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Screening of pre-school children for ocular anomalies

I. Screening methods and their practicability at different ages

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The screening of pre-school children for ocular anomalies, particularly amblyopia has been advised by Sheridan (1960), Savitz, Reed, and Valadian (1964), Aaberg (1968), Press and Austin (1968), and Gansner (1968). However, many of the difficulties associated with screening programmes of this nature have not yet been solved. Most children under 4 years of age do not attend kindergarten or other institutions, where opportunities for group visual screening are more readily available. Furthermore, though a variety of screening tests have been suggested for small children (Sheridan, 1963; Press and Austin, 1968), there is no agreement on which best fulfils the necessary requirements.

This report represents data based on the screening of 5,329 pre-school children. The method of screening is described and the practicability of the tests used is discussed in relation to the age of the subjects.

Material and methods

The screening was performed in Beer-Sheba, a town of 70,000 inhabitants, most of whom are recent immigrants to Israel. Approximately half of the population is from North African countries (Morocco and Tunisia) and the rest are immigrants from different countries of the world. The screening period was August, 1967, to November, 1968. The children were screened in Mother and Child care clinics or kindergartens. The former are National Health Institutions providing regular antenatal care for pregnant women and medical services for children from birth to school age. The attendance at both these institutions is generally very high – approximately 90 per cent. in Mother and Child care clinics, and almost 100 per cent. in the kindergartens. This study is based on a random sample of children in these institutions.

Children

Two major groups of children were considered (Table I, opposite):

CLINICS 3,472 children aged from 1½ to 6 years, were invited for examination according to their date of birth, beginning with those born in 1965.

KINDERGARTENS 1,857 children were examined, most of whom were aged 4 to 6 years.

The screened population was subdivided into five age groups, according to age at time of screening.

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Table I *Screened population subdivided according to age at time of screening*

Population	*Total no. of cases*	*Age group (yrs)*				
		A (1½–2)	*B* (2–3)	*C* (3–4)	*D* (4–5)	*E* (5–6)
Mother and child care clinics	3,472	472	1,438	845	497	220
Kindergartens	1,857	–	–	31	563	1263
Total	5,329	472	1,438	876	1,060	1,483

Screening tests

These were performed by orthoptists:

(1) Hirschberg corneal reflex and cover tests

(2) Visual acuity tests

(*a*) Small toys (Sheridan, 1963). The size of toys chosen correlated with a visual acuity of 6/60, 6/30, 6/21, 6/12, and 6/9.

(*b*) Matching tests, according to a modification of the method of Sheridan (1963): (*i*) Matching with numbers; (*ii*) Matching with pictures (Metallene Surgical Instruments Co.). In both these tests, the symbols were taken from conventional visual acuity charts.

(*c*) Picture charts.

(*d*) Illiterate E charts

Screening procedure

At the time of screening, every child was accompanied by one or both parents, who were asked to provide a general and ophthalmological history according to a scheduled questionnaire. Medical data was also obtained from the family records of the clinics. Thereafter, Hirschberg and cover tests were performed. The cover test for near was done in all cases and kindergarten children were also tested for distance.

Finally the visual acuity was assessed. To ascertain the degree of cooperation, the visual acuity testing began at a distance of 50 cm. with both eyes uncovered. If the child did not provide reliable answers or did not reply at all, he was considered "non-cooperative", and another visual acuity test was attempted as above. Only children who cooperated for a given visual acuity test were examined at a testable distance (3 m. at Mother and Child care clinics and 6 m. at kindergartens), using the same test.

Different visual acuity tests were used for each of the major groups:

In the Mother and Child care clinics the tests attempted included small toys, both matching tests and picture charts. Children who were examined at the beginning of this study (aged 1½ to 3 years) were examined by each of the tests mentioned above. The older groups (3 to 6 years) were tested mainly with picture charts. All these tests were performed at a distance of 3 m.

In the kindergartens a group explanation of the technique of examination was given to the class. This included a test demonstration using a child recommended by the teacher. An illiterate E chart test was performed on every child. Children who did not cooperate during this examination were subsequently examined with picture charts. Both tests were performed at a distance of 6 m. Children who did not cooperate with the illiterate E chart test or who gave unreliable answers for picture charts test at a distance of 6 m. were examined with picture charts at a distance of 3 m. Finally, if a kindergarten child did not cooperate with any of these visual acuity tests, he was referred for subsequent ophthalmological examination.

All screening and clinical data were compiled for each child on questionnaires designed for computer analysis.

Results

In this report only the results relating to the practicability of the screening tests are reported. The clinical findings will be the subject of a later report.

(1) Hirschberg and cover tests: It was possible to perform these tests on almost every child.

(2) Visual acuity tests: These were evaluated by considering the percentage of children cooperating during a given test in each age group. Since the methods used were different in Mother and Child care clinics and kindergartens, the results were reported separately and the numbers of cooperative children are summarized in Tables II and III.

Table II *Visual acuity tests in Mother and Child care clinics. Number and percentage of cooperative children with the different visual acuity tests in relation to age groups.*

Age group (yrs)	*No. of children*	*Visual acuity test*							
		Small toys		*Matching pictures*		*Matching numbers*		*Picture charts*	
		No. of cooperative children	*Per cent.*	*No. of cooperative children*	*Per cent.*	*No. of cooperative children*	*Per cent.*	*No. of cooperative children*	*Per cent.*
A 1½–2	472	29	6·1	6	1·2	2	–	25	5·3
B 2–3	1,438	122	8·4	19	1·3	2	–	193	13·4
C 3–4	845	Not performed						447	53
D 4–5	497	Not performed						406	81·7
E 5–6	220	Not performed						196	89

Table III *Visual acuity tests in kindergartens. Number and percentage of cooperative children in relation to age groups*

Age group (yrs)	*No. of children*	*Visual acuity tests*									*Total no. of cooperative children*	*Overall percentage cooperative*
		Illiterate E charts (6 m.)			*Picture charts*							
					6 m.			*3 m.*				
		No. screened	*No. co-operative*	*Per-centage co-operative*	*No. screened*	*No. co-operative*	*Per-centage co-operative*	*No. screened*	*No. co-operative*	*Per-centage co-operative*		
C 3–4*	31	31	2	–	29	16	–	13	8	–	26	–
D 4–5	563	563	238	42·3	325	286	88	39	10	25·6	534	94·9
E 5–6	1,263	1,263	919	72·7	344	291	84·6	53	8	15·1	1,218	96·5

*This age group was too small and without statistical significance

MOTHER AND CHILD CARE CLINICS (Table II)

Children of the lowest age groups A and B were least cooperative when matching tests were used. Cooperation improved when small toys and picture charts were employed. Only 5·3 per cent. of the children in age group A cooperated with picture charts compared with 89 per cent. in age group E.

KINDERGARTENS (Table III).

The prevalence of cooperation with illiterate E charts was 42·3 per cent in age group D and 72·7 per cent. in age group E. Of the remaining "non-cooperative" children, 88 per cent. in age group D and 84·6 per cent. in age group E cooperated with picture charts at a distance of 6 m. Of the "non-cooperative" children tested with both the above tests, 25·6 per cent. in age group D and 15·1 per cent. in age group E cooperated with picture charts at a distance of 3 m. The overall percentage cooperation in children aged 4–5 years was 94·9 per cent., and in those aged 5–6 years it was 96·5 per cent. In age group C, consisting of 31 children, the prevalence of cooperation was not calculated as there was no statistical significance to such a small group of children.

In Table IV the percentages of cooperative older children (age groups D and E) of Mother and Child care clinics and kindergartens are compared. The figures for kindergarten children are related to the overall cooperation in all the visual acuity tests.

Discussion

Screening tests for the detection of amblyopia and binocular disturbances in young children should be designed to be independent of cooperation and easy to perform. With the conventional methods of examination at our disposal, no single test can fulfil these requirements, and accordingly, in the present study, every child was screened with three tests.

The Hirschberg and cover tests provided information which to a great extent was not dependent on the degree of cooperation. Since it was possible to perform both these tests with almost every child, even in the lowest age groups, they proved very valuable. Nevertheless, they do not provide adequate information on ocular anomalies unassociated with squint. In the present study different visual acuity tests were performed in an attempt to determine the best method of screening for each age group and the value of these tests was assessed in relation to their accuracy and the extent of cooperation in the different age groups.

In age groups A and B (1½–3 years), the visual acuity tests used proved to be of little value until the age of 3 years, mainly because of lack of cooperation.

In age group C (3–4 years), 53 per cent. of the children could be screened with picture charts. It is probable, however, that a high percentage of ocular disturbances still remained undetected in the "non-cooperative" children. Whether this age group is suitable for screening will be discussed in later reports, taking into account the incidence of anomalies diagnosed at this age.

Table IV *Visual acuity tests. Comparison of percentage of cooperative children in the older age groups in clinics and kindergartens.*

Age group (yrs)	*Prevalence of cooperation in mother and child care clinics*	*Prevalence of cooperation in kindergartens**
D 4–5	81·7	94·9
E 5–6	89	96·5

*The figures for kindergartens are related to the overall cooperation obtained during all the visual acuity tests

In age groups D and E (4–5 years), cooperation was high. The kindergarten children were significantly more cooperative (94·9 and 96·5 per cent.) than those of corresponding age examined in the Mother and Child care clinics (81·7 and 89 per cent.) (Table IV).

This may be related to the fact that children regard the clinics as medical institutions and are less relaxed. In the kindergartens, the test was regarded as a game and the children

volunteered to be examined. Moreover the methods of testing visual acuity in the two groups were different.

The picture chart test was more understandable to the children than the illiterate E chart. However, the latter is more accurate, and a fairly high percentage of children aged 4–6 years were cooperative in performing it. It therefore seems advisable to screen the visual acuity of children of this age by the method used in the kindergartens.

The results of this survey are not in accordance with those of Press and Austin (1968). In their study the children were examined at home by their own parents using Sjögren visual acuity charts, and a higher rate of cooperation was apparently obtained in the 3–4 year old children. It is possible that the Sjögren charts are more easily understood than the illiterate E charts, although their accuracy does not exceed that of picture charts. The higher degree of cooperation is probably also related to the fact that the Press screening method was confined to a population which mainly included children of high and middle-class levels. In the present survey the population consisted mainly of children of the lower social level with a minority of middle-class children. It is also possible that the Press results were related to the fact that the tests were performed by untrained staff in a home environment

Summary

(1) A total of 5,329 pre-school children (aged $1\frac{1}{2}$–6 years) were screened for ocular anomalies in two separate localities and classified in five age groups.

(2) The screening tests included: the Hirschberg corneal reflex and cover tests and visual acuity tests comprising small toys, matching tests, picture charts, and illiterate E charts.

(3) It was possible to perform the Hirschberg and cover tests with every child.

(4) Different degrees of cooperation were found in the five age groups using the visual acuity tests:

(*a*) Up to the age of 3 years only a small percentage of children cooperated in visual acuity examinations no matter what test was used.

(*b*) From 3 to 4 years 53 per cent. of children cooperated using picture charts.

(*c*) At the age of 4 to 6 years a high degree of cooperation was found (up to 96 per cent.). It is suggested that visual acuity should be examined at this age with the illiterate E charts, and that picture charts should be used with "non-cooperative" children.

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