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CHILD HEALTH

Vision and eye problems in seven year olds: a report from the Dunedin Multidisciplinary Health and Development Research Unit

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Abstract

An eye examination, including tests of distance visual acuity, near visual acuity, cover tests, and an examination of pupils, eyes, adnexia, and eye movements, was carried out on 988 Dunedin children within approximately one month of their seventh birthday. Information concerning glasses and patching of one eye was obtained by questionnaire. Eye defects were noted in 9.4% of the children with several having more than one problem. Eye defects noted included 5.1% with unaided distance visual acuity of 6/12 or worse in one or both eyes, 4.4% with near visual acuity of the equivalent of N8 or worse in one or both eyes, 3.9% had manifest strabismus, 2.9% had had occlusion of one eye for amblyopia, and 1.2% had other important eye defects. Glasses had been prescribed for 3.6%.

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Introduction

Normal visual function has always been considered to be important for the normal development of the child, so visual acuity screening has been carried out in New Zealand schools by public health authorities for many years. Attempts to accurately measure visual acuity at younger ages (at Plunket, kindergarten, and playcentres) are also being made so that defective visual acuity can be detected and treated before school entry.

The reported prevalence of defective vision varies from place to place. Part of this variation is caused by different definitions of defects and varying screening and assessment techniques.

In New Zealand in 1972, Ellingham et al [1] found visual defects in 5.9% of preschool children and Department of Health Statistics [2] show that of the children tested at school entry in 1979, 6.7% had a visual acuity of 6/12 or worse in one or both eyes (or alternatively had a vision of 6/9 in one or both eyes (or alternatively had a vision of 6/9 in one or both eyes several years running). The percentage found to have a suspected defect, however, varied from 1.2% in one district to 24.4% in another. Another factor to be considered is that acuity screening on its own may fail to detect children in need of treatment because of other eye defects such as strabismus.

Table 1.-Distance visual acuity at seven years (n = 988).

In order to plan effective medical services, it is important to know the prevalence of vision and eye problems in the community. The Dunedin Multidisciplinary Health and Development Research Unit has been investigating the prevalence and significance of vision problems in a cohort of children. This paper reports the prevalence of eye problems detected at age seven years.

Method

Subjects: The Dunedin Multidisciplinary Health and Development Research Unit is studying the long term growth and development of a group of children born at Queen Mary Hospital, Dunedin, between 1 April 1972 and 31 March 1973 whose mothers were resident in the metropolitan area at the time of birth. In all, 1037 children were traced for study at age three years and a further 123 were traced tor school entry (the added sample). A total of 988 children were assessed at the research unit within approximately one month of their seventh birthday [3].

Socio-economically, as determined by the father's occupation using the Elley and Irving scale (4), this sample was slightly advantaged in comparison to the expected New Zealand frequency. It was under-representative of the Maori and Polynesian races compared with the country as a whole, being 95.5% European, 3.5% whole or part Maori or Polynesian, and the remaining 1% were other or mixed races. The sample is fully described elsewhere [3].

Vision group	Better eye	Other eye	Unaided	With glasses	
		-	ejo	if available	
Optimal	6/6	6/6	89.0	89.4	
Near optimal	6/6	6/9	4.1)	4.9	
	6/9	6/9	1.7 5.9	2.1 7.0	
Sub total			94.9	96.4	
Unilateral impairment moderate	6/6	6/12	0.6 0.7	0.5 } 0.6	
		6/18	0.1	0.1)	
	6/9	6/12	0.7	^{1.0} .,	
		6/18	0.3	0.2	
Sub total			1.7	1.8	
Unilateral impairment severe	6/6	6/24	0.1 0.6	0.1 3 0.6	
	worse than	6/24	0.5	0.5	
	6/9	6/24	- 101	-	
	worse than	6/24	0.1	_	
Sub total			0.7	0.6	
Bilateral impairment moderate	6/12	6/12	0.7 1.0	0.4 0.5	
		6/18	0.3	0.1)	
	6/12	6/24	- 1 0.1	-101	
	worse than	6/24	0.3)	0.1	
	6/18	6/18	0.1)	0.1)	
		6/24	- } 0.2	2 0.1	
	worse than	6/24	0.1)	/	
Sub total			1.5	0.7	
Bilateral impairment severe	worse than 6/24 each eye		0.7		
Other	6/6 in only eye		0.1	0.1	
Inable to be tested			0.4	0.4	
Total			100.0	100.0	

· Rounding Error

Measures: Distance visual acuity: Distance visual acuity was assessed using the Sheridan Gardiner single optotype letter matching test at 6 m (3). Each eye was tested separately and the contralateral eye was occluded. The tests were performed without glasses and repeated with glasses, if they were available.

Near visual acuity: Near visual acuity was measured using reduced single letters of the type used in the Sheridan Gardiner distance visual acuity test [3]. These were reduced photographically to be equivalent in size to the N₃, N₆, N₆, and N_{1.4} size of the British Faculty of Ophthalmologists tests [6]. The results are recorded as N₃, N₆, N₆, and N_{1.4}. These single letters (using a frame to hold them) were presented to the child at a set distance of 37 cm. Like the distance visual acuity test, this test was carried out on each eye separately, with the other eye occluded, without glasses, then repeated with glasses if they were available.

Visual acuity testing was carried out by a Department of Health vision tester seconded to the research unit (CK).

Cover test: An alternate cover test and a cover-uncovertest were carried out by one of us (AS) to detect latent and manifest strabismus. These tests were performed with the child fixating a small target at approximately 0.5 m. The eye movements were assessed in nine positions of gaze to test for the presence of non concomitant strabismus.

General eye examination: Abnormalities of the pupils, eyes and adnexia were noted by the physician but funduscopic examination was not carried out.

Questionnaire: Information was collected by questionnaire from the mother as to whether the child had ever had glasses prescribed, whether the glasses were still being worn and whether one eye had ever been patched. The information obtained by questionnaire was confirmed, where possible,

Table 2.-Near visual acuity at seven years (n = 988).

by reference to records in the ophthalmology department of the Dunedin Hospital.

Results

Distance visual acuity: Visual acuity results are reported for 984 children. Four children could not be tested because of intellectual handicap. Table 1 presents the visual acuity of one eye in relation to the other, both with and without glasses.

A total of 97.4% (99.0% with glasses) of children in the sample had a visual acuity of 6/9 or better in at least one eye.

Of the 22 children with vision worse than 6/12 in the better eye 19 had been prescribed glasses, (one failed to bring them to the research unit).

Near visual acuity: The near visual acuity of one eye in relation to the other, both with and without glasses is shown in Table 2.

A total of 98.1% (99.0% with glasses) of the children had a near visual acuity of N5 or better in at least one eye.

Distance and near visual acuity: Only three children with optimal distance visual acuity had reduced near acuity (N3, N5; N3, N6; and N8, N8) and four children with near optimal distance visual acuity had reduced near visual acuity (N3, N5; $2 \times N5$; N8; N5, N14).

Glasses: A total of 36 children (3,6%) had been prescribed glasses. Three had been told that they no longer needed to wear glasses and three did not bring them to the research unit. The distance and near visual acuity of the 30 children tested wearing glasses is shown in Table 3.

The unaided visual acuity of the three children who did not bring their glasses to the assessment centre was 6/6 and

Vision group	Better eye	Other eye		Unaided	With glasses if available %	
				970		
Optimal	N3	N3	37 - 51	90.9	92.2	
Near optimal	N3	N5		2.9	3.3	
	N5	N5		1.8 4.7	1.75 3.10	
Sub total			· ·····	95.6	97.3	
Unilateral impairment (moderate	N3	N8		0.4	0.5 } 0.9	
		N14		0.5)	0.4)	
	N5	N8		1.0	0.6	
		N14		0.2	_ } 0.6	
Sub total				2.1	1.5	
Unilateral impairment	N3	>N14		0.3	0.2	
(severe	N5	>N14		-	-	
Sub total				0.3	0.2	
Bilateral impairment	N8	N8		0.2)	0.1)	
		N14		0.3 0.6	0.1 0.3	
		>N14		0.17	0.17	
	N14	N14		0.5	0.1	
		> NI4		0.6	§ 0.1	
	>N14	>N14		0.17	-,	
Sub total				1.4	0.4	
Other	N3 in only ex			0.1	0.1	
Unable to be tested	in only of	-		0.4	0.1	
Total				99.9*	100.0	

Rounding error

able 3Visual acuity of children aged seven years who were tested wearing glasses. Results are numbers of child	fren.
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					are numbers of emarca.				
	Dis visual	Distance visual acuity		With glasses	Near visual acuity		Without	With	
-	Better eye	Other eye	-	-	Better eye	Other	Busses	Biasses	
Optimal	6/6	6/6	3	7	N3	N3		18	
Near optimal		6/9	ī	8		N5	3	7	
	6/9	6/9	i	5	N5	N5	ĩ	_	
Unilateral impairment	6/6	6/12	2	1	N3	N8	1	2	
(moderate)		6/18	_	-		N14	-	1	
	6/9	6/12	1	4	N5	N8	4	_	
		6/18	2	1		N14	2	-	
Unilateral impairment	6/6	6/60*	1	1	N3	N14•	1	_	
(severe)	6/9	6/60*	1	-	N5	N14*	1	-	
Bilateral impairment	6/12	6/12	4	1	N8	N8	ı	-	
		6/18	3	-		N14	3	1	
		6/60*	2	1		N14*	1	1	
	6/18	6/18	1	1	N14	N14	4	_	
		6/60*	1	-		N14*	1		
	6/60*	6/60*	7		N14*	N14*	2	-	
Total			30	30			30	30	

* denotes "worse than"

N3 in the better eye in two children but only 6/12 and N14 in the better eye in one child.

The relationship between the prescription of glasses and decreased visual acuity is shown in the Venn diagram (Figure 1). This diagram shows the overlap between those children wearing glasses and those children with decreased visual acuity-6/12 (distance) or N8 (near) or worse in the better eye. If glasses were prescribed for all these children, four more children would have been prescribed glasses, a total of 40 (4.0%).

Strabismus: Manifest strabismus (squint) was found to be present in 39 (3.9%) of the children. In 29 the squint was



Figure 1 .- Venn diagram: children with decreased distance visual acuity (6/12 or worse in better eye) Decreased near visual acuity (N8 or worse in better eye) and children who wear glasses.

detected on cover test-20 with convergent, six with divergent and three with mainly vertical squints. Squints which were only detected on examination of the eye movements were found in seven children (five had deviation on elevation and adduction of the eye). The remaining three children had no squint detected with glasses on but had manifest squints (two convergent and one divergent) when tested without glasses. Of the 39 children with manifest strabismus, 11 had been prescribed glasses and a further five had vision of 6/12 or worse in one eye (including one child with a cataract).

Latent convergent squint was found in 29 (2.9%) of the children. Other eye problems were detected in eight of the 29 children with latent convergent squint. Two had been prescribed glasses, two had vision of 6/12 or worse, one had had a recent squint operation, and three had only a slow recovery to presumed binocular single vision.

Latent divergent squint was noted in 182 children (18.4%). Only four out of 182 children with latent divergent squints had other eye problems detected. One had a manifest squint for distance, one a non concomitant squint, one had poor convergence, and one had been prescribed glasses.

Amblyopia: Treatment of amblyopia by patching one eye was confirmed in 29 children (2.9%). Of these children 14 had manifest squints, five had latent convergent squints and one had a latent divergent squint. Glasses had been prescribed for 17 of these amblyopic children including five who also had squints. The visual acuity (with glasses if worn) in the amblyopic eye was 6/6 in ten, 6/9 in eight, and 6/12 or worse in 11.

Other eye problems: Twelve children (1.2%) had other eye problems. One had had uniocular retinoblastoma. One had a unilateral cataract (vision worse than 6/60 and N14 in the affected eye). One child had a suspected congenital Horner's syndrome while five children had slight ptosis with normal pupils. A further three children had abnormal pupils-one had an eccentric pupil, one had an enlarged, sluggishly reacting pupil following chickenpox, and one had unequal sized but briskly reacting pupils. One child had a congenital nystagmus.

Discussion

Distance visual acuity testing in the Dunedin study shows slightly better results than those found in Britain for seven year old chidren [71: eg, in Dunedin, 89% of the children bad 6/6 vision in each eye in comparison with 80% in Britain. There were, however, slight differences in methodology. In Dunedin the Sheridan Gardiner single optotype letter matching test was used and testing done in the same well lit room by one examiner, while in Britain, a standard Snellen chart was used, there were many testers working in many different schools.

Only one child was identified as having a significant near vision problem (N8 in each eye) while having 6/6 distance vision in each eye. This suggests that at age seven years, when there is good accommodation, screening for near visual acuity is not necessary.

In Dunedin 3.6% of the children had been prescribed glasses while 6% in Britain had glasses [7]. Possible reasons for this difference are a real difference in the refractive errors of the children, a difference in the detection rate of refractive errors, or a difference in prescribing practices in the two countries. The refractive errors of the children are not known in either Dunedin or Britain. As noted above, there was a slight difference in the visual acuity measurements in the two samples.

In children who wore glasses, unaided vision in the better eye was 6/6 in 23.3% and 6/9 in 16.6% in Dunedin compared with 45.4% and 23.1% respectively in Britian [7]. This suggests that there may be differences in prescribing practices in the two countries with the British prescribing glasses more often for uniocular decreased vision.

In Dunedin, 10% of those who wore glasses and in Britain, 15% [7] had vision of 6/12 or worse in the better eye when tested with glasses on. This figure underlines the importance of the recommendation made by the National Children's Bureau [8] that children who wear glasses should still sit near the front of the class at school as even after correction, a substantial proportion still have sub optimal vision.

The prevalence of manifest squint was 3.9% in Dunedin and increased to 4.3% if those four children with poorly controlled latent squints are included. Since some children may have been treated for squint and perhaps cured by age seven years, the true prevalence of squint is probably higher.

Of the children with manifest strabismus, 41% wore glasses or had distance vision of 6/12 or worse in one eye. Because of earlier treatment it was difficult to assess from this data the importance of latent squints but since latent divergent squints are common and rarely associated with other eye problems it may be unnecessary to refer children for specialist assessment because of an isolated latent divergent squint.

Only children with permanent eye problems which might have needed investigation, follow up, or treatment were noted in this study. Transient problems such as conjunctivitis were not noted. A total of 12 children (1.2%) had abnormalities (mostly congenital) of the eye and adnexia. A child was defined as having an eye defect if he/she wore glasses, had vision of 6/12 (distance) or N8 (near) or worse in one eye, had a manifest squint, or a latent squint which broke down on testing to a manifest squint, or had a permanent eye problem as described above. Using this definition, 93 children (9.4%) had eye defects while some children had more than one problem.

Only 5.1% of the children (those with distance visual acuity of 6/12 of worse) were detected by a visual acuity screening examination. Fourteen children, however, who had been treated for amblyopia now had vision of 6/6 or 6/9 in each eye. It is assumed that these children would have been detected by visual acuity screening at a younger age. If they were included, a total of 6.5% would have failed a visual acuity screening test. This means that approximately 3.0% of the children had eye defects which would not have been detected on visual acuity screening. It is not yet known whether these children would have been noted as needing referral without a screening examination.

In order to plan health services for screening and treatment of eye problems it is necessary to know the prevalence of eye problems, which problems have been noted and referred without screening tests, and the significance of the problems for the development of the child. Further analysis of the data collected in this longitudinal study since age three years should provide this information.

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Reprints: Requests for reprints to Dr Anne Simpson, Dunedin Multidisciplinary Health and Development Research Unit, PO Box 913, Dunedin.

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Japan's unplanned medical system is proving the most economic with the best health delivery per few dollars spent . . . it successfully has the fewest doctors, the highest life expectancy, the lowest recorded infant mortality and fewest deaths from heart disease; it also has the fewest workdays lost through workers saying they are sick . . . in every industry the reaction to output figures from Japan has been "at first deny, then copy". Other rich countries will some day suddenly imitate some features of Japan's medical system, including its emphasis on preventive medicine and extensive use of unqualified medical staff. There will be huge political and professional ructions as they do.

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