A SURVEY OF THE INCIDENCE OF DEFECTIVE VISION AND STRABISMUS IN KINDERGARTEN AGE CHILDREN – SYDNEY, 1976

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Introduction

In recent years much attention has been given to the early detection of visual defects in young children. It is recognised that early diagnosis of strabismus and associated visual defects improves the chance of restoring maximum visual acuity and of preventing deep amblyopia (Lyle[9], Burian & von Noorden[4]).

A study of 5,000 children of kindergarten age in the Sydney metropolitan area was made, with a view to determining the visual norm of kindergarten age children, the proportion of children with reduced vision, the proportion with latent or manifest strabismus, and the degree of convergence ability and level of stereo-acuity to be expected in the normally sighted child.

Personnel

All tests were performed by orthoptists from Sydney Eye and Prince of Wales Hospitals, and from the Western Metropolitan area. Each orthoptist used similar apparatus and steps were taken to ensure that the methods of examination and recording were as uniform as possible.

As the results of this survey were to be used for the updating of the standards for referral by the School Medical Service, it was decided that all tests should be conducted in the school clinic or similar area. While conditions are not always ideal they are conditions that would realistically be encountered by any screening programme in the schools.

Sample

5430 children of kindergarten age from 51 specifically selected public schools were examined. The schools selected had an infant enrolment of 200 upwards to ensure that a statistical and therefore truly representative sample of children from the Sydney Metropolitan area was maintained. Socio-economic and ethnic grouping was considered in the selection of this sample. Special schools (for the intellectually and physically handicapped and non-government schools) were excluded. Written parental permission was required of all children. Date of birth of the child and place of birth of the child and the parents were also requested.

Tests Performed

1. Visual acuity was tested at 6m with the Snellen's test type, using the Sheridan Gardiner board of magnetic letters. Vision was recorded as the lowest line in which more than half the letters were read correctly.

2. Near visual acuity was tested at 1/3m with the Sheridan Gardiner near test type.

3. The cover test for near (1/3m) with an accommodative target and distance (6m) was chosen simply to detect the presence or absence of a manifest or latent strabismus. The deviation, when detected,was not measured.

4. The convergence near point was measured and annotated according to the R.A.F. rule. Convergence ability was classed as normal (0-5 cms), reduced (6-10 cms) and defective (11 cms+).

5. Stereo acuity was measured with the Titmus Test.

Results and Discussion

5430 children were tested of whom 52% were boys and 48% were girls. Of the 5396, who gave a date of birth, the majority (86%) were aged between 5 and 6 years. (See Appendix Table 1).

Visual Acuity

The survey was initiated to determine the visual norm of kindergarten age children in the

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Sydney Metropolitan Area and to determine what proportion of the children had vision which fell below the norm, and therefore needed further investigation. It is important to note that all children were able to manage the Sheridan Gardiner magnetic board (Macfarlane 10)with ease to indicate the matching letter, even though they might not be able to name it. Illiteracy, as such, was not a problem.

80% of the children without glasses were found to have 6/6 or better vision in both eyes. (See Appendix Table II). It would be reasonable, therefore, to regard 6/6 as the visual norm for children of kindergarten age in the Sydney Metropolitan Area.

20% of the children without glasses were found to have less than 6/6 in at least one eye. (See Appendix Table III). This survey was not designed to identify the reasons for vision which fell below the norm, but one may hypothesise about the possible causes.

There was no provision made for the recording of congenital defects e.g. nystagmus or congenital cataract, and some of the children with reduced vision may fall into this group.

11% of those with reduced vision had strabismus, so in these cases strabismic amblyopia may be part of the cause for the reduced vision.

It is interesting to note that,of the 20% with reduced vision, 13.7% had only slightly reduced vision, i.e. either 6/9 in both eyes, or 6/9 in one and 6/6 or better in the other eye. (See Appendix Table III).

Comparison of visual acuity levels at different ages (see Appendix Table IV) shows a progressive increase with age of the proportion of children reading 6/5 and a decreasing proportion reading 6/9 or less. This agrees with Dunlop's finding (Page 20 of this journal).

It is likely that failure of some children to read 6/5 may be due simply to inattention, lack of familiarity with the test, or lack of confidence in the test situation. 113 children are recorded (Appendix Table II) as reading right eye 6/6, left eye 6/5, and only 66 as reading right eye 6/5, left eye 6/6. It was routine practice to test the right eye first. McKenzie (Page 29 of this journal) observed that an immediate retest on such occasions often revealed improved vision in the eye first tested.

A comparison was made of the visual acuity distributions in children grouped according to birthplace of parents, omitting all but three major groups - Australia, Northern Europe, and Southern Europe (see Appendix Table V). A chi square test of homogeneity indicates significant differences between the groups; it appears that a lower proportion (73%) of Southern European children in the Sydney Metropolitan Area may be expected to read 6/6 or better with each eye, as compared with the Australian and Northern European groups (82% & 80%) as here defined. It is not unlikely that difficulties in accepting the test situation, as suggested above, may play a part here.

Glasses and Visual Acuity

64 (1.2%) of the children wore glasses (See Appendix Table VI). The great majority of these (81%) had vision of less than 6/6 in one or both eyes, that is, they were below the norm quoted above. There is no doubt that glasses are not the only form of treatment needed to give maximum vision.

Near Visual Acuity

94.8% of the children without glasses had a near vision equivalent of 6/6 or better in both eyes, and 5.2% had vision of less than 6/6 in both eyes. Of the children wearing glasses 79% had the near vision equivalent of 6/6.

Testing near visual acuity with the Sheridan Gardiner single letter test type on this group, proved that no additional defects were found by incorporating this test.

Cover Test

The cover test showed that 3.5% of the children had strabismus; (See Appendix Table VII).

Of the 192 children with strabismus, 39% had constant strabismus and 61% had intermittent strabismus.

Of the 192 children with strabismus, 39% had 6/6 or better vision in both eyes, and 61% had less than 6/6 vision in at least one eye.

It is interesting to note that intermittent divergent strabismus was the most common type of strabismus detected.

All those cover tested can be summarised as follows:-

Strabismus	=	192 (3.5%)
Heterophoria	=	3026 (55.8%)
Orthophoria	=	2208 (40.7%)
Total	=	5426 (100%)

A vision survey conducted in Cardiff (Graham 8) detected 5.7% with manifest strabismus. This higher figure may be explained by the inclusion of the mentally and physically handicapped in the Cardiff survey. A further reason for the lower percentage of strabismus detected in Sydney is that some children with previously diagnosed defects were withdrawn from the survey by their parents.

56% of the children had a heterophoria. The most common type of heterophoria detected was exophoria for near. (see Appendix Table VIII).

It is not possible to compare these results with those in the Cardiff study because the Sydney survey was designed to detect the presence of a heterophoria, but no measurement was made. In the Cardiff survey only heterophorias of more than 8 Δ were included.

Convergence Near Point

The majority of kindergarten age children were found to have good convergence. 86% had convergence ability of better than 6cms, and a further 10% had convergence of better than 11cms. (see Appendix Table IX).

Comparison of the convergence figures with those of exophoria for near show that many of the latter cases must have had good convergence.

The Titmus Stereo Test

31% of the children demonstrated full stereo-acuity on the Titmus stereo test, the proportion of good stereo-acuity being higher for each successive age group. This finding is in agreement with those of Romano et al[11] and Dunlop (6) (see Appendix Table X).

Conclusion

6/6 was determined to be the visual norm of kindergarten age children in the Sydney Metropolitan Area by this survey. 20% of the children recorded vision which fell below this norm. The survey was not designed to find the reasons for the reduced vision, but to determine the proportion of children who require either a retest and/or further investigation. The survey also showed that the majority of the children tested had good convergence, that 31% demonstrated full stereo-acuity, and that the proportion of good stereo-acuity increases with each successive age group.

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APPENDIX

TABLE I. AGE DISTRIBUTION IN SAMPLE

Age last birthday	Number	Percent
4	200	3.7%
5	4661	86.4%
6	524	9.7%
7	11	0.2%

TABLE II. VISUAL ACUITY

Right eye	Left eye				Total
	Less than 6/9	6/9	6/6	6/5	
Less than 6/9	163	53	32	6	254
6/9	53	439	140	10	642
6/6	25	139	3040	113	3317
6/5	7	13	66	1113	1199
Total	248	644	3278	1242	5412

TABLE III. SUMMARY OF FIGURES, TABLE II

6/6 or better both eyes	= 4332 (80%)
6/6 or better one eye; 6/9 other eye	= 302 (5.6%)
6/9 both eyes	= 439 (8.1%)
at least one eye less than 6/9	= 339 (6.3%)

TABLE IV. AGE AND VISUAL ACUITY

Acuity	Age 4 yrs	Age 5 yrs	Age 6 yrs.
6/9	34(17%)	465(10%)	35(6.8%)
6/6	140(70%)	2915(63%)	293(56.8%)
6/5	21(10.5%)	1112(24%)	117(34%)

TABLE V. VISUAL ACUITY AND BIRTHPLACE OF PARENTS

Visual Acuity	*BIRTHPLACE OF PARENTS*			Total
	Australia	Northern Europe	Southern Europe	
Less than 6/9	165 (5.5%)	42 (7.5%)	41 (9%)	248
6/9	358 (12%)	68 (12%)	87 (18.5%)	513
6/6	1770 (59%)	365 (63.5%)	286 (61%)	2421
6/5	694 (23.5%)	100 (17%)	54 (11.5%)	848
Total	2987	575	468	4030

TABLE VI. VISUAL ACUITY WITH GLASSES

64 (1.2%) children wore glasses. This 1.2% is made up as follows:

	6/6 or 6/5 in both eyes	=	12 (19% of 64)
Less than	6/6 in one or both eyes	=	52 (81% of 64)

TABLE VII.

The cover test revealed 192 (3.5%) of the children had constant or intermittent strabismus. This 3.5% is made up as follows:

	Constant Strabismus	Intermittent Strabismus	Total
Convergent	62 (32.3%)	35 (18.2%)	97 (50.5%)
Divergent	10 (5.2%)	79 (41.1%)	89 (46.3%)
Vertical Deviation only	3 (1.6%)	3 (1.6%)	6 (3.2%)
Total	75 (39.1%)	117 (60.9%)	192 (100%)

TABLE VIII.

3 026 (55.8%) had heterophoria which break down as follows:

	Near	Distance	Near & Distance	Total
Esophoria	285 (5.3%)	5 (.1%)	191 (3.5%)	481 (8.9%)
Exophoria	1964 (36.4%)	24 (.4%)	549 (10.1%)	2537 (46.8%)
Hyperphoria	2 (0%)	0	6 (.1%)	8 (.1%)
Total	2251 (41.5%)	29 (.5%)	746 (13.7%)	3026 (55.8%)

TABLE IX. CONVERGENCE NEAR POINT

Normal convergence	(0-5 cms)	=	4647 (86.4%)
Reduced convergence	(6-10 cms)	=	644 (10%)
Defective convergence	(11 cms+)	=	85 (1.6%)
			5376 (100%)

TABLE X. AGE & STEREO-ACUITY OF MORE THAN 100 SECONDS OF ARC.

83%	of	4 years		92%	of	6 years
87%	of	5 years		93%	of	7 years

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