AUSTRALIAN CONTRIBUTION TO INTERNATIONAL ORTHOPTIC ASSOCIATION SURVEY

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Abstract

At the meeting of the Permanent Scientific Committee of the International Orthoptic Association held in Berne, Switzerland in September 1979, it was decided to collect data on the relative incidence of esotropia and exotropia over a 12 month period relating this to latitude, hours of sunlight and race. Later additional data was suggested including age of onset, type of deviation whether congenital or acquired, constant or intermittent, comitant or incomitant and the presence or absence of refractive error and amblyopia for each case. Each member country's representative was to be responsible for collecting data from her country. A pro-forma was prepared and sent out with explanation.

Members of the Orthoptic Association of Australia were sent these pro-formas and 26 clinics returned usable data. A total of 2620 valid cases were obtained and the data from these was stored in a computer. This paper presents preliminary analyses relating type of deviation and latitude to the other variables.

Key words: *Incidence of esotropia, incidence of exotropia, latitude, sunlight, race, type of deviation, onset, refractive error, amblyopia.*

INTRODUCTION

A survey document requesting information relevant to the International Project was circulated to orthoptic practices throughout Australia. Data, for each practice, over the past 12 months for cases of esotropia and exotropia was obtained, along with the sex, age, race, whether congenital or acquired, constant or intermittent, comitant or incomitant, presence or absence of a refractive error and presence or absence of amblyopia, for each such case.

The authors assigned latitude and yearly sunlight to each return on the basis of astronomical and meteorological data. All data were coded and placed on computer tape for analysis using the Statistical Package for the Social Sciences (SPSS).

RESULTS

Returns to the survey were obtained from a total of 26 practices. A total of 2620 valid cases were obtained with 1390 (53%) being female and 1230 (47%) being male. The age range for the sample was newborn to 88 years of age; the modal and median ages being 7 years with a mean of 10.5 years (± 12.11 years).

There were 1794 (69%) esotropias and 825 (31%) exotropias. Cross tabulations of deviation type by various variables will be discussed below.

Cross tabulation of deviation by sex can be seen in Table 1. From the percentages in this table there appears to be marginal differences between males and females in the type of deviation that they have ($\chi^2 = 0.73$, N.S.).

Examination of type of deviation by age at first presentation, Table 2, reflects the age distribution of the sample described above. Although the numbers are small beyond the 20 year age group, as one would expect there is an increase in the number of exotropias with age. In the younger age groups (12 years of age and

TABLE 1
Type of deviation by sex

	Deviation			
	Esotropia		Exotropia	
Sex	No.	%	No.	%
Female	942	36	448	17
Male	852	33	377	14
Total	1794	69	825	31

less) 64% of the total are esotropic while 22% exotropic.

Table 3 is the cross tabulation of deviation by race. As can be seen 98.6% of the total sample are of European origin. No relationship between the two variables here presented is apparent.

TABLE 2
Type of deviation by age

	Deviation			
	Esotropia		Exotropia	
Age categories	No.	%	No.	%
0-3	430	18	93	4
4-7	683	29	229	10
8-12	400	17	184	8
20-29	59	2	76	3
30-39	31	1	56	2
40-49	13	0.5	25	1
50-59	10	0.5	20	1
60-69	9	0.5	15	0.5
70+	13	0.5	14	0.5

As can be seen in Table 4, 49% of the sample were classified as congenital and 51.5% as acquired. There appears to be no difference between the incidence of either congenital or acquired esotropias or exotropias. A chi-square test reveals the prevalence of esotropia in both onset categories ($\chi^2 = 71.40$, $P < 0.001$).

TABLE 3
Type of deviation by race

	Deviation			
	Esotropia		Exotropia	
Race	No.	%	No.	%
Unknown	0		2	0.1
Southern European	189	7.2	94	3.6
Northern European	1591	60.7	710	27.1
Negro	3	0.1	0	
Aboriginal	2	0.1	0	
Asiatic	9	0.3	19	0.7
Total	1794	68.5	825	31.5

Table 5, below, shows the type of deviation by periodicity, i.e. constant versus intermittent. A chi-square analysis of this data yielded $\chi^2 = 29.691$ ($P < 0.001$). It can be seen in the table that there are more constant esotropias (45%) than intermittent esotropias (23%), i.e. almost 2 to 1. The situation is reversed for exotropias, the ratio being 2 to 1 intermittent exotropias to constant exotropias.

TABLE 4
Type of deviation by onset

	Deviation					
	Esotropia		Exotropia		Total	
When Acquired	No.	%	No.	%	No.	%
Congenital	979	37	304	12	1283	49
Acquired	805	31.5	518	20	1324	51.5
Not known	10	0.4	3	0.1	13	0.5

A chi-square test of the relationship between deviation type and comitance (Table 6) yielded a non-significant value ($\chi^2 = 1.02$). That is to say there is no variations between the levels of these two variables. This can be seen in Table 6 where there are more concomitant squints than incomitant squints for both deviation types.

TABLE 5
Type of deviation by periodicity

	Deviation					
	Esotropia		Exotropia		Total	
Periodicity	No.	%	No.	%	No.	%
Constant	1179	45	243	10	1422	55
Intermittent	611	23	580	22	1191	45

Although the majority (60.6%) of the subjects had a refractive error analysis of type of deviation by refractive error yielded a significant difference between esotropias and exotropias ($\chi^2 = 242.6$, $P < 0.001$). It can be seen (Table 7) that the majority of esotropias have a refractive error while the majority of exotropias do not

TABLE 6
Type of deviation by comitance

	Deviation					
	Esotropia		Exotropia		Total	
Comitance	No.	%	No.	%	No.	%
Not known	6	0.2	2	0.1	8	0.3
Concomitant	1449	55.3	652	24.9	2101	80.2
Incomitant	340	13.0	171	6.5	511	19.5

have a refractive error. The greatest proportion (48.4%) of the total sample are esotropic with a refractive error.

Consideration of the relationship between type of deviation and presence/absence of amblyopia (Table 8) yielded some interesting results. One can see that there appears to be little difference in the number who presented with amblyopia (46%) and the number who presented without

TABLE 7
Type of deviation by refractive error

	Deviation					
	Esotropia		Exotropia		Total	
Refractive Error	No.	%	No.	%	No.	%
Not known	8	0.3	7	0.3	15	0.6
Present	1270	48.4	319	12.2	1589	60.6
Absent	517	19.7	499	19.0	1016	38.8

amblyopia (54%). A chi-square analysis yielded a significant difference ($\chi^2 = 158.57$, $P < 0.0001$) between the two variables, approximately equal numbers of the esotropes were distributed between the other two categories, however of the exotropes the ratio of amblyopia absent to amblyopia present is greater than two to one.

When residential latitude was assigned to the various returns it was found that patients had

TABLE 8
Type of deviation by amblyopia

	Deviation					
	Esotropia		Exotropia		Total	
Amblyopia	No.	%	No.	%	No.	%
Present	960	37	226	9	1186	46
Absent	798	31	583	23	1381	54

come from as far south as 46 °S to as far north as 27 °S, which correspond to Hobart and north of Brisbane (including Alice Springs and Mount Tom Price). As we would expect the greatest number of returns came from the larger centres of population and this is reflected in the data in Table 9. Melbourne (38 °S), Adelaide and

TABLE 9
Type of deviation by residential latitude

	Deviation					
	Esotropia		Exotropia		Total	
Residential Latitude	No.	%	No.	%	No.	%
North of 27 °S	23	0.8	12	0.5	35	1.3
27 °S	36	1.4	59	2.2	95	3.6
31 °S-28 °S	15	0.5	11	0.4	26	0.9
32 °S	345	13.2	81	3.0	426	16.2
33 °S	220	8.4	71	2.7	291	11.1
34 °S	394	15.3	280	10.7	674	26.0
35 °S	458	17.5	184	7.0	642	24.5
37 °S-36 °S	61	2.3	79	3.0	140	5.3
38 °S	196	7.5	24	0.9	220	8.4
46 °S-42 °S	46	1.8	24	0.9	70	2.7

Canberra (35 °S), Sydney, Wollongong and Esperance (34 °S), Newcastle (33 °S), Perth and Broken Hill (32 °S), Brisbane (27 °S) are the principal areas of population for which data has been obtained. Categorisation of the variable latitude proved difficult since we wished to eliminate population size bias while still retaining

TABLE 10
Type of deviation by annual hours of sunlight

	Deviation					
	Esotropia		Exotropia		Total	
Hours of Sunlight	No.	%	No.	%	No.	%
3200+	20	0.8	6	0.2	26	1.0
2800-3100	167	6	39	1.5	206	7.5
2500-2800	512	20	229	9	741	29.0
2200-2500	844	32	458	17	1302	49.0
1900-2200	250	10	93	3.5	343	13.5
1000-1300	2	0	0	0	2	0

a fair range of latitude. A chi-square analysis of the data in Table 9 yielded a significant value ($\chi^2 = 198.05$, $P < 0.001$) which indicates some variation in deviation type by latitude, however it can be seen that there is no distinct preference

for one deviation type with a change in latitude, but rather a random change.

On the basis of the marginal totals of esotropias to exotropias one would expect to find twice as many of the former than the latter of each latitude. If a trend with latitude was to be apparent we should have a reversal in this ratio

TABLE 11
Residential latitude by type

Residential Latitude	Type			
	Concomitant		Incomitant	
	No.	%	No.	%
North of 27 °S	29	1.1	6	0.26
27 °S	93	3.5	2	0.07
31 °S-28 °S	24	0.9	2	0.07
32 °S	347	13.2	79	3.0
33 °S	243	9.3	48	1.8
34 °S	518	19.8	156	6.0
35 °S	519	19.8	123	4.7
37 °S-36 °S	107	4.1	33	1.3
38 °S	162	6.2	58	2.2
46 °S-42 °S	63	2.4	7	0.3

which remains constant with an increase/decrease in latitude.

Comments similar to the above can be made regarding analysis of duration type by annual hours of sunlight (Table 9). We are told that

TABLE 12
Residential latitude by periodicity

Residential Latitude	Periodicity			
	Constant		Intermittent	
	No.	%	No.	%
North of 27 °S	21	0.8	14	0.5
27 °S	48	1.8	47	1.8
31 °S-28 °S	13	0.5	13	0.5
32 °S	276	10.5	150	5.7
33 °S	91	3.5	200	7.6
34 °S	387	14.8	287	11.0
35 °S	372	14.2	270	10.3
37 °S-36 °S	62	2.4	78	3.0
38 °S	122	4.7	98	3.7
46 °S-42 °S	34	1.3	36	1.4

Australia has more than its share of sunlight and to obtain a finer categorisation than that presented in the data would have resulted in ridiculously small numbers in many more sunlight categories.

One would expect a distribution of two esotropias to each exotropia for each category of sunlight hour but in the majority of cases the ratio equals or exceeds three esotropias per exotropia ($\chi^2 = 27.52$, $P = 0.001$). It appears, then, that there are more esotropias than exotropia than would normally be expected for variation in sunlight hours.

To some extent hours of sunlight can be related to latitude however the difficulty in terms of obtaining satisfactory categories for the former variable led us to complete comparisons on the basis of residential latitude.

Analysis of latitude by comitance (Table 11) yielded $\chi^2 = 40.30$ ($P = 0.001$), indicating that the distribution of concomitants to incomitants was

TABLE 13
Residential latitude by onset

Residential Latitude	Onset			
	Congenital		Acquired	
	No.	%	No.	%
North of 27 °S	18	0.7	17	0.6
27 °S	30	1.1	65	2.5
31 °S-28 °S	14	0.5	12	0.5
32 °S	279	10.6	147	5.6
33 °S	140	5.3	151	5.8
34 °S	381	14.5	293	11.2
35 °S	247	9.4	395	15.2
37 °S-36 °S	52	2.0	88	3.4
38 °S	84	3.2	136	5.2
46 °S-42 °S	44	1.7	26	1.0

not uniformly distributed by latitude. Under the marginal totals one would expect four concomitant deviations to each incomitant deviation. However, there is a marked deviation away from this ratio in lower latitudes and the extreme of high latitudes.

As discussed above there were approximately equal numbers of constant and intermittent deviations and analysis of this variable, periodicity, by latitude should yield equal numbers for each category for each latitude. A chi-square test leads to the rejection of this hypothesis ($\chi^2 = 95.08$, $P < 0.001$), the difference occuring at latitudes 32 °S (Perth/Broken Hill) where there are twice as many constant than

intermittent deviations and 34°S (Sydney, Wollongong and Esperance) where there are half as many constant deviations than intermittent deviations (Table 12).

Table 13 gives the cross tabulation of residential latitude by onset. Although the chi-squared tests indicates a significant variation ($\chi^2 = 125.58$, $P < 0.001$) between these two variables there is no consistent variation apparent. Only two cells have anomalous deviations, viz 27° where there is one congenital squints for two acquired squints and 32°S where there are two congenital squints for each acquired squint.

CONCLUSION

While no significant variation by latitude and hours of sunlight can be found from the data collected we feel that the principal limitation is the sparse population distribution in Australia with localised maxima especially upon the east coast.