Keratoconus: maternal age and social class

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SUMMARY A group of patients (150) suffering from keratoconus were asked their mother's age at their birth. A statistically significant excess of older mothers as compared with the general population was found. The social class of the patients was found to have a distribution different from the general population, and it is suggested that this is related to the patient's maternal age.

After a number of years working with patients suffering from keratoconus the writer formed the impression that when first presenting for contact lens fitting patients were often accompanied by relatively aging parents. In order to test this impression patients entering a long-term study on the progression of keratoconus were asked the age of both parents at birth. Analysis of the findings from the first 50 patients strongly suggested there was a significantly different frequency distribution of the age of mothers at birth as compared with the general population, so the sample was expanded to a total of 150 patients.

Karseras and Ruben¹ have reported that in their group of 75 patients most of the keratoconus patients were from social classes I and II (Registrar General's classification), whereas half of the total general population was from social class III. There is a relationship between social class and maternal age, and it is suggested that the social class findings in keratoconus may derive from the age of the mother.

Patients and methods

The first 50 patients in the study were all new referrals to the Keratoconus Clinic of the Department of Contact Lens and Prosthetics, Moorfields Eye Hospital. Although new referrals, they were not all newly diagnosed. Some had been diagnosed for several years and had been referred only when the management became more difficult, and some had newly moved to the London area. The mean age ($\pm$ SD) of this group was 24.45 ± 7.29 . The mean age at diagnosis ($\pm$ SD) was 22.18 ± 7.31 .

The further 100 patients questioned were consecutive patients attending the Keratoconus Clinic, some

Table 1 Years of birth of patients in keratoconus sample

Year	Number of patients	Year	Number of patients	Year	Number of patients
1909	1	1939	4	1952	4
1913	1	1940	4	1953	6
1919	1	1941	5	1954	9
1927	1	1942	4	1955	5
1928	2	1943	3	1956	4
1929	1	1944	6	1957	6
1930	1	1945	2	1958	4
1932	1	1946	3	1959	9
1933	1	1947	5	1960	8
1935	2	1948	4	1961	9
1936	1	1949	9	1962	3
1937	3	1950	7	1963	
1938	2	1951	5	1964	1

Total number of patients 150. Mean year of birth 1949. Standard deviation 12.36.

being old and some new patients. This gave a large spread of the years of birth for the total sample, i.e., 1909-65.

Results

The frequency distribution of the years of birth of the patients in the sample is shown in Table 1.

In making a comparison between the keratoconus sample and the general population this spread of years of birth presents a historiographic problem in that the pattern of child bearing has changed during that period. However, of the 150 patients 128 were born after 1939 and 112 were born during the period 1940-60. It thus seemed reasonable to look at the pattern of child bearing in 1940, 1950, and 1960 (see Tables 2, 3, and 4). The source of the figures was the Registrar-General's *Statistical*

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Table 2 *Pattern of child bearing 1940*

	Maternal age							Total
	<20	20-24	25-29	30-34	35-39	40-44	45-49	
Number	27 043	144 693	195 863	136 697	74 264	23 452	2016	604 029
%	4.48	23.95	32.43	22.63	12.29	3.88	0.33	100

Table 3 *Pattern of child bearing 1950*

	Maternal age							Total
	<20	20-24	25-29	30-34	35-39	40-44	45-49	
Number	31 753	200 406	244 007	136 767	87 398	25 796	1829	728 556
%	4.36	27.51	33.57	18.77	12.00	3.54	0.25	100

Table 4 *Pattern of child bearing 1960*

	Maternal age							Total
	<20	20-24	25-29	30-34	35-39	40-44	45-49	
Number	46 067	229 064	233 579	143 475	77 261	17 736	1315	748 498
%	6.15	30.50	31.21	19.17	10.32	2.37	0.18	100

Table 5 *Maternal age of general population compared with keratoconus sample*

	Maternal age							Total
	<20	20-24	25-29	30-34	35-39	40-44	45-49	
General population 1940	4.48	23.95	32.43	22.63	12.29	3.88	0.33	100
General population 1950	4.36	27.51	33.57	18.77	12.00	3.54	0.25	100
General population 1960	6.15	30.50	31.21	19.17	10.32	2.37	0.18	100
Keratoconus sample	3.33	12.00	24.67	31.33	22.00	5.33	1.33	100

Table 6 *Comparison of percentage of births to women over 30 and 35, general population and keratoconus sample*

Year	Maternal age 30+	Maternal age 35+
General population 1940	39.13	16.50
General population 1950	34.58	15.79
General population 1960	32.04	12.87
General population 1973	20.04	6.5
Keratoconus sample	59.99	28.66

Review from the Office of Population Census and Surveys.

As can be seen for the whole of the period under consideration the tendency was for women to have their children earlier and earlier.

Births by maternal age for the general population were then tabulated against the keratoconus sample (Table 5).

Since the mean year of birth for the sample was

1949 but the sample was skewed towards the later years, it seemed that the most valid comparison would be with the 1950 figures. Another way of presenting the figures would be to consider the percentage of births to women over 30 and over 35 (Table 6).

The number of babies born to women over the age of 35 has been falling both in absolute terms and as a percentage since 1965, so if there is a connection between maternal age and the incidence of keratoconus there should be a fall in the number of cases presenting over the next few years.

STATISTICAL ANALYSIS

The χ^2 goodness of fit test was used to test the hypothesis that maternal age distribution of keratoconus differs significantly from the maternal age distribution of the general population.

The choice of the model population might be questioned for appropriateness in that the Registrar-General's population census data describes a population at fixed points in time (1940, 1950, and

Table 7 χ^2 goodness of fit test applied to 1940 data

Keratoconus patients (n = 150)	Maternal age							Total
	<20	20-24	25-29	30-34	35-39	40-44	45-49	
Number observed	5	18	37	47	33	8	2	150
%	3.33	12.00	24.67	31.33	22.00	5.33	1.33	100
Number expected	6.72	35.93	48.65	33.95	18.44	5.82	0.49	150
%	4.48	23.95	32.43	22.63	12.29	3.88	0.33	100

$\chi^2=30.84$. Degrees of freedom = 5. $P<0.001$.

Table 8 χ^2 goodness of fit test applied to 1950 data

Keratoconus patients (n=150)	Maternal age							Total
	<20	20-24	25-29	30-34	35-39	40-44	45-49	
Number observed	5	18	37	47	33	8	2	150
%	3.33	12.00	24.67	31.33	22.00	5.33	1.33	100
Number expected	6.54	41.26	50.35	28.15	18.00	5.31	0.38	150
%	4.36	27.51	33.57	18.77	12.00	3.54	0.25	100

$\chi^2=45.402$. Degrees of freedom = 5. $P<0.001$.

Table 9 χ^2 goodness of fit test applied to 1960 data

Keratoconus patients (n=150)	Maternal age							Total
	<20	20-24	25-29	30-34	35-39	40-44	45-49	
Number observed	5	18	37	47	33	8	2	150
%	3.33	12.00	24.67	31.33	22.00	5.33	1.33	100
Number expected	9.23	45.90	46.82	28.76	15.48	3.56	0.27	150
%	6.15	30.60	31.21	19.17	10.32	2.37	0.18	100

$\chi^2=62.293$. Degrees of freedom = 5. $P<0.001$.

Table 10 χ^2 goodness of fit test applied to mothers of less than 30 years of age and more than 30 years of age

	<30	30 and over	Total
Number (sample)	60	90	150
%	40	60	100
1940 Number expected	91.29	58.71	150
%	60.86	39.14	100
1950 Number expected	98.16	51.84	150
%	65.44	34.56	100
1960 Number expected	101.94	48.06	150
%	67.96	32.04	100

1940 comparison, $\chi^2=27.40$. 1950 comparison $\chi^2=42.92$. 1960 comparison $\chi^2=53.85$. All 1 degree of freedom. All significant of $P<0.001$.

1960), whereas the sample of patients were born over a wider time period when the pattern might have been different and changing. However, the distribution of the 3 census years of maternal age is basically similar, and since the arithmetic mean year of birth of the sample of 150 patients is 1949 and the median is 1951 it would seem appropriate to take the 1950 data as the most useful indicator of expected frequencies.

For comparison with 1940 data see Table 7, 1950 data Table 8, and 1960 data Table 9.

The χ^2 test was also used to compare frequencies for mothers of less than 30 years of age and more than 30 years of age (Table 10).

There is therefore no doubt that the sample shows a statistically significant excess of older mothers as compared with that expected on the basis of the Registrar-General's data.

SOCIAL CLASS

The 55 patients entering the initial study were analysed in accordance with the current Registrar-General's classification based on occupation: I professional, etc.; II intermediate; III skilled (N) nonmanual, (M) manual; IV partly skilled; V unskilled.

The Registrar-General's classification of occupations has a list of more than 20 000 separate occupational titles which are grouped into 200 occupational units. The 4 housewives were classified on the basis of their previous occupations, and a prediction based on the subjects studied was used for students.

The figures obtained were compared with figures from the 1975 10% sample (Economic Activity, Part 4). The results from the sample are shown in Tables 11 and 12.

These figures show the same tendency, but are even more skewed than the results of Karseras and Ruben¹ in that 76% of the patients come from social classes I and II. It is of course quite possible that people from these classes were more likely to offer to co-operate in a study of this nature. Also patients in social class V are often not paid if they are away from work, so are less likely to volunteer, which may well explain the absence of any patient from this class in the study. It can be argued that people from the higher social classes are more likely to get to Moorfields in that they are more active in seeking advice if their vision deteriorates in one eye and persist until they are referred. Nevertheless, despite all these considerations it would appear that there must be reasons why keratoconus patients tend to be of a higher social class than the general population. One possible answer is the age at which different social classes tend to have their children.

The Newsoms² in a study of 700 families in Nottingham produced clear evidence that mothers are younger in the manual class. This can be seen not only in terms of earlier marriage, but also in

relation to the fact that the interval between marriage and the first birth (and to some extent subsequent births) is shorter for manual mothers than for non-manual mothers.³

The percentage of mothers under the age of 21 at birth of first child by social class is shown in Table 13 (derived from Table XII Newsom and Newsom²).

Discussion

There is no doubt that keratoconus is a maternally age related condition and that this is reflected in the social class of the patients attending the Keratoconus Clinic of the Department of Contact Lens and Prosthetics, Moorfields Eye Hospital. There is still the possibility that Moorfields Eye Hospital attracts a rather atypical population, but the χ^2 is so large that there must be a significant difference between the keratoconus sample and the general population. The finding of a maternal age factor does suggest that keratoconus is probably chromosomally determined. It is of course possible that the genetic mechanism may act synergistically with another mechanism such as allergy which may itself be independently genetically determined.

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References

- 1 Karseras AG, Ruben M. Aetiology of keratoconus. *Br J Ophthalmol* 1976; **60**: 522-5.
- 2 Newsom J, Newsom E. *Infant Care in an Urban Community*. London: Allen and Unwin, 1963.
- 3 Woolf M. *Family Intentions*. London: HMSO, 1971: Table 3.13.

Table 11 Social class of patients in keratoconus sample

Social class	Number	%
I	16	29.09
II	26	47.27
III N	8	14.55
III M	4	7.27
IV	1	1.82
V	0	0

N = nonmanual. M = manual.

Table 12 Social class of patients in keratoconus sample compared with general population (1975)

	I	II	III(N)	III(M)	IV	V	All
Keratoconus group	19.09	47.27	14.55	7.27	1.82	0	100
General population (1975)	4	18	21	28	21	8	100

Table 13 Percentage of mothers under the age of 21 at birth of first child: general population and keratoconus sample

Social class (Registrar-General AB definition 1960)						
	I	II	III(N)	III(M)	IV	V
Mothers under 21	9	15	25	40	46	53
Comparing these with social class distribution in the keratoconus sample:	29.07	47.27	14.55	7.27	1.82	0