Refraction of 1-year-old children after atropine cycloplegia

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SUMMARY The refractions of 1648 children aged 11 to 13 months are reported. Atropine 1% was used for cycloplegia. 11.83% of the children had bilateral hypermetropia of +2.00 or more D. 13.23% of them had +1.50 or more D astigmatism in one or both eyes, and 6.5% had anisometropia. Anisometropia was significantly ($P=0.000\ 001\ %$) associated with bilateral hypermetropia, but even more significantly ($P=0.000\ 000\ 4\ %$) associated with astigmatism of +1.50 or more D in one or both eyes.

Cyclopentolate was used in our pilot study (Ingram *et al.*, 1979) for reasons of convenience, but its cycloplegic effect has not been proved (Davidson, 1976). Atropine is accepted generally as the most efficient cycloplegic drug, and the true range of refractions at age 1 year would be more accurately recorded after 'atropinisation'. This is a report of the refractions of 1648 1-year-old children examined after 'full atropinisation'. The findings are compared with those of other 1-year-old children refracted after instillation of cyclopentolate in a subsequent publication (Ingram and Barr, 1979).

Sample of children

The children were all born between 1 January 1974 and 31 December 1976. They were registered at the time of their first birthday under one of the partners in seven adjacent group general medical practices in the Kettering district.

Methods

Mothers were introduced to the idea of vision screening by the health visitors when the child had a hearing test at the age of 9 months. Those wishing to have their children's eyes examined were subsequently issued with written instructions on how to instil 1% atropine ointment twice daily for the 4 days preceding their appointment. The examinations were carried out in the respective general practitioners' premises.

The plan was to screen the children during the

month of their birth, but some children born late in the month were refracted early in that month and others, for one reason or another, attended during the following month. Thus their ages ranged from 11 to 13 months inclusive.

All the refractions were carried out by the author. When cycloplegia was obviously incomplete, for example, the pupils were mobile or when the refraction changed during retinoscopy, the refraction was excluded. Anybody experienced in refracting children will, however, recognise that there are occasions when complete cycloplegia is in doubt in spite of the pupils being fixed and the refraction appearing to be static, and such children have been included.

The refractions were recorded as before (Ingram, 1977), the basic spherical refraction being that of the less hypermetropic or more myopic meridian for each eye, with any astigmatism (in + cylinders) or anisometropia being recorded separately.

Children found to have squint or congenital abnormalities were managed on traditional lines.

Results

A variety of clinical and pathological conditions were either identified at the time of screening or previously known (Tables 1 and 2).

A summary of the figures for the basic spherical refraction of individual eyes is given in Table 3. There is no significant difference between any of these 3 samples of children. Distribution curves drawn for each individual sample are so similar that 1 composite curve is presented (Fig. 1).

Figures for the refractions of children recorded as the basic spherical refraction of the more emmetropic eye are summarised in Table 4. There

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Table 1 *Particulars of the sample of children available for screening*

	Born 1974	Born 1975	Born 1976
Total number available for screening	987	941	896
Number who 'declined' examination	104	139	136
Number who did not attend	285	249	216
Number who attended but were not 'fully atropinised'	17	7	19
Number where refraction was impossible	2	0	2
Number who were refracted	579	546	523

Table 2

	Born 1974	Born 1975	Born 1976
Esotropia	4	3	3
Esotropia + nystagmus	1	—	—
Exotropia + dislocated lens	1	—	—
Coloboma of uveal tract	—	1	—
Coloboma of uveal tract + esotropia	—	1	1
Congenital cataract	—	1	—
Congenital nystagmus	—	—	2
Buphthalmos	—	—	1
Angioma of eyelid	—	1	—
Heterochromia iridis	1	—	—
Gross anomaly of ocular movements	1	—	—

Fig. 1 *Spherical refraction of eyes, age 1 year, atropine, n = 3296*

Table 3

	Mean	SD	SE
Born 1974	0.9817	1.0181	0.0299
Born 1975	0.9771	1.0626	0.0322
Born 1976	1.0019	0.9865	0.0305

Table 4

	Mean	SD	SE
Born 1974	0.9593	0.9533	0.0396
Born 1975	0.9270	0.9779	0.0418
Born 1976	0.9136	0.9234	0.0405

Fig. 2 *Spherical refraction of better eye, age 1 year, atropine, n = 1648*

is no significant difference between any of these 3 samples of children. Again, the distribution curves drawn for each sample are so similar that 1 composite curve is presented (Fig. 2).

The incidence of astigmatism differs most between children born in 1974 and those born in 1975. However, this difference is not significant in terms of the numbers of individual eyes with +1.50 or more astigmatism ($P=6.148\%$) or of the number of children who had this amount of astigmatism in either or both eyes ($P=59.806\%$) (Table 5). The difference in the incidence of children who had anisometropia is most marked when children born in 1974 are compared with those born in 1976, but it is not significant ($P=5.617\%$).

The overall incidence of anisometropia was 107/1648, that is, 6.5%. The overall incidence of

Table 5 Incidence of spherical hypermetropia, astigmatism, and anisometropia

	Born 1974	Born 1975	Born 1976
Number of children with bilateral spherical hypermetropia of +2.00 or more DS	77	61	57
Incidence of bilateral spherical hypermetropia	13.3%	11.2%	10.9%
Number of individual eyes with +1.50 or more D astigmatism	102	123	113
Incidence of astigmatism +1.50 or more D in individual eyes	8.8%	11.3%	10.8%
Number of children who had +1.50 or more D astigmatism in one or both eyes	66	81	71
Incidence of astigmatism +1.50 or more D in one or both eyes	11.4%	14.8%	13.6%
Number of children who had anisometropia	45	37	25
Incidence of anisometropia	7.77%	6.77%	4.78%
Incidence of bilateral hypermetropia and/or anisometropia	104/579 = 17.96%	90/546 = 16.48%	76/523 = 14.53%
Incidence of bilateral hypermetropia and/or astigmatism of +1.50 or more D in one or both eyes	131/579 = 22.62%	134/546 = 24.54%	119/523 = 23.30%

Table 6 Association between anisometropia and spherical hypermetropia

	< +2.00 DS		+2.00 DS or more	
	No aniso.	Aniso.	No aniso.	Aniso.
Children born 1974	951	29	162	16
Children born 1975	912	26	143	11
Children born 1976	876	13	145	12
Total	2739	68	450	39
< +2.00 DS	No aniso. 2739		Aniso. 68	Total 2807
+2.00 or more DS	450		39	489
Total	3189		107	3296

P=0.000 000 1%

bilateral spherical hypermetropia was 195/1648, that is 11.83%. The overall incidence of bilateral hypermetropia and/or anisometropia was 270/1648, that is, 16.38%. The overall incidence of bilateral hypermetropia and/or astigmatism was 384/1648, that is, 23.30%. 13.23% of the children had +1.50 or more D astigmatism in one or both eyes.

An anisometropic eye is significantly more likely to be hypermetropic, for example, have a basic spherical refraction of +2.00 DS or more and vice versa (Table 6).

Also a child with bilateral spherical hypermetropia is significantly more likely to have an anisometropic eye and vice versa (Table 7).

An anisometropic eye is significantly more likely to have astigmatism of +1.50 or more D and vice versa (Table 8).

Table 7

	< 2.00 DS		+2.00 or more DS in both eyes	
	No aniso.	Aniso.	No aniso.	Aniso.
Children born 1974	475	27	59	18
Children born 1975	456	29	53	8
Children born 1976	447	19	51	6
Total	1378	75	163	32
< +2.00 DS	No aniso. 1378		Aniso. 75	Total 1453
+2.00 or more DS	163		32	195
Total	1541		107	1648

P=0.000 001 %

Table 8 Association between anisometropia and astigmatism

	< +1.50 D cyl.		+1.50 D cyl. or more	
	No aniso.	Aniso.	No aniso.	Aniso.
Children born 1974	1039	17	74	28
Children born 1975	955	14	100	23
Children born 1976	923	10	98	15
Total	2917	41	272	66
< +1.50 D cyl.	No aniso. 2917		Aniso. 41	Total 2958
+1.50 or more D cyl.	272		66	338
Total	3189		107	3296

P=0.000 000 012%

Also, a child with +1.50 D or more astigmatism in either or both eyes is significantly more likely to have an anisometropic eye and vice versa (Table 9).

Discussion

57 to 59% of the available children were refracted in each year, but those examined were not necessarily representative of the whole. Information relevant to this point, such as social class, was unfortunately not obtained.

There is no significant difference in the findings of the children born in each of the years 1974, 1975, and 1976 (Tables 1-4). The apparent decrease in the number of anisometropes has possibly arisen

because the author became more conscious of the significance of anisometropia, and this might have influenced interpretation of when the retinoscopy shadows actually 'turned'. It is also a timely reminder of how arbitrarily the criteria for 'anisometropia' were selected and that in reality isometropia gradually merges into anisometropia. For example, a child who has 2 eyes with a refraction differing by +0.75 DS/+0.75 D cyl. could be more 'anisometropic' than one whose eyes differed by just +1.00 DS or +1.00 D cyl.

When the refractions of those children born in 1974 were summarised, it was noted that the incidence of children having hypermetropia and/or anisometropia was 17.9%.⁶ This was close to the figure of 20% that had been suggested (Ingram, 1977) might be found in the child population as a whole. Attention then became focused on the incidence of anisometropia alone. Mindful of Ikeda and Wright's (1975) hypothesis that infantile anisometropia might cause stimulus deprivation amblyopia, the finding that 7.77% of 1-year-old children born in 1974 had anisometropia seemed particularly interesting, because approximately 7% of children present at some time with squint and/or amblyopia. There was also a highly significant association in this one year's sample between anisometropia and bilateral spherical hypermetropia (Table 10).

However, there was an even more significant association between anisometropia (of +1.00 or more D sphere and/or +1.00 or more D cyl.) and the presence of +1.50 or more D astigmatism in either or both eyes of a child (Table 11). This association was confirmed in the samples of children born in 1975 and 1976 and also in the overall figures for the 3 years added together: anisometropia and hypermetropia (Table 7, $P=0.000\ 001\%$); anisometropia and astigmatism (Table 9, $P=0.000\ 000\ 4\%$). This may be a very significant finding and it poses the question whether, if meridional amblyopia is a form of stimulus deprivation amblyopia (Mitchell *et al.*, 1973, Noorden, 1974), 'anisometropic' amblyopia as we understand the term might also be due to stimulus deprivation. It also led us to consider what might be the effects of an abnormal amount of hypermetropia in one or more meridians on the development of vision during the sensitive period (see Ingram *et al.*, 1979).

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Table 9

	< +1.50 D cyl. in both eyes		+1.50 D cyl. in either eye	
	No aniso.	Aniso.	No aniso.	Aniso.
Children born 1974	496	17	38	28
Children born 1975	452	13	57	24
Children born 1976	442	10	56	15
Total	1390	40	151	67
	No aniso.		Aniso.	Total
< +1.50 D cyl. in both eyes	1390		40	1430
+1.50 or more D cyl. in either eye			151	218
Total	1541		107	1648

$P=0.000\ 000\ 4\%$

Table 10

	No aniso.	Aniso.	Total
< +2.00 DS	475	27	502
+2.00 or more DS	59	18	77
Total	534	45	579

$P<0.0001\%$

Table 11

	No aniso.	Aniso.	Total
< +1.50 D cyl.	496	17	513
+1.50 or more D cyl.	38	28	66
Total	534	45	579

$P<0.0001\%$

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