

# Screening of pre-school children for ocular anomalies

## II. Amblyopia. Prevalence and therapeutic results at different ages

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It is generally assumed that early diagnosis and therapy improve the prognosis of amblyopia, and screening of pre-school children for this disease has therefore been advised by many authors (Savitz, Reed, and Valadian, 1964; Press and Austin, 1968; Gansner, 1968). The best age for screening has not yet been established, probably because of the diagnostic difficulties encountered in examining very young children.

This report presents data on the incidence of amblyopia in an almost unselected population of 5,329 children between the ages of 1½ and 6 years. The relation of the age at which amblyopia was diagnosed to therapeutic results was also studied in an attempt to clarify some of the problems related to the choice of the most suitable screening age for pre-school children.

### Methods

A detailed description of the screened population subdivided into five age groups, the screening tests used, and the procedures have already been reported (Oliver and Nawratzki, 1971).

The diagnostic criteria for amblyopia in this study were:

- (1) Unilateral tropia confirmed by the cover test;
- (2) An obvious difference in the behaviour of the child when one eye was covered, as compared with the other;
- (3) A difference of at least two lines between the two eyes, calculated for a distance of 6 m. on the visual acuity chart, with correction if necessary.

Whenever a visual acuity test could be performed, it was used as the basis for the diagnosis. In young children who did not cooperate during the visual acuity test, the diagnosis was established by the first or second criterion or both.

Children in whom these tests for amblyopia were positive were referred to the Outpatient Clinic of the Ophthalmology Department of the Negev Hospital, Beer-Sheba, for further investigations. There they were examined by an ophthalmologist, an orthoptist, and an optometrist, who decided on the diagnosis and subsequent treatment. The latter included glasses, the use of a ½ per cent. solution of atropine eye drops in the healthy eye (mainly in the younger children), conventional and inverse occlusion, pleoptic treatment (in a few of the oldest children), and surgery. The follow-up examinations and therapy were performed by the same team.

Patients with evidence of organic eye disease were excluded from the study.

## Results

Among the 5,329 children examined, a total of 67 cases of amblyopia were found – 36 boys and 31 girls. The right eye was affected in 34 children and the left eye in 33.

The prevalence of amblyopia encountered in each of the five age groups (Table I) ranged from 0.4 per cent. in the youngest age group (1½ to 2 yrs) and to 2.1 per cent. and 1.6 per cent. in the oldest age groups (4 to 6 yrs).

**Table I** Prevalence of amblyopia in each of five age groups

Age group (yrs)	A (1½–2)	B (2–3)	C (3–4)	D (4–5)	E (5–6)	Total no. of children
No. of children screened	472	1438	876	1060	1483	5329
Cases of amblyopia No.	2	9	9	23	24	67
Per cent.	0.4	0.6	1.0	2.1	1.6	Mean 1.2

Table II shows the relationship of amblyopia to ocular deviation. Cases of amblyopia without squint were not found until the age of 3 years, and in the oldest age groups 38 per cent. of those with amblyopia showed no strabismus.

**Table II** Relation of amblyopia to type of ocular deviation in each of five age groups (percentages in parentheses)

Type of ocular deviation	Age group (yrs)				
	A (1½–2)	B (2–3)	C (3–4)	D (4–5)	E (5–6)
Esotropia	2	8(89)*	6(67)*	12(52)*	13(54)*
Exotropia	–	1	–	2(9)*	2(8)*
No tropia	–	–	3(33*)	9(39)*	9(38)*

\*In this Table the percentages are calculated for the total number of children with amblyopia in the same age group

Table III lists the prevalence of the different refractive errors associated with amblyopia in relation to the type of ocular deviation. There was a high incidence of hypermetropia,

**Table III** Prevalence of different refractive errors in children with amblyopia in relation to type of ocular deviation (percentages in parentheses)

Type of ocular deviation	No. of cases	Refractive error					
		Hypermetropia		Myopia		Astigmatism	Anisometropia
		Less than 3D	3D and more	Less than 3D	3D and more	2 D and more	2 D and more
Esotropia	41	11(27)	30(73)	–	–	6(14.6)	5(12)
Exotropia	5	–	1	2	2	3	2
No tropia	21	3(14)	12(57)	3(14)	3(14)	6(28.6)	13(62)

equal to, or more than 3 diopters, in cases of amblyopia without squint (57 per cent.) or associated with esotropia (73 per cent.). Astigmatism of 2 diopters or more was found in 14.6 per cent. of the children with esotropia and in 28.6 per cent. of those without strabismus. Anisometropia of 2 diopters or more was encountered more frequently in cases of amblyopia without ocular deviation (62 per cent.) than those with esotropia (12 per cent.). A group of five children showing amblyopia with exotropia was considered not to be of statistical significance and thus the prevalences of refractive errors in this group were not calculated.

Table IV shows the therapeutic results for the different age groups in terms of improved visual acuity. Since the number of very young children was small, the therapeutic results for Groups A and B were combined as one group treated before the age of 3 years. Only children with a follow-up period of at least 6 months after treatment were included in these results, and for this reason two children in age group E were excluded. A visual acuity of at least 6/12 or 3/9 was considered to be a good therapeutic result only if the difference in visual acuity between the normal and amblyopic eye was not more than one line. Good therapeutic results using the criteria described above, were obtained in 64 to 69 per cent. of the treated children in all age groups.

**Table IV** *Therapeutic results in terms of improved visual acuity, in each age group*

Age group (yrs)	Number of cases	Good visual acuity obtained*	
		No.	Per cent.
A and B (1½-3) 472 + 1,438	11	7	64
C (3-4) 876	9	6	67
D (4-5) 1060	23	16	69
E (5-6) 1483	22**	15	68
Total	65	44	mean 67

\*"Good visual acuity obtained" was defined as a visual acuity of at least 6/12 or 3/9, the difference in vision between the normal eye and the amblyopic eye being not more than one line.  
\*\*In this group two children were excluded because of a follow-up period of less than 6 months.

Of 46 children having amblyopia associated with squint, only twelve (26 per cent.) became alternators at the end of the treatment period.

## Discussion

Opinion still differs regarding the prevalence of amblyopia in the general population; recorded incidences range from 1 to 5.3 per cent. (Downing, 1945; Cole, 1959; Helveston, 1965; Flom and Neumaier, 1966). These differences are based on the various methods and criteria employed. This is also evident when the findings of Gansner (1968) are studied. She examined 11,000 children between the ages of 4 and 8 years and found amblyopia in 2.2 per cent. However, when the diagnostic criteria for amblyopia were strict, *i.e.* visual acuity 6/18 or less, the incidence of amblyopia was found to be as low as 0.45 per cent.

Our findings indicate that, in pre-school children, there is a tendency for the prevalence of detected amblyopia to increase with age (Table. I) The hypothesis that the prevalence

remains constant, can be rejected at the 1 per cent. significance level (according to the Mann-Whitney test with ties, Kendall, 1955), despite the fact that the differences between individual age groups are not significant. The low incidence of amblyopia in the younger children (1½ to 3 yrs) seems to be related mainly to the difficulty of diagnosing amblyopia at this age. Children less than 3 years old are not cooperative during the visual acuity tests and the acceptance of a difference in the child's behaviour when one eye is covered in comparison with the other as a diagnostic criterion also appears to be somewhat unreliable and inaccurate. Despite the fact that unilateral tropia may exist without amblyopia, the main diagnostic feature of amblyopia at this age is unilateral tropia, confirmed by the cover test; accordingly, cases of amblyopia without obvious tropia are often overlooked in small children. Table II shows that, after the age of 3 years, at least 33 per cent. of the cases of amblyopia do not squint, and all these cases were discovered by means of a visual acuity test. The increased prevalence of amblyopia without ocular deviation is due to the better cooperation of children at this age (Oliver and Nawratzki, 1971). As shown in Table III a high prevalence of anisometropia (62 per cent.) and/or astigmatism of 2 diopters or more was found in these cases.

A comparison of the therapeutic results shows that, until the age of 6 years, there are no great differences in the response of children of different age groups; in 67 per cent. of the children with amblyopia the visual acuity improved to at least 6/12. These findings are consistent with the therapeutic results reported by Scobee (1951), who studied 91 amblyopic children over 5 years of age, of whom 69 per cent. achieved a visual acuity of 6/12 (20/40) or more after therapy. Similar results were reported by Dowling (1942) and Kasser and Feldman (1953).

These findings suggest that up to the age of 6 years there is no critical period for the treatment of amblyopia as far as results are concerned. Therefore, it seems best to screen pre-school children at the age at which the greatest number of cases can be detected. Most children with amblyopia can be diagnosed at the age of 4 years and this is perhaps the best age for screening. There is little doubt, however, that early treatment of amblyopia has many advantages, including the prevention of the establishment of sensory anomalies. It is also a common experience that younger children accept amblyopic treatment more easily than older children and require a shorter period of treatment so that it is completed before they start school. Since it is doubtful whether screening at the age of 4 years can fulfil all these requirements, it seems advisable that the first screening should be performed at about the age of 3 years. At this age, all the cases of amblyopia associated with tropia will be diagnosed and possibly some of the non-squinting cases. The screening should be performed by orthoptists since professional skill and experience are required. Many amblyopic children without ocular deviation may be overlooked at the age of 3 years, and it is therefore advisable for an additional visual acuity test to be performed at kindergarten age (5 years), when children are generally cooperative and visual acuity tests can be performed with relative ease (Oliver and Nawratzki, 1971). Furthermore, screening at the kindergarten age, under standard conditions, can also be performed by relatively unskilled examiners, including kindergarten teachers and nurses who have not been specially trained for this purpose.

### Summary

5,329 children aged 1½ to 6 years were screened for amblyopia and subsequently divided into five age groups. There was a significant increase in the prevalence of amblyopia with age, from 0.4 per cent. in the youngest to 1.6–2.1 per cent. in the oldest. Above the

age of 3 years, at least 33 per cent. of the patients with amblyopia did not squint and were diagnosed by means of visual acuity tests. They were probably not diagnosed earlier because of lack of cooperation.

Successful therapeutic results were obtained in about 67 per cent. of the cases and were similar in the various age groups. Until the age of 6 years, it appears that there is no critical age for the treatment of amblyopia, but a number of reasons appear to justify a screening test at the age of 3 years. Cases of amblyopia (mostly without squint) not diagnosed during this first screening period may be discovered later by a routine visual acuity test.

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