattern intensity on the fingers (PIF) was scored as the sum of triradii on the 10 fingers, and pattern intensity on the palms (PIP) and soles (PIS) as the number of loops on both palms or both soles. Total triradii (TT), being the total number of triradii on both hands and feet but excluding toes, was also calculated.

In addition to the dermatoglyphics, palmar creases were also studied. The scoring of abnormalities of the palmar creases is very subjective, owing to the wide range of aberrant forms. A classical simian line was scored as such and aberrant forms of it separately. A Sydney line was only scored if the proximal palmar crease reached the ulnar margin of the palm. No aberrant forms were scored. The prints were read independently by 2 of us and then all were read "blind" a second time. Only those creases consistently reported as abnormal were scored.

Results were compared using the χ^2 or Student's t test as appropriate. In composing groups of control boys and girls for comparison with patients of like sex, children of both sexes were used from every control family where they were available. In order to obviate any possible bias due to overrepresentation of large families, not more than one boy and girl from any one control family was included, those selected being those nearest in age to the patient to whose family the control family was matched.

TABLE I.—*Frequencies of Dermatoglyphic Features on Fingers in Patients, their Parents and Controls*

	Male pts ALL	Male pts AML	Fathers of ALL	Fathers of AML	Control fathers	Control boys	Female pts ALL	Female pts AML	Mothers of ALL	Mothers of AML	Control mothers	Control girls
Number	87	19	54	25	75	50	65	12	54	25	75	54
Mean TRC†	132	142	133	139	145	149	134*§	144*	133	140	131	116
% of fingers with pattern type												
W	28·7	25·8	33·5	28·8	30·7	34·4	22·5	50·8**	24·3	36·0	25·7	19·3
UL	58·6	65·3	51·9	60·8	60·1	58·4	69·2	42·5	67·8	58·8	62·7	69·0
RL	6·4	6·3	4·8	7·2	5·7	4·0	4·9	2·5	4·3	3·6	4·0	5·9
A	6·2	2·6	9·6*	3·2	3·2	3·2	3·4	4·2	3·7	1·6	7·5	5·4
Wr	7·9	9·0	7·4	5·2	6·1	8·6	4·9	10·0	5·2	9·2	6·7	3·6
Mean PIF	12·3	12·5	12·5	12·6	12·9	13·2	12·0	14·7*	12·1	13·5	11·9	11·4

† TRC = Total ridge count. W = whorls; UL = ulnar loop; RL = radial loop; A = arch; Wr = whorls where ulnar count > radial count; PIF = Pattern intensity in fingers.

§ In the statistical testing, patients were compared with control children and parents of same sex and patients' parents were compared with control parents of the same sex.

Statistically significant differences are in bold type and the significance level coded *P<0·05, **P<0·01.

TABLE II.—*Frequencies of Dermatoglyphic Features on the Palms in Patients, their Parents and Controls§*

	Male pts ALL	Male pts AML	Fathers of ALL	Fathers of AML	Control fathers	Control boys	Female pts ALL	Female pts AML	Mothers of ALL	Mothers of AML	Control mothers	Control girls
Number	87	19	54	25	75	50	65	12	54	25	75	54
CREASES†												
Simian—classical	1(1)	5(3)	4(2)	0(0)	3(1)	2(1)	5(2)	8(4)	2(2)	0(0)	1(1)	4(2)
aberrant	5(3)	0(0)	9(6)	16(10)	12(7)	2(1)	5(3)	8(4)	7(4)	8(6)	3(1)	0(0)
Sydney	21(12)	21(16)	11(6)	16(8)	20(13)	12(6)	23(16)	25(21)	11(6)	24(14)	17(11)	24(13)
At least one abnormal	25(16)	26(18)	24(13)	32(18)	32(21)	16(8)	29(22)	33(29)	20(11)	32(20)	20(13)	26(15)
c triradius missing	6(5)	0(0)	6(3)	12(8)	13(9)	2(1)	6(5)	8(8)	6(6)	12(6)	11(7)	13(8)
Mean sum a–b ridge count	86	86	82	87	83	84	86	85	88	86	84	87
Mean sum add angles	94	91	87	88	87	95	97	92	95	88	89	97
LOOPS† thenar‡	21(13)	16(11)	19(12)	12(10)	13(9)	18(11)	23(17)	8(4)	9(7)	12(10)	13(9)	20(11)
Interdigital II	7(4)	5(3)	6(3)	12(6)	7(5)	10(7)	5(4)	0(0)	4(2)	4(4)	7(4)	7(4)
III	**74(57)	68(50)	57(42)	56(44)	57(44)	76(60)	51(35)	67(54)	63(50)	76(52)	64(49)	57(42)
IV	69(52)	79(63)	78(60)	72(56)	72(57)	74(55)	83(68)	67(50)	67(51)	72(52)	71(54)	80(66)
Hypothenar‡	45(32)	37(32)	50(39)	60(44)	47(37)	54(40)	57(42)	*83(54)	65(49)	60(36)	56(41)	41(31)
H	20(11)	16(13)	17(11)	24(18)	23(14)	22(14)	25(15)	8(4)	30(22)	28(20)	24(14)	9(6)
H	31(23)	26(18)	33(25)	40(26)	35(26)	34(24)	34(24)	*75(42)	44(29)	40(22)	39(29)	31(25)
Hr	1(1)	0(0)	4(2)	8(4)	1(1)	4(2)	3(2)	8(4)	4(2)	0(0)	7(4)	2(2)
Tr	3(2)	0(0)	0(0)	0(0)	1(1)	0(0)	0(0)	0(0)	2(1)	0(0)	1(1)	0(0)
Ar	1(1)	0(0)	4(2)	4(2)	0(0)	2(1)	3(2)	17(8)	6(3)	0(0)	1(1)	2(2)
mean loops on palm (PIP)	3·4	3·2	3·3	3·5	3·3	3·8	3·5	3·3	3·4	3·4	3·5	3·3

§ See footnote § of Table I.
† Figures refer to % of individuals bearing stated features on either or both hands; figures in brackets refer to % of hands bearing stated features.
‡ = Any pattern.

TABLE III.—*Frequencies of Dermatoglyphic Features on the Soles in Patients, their Parents and Controls§*

	Male pts ALL 87	Male pts AML 19	Fathers of ALL 54	Fathers of AML 25	Control fathers 75	Control boys 50	Female pts ALL 65	Female pts AML 12	Mothers of ALL 54	Mothers of AML 25	Control mothers 75	Control girls 54
Number												
LOOPS												
I	56(51)	68(55)	56(47)	68(64)	56(49)	46(42)	72(61)	58(58)	69(55)	52(46)	61(54)	57(53)
Tibial Î	20(14)	11(11)	17(9)	0(0)	15(11)	20(15)	17(10)	17(13)	13(8)	*28(18)	8(7)	6(3)
Whorl I & Î	41(33)	47(32)	46(37)	28(26)	44(33)	46(38)	34(25)	25(25)	50(35)	48(32)	39(31)	39(32)
II	7(5)	5(3)	13(8)	8(4)	4(2)	6(3)	8(5)	8(4)	11(6)	20(12)	13(8)	7(6)
ÎI	45(32)	37(26)	48(35)	36(28)	35(27)	36(25)	26(20)	25(17)	26(20)	40(32)	33(24)	30(23)
III	83(74)	63(58)	72(65)	80(64)	75(69)	78(75)	72(61)	67(58)	63(50)	60(54)	68(57)	74(61)
ÎII	21(16)	16(16)	20(16)	20(18)	23(18)	20(17)	18(14)	8(8)	11(9)	20(18)	17(15)	20(16)
IV	25(18)	32(21)	35(27)	20(14)	32(21)	28(22)	14(10)	8(4)	17(12)	12(10)	15(12)	28(19)
ÎV	7(5)	11(8)	2(1)	8(8)	7(5)	4(4)	0(0)	0(0)	4(2)	4(4)	5(5)	7(6)
V	0(0)	0(0)	0(0)	0(0)	1(1)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
V̂	59(50)	74(71)	59(48)	72(58)	61(53)	50(42)	57(49)	42(38)	63(56)	64(54)	55(47)	50(37)
Calcar	2(2)	0(0)	2(2)	0(0)	1(1)	2(1)	5(2)	8(8)	2(2)	4(4)	1(1)	6(5)
Mean loops on sole (PIS)	6·7	6·7	6·7	6·3	6·5	6·5	5·6	5·2	5·8	6·3	5·9	5·9
Total triradii (TT)	38·4	38·4	38·6	38·4	38·7	39·5	37·2	39·4	37·3	39·2	37·3	36·7

§ See footnote †, Table II and footnote §, Table I.

RESULTS

ALL patients

Comparison of the findings in the ALL patients with those of both control children and control parents of like-sex are shown in Tables I, II and III. In Table I the mean ridge count (TRC) for female patients (134) is significantly ($P<0.05$) higher than that for the girl controls (116) but it scarcely differs from that for control mothers (131). In Table II, the proportion of male patients with third interdigital loops (74%) is significantly higher than that in control fathers (57%) but is close to that in control boys (76%). Amongst all the features listed, the values for ALL patients differ significantly from those of controls in only these 2 instances. The inconsistency of these two differences when control parents and children are used for comparison suggests that they probably arose by chance. Sydney lines (Table II) occur more frequently in male patients than control boys but not significantly so. No similar difference is seen between female patients and controls. The normal sex differences (Cummins and Midlo, 1942) which are in the main well demonstrated by the controls, are not consistently apparent among the patients. The expected male excess of digital whorls and radial loops is present, but the higher mean TRC in males and the excess of arches in females are absent. The mean values for TRC, PIF and digital whorls for the 10 patients with T-cell ALL are 130·5, 12·5 and 33 respectively. These do not differ significantly from the values for the other 142 ALL patients.

These results are similar to those of the small series of patients reported by Berka *et al.* (1971) who found no significant differences between patients and controls, and do not support the finding of increased prevalence of digital whorls and raised PIF in the 2 other series of patients (Purvis-Smith and Menser, 1973*a*; Wertelecki *et al.*, 1973). It is possible that these apparent differences between series might be resolved if digital whorls and PIF

were found to be associated with some other characteristic which was differently represented amongst the patients in the various series.
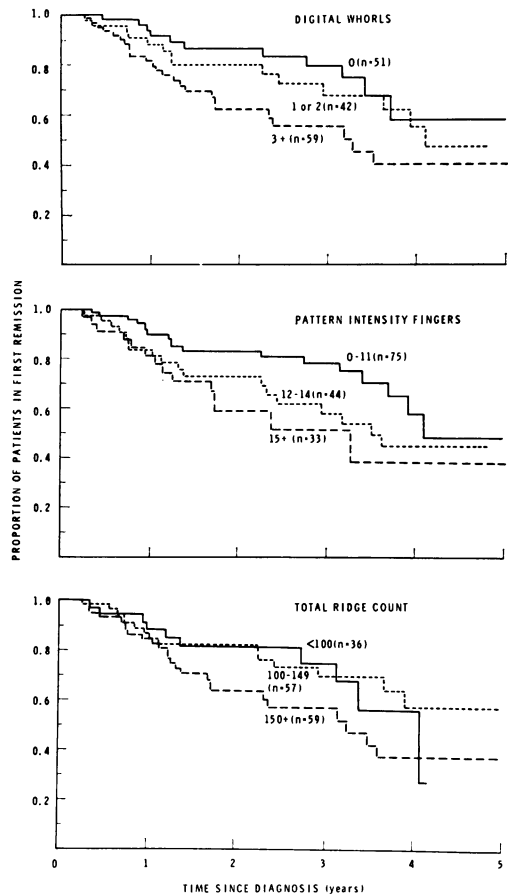
Dermatolyphics and prognosis.—The mean

Fig.—Length of first remission in patients with ALL according to dermatoglyphic characteristics. The curves are biased towards overestimating the time to first relapse in each of the groups, as they do not include data on 12 patients who presented for treatment in the period 18 May 1972–31 December 1976 and who achieved clinical remission. Nine of these patients died before dermatoglyphic studies could be performed (these patients died at 14, 16, 19, 19, 26, 32, 40, 53 and 64 weeks after diagnosis). One patient emigrated 93 weeks after diagnosis. One patient is too young to obtain satisfactory dermatoglyphics and one is congenitally malformed and has only rudimentary fingers. Five additional patients did not achieve clinical remission and are also excluded.

TABLE IV.—*Digital Pattern Indices in ALL Patients According to Age at Diagnosis*

	ALL patients (both sexes) Number					
Age at diagnosis	♂	♀	Total	TRC	Dig. Wh. %	PIF
<3 yrs	27	19	46	133·0	·33·0	12·8
3–5 yrs	27	26	53	137·9	23·0	12·0
⩾6 yrs	33	20	53	126·0	22·8	11·6

TABLE V.—*Digital Pattern Indices in ALL Patients According to Leucocyte Count at Diagnosis*

WBC at diagnosis (10⁹/l)	ALL patients (both sexes) Number					
	♂	♀	Total	TRC	Dig. Wh. (%)	PIF
<5·0	31	26	57	122·0	22·8	11·8
5·0–20	28	30	58	137·9	27·5	12·4
>20	28	9	37	140·4	28·9	12·3

TABLE VI.—*Comparison of Dermatoglyphic Features in ALL Patients According to Response to Treatment*

	Death or relapse within 2 years of diagnosis	Survival 2 years from diagnosis without relapse
No. of patients†	35 (26, 9)‡	72 (34, 38)
Mean TRC	142 (143, 140)	126 (115*, 136)
Mean % fingers with digital whorls	36·3 (36·5, 35·6)	21·5* (19·7*, 23·2)
ulnar loops	54·9 (54·2, 56·7)	66·9* (63·8, 69·7)
Mean PIF	13·1 (13·1, 13·0)	11·7* (11·2, 12·1)
% hands with interdigital loop III	60·0 (71·2, 27·8)	39·6** (41·2**, 38·2)
(% of persons with loop on 0,1 or 2 hands)	(26, 28, 46)	(43, 35, 22)*

* P<0·05
** P<0·01

† omitting 45 patients who were in their first remission but had survived less than 2 years at the end of the study.

‡ (males, females)

values for digital whorls, PIF and TRC for patients in this series, listed according to the patient's age and leucocyte count at diagnosis in Tables IV and V respectively, show a tendency towards increased pattern in younger patients and in those patients with high leucocyte counts. Although none of these differences reach statistical significance the trends are present in both sexes. Younger patients and those with high initial leucocyte counts are known to have a poorer prognosis, and therefore the dermatoglyphic features of patients who relapsed or died within 2 years of diagnosis (while still receiving chemotherapy) were compared with those who survived at least 2 years after diagnosis without relapse (Table VI). The 35 patients in the relapsed group

include 9 with T-cell leukaemia, 1 with B-cell leukaemia, and 12 others with leucocyte counts greater than 20×10⁹/l at diagnosis. There is a significant difference between the 2 groups for digital whorls, ulnar loops, PIF and interdigitial loop III which remains even after omission of the data from the 9 patients with T-cell leukaemia. The difference in TRC is significant if boys are considered alone, and in general the differences are more marked in boys. The results in girls, however, show the same trends, except in the incidence of interdigital loop III. These differences, in which increased finger-tip pattern expressed either as digital whorls, PIF or TRC, appears to be associated with poor prognosis, are more effectively demonstrated by including the whole group

of 152 patients in life tables for the length of first remission (Fig.). The trend of decreasing length of 1st remission with increasing pattern is statistically significant for digital whorls ($P = 0.02$) and PIF ($P = 0.02$) but not for TRC ($P = 0.13$). No other dermatoglyphic features were found to have any significant association with prognosis.

ALL families

Parents.—Comparison of the dermatoglyphic features of the parents of children with ALL with those of the control parents is shown in Tables I, II and III, the only significant difference being the higher prevalence of digital arches in ALL fathers compared to control fathers (Table I). Six of the 54 ALL fathers have 4 or more arches, compared with none of the 75 control fathers. The prevalence of any abnormal crease in ALL fathers is lower than that in control fathers and the prevalence of the hypothenar loop H is higher in ALL mothers than in control mothers,

but none of these differences is statistically significant (Table II).

No significant difference was found between the dermatoglyphics of the parents of patients with T-cell ALL and those of the parents of other ALL patients. Comparison of the parents of 22 ALL patients who relapsed or died within 2 years of diagnosis with the parents of 30 patients who had survived 2 years since diagnosis without relapse, showed that the mean values for both mothers and fathers for TRC, digital whorls and PIF are very similar in the 2 groups. However, the number of parents included in the study is considerably smaller than the number of patients and, indeed, if the analyses shown in Table VI are restricted to those children whose parents were also studied, the differences are no longer apparent.

Children.—In the families of both the patients and the controls, the proportion of children with abnormal creases is higher where a parent has an abnormal crease, and the difference is significant if cases

TABLE VII.—*Prevalence of Abnormal Palmar Creases in Parents and their Offspring in Patients' and Control Families*†

	Total numbers of				Numbers with anomalous crease			
	Families	Patients	Sibs	Children	Patients	Sibs	Total children	%
ALL families								
Neither parent has abnormal crease	32	32	42	74	7	6	13	17·5
One or both parents have abnormal crease	21	21	29	50	8	8	16	32
CONTROL families								
Neither parent has abnormal crease	38			77			13	16·8
One or both parents have abnormal crease	34			68			21	30·9
AML families								
Neither parent has abnormal crease	11	11	13	24	4	0	4	16·6
One or both parents have abnormal crease	14	14	14	28	4	3	7	25
Combined data (cases and controls)								
Neither parent has abnormal crease	81			175			30	17·1**
One or both parents have abnormal crease	69			146			44	30·1**

**$P < 0.01$
† One ALL family omitted where patient has congenital deformity of hands.

and controls are considered together (Table VII). This finding is unrelated to the sex of the parent or offspring, or to the type of crease. There is no significant difference between the prevalence of abnormal creases in patients and that in their siblings of either sex.

Comparison of values for TRC, digital whorls and PIF between the patients (18 male and 5 female) and their like-sex sibs, the 36 male patients and their fathers and the 17 female patients and their mothers are shown in Table VIII. None of the

TABLE VIII.—*Comparison of Dermatoglyphic Features in ALL Patients and their First-degree Relatives*†

	No.	Mean TRC	Mean Dig.Wh.	Mean PIF
Male patients	18	148	44	13·8
Their brothers	18‡	166	50	15·1
Female patients	5	142	28	12·8
Their sisters	5‡	114	23	11·4
Male patients	36	142	36	13·0
Their fathers	36	132	33	12·3
Female patients	17	134	24	12·1
Their mothers	17	142	26	12·5

† Statistical tests were performed on the matched pairs.

‡ If there was more than 1 like-sexed sib in a family (4 instances for males, 2 for females) mean values for sibs in same family were used in calculating mean for the group of families.

differences reaches a level of significance, but it is noteworthy that for each parameter the value for male patients is lower than that of their brothers. The numbers of individuals involved, however, is small.

AML patients

In the dermatoglyphic analysis summarised in Tables I, II and III, the 19 boys with AML do not differ significantly from the controls, or from the patients with ALL. The group of 12 girls, however, have significantly greater TRC, PIF, numbers of digital whorls, hypothenar pattern and hypothenar loop $\hat{H}$ than girl controls.

Grouping the patients according to cytological type, age or survival did not reveal any differences in the distribution of dermatoglyphic features, but it should be noted that the number of patients is small.

AML families

Parents.—The dermatoglyphic findings in AML parents are also shown in Tables I, II and III. Those of the AML fathers differ little from controls. The mean values for TRC, digital whorls, and hallucal tibial loops are higher in AML mothers than in control mothers, but only in tibial loops does the difference reach statistical significance.

Only 6 of the male and one of the female AML patients had like-sex sibs, making comparisons of little value.

Significantly ($P < 0.05$) more first-degree relatives of AML patients (66%) than control subjects (50%) bore hypothenar patterns on at least one hand. This was mainly due to the increased prevalence in AML families of the common loop $\hat{H}$ (L^r). A rare form of this loop $\hat{H}!$, designated $L^r!$ by Weninger (1947) and described by her as occurring in 0·76% of normal males and 1·25% of normal females, was later reported as occurring in 6·4% of male schizophrenics (Pons, 1959). This pattern was not found in our series amongst 295 members of the control families, nor among 234 members of families of ALL patients, but was present in one ALL patient and in 5 individuals (2 male patients, one father, one brother and one sister) in 5 different families of AML patients (Table IX). One of the affected AML patients survived 127 weeks after diagnosis (the median survival for the group being 69 weeks) and the other is well and off treatment more than 4 years since diagnosis. The ALL patient is still in her first remission, 5 years since diagnosis.

DISCUSSION

ALL

Analysis of the dermatoglyphic prints of this series of 152 children with ALL and 181 first-degree relatives of 54 of them shows few differences from control individuals, and these not of convincing significance, and thus does not support the suggestion that, except in the case of Down's Syndrome, a congenital suscept-

TABLE IX.—*Prevalence of Hypothenar Loop $\hat{H}$! in Patients, their First-degree Relatives and Controls*

	No.	Hypothenar loop $\hat{H}$!	Fisher's Exact Test (vs. controls) (2-sided prob)
AML			
Families	25	5	0·001
Family members (including patients)	103	5	0·002
Patients*	31	2	0·02
ALL			
Families	54	0	—
Family members (including patients)	234	0	—
Patients*	152	1	0·7
CONTROLS			
Families	75	0	
Family members	295	0	

* Includes patients whose families were not studied. Statistical comparion is made with control family members.

ibility to ALL might be identified by means of dermatoglyphics. The absence of the normal sex difference for PIF and TRC and the reversed sex incidence of digital arches in ALL patients, although not significant, supports in some measure the findings of Purvis-Smith and Menser (1973a) but the lack of increased incidence of digital whorls in patients is in disagreement with these authors.

The subjective element involved in reading abnormalities of the palmar creases and the various ways of reporting them makes direct comparison between published reports difficult. In the series reported here, where the prints were examined more than once without knowledge of the identity of the subjects, the prevalence of simian lines agrees reasonably well with the findings of Purvis-Smith and Menser (1973a) and Wertelecki et al. (1973) but the frequency of Sydney lines is greater, particularly in control groups, than that found by those authors. There is agreement with both the previous reports that anomalous creases occur as often in the patients' sibs as in the patients and also with Purvis-Smith and Menser (1973a) that anomalous creases of any type occur more often in the children of parents, who have anomalous creases than in those whose parents have normal creases; but since these findings are equally

applicable to control families (Table VII) they cannot be associated with a genetic predisposition to ALL.

The possibility that some environmental factor affecting early foetal development, and in particular the development of the skin ridges, might be of aetiological importance in ALL arose following reports that subjects with congenital rubella have unusually high mean values for digital whorls and PIF (Alter and Schulenberg, 1966; Purvis-Smith and Menser, 1973b). The finding that male patients with ALL had more finger-tip pattern than their like-sex sibs (Wertelecki et al., 1973; Purvis-Smith and Menser, 1973a) supported this possibility, but a numerically similar group of male ALL patients with brothers in the series described here, show quite opposite results. Since none of the differences reported here between ALL patients and their brothers is statistically significant, and there are no marked differences between female patients and their sisters, there is no support for the hypothesis that an antenatal event which is of aetiological importance in ALL also affects the development of dermatoglyphic features.

Since development of the thymus and the immune system and that of the skin ridges both commence during the third month of foetal life, it is tempting to argue that factors affecting the development of

one of these sytems may affect both. Since the ALL patients described here all received very similar treatment, the fact that their dermatoglyphic features were associated with response to treatment might be attributable to an underlying association of dermatoglyphics with the efficiency of the immune response.

The variation in results reported by different authors may be partly explained (as emphasised by Berka *et al.*, 1971) by the large number of dermatoglyphic features available for comparison. No constant distinguishing characteristic for ALL patients is found in every series and there is no strong suggestion of a genetic susceptibility for ALL. The results reported here relating the association of dermatoglyphic features with prognosis need to be tested in other series but, if confirmed, might have clinical application in choosing treatment protocols. The extent to which these results could explain the discrepancies between the various reports cannot be assessed, since most authors do not detail how the patients were sampled.

AML

In contrast to the results in ALL, the greatly increased incidence of the rare loop Ĥ! in AML patients and their first-degree relatives suggests the presence of a genetically determined factor carrying a high risk of AML. There is also a suggestion that this pattern might be associated with good prognosis in individuals developing leukaemia.

The significantly raised PIF and digital whorls in girls with AML are as high as those quoted for girls with congenital rubella (Alter and Schulenberg, 1966; Purvis-Smith and Menser, 1973b) but interpretation of this finding is difficult, since the number of patients is small and only one had a sister for comparison. The finding that the boys with AML show no such distinguishing features, however, is

against the suggestion of an antenatal environmental cause, as is the finding that mothers of AML patients resemble the female patients to a limited extent in having a higher incidence of both digital whorls and hypothenar pattern than control mothers.

Dermatoglyphics have previously been reported only in very small numbers of children with AML and the series reported here is only large enough to allow tentative conclusions. However, the increased frequency of the loop Ĥ! in these patients and their families is striking and suggests that a study of other genetic markers, such as HLA, might be of interest in such families.

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