SCREENING RESULTS OF CHAPTER ONE CHILDREN vs. EXPECTED RESULT

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OPTM 797
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INTRODUCTION

This study compares results from a vision screening of Chapter One Reading Program students to expected results from the general population. The children, ranging in ages from seven to twelve-years-old, were from the Mecosta, Barryton, and Weidman Elementary Schools in Mecosta and Isabella Counties in Central Michigan, during 1992-1994.

Mecosta County, which contains Mecosta and Barryton Schools, has a population of 38,553 (1). The majority of the population is white (95.8%), 2.6% being black, 0.7% American Indian or Eskimo, 0.5% Asian or Pacific Islander, and 0.4% of other races. 1.0% is of Hispanic origin. Most people are employed by Ferris State University, Mecosta County General Hospital, or various industries in the area. Median household income is $20,784 and median home value is $49,100 (1). Isabella County, the location of Weidman School, has a population of 56,212. The majority is white (92.9%), 1.1% is black, 1.8% American Indian or Eskimo, 0.8% Asian or Pacific Islander, 3.4% of other races. 1.3% is of Hispanic origin. Most people work in wholesale or retail or in manufacturing. The median household income is $22,659 and the median home value is $53,200 (1).

Chapter One is a nationwide special education program for reading, mainly, with some mathematics, consisting of children from kindergarten through sixth grade. Entrance into the program is based on a score of 50% or less on the Stanford Achievement Test or upon teacher recommendation (kindergarten and first grade). Each year a maximum of 50 new children are allowed into the program and may remain there throughout elementary school depending on need as determined by yearly testing. There is no visual screening or examination required before admittance into the program (2). However, the State of Michigan requires vision screenings for children once between ages three to five, then every other year beginning in first grade on through eleventh, with testing in ninth and eleventh grades replaced by enrollment in driver's education (3).

This screening was preformed by Doctors of Optometry and third year optometry students from Ferris State University. Referrals were based on the Modified Clinical Technique (4). Cut-off levels for referral were visual acuity of 20/40 or worse at distance (20ft or 10ft Snellen equivalent) and near (40cm), 1.00D or more of hyperopia, astigmatism, or anisometropia, 0.50D or more of myopia, any strabismus, more than 6P.D. of exophoria or esophoria at distance, more than 6P.D. of esophoria or 10P.D. of exophoria at near, or any organic or health problems noted. These were determined with Snellen acuity cards, retinoscopy, cover testing, and direct ophthalmoscopy. Stereopsis, extra-ocular motility, color vision, and near point of convergence were also performed, but will not be addresses in this analysis.

DATA

In 1992, 152 students were tested. 18 students failed distance visual acuity (DVA), 7 failed near visual acuity (NVA), 24 failed retinoscopy, 6 failed distance cover test (dCT), 12 failed near cover test (nCT), and 8 failed for health reasons (Table 1).

In 1993, 152 students were tested. 11 students failed DVA, 9 failed NVA, 26 failed retinoscopy, 3 failed dCT, 8 failed nCT, and 7 failed for health reasons (Table 2).

In 1994, 196 students were tested. 22 students failed DVA, 26 failed NVA, 55 failed retinoscopy, 12 failed dCT, 14 failed nCT, and 20 failed for health reasons (Table 3).

This makes a total of 51 students failing DVA, 42 failing NVA, 105 failing retinoscopy, 21 failing dCT, 34 failing nCT, 35 failing for health reasons, and a total of 128 referred out of 500 children tested (Table 4).

More information is contained in the other figures included in this paper and will be referred to later.

ANALYSIS

Over the three years of testing, muscle imbalances, as detected by distance and near cover-uncover and alternating cover testing, resulted in 19.17% of failures noted (Fig. 1). This is less than noted by Michigan screenings. In the statewide program, 27.0% of its referrals were for phorias (5). However, the standards for exophoria were lower, 4P.D. at distance and 8P.D. at near, which may result in a larger amount of failures when compared to the standards used in this screening.

Near cover testing resulted in more referrals than the distance cover testing except in 1994, when dCT approached nCT (Fig. 1). At near, exophoria was the larger number of failures in each year with esophoria closest in 1993 (Fig. 2). Over-all, esophoria was only slightly more common than strabismus as a reason for referral (Fig. 2). There did not seem to be such trends in the dCT. Referral rates were very similar between exophoria, esophoria, and strabismus (Fig. 3).

When comparing referrals for cover test failure in different ages, nCT and dCT were very similar, both having peaks at age 10 and lows at ages 8 and 12-years-old (Fig. 4 & 5).

Distance visual acuity had a consistently higher failure rate than near visual acuity except in 1994 (Fig. 1). Both NVA and DVA increased in percentage at 7 and 11-years-old with NVA only slightly higher than DVA at 12-years-old (Fig. 6 & 7). Retinoscopy also increased in failure rate with age (Fig. 8). Retinoscopy represents a higher percent of failures than either DVA or NVA separate or combined, with the exception of the combined results in 1992 (Fig. 1).

The Michigan screening did not include retinoscopy, but it did include plus lens testing. The combined visual acuity and plus lens tests resulted in 67.1% of failures (5). Over-all, this is only slightly lower than the combined results of DVA, NVA, and retinoscopy in this screening, 68.99% (Fig. 1).

In the retinoscopy findings, hyperopia was the most common cause for failure, followed by myopia, astigmatism, and anisometropia (Fig. 9). The percentages for anisometropia were around expected values up until age 11 where there was a rise above normal values (Fig. 10 & 11)(6). While no trends are very apparent in each year separately for astigmatism, when combined the percentages are fairly constant around expected values except for a dip around age 9 and 10-years-old (Fig. 10 & 11). Myopia shows a continuous rise in percentage with age (Fig. 10). These values are very close to expected norms with the exception of a higher percentage at 7-years-old (Fig. 10 & 11). The large exception was seen in hyperopia. While fairly constant over most ages, there was a sharp increase at 12-years-old (Fig. 10). Hyperopia is expected to remain at a fairly constant level (Fig. 11). However, that expected level is approximately half the level found in this screening and the increase at age 12 is very unexpected.

When comparing the sexes, anisometropia appears consistent (Fig. 12 & 13). Astigmatism showed a marked difference around age 10. The females showed an increase then large drop while the males showed a decrease then a steep increase to over three times expected values at age 12 (Fig. 11, 12, & 13). Myopia is very close to expected values in the girls tested, however, the boys showed below normal values around 11 and 12-years-old (Fig. 11, 12, & 13). This indicates myopia may be slightly more frequent in the female population. Hyperopia showed the reverse. The girls had high rates up to 10-years-old where the values decreased to expected (Fig. 11 & 12). The boys began around normal values with an increase beginning at age 11 and rising to more than four times expected by age 12 (Fig. 11 & 13).

Failure for a health condition was consistently over 10% (Fig. 1). Reasons for referral included findings such as blepharitis, stye, ptosis, anisocoria, irregular pupils, large or asymmetrical C/D ratios, abnormal optic nerves, congenital and traumatic cataracts. A retinal detachment with scleral buckle was also seen in the population. The patient reported regular ocular care.

The referral rate increased with age similarly to NVA, DVA, and retinoscopy rates (Fig. 6, 7, 8, & 14). Referrals also increased with each year (Fig. 15). The over-all referral rate of this screening was 26.50% (Table 4). This is more than three times the rate in the Michigan State program, 8% referrals (5). The male and female rates were similar over the middle ages, 8-10, with the female rates having a higher referral rate at ages 11, 12, and especially 7 (Fig. 15 &16).

CONCLUSION

More muscle imbalances were detected around 10-years-old and more, in general, by near testing over distance testing. Visual acuity, distance and near, and retinoscopy all showed an increase in referrals with age. The DVA should be expected because of the normal increase of myopia with age. The NVA increase can possibly be explained by the unexpected rise in hyperopia noted in this study. The hyperopia rates may be deceptively high as the standard used for the screening was 1.00D and the standard for the normals was 1.25D.

The high percentage of referrals along with findings noted above and the amount of health problems noted indicate a particular need for vision care in this population. An extensive visual screening or complete optometric examination should be recommended for the children entering the Chapter One program followed by yearly screening with an emphasis on detecting hyperopia. Further study would be beneficial. More in depth comparisons of refractive error deviations from expected, follow-ups on referrals, and comparisons of screenings performed by school nurses and other volunteers to those done by eye care professionals are among some areas that need further investigation. Professional screenings have not proved economically feasible, however, with the higher referral rate and smaller population size, they may be feasible with this population.

Regardless, it appears that this particular population has a significantly high amount of visual problems and steps should be taken to detect and correct them as soon as possible. Teachers may be very instrumental in this attempt and they should be carefully and completely informed about signs of visual problems. Pamphlets, such as the one included in this paper from the American Optometric Association, can be a very useful aids.

This area is worthy of further research, not only for our own interests, but also for the help of those with reading problems.

BIBLIOGRAPHY

1 County and City Data Book 1994, U.S. Department of Commerce, Economics and Statistics Administration and Bureau of the Census, Aug. 1994, 270-283.

2 Harry Howard, Administrator of Chippawa Hills School District, interview, 1993.

3 Michigan Public Health Code, Act 368 of 1978, Rules on Vision for Administration 325.13094.

4 "The Orinda Vision Study", American Journal of Optometry and Archives of American Academy of Optometry, Vol. 36(9), Sept. 1959, 455-469.

5 "Fifty Years of Vision Screening in Michigan", The Michigan Optometrist, Vol. 72(9), Sept. 1993, 3-5.

6 Clinical Refraction, 3rd ed., Irvin M. Borish, O.D., D.O.S., LL.D., Professional Press, Inc., 1970, 13, 259.

DISTRIBUTION OF FAILURES

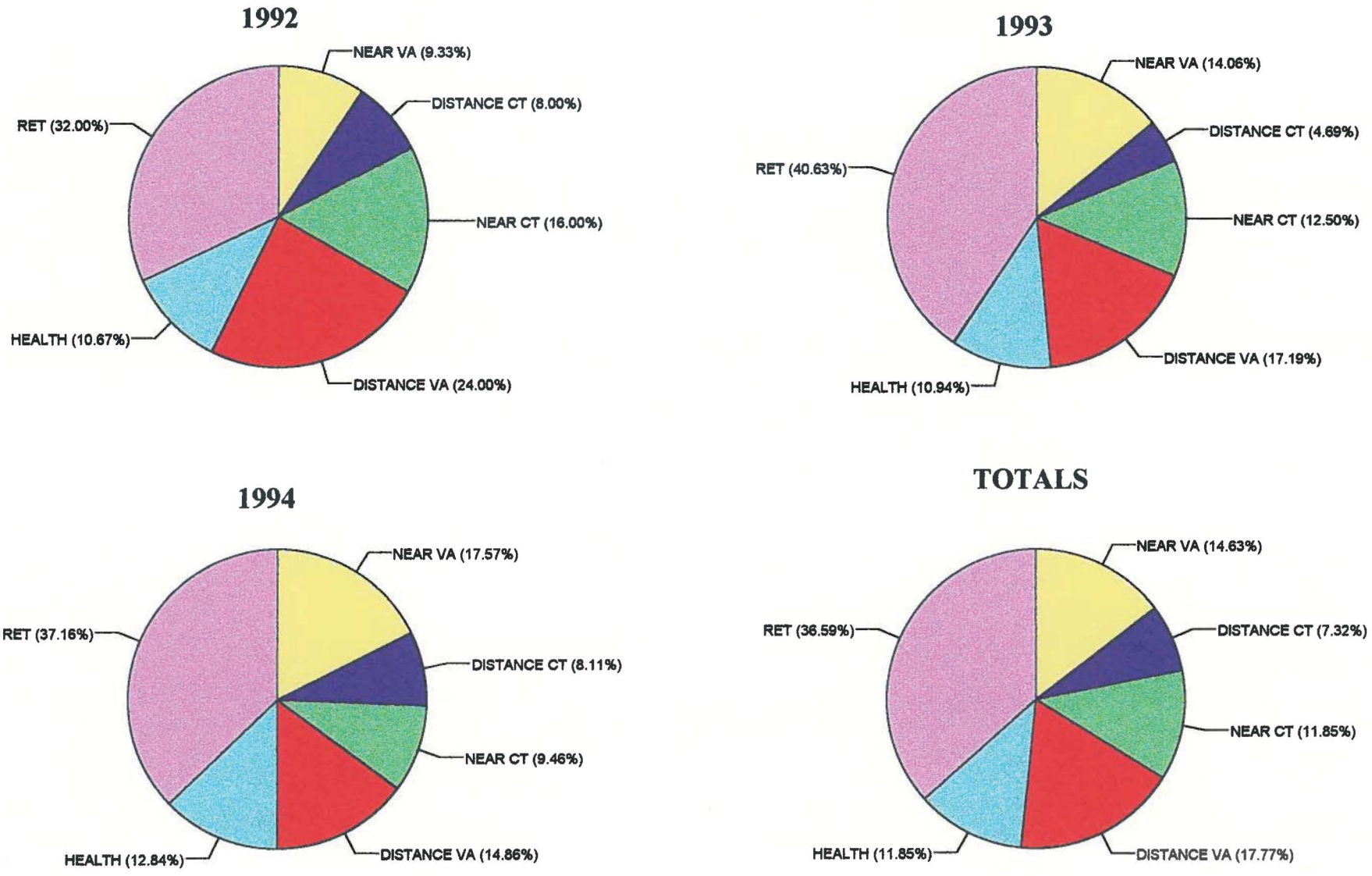


Figure 1

NEAR COVER TEST

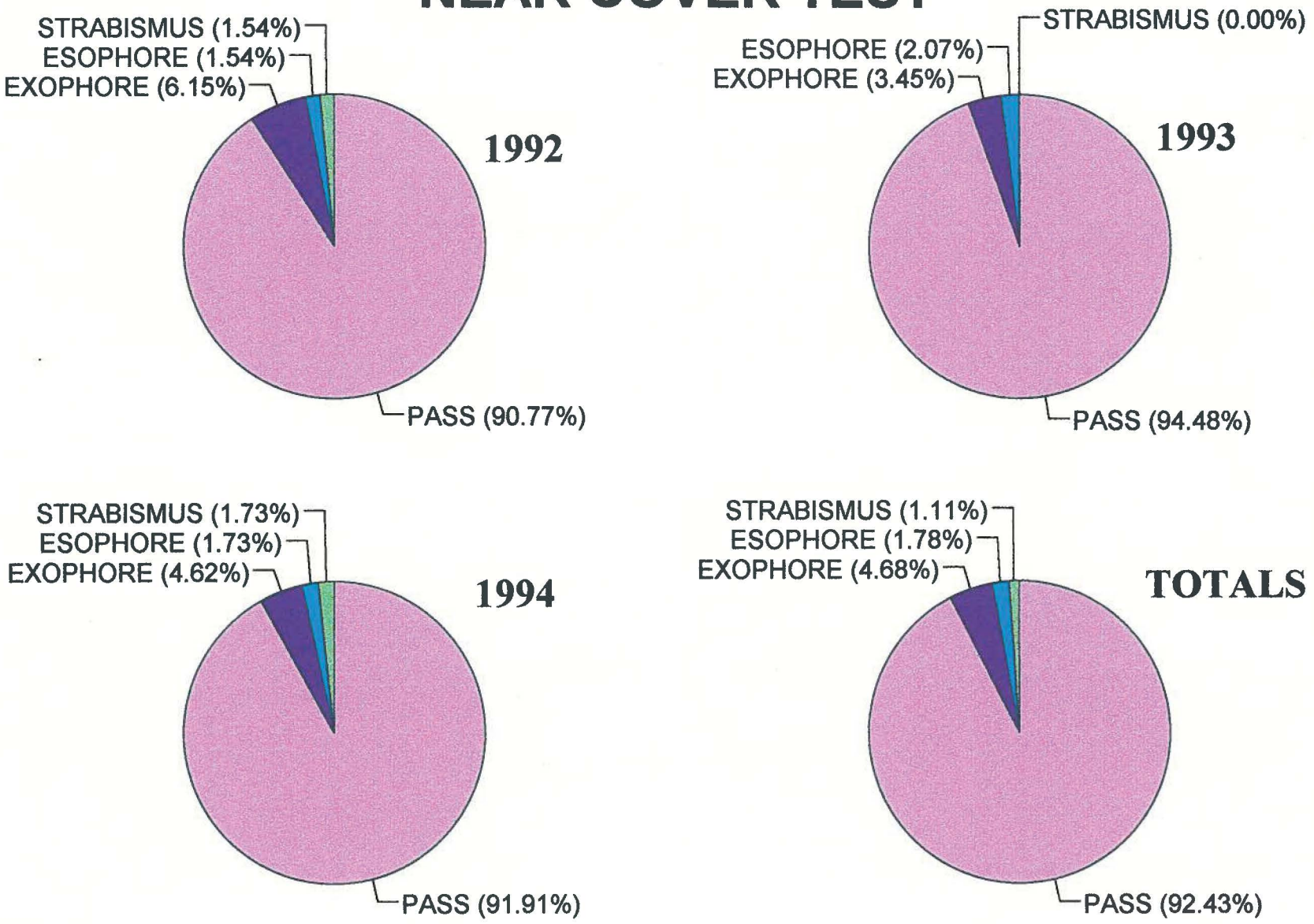
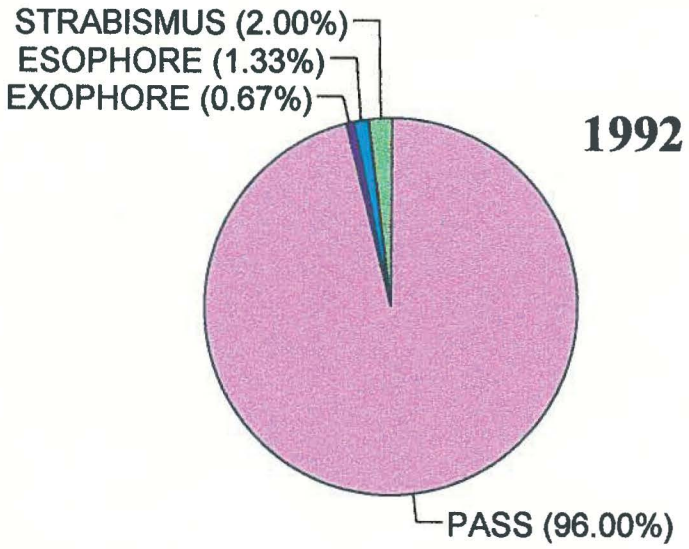
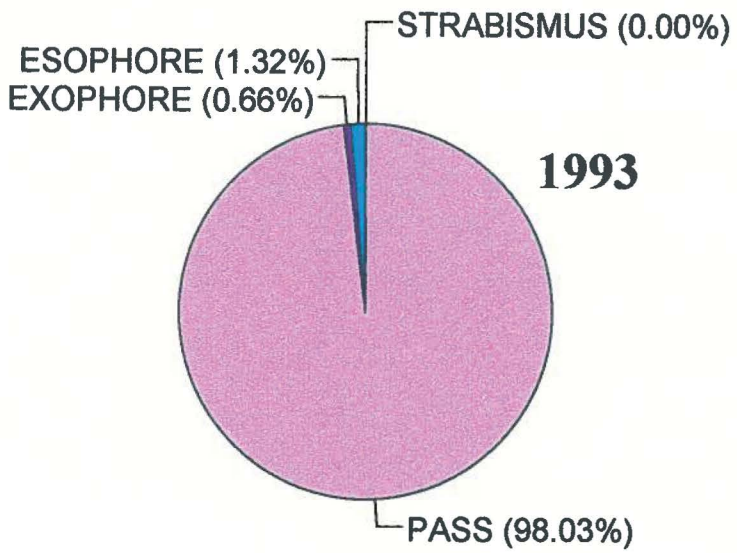
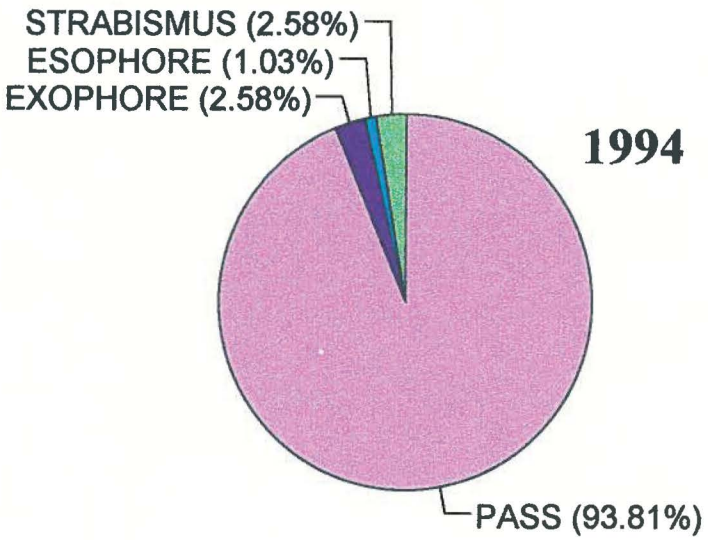


Figure 2

DISTANCE COVER TEST







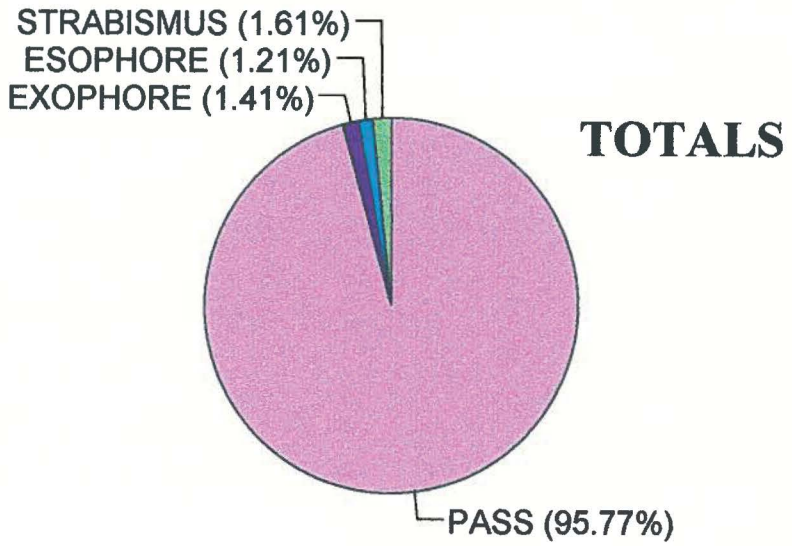
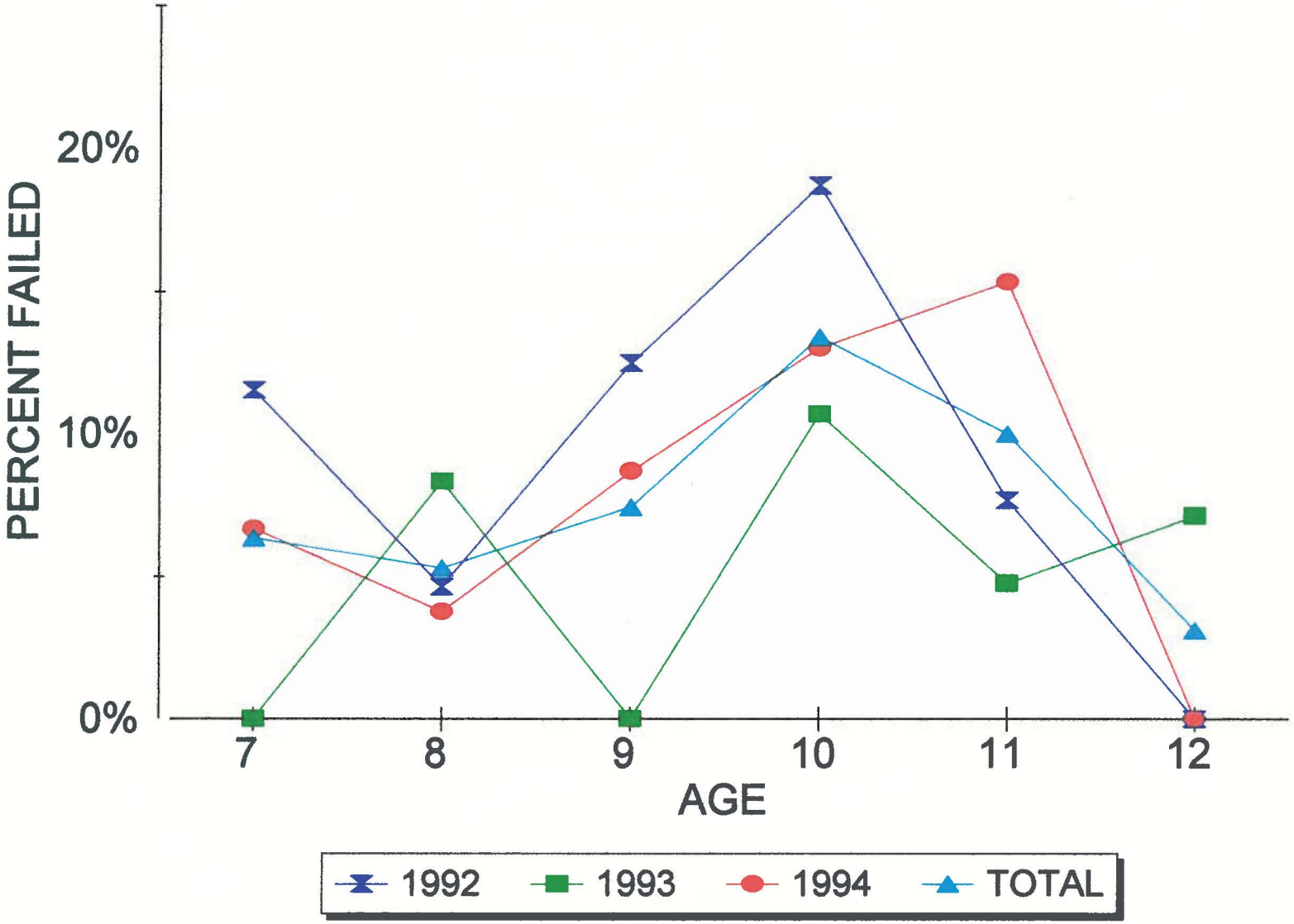


Figure 3

NEAR COVER TEST



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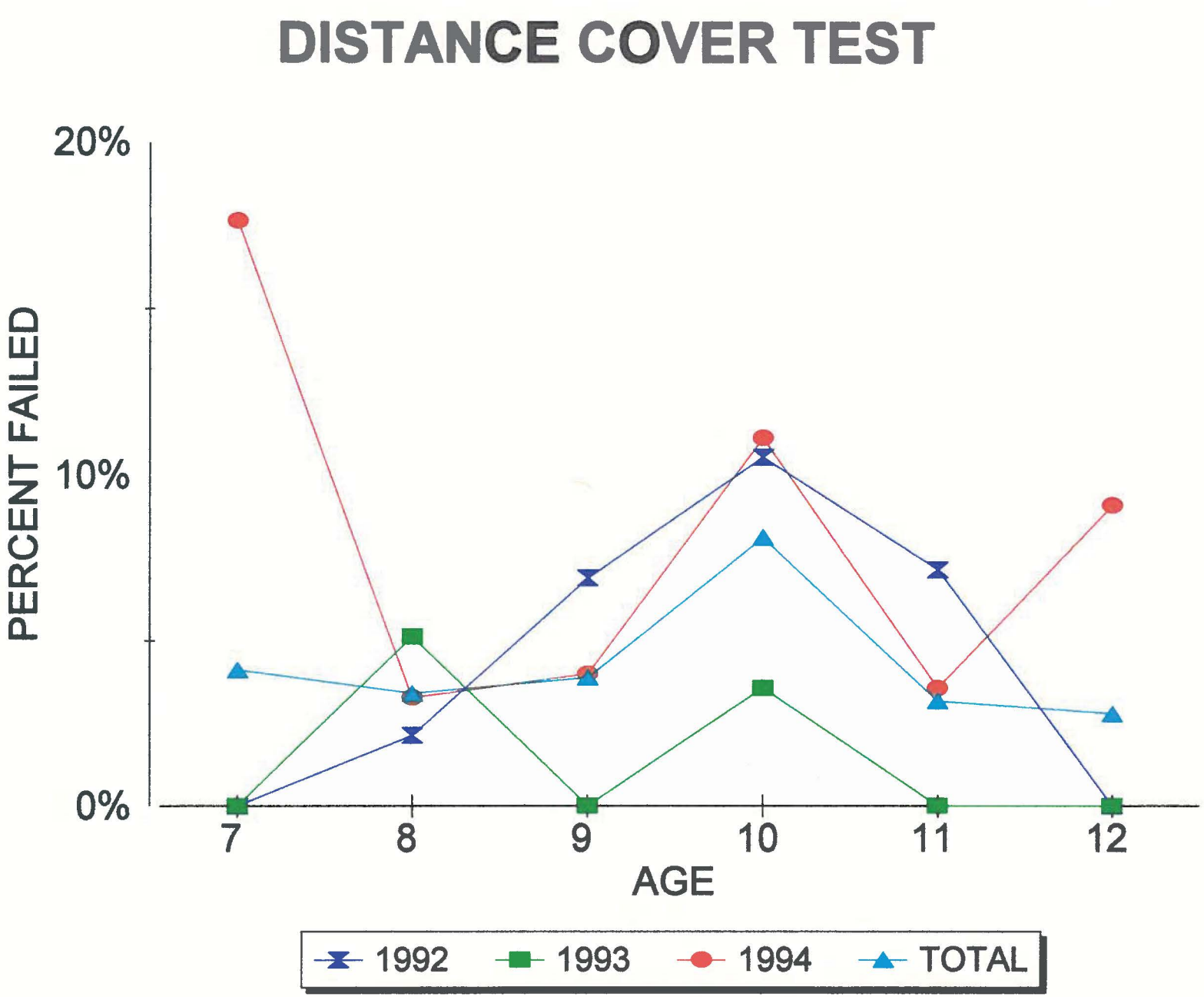
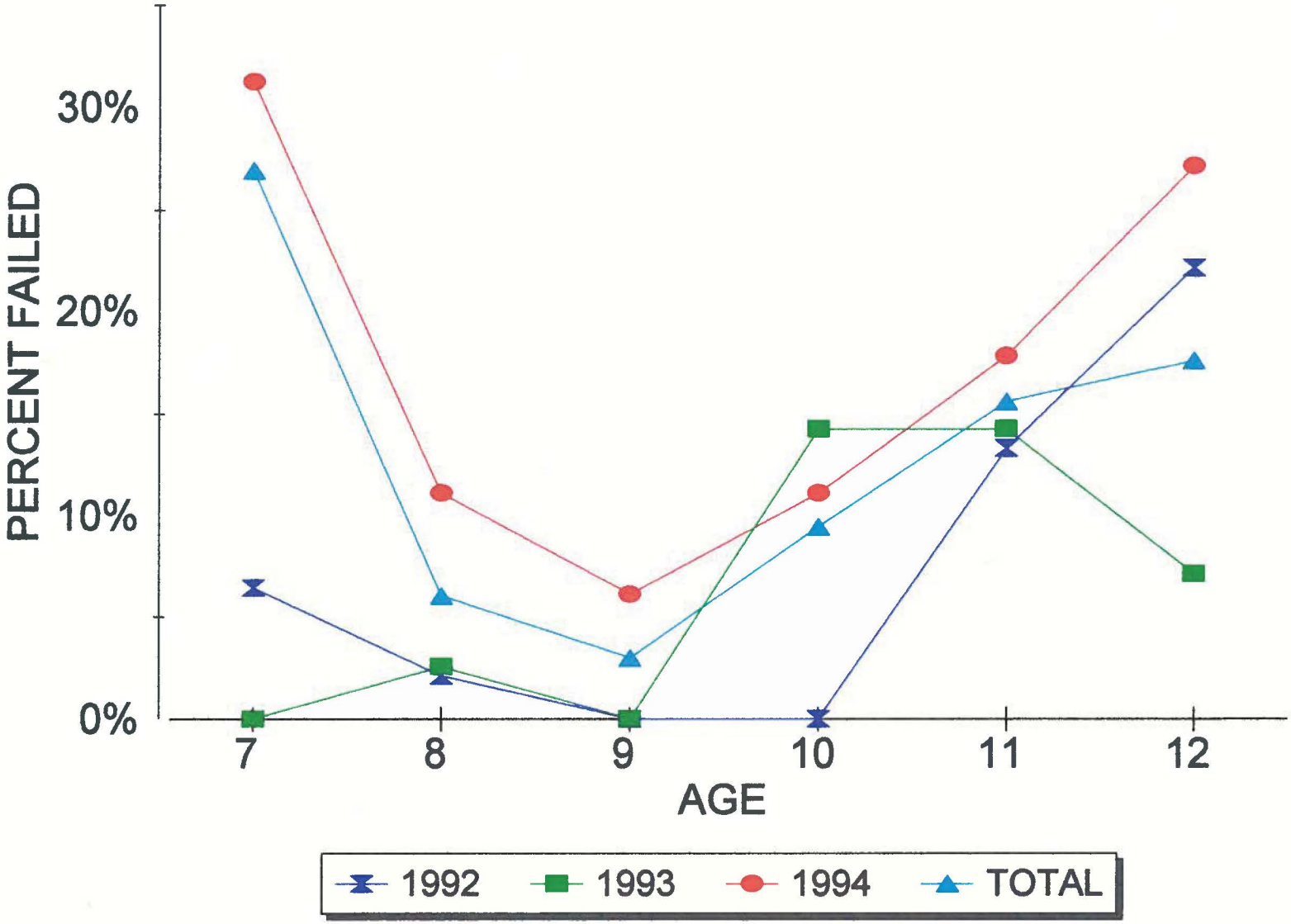

DISTANCE COVER TEST
20%
10%
0%
PERCENT FAILED
7
8
9
10
11
12
AGE
1992
1993
1994
TOTAL

Figure 5

NEAR VISUAL ACUITY



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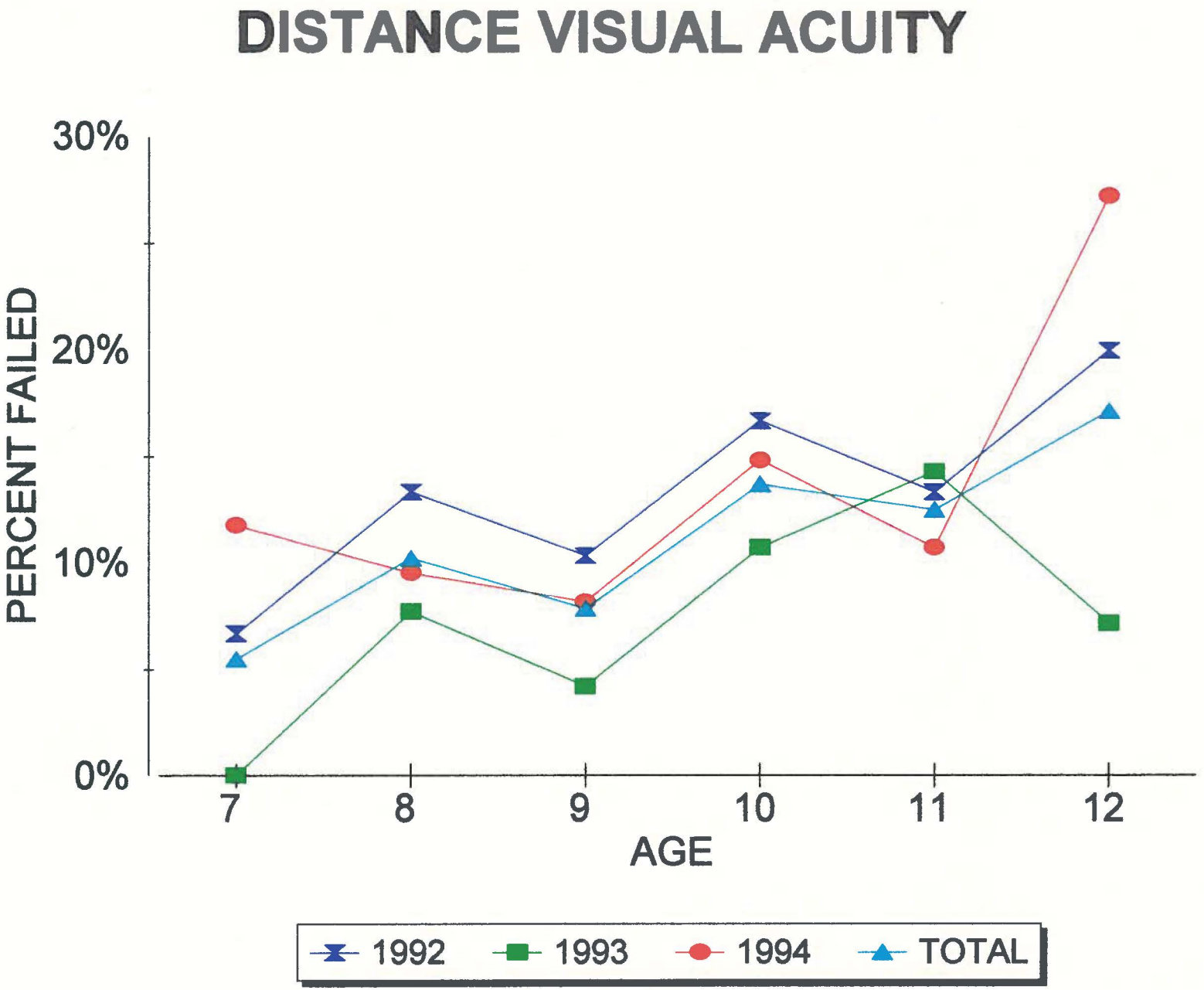

DISTANCE VISUAL ACUITY
PERCENT FAILED
30%
20%
10%
0%
7
8
9
10
11
12
AGE
1992
1993
1994
TOTAL

Figure 7

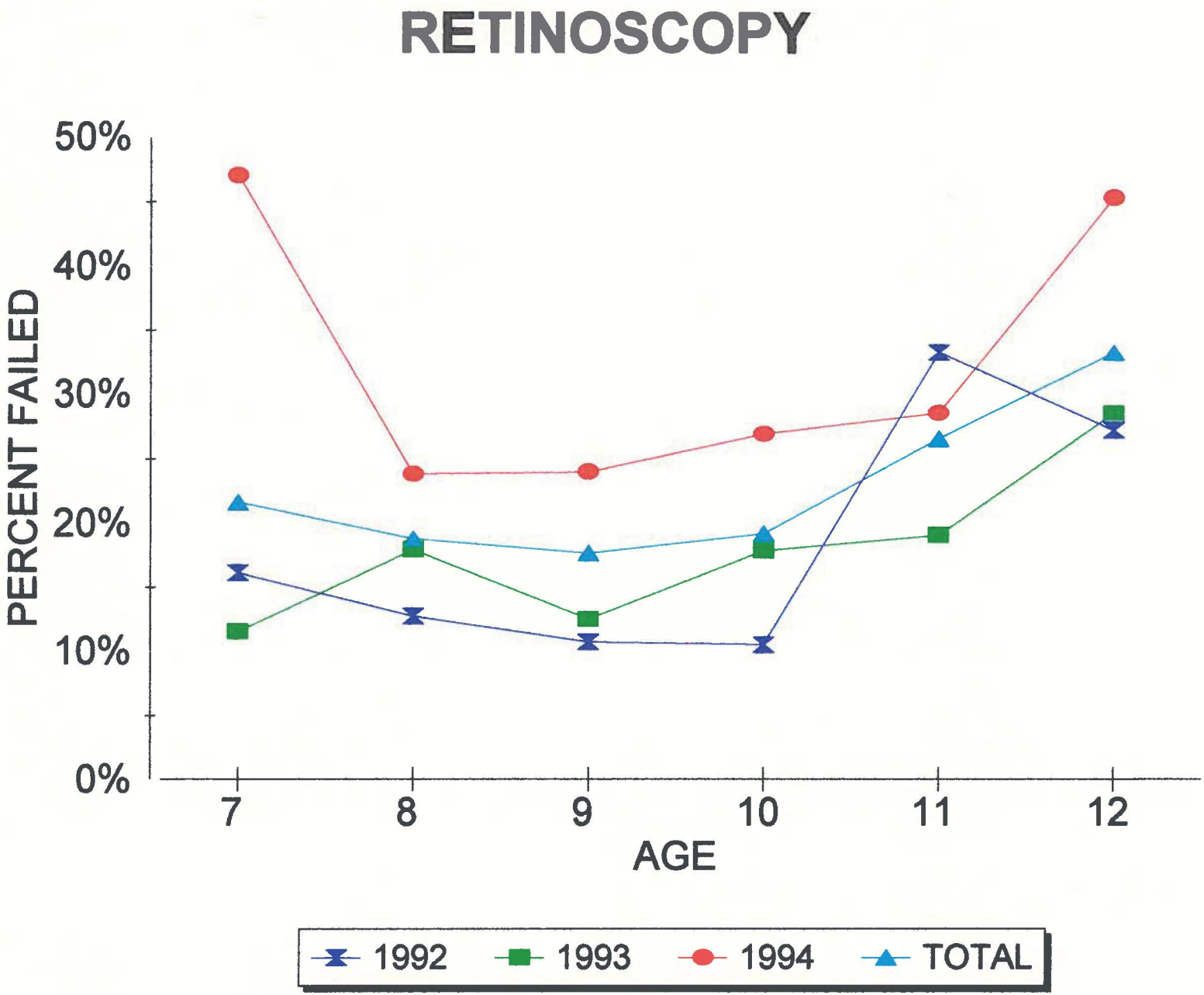
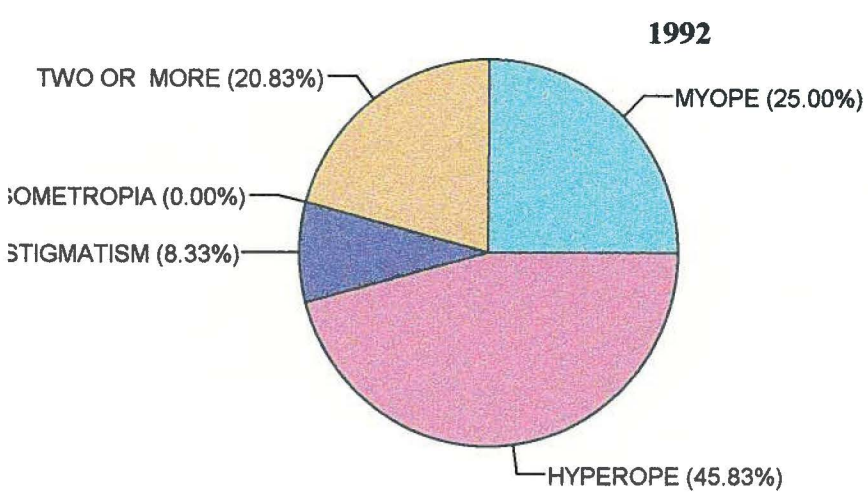
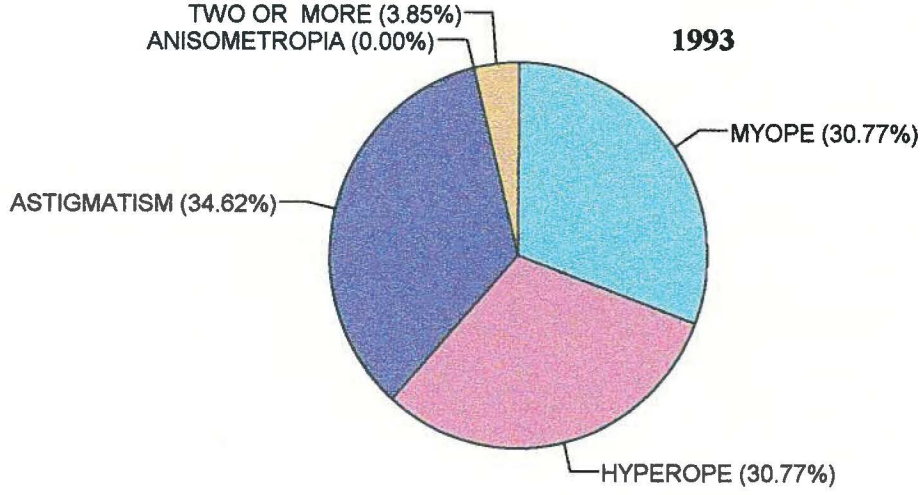
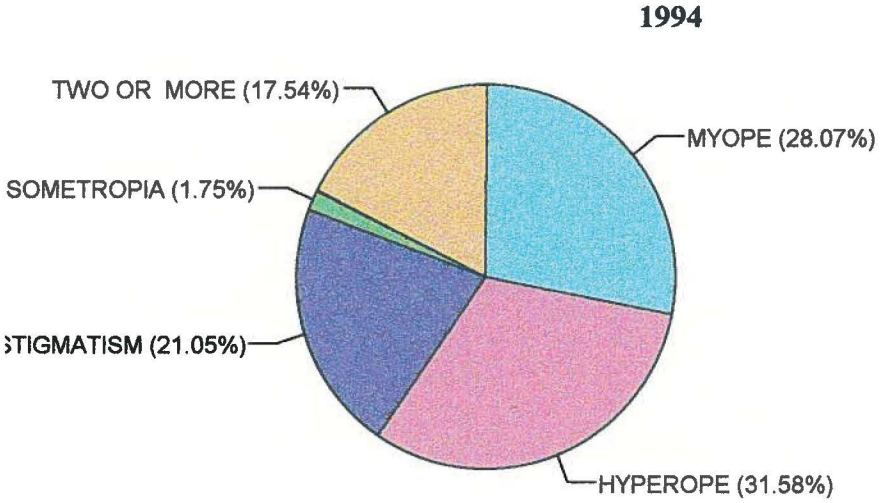

RETINOSCOPY
50%
40%
30%
20%
10%
0%
PERCENT FAILED
7
8
9
10
11
12
AGE
1992
1993
1994
TOTAL

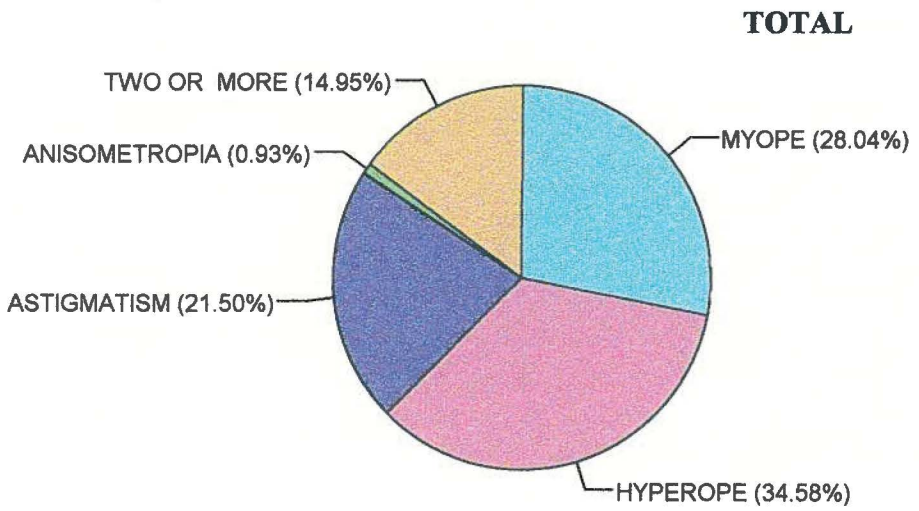
Figure 8

RETINOSCOPY RESULTS









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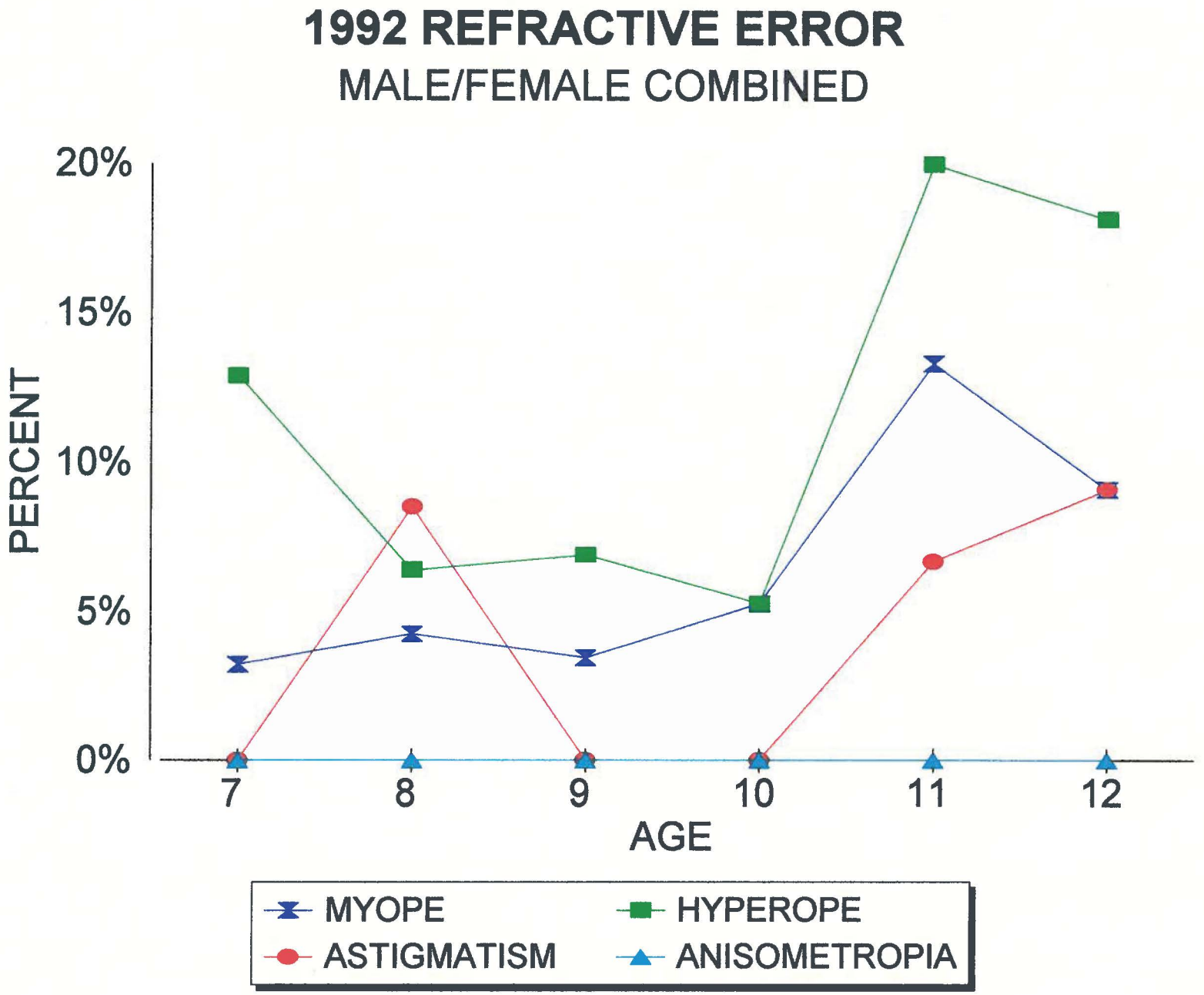

1992 REFRACTIVE ERROR
MALE/FEMALE COMBINED
20%
15%
10%
5%
0%
PERCENT
7
8
9
10
11
12
AGE
MYOPE
HYPEROPE
ASTIGMATISM
ANISOMETROPIA

Figure 10a

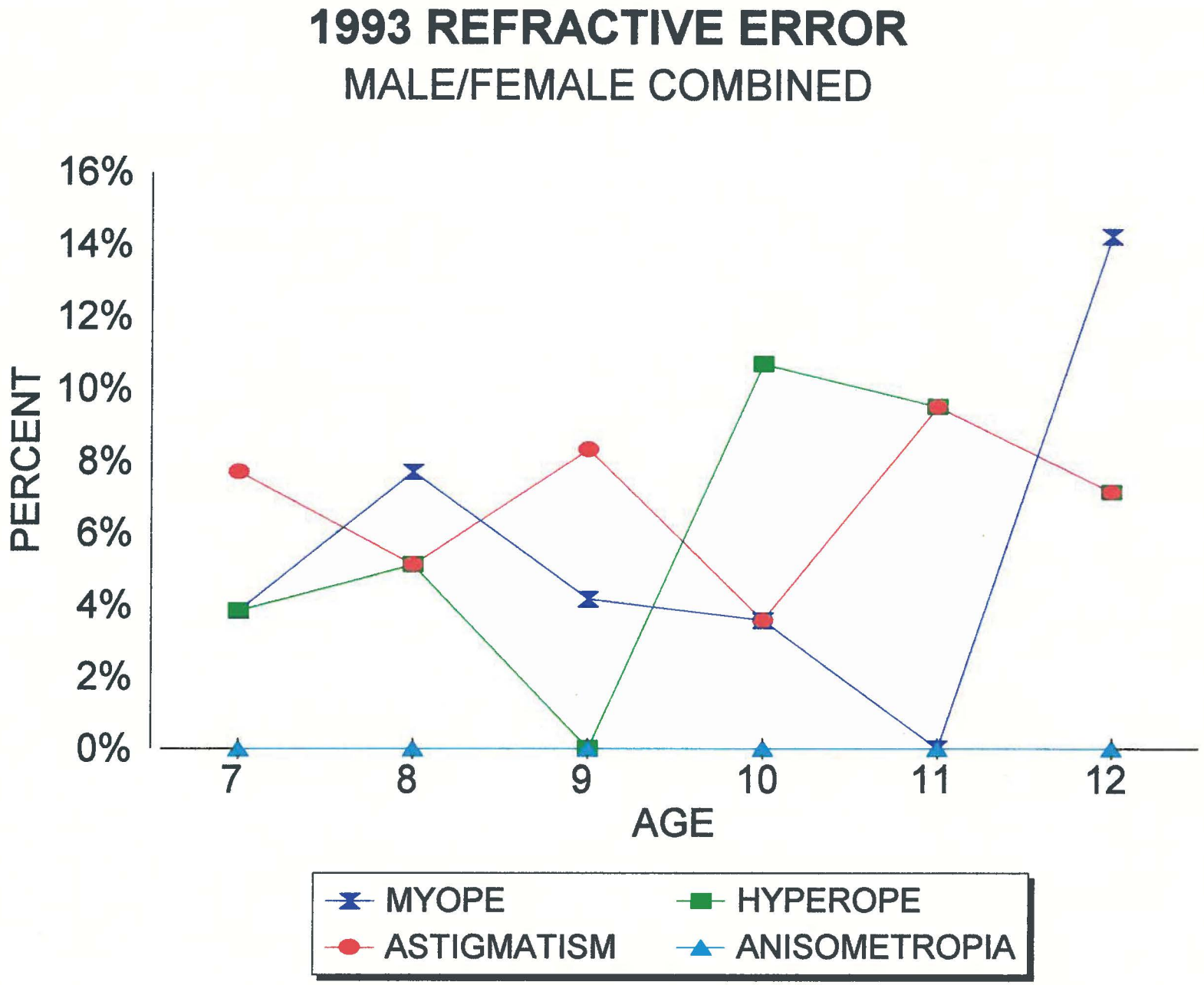

1993 REFRACTIVE ERROR
MALE/FEMALE COMBINED
PERCENT
16%
14%
12%
10%
8%
6%
4%
2%
0%
7
8
9
10
11
12
AGE
MYOPE
HYPEROPE
ASTIGMATISM
ANISOMETROPIA

Figure 10b

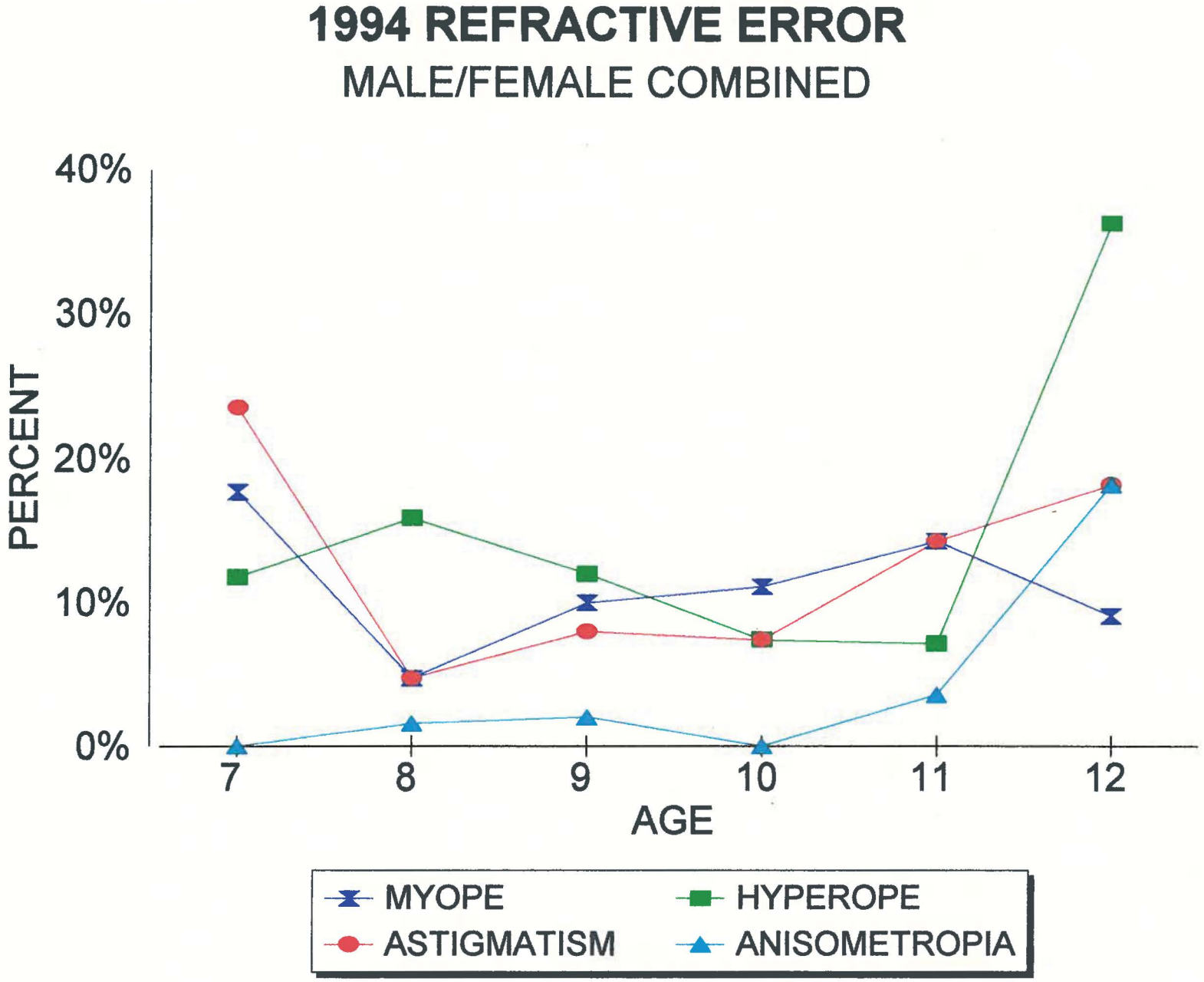

1994 REFRACTIVE ERROR
MALE/FEMALE COMBINED
40%
30%
20%
10%
0%
PERCENT
7
8
9
10
11
12
AGE
MYOPE
HYPEROPE
ASTIGMATISM
ANISOMETROPIA

Figure 10c

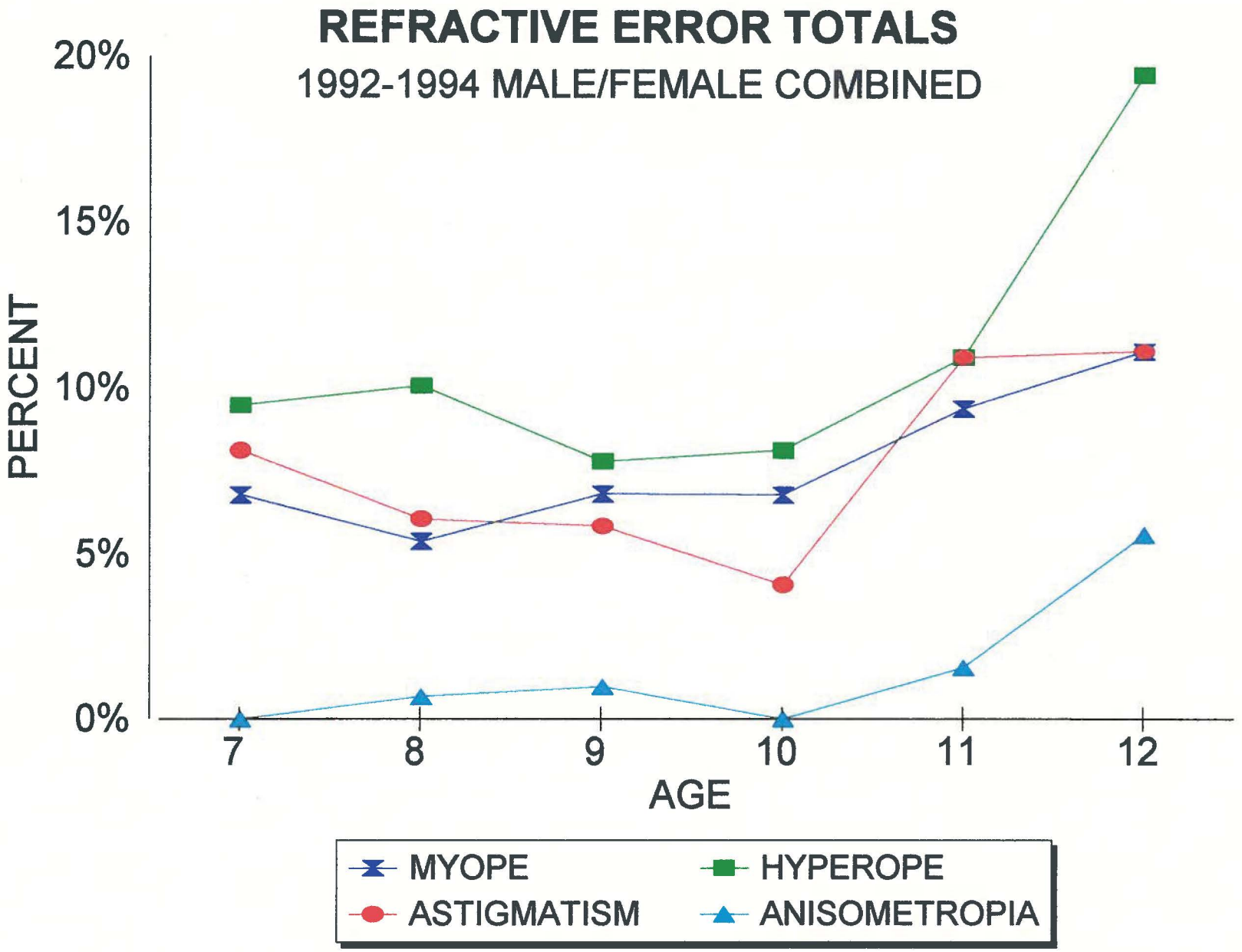
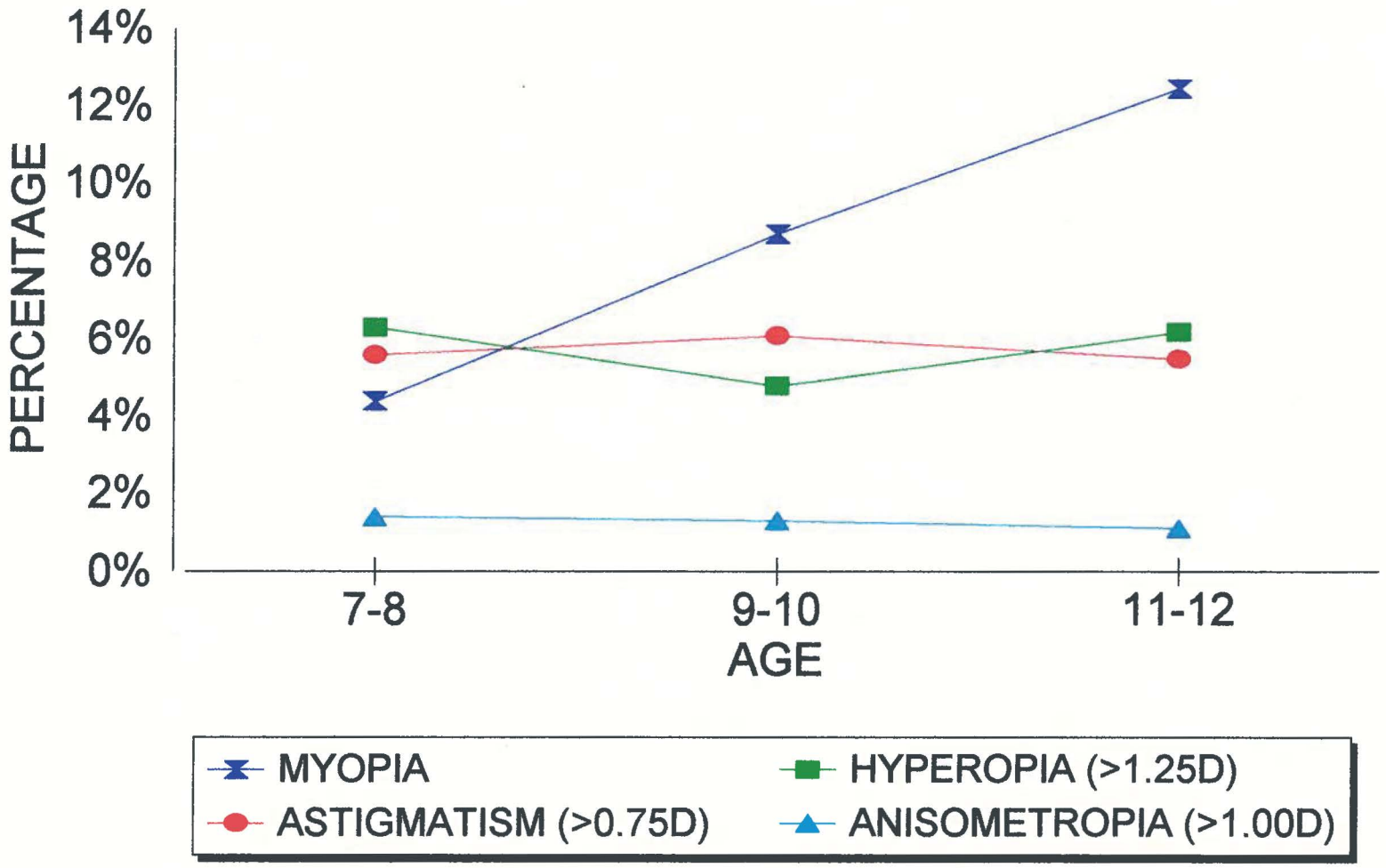

REFRACTIVE ERROR TOTALS
1992-1994 MALE/FEMALE COMBINED
20%
15%
10%
5%
0%
PERCENT
7
8
9
10
11
12
AGE
MYOPE
HYPEROPE
ASTIGMATISM
ANISOMETROPIA

Figure 10d

NORMATIVE RESULTS FOR REFRACTIVE ERROR

calculated from Clincal Refraction (7)



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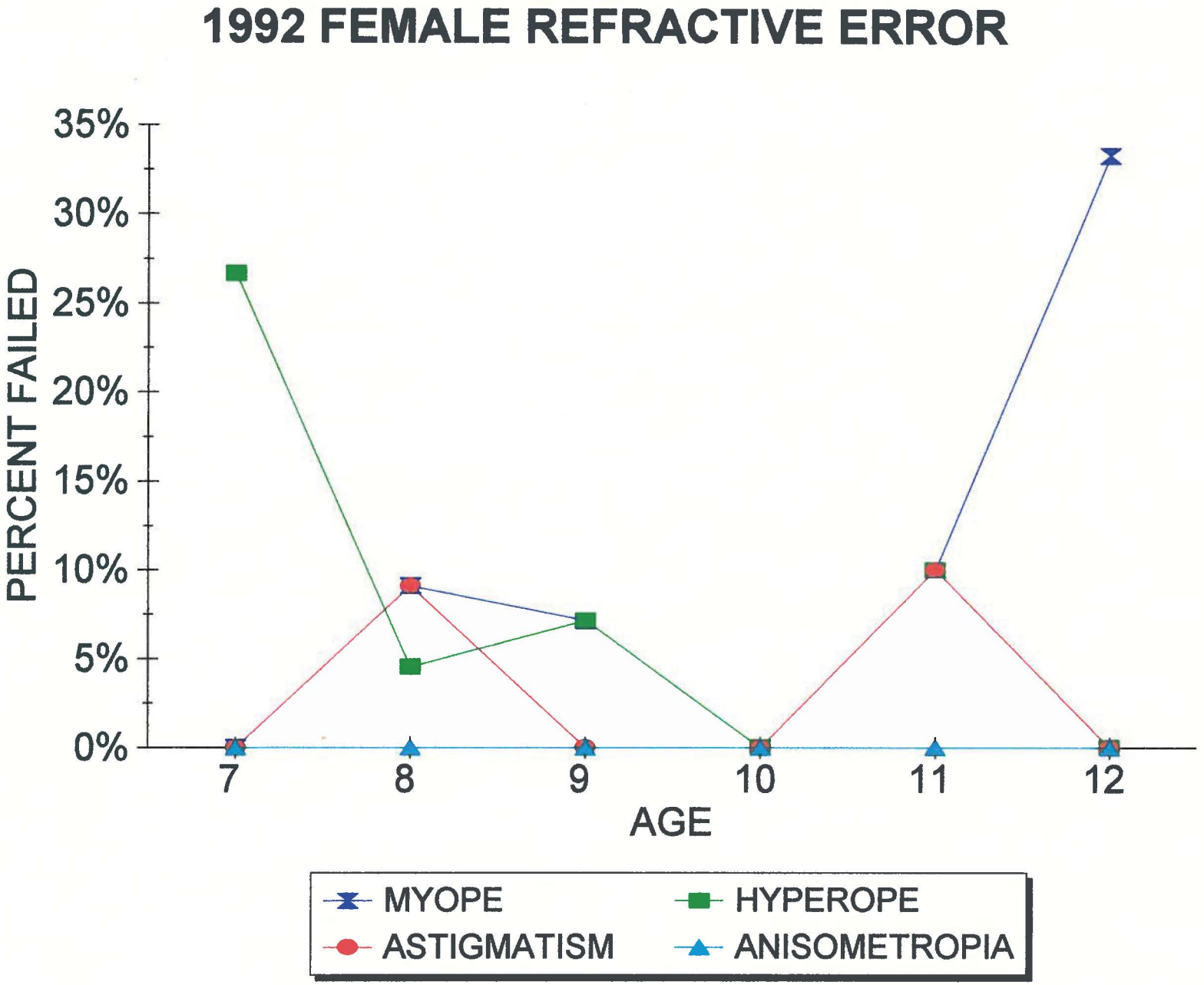
1992 FEMALE REFRACTIVE ERROR
35%
30%
25%
20%
15%
10%
5%
0%
PERCENT FAILED
7
8
9
10
11
12
AGE
MYOPE
HYPEROPE
ASTIGMATISM
ANISOMETROPIA

Figure 12a

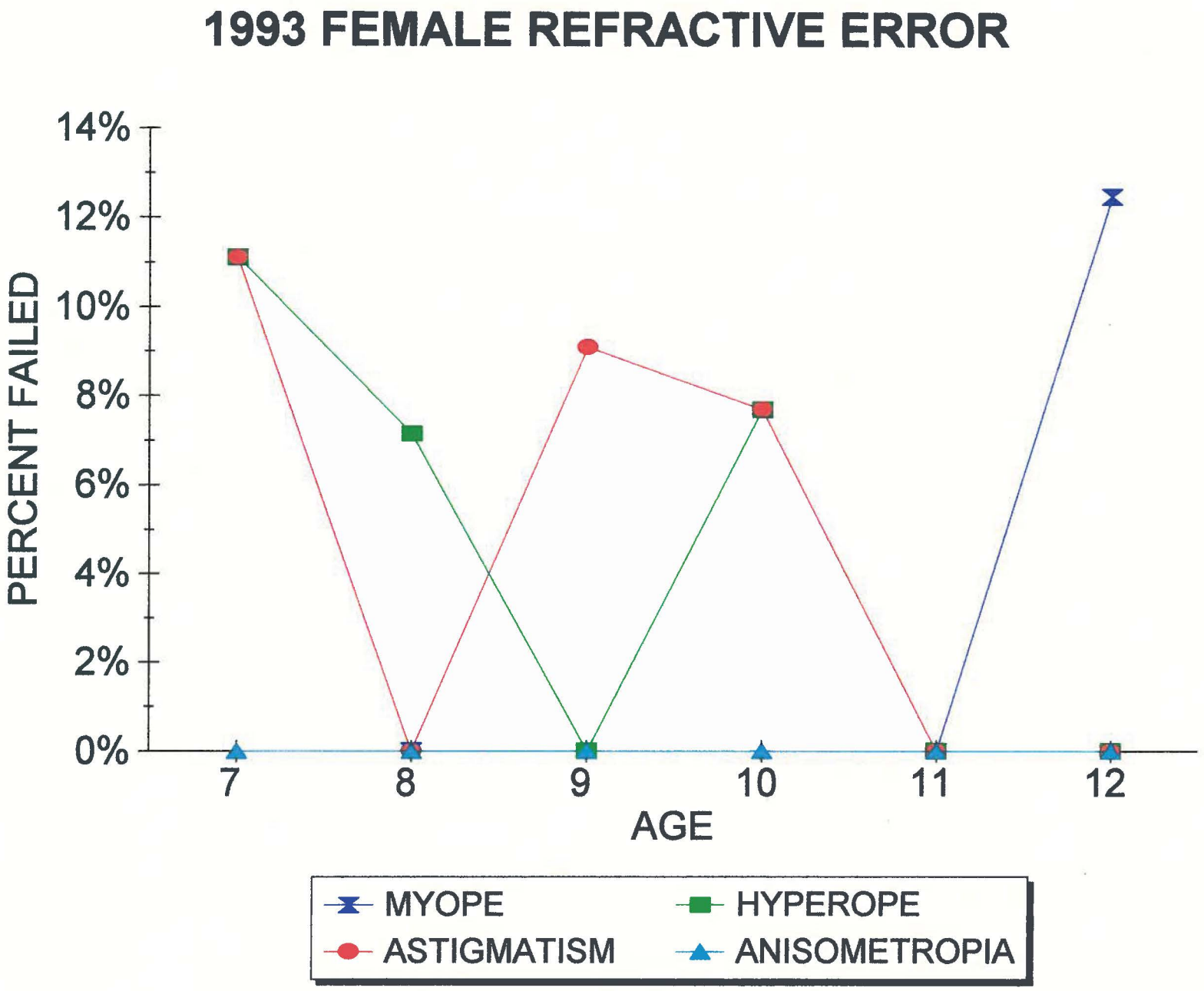
1993 FEMALE REFRACTIVE ERROR
PERCENT FAILED
14%
12%
10%
8%
6%
4%
2%
0%
7
8
9
10
11
12
AGE
MYOPE
HYPEROPE
ASTIGMATISM
ANISOMETROPIA

Figure 12b

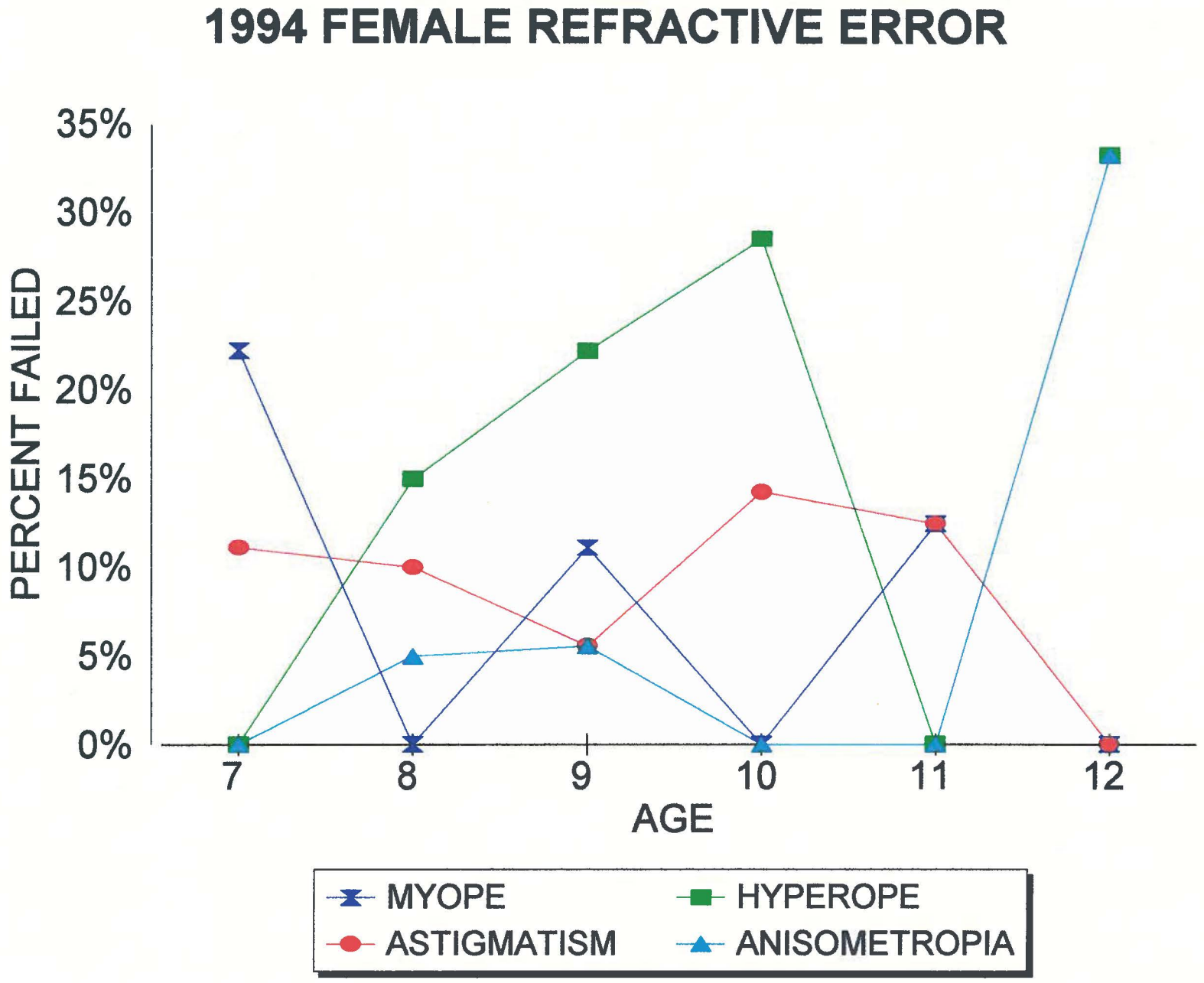
1994 FEMALE REFRACTIVE ERROR
PERCENT FAILED
35%
30%
25%
20%
15%
10%
5%
0%
7
8
9
10
11
12
AGE
MYOPE
HYPEROPE
ASTIGMATISM
ANISOMETROPIA

Figure 12c

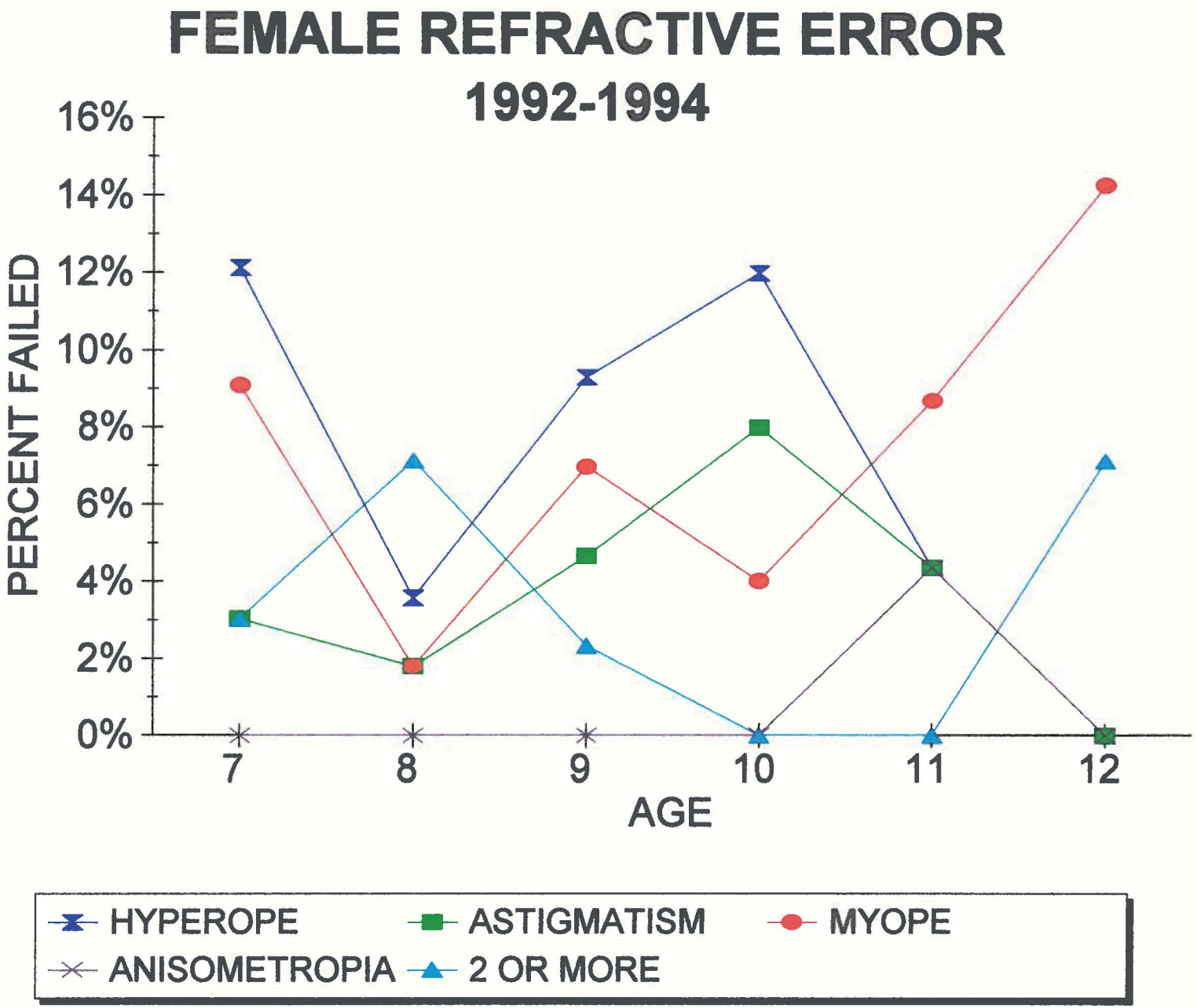
FEMALE REFRACTIVE ERROR
1992-1994
PERCENT FAILED
16%
14%
12%
10%
8%
6%
4%
2%
0%
7
8
9
10
11
12
AGE
HYPEROPE
ASTIGMATISM
MYOPE
ANISOMETROPIA
2 OR MORE

Figure 12d

1992 MALE REFRACTIVE ERROR

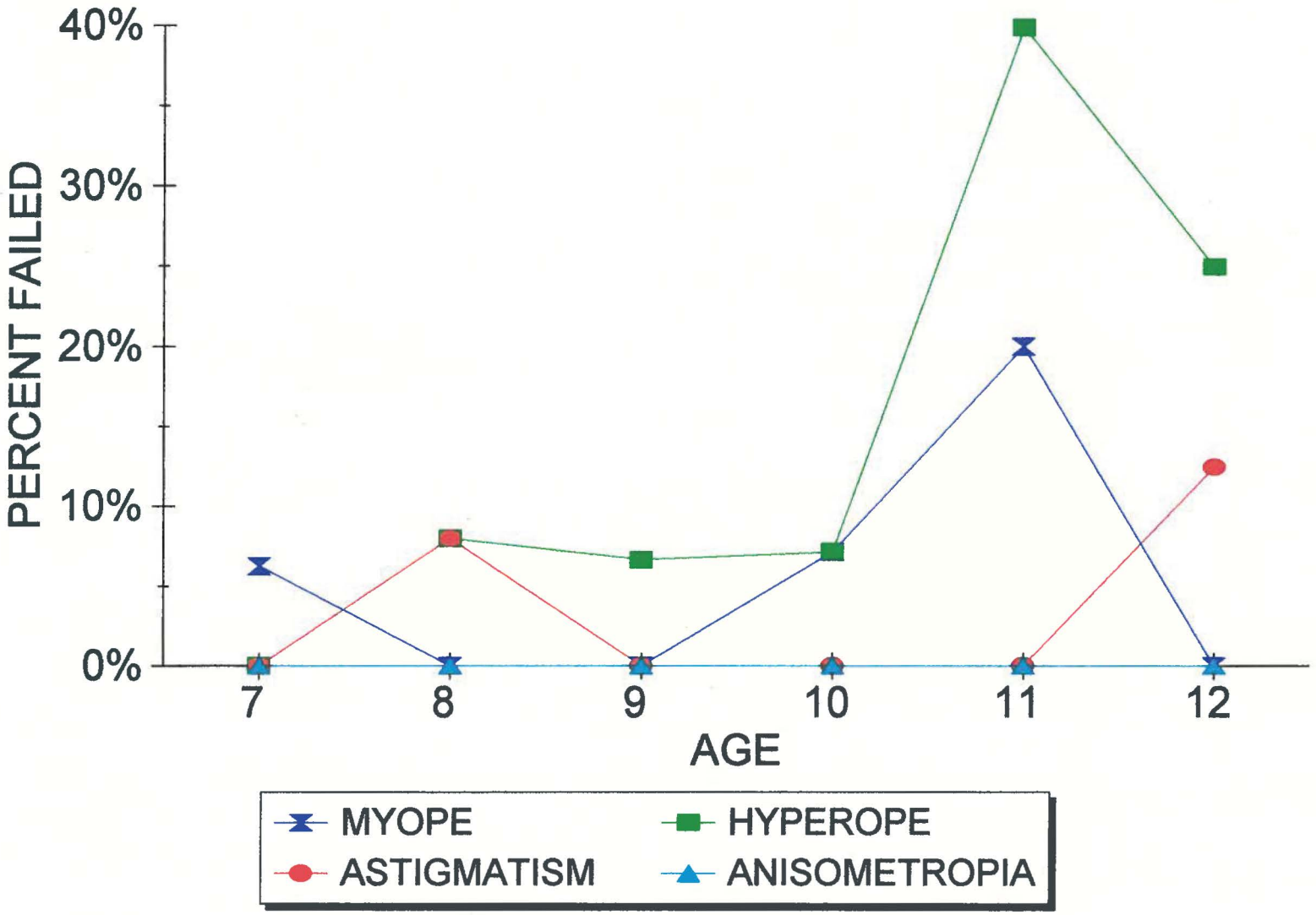

Figure 13a

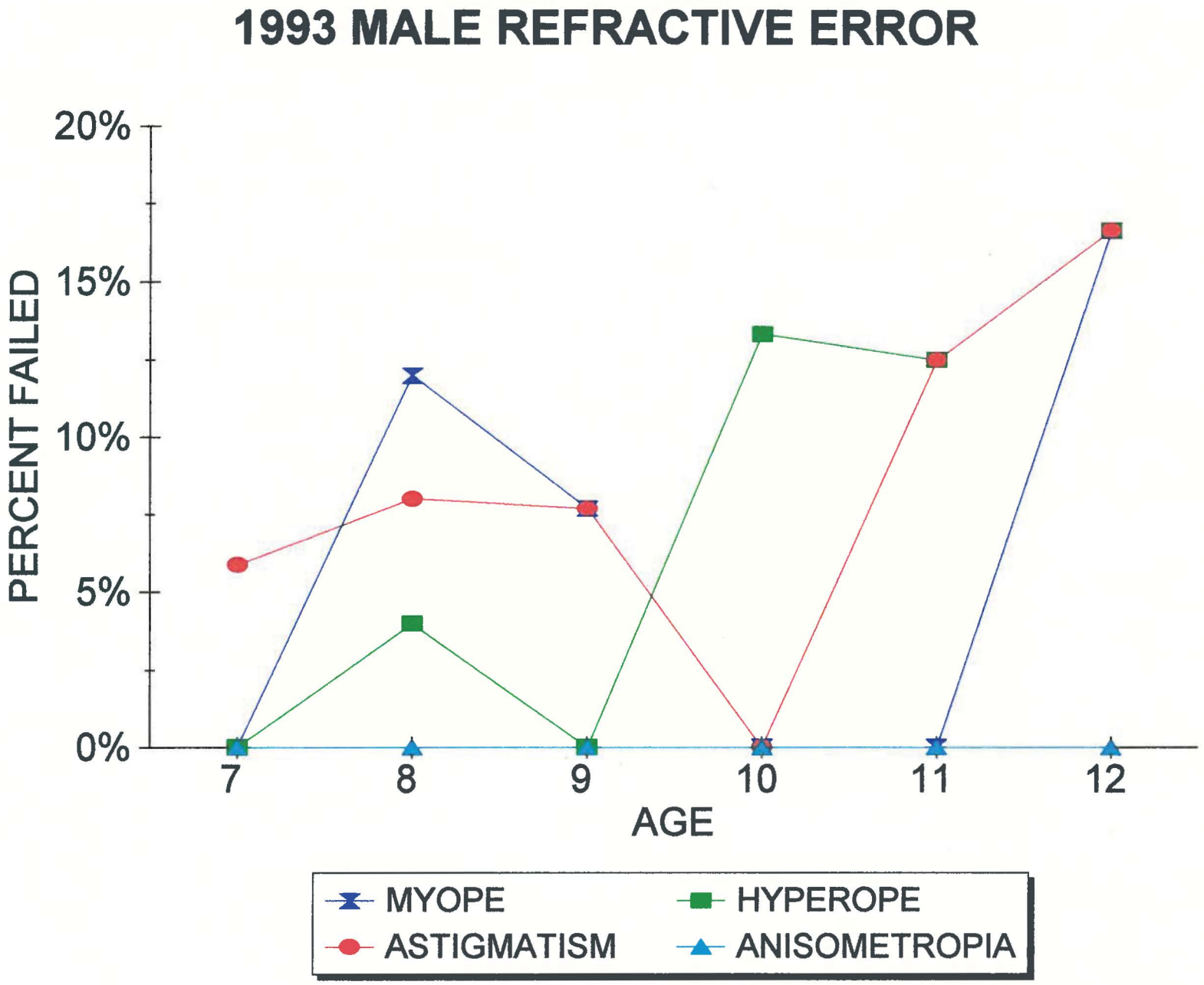
1993 MALE REFRACTIVE ERROR
20%
15%
10%
5%
0%
PERCENT FAILED
7
8
9
10
11
12
AGE
MYOPE
HYPEROPE
ASTIGMATISM
ANISOMETROPIA

Figure 13b

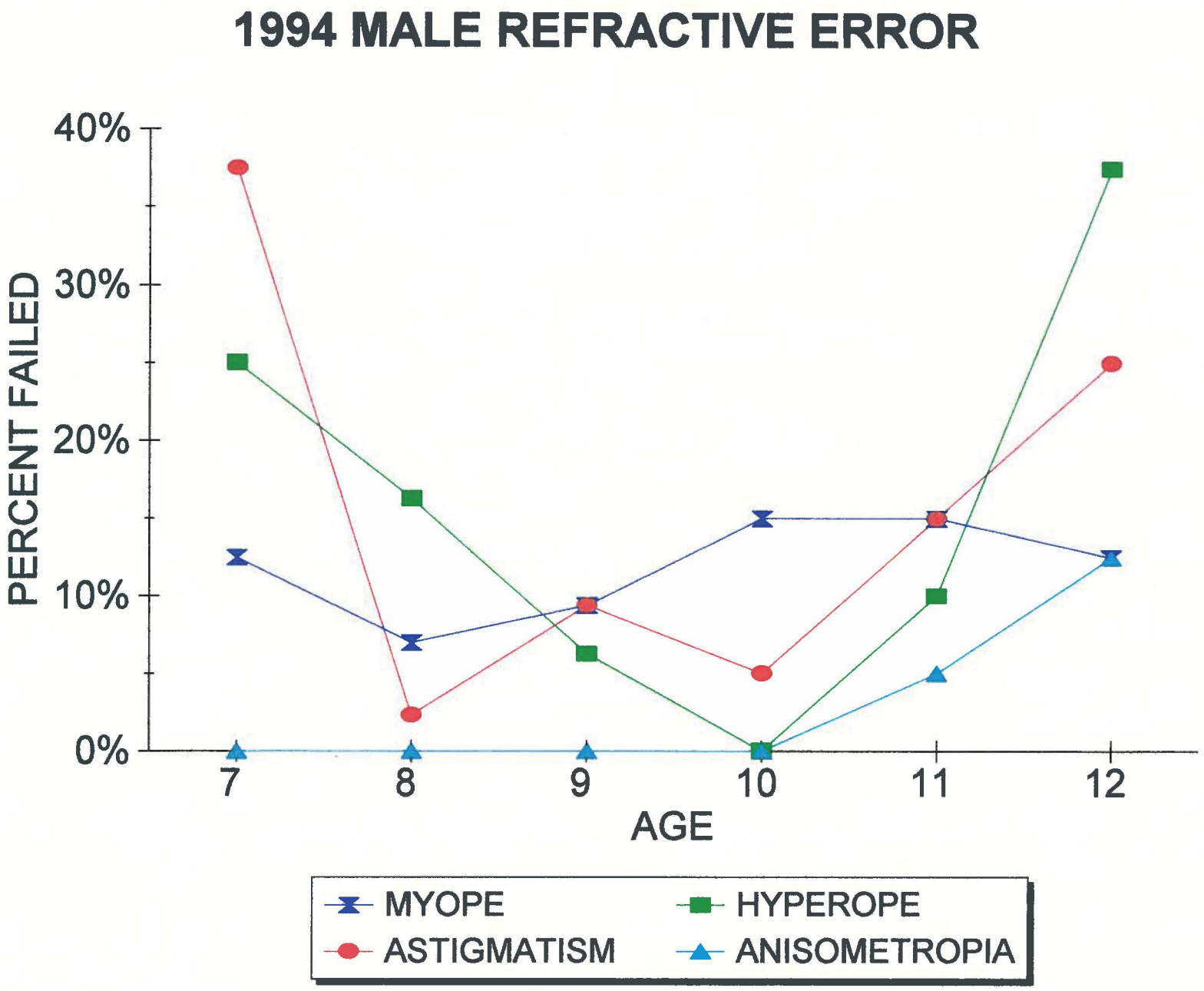
1994 MALE REFRACTIVE ERROR
40%
30%
20%
10%
0%
PERCENT FAILED
7
8
9
10
11
12
AGE
MYOPE
HYPEROPE
ASTIGMATISM
ANISOMETROPIA

Figure 13c

MALE REFRACTIVE ERROR
1992-1994

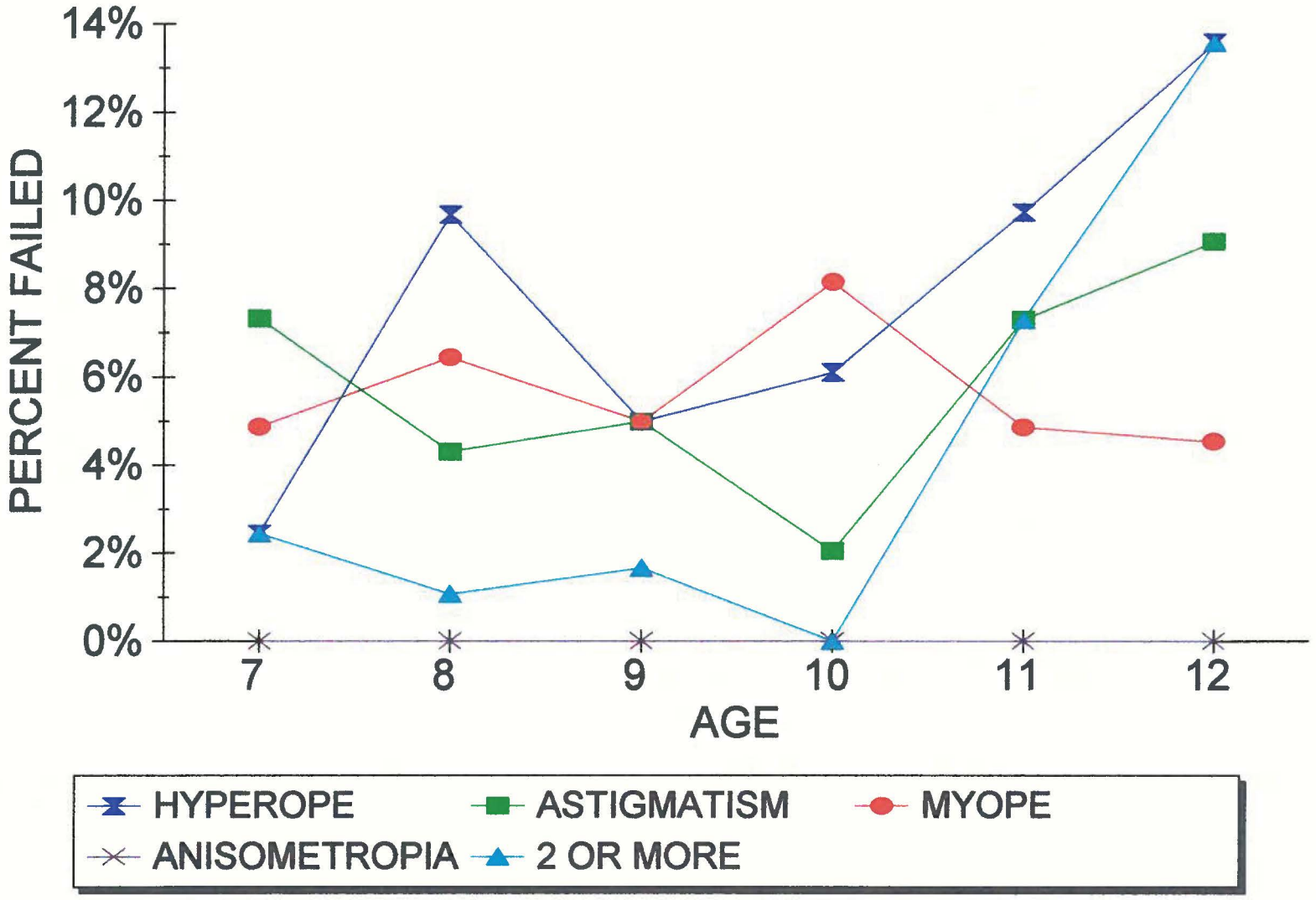

Figure 13d

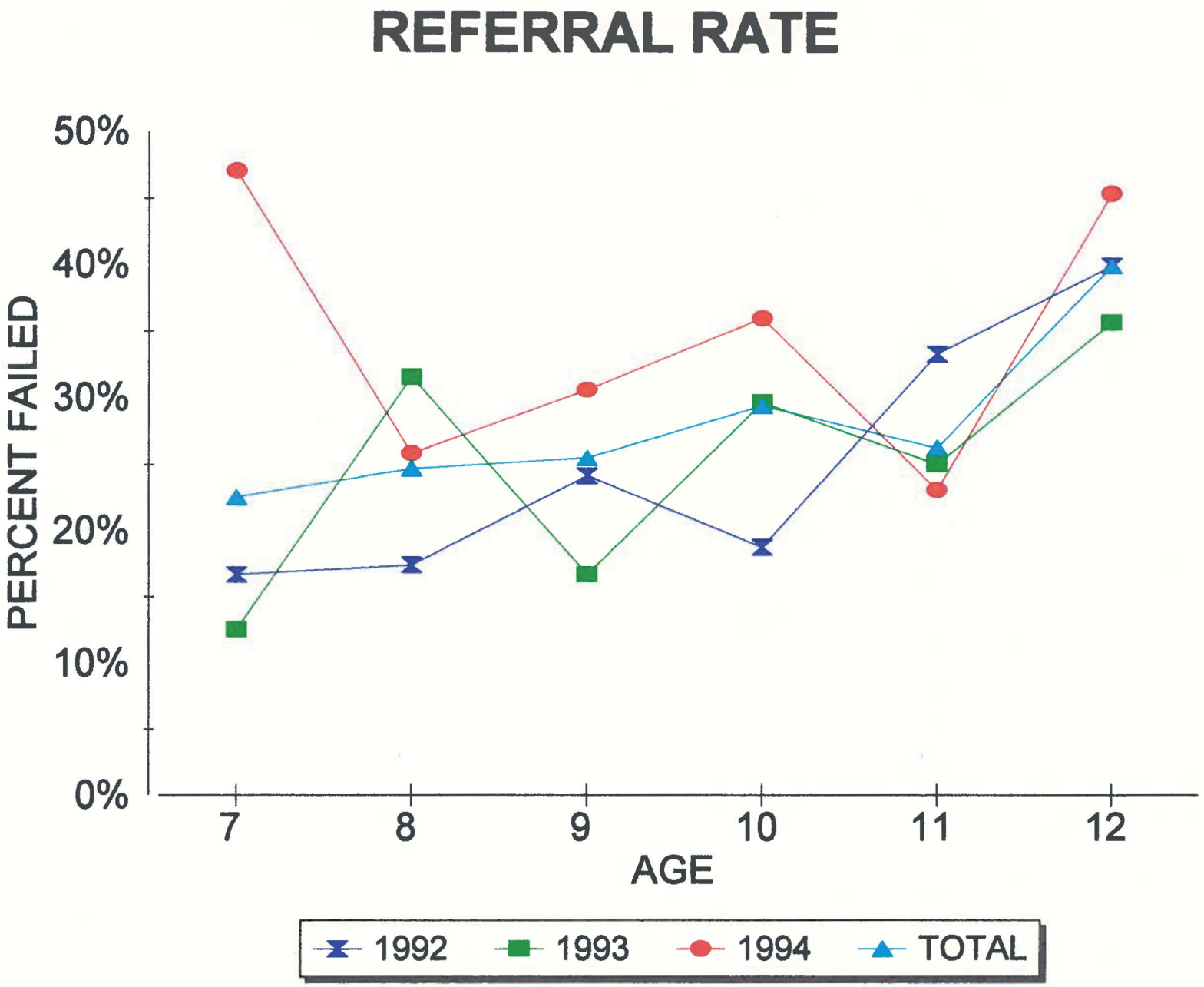
REFERRAL RATE
50%
40%
30%
20%
10%
0%
PERCENT FAILED
7
8
9
10
11
12
AGE
1992
1993
1994
TOTAL

Figure 14

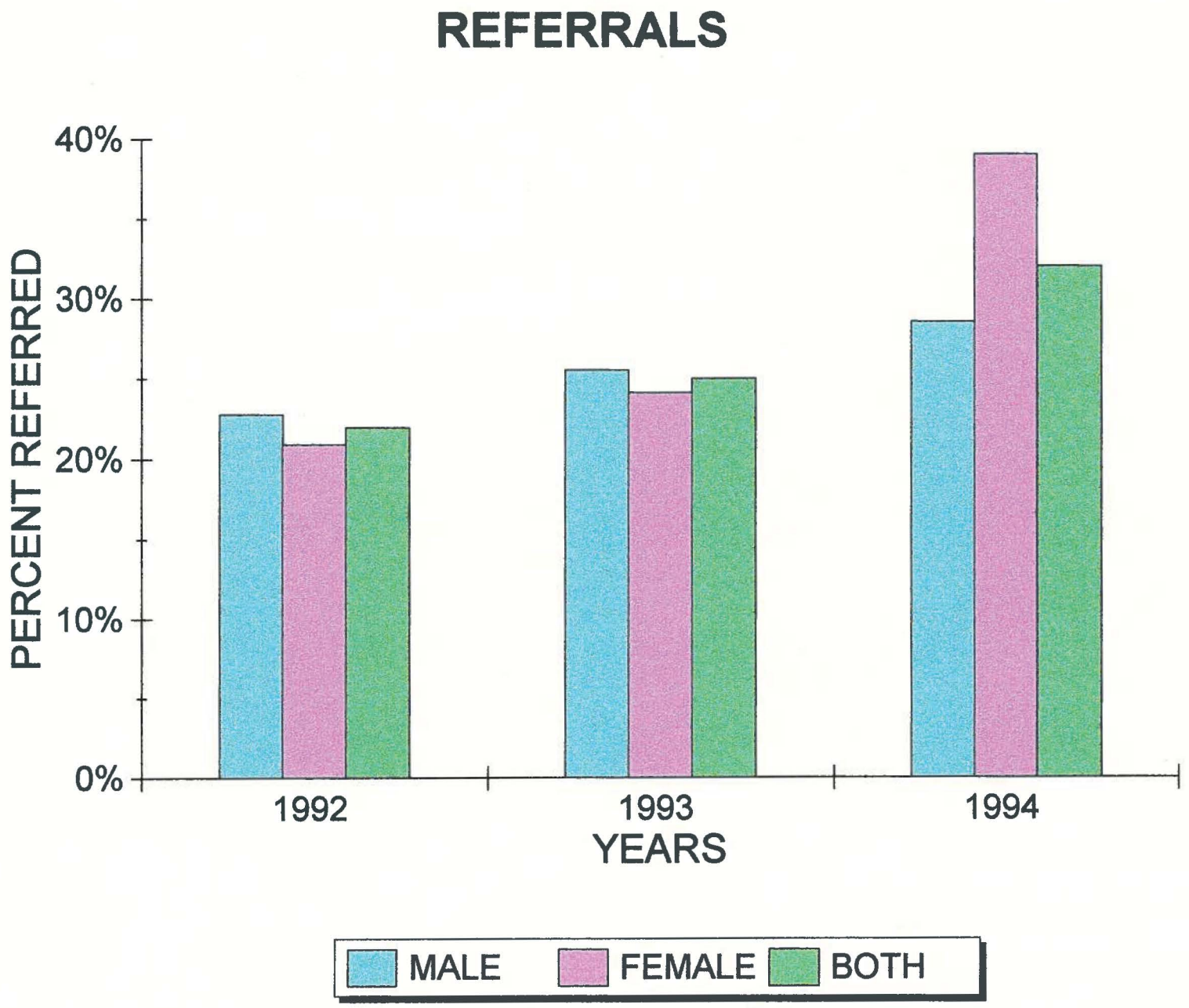
REFERRALS
PERCENT REFERRED
40%
30%
20%
10%
0%
1992
1993
1994
YEARS
MALE
FEMALE
BOTH

Figure 15

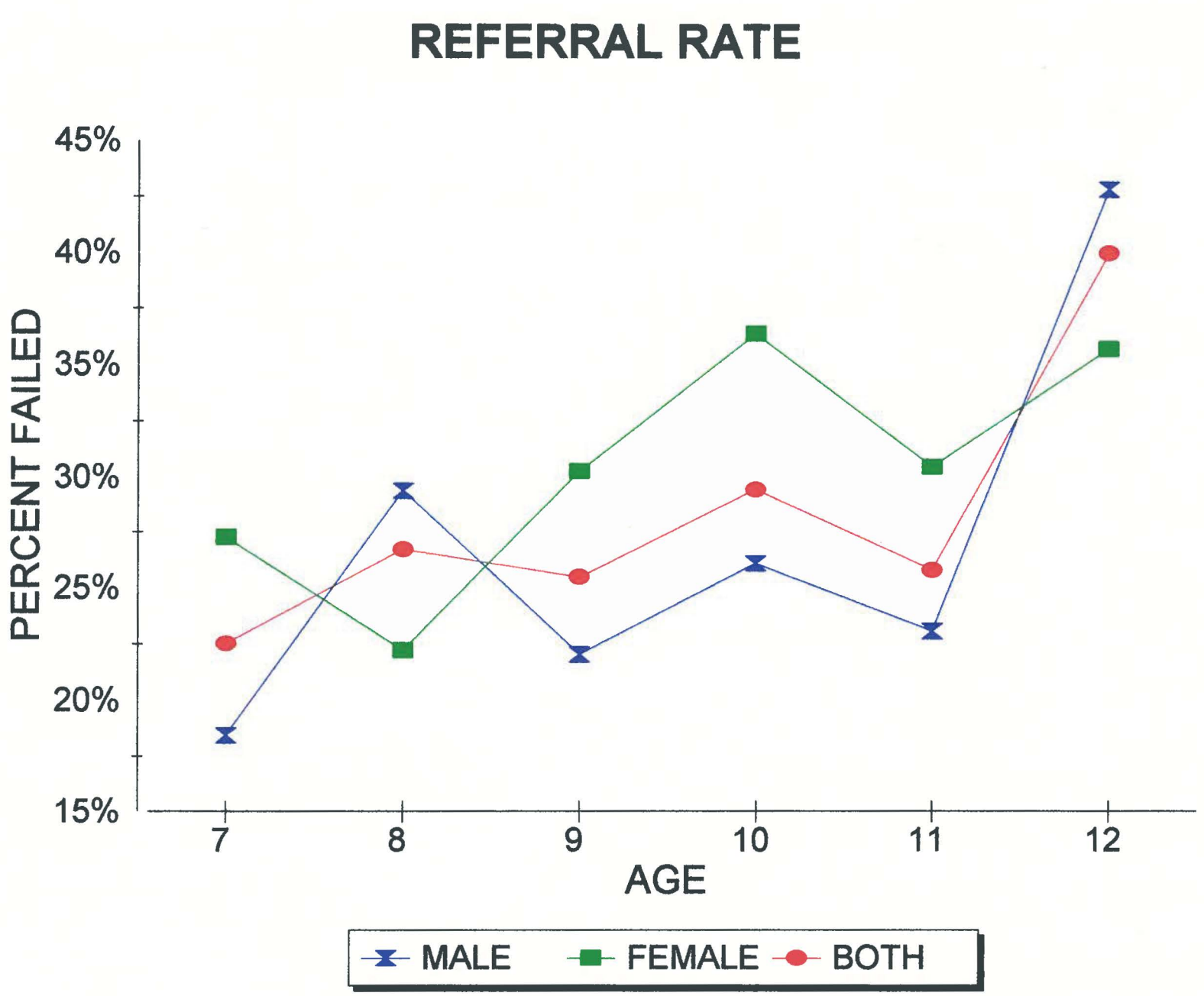
REFERRAL RATE
45%
40%
35%
30%
25%
20%
15%
PERCENT FAILED
7
8
9
10
11
12
AGE
MALE
FEMALE
BOTH

Figure 16

1992 DATA TABLE

AGE	7	8	9	10	11	12	TOTAL
NUMBER TESTED	n=31	n=47	n=29	n=19	n=15	n=11	n=152
DISTANCE VISUAL ACUITY	2/30	6/45	3/29	3/18	2/15	2/10	18/147
NEAR VISUAL ACUITY	2/31	1/47	0/27	0/19	2/15	2/9	7/148
DISTANCE COVER TEST	0/30	1/47	2/29	2/19	1/14	0/11	6/150
ESOPHORE	0/30	0/47	1/29	0/19	1/14	0/11	2/150
EXOPHORE	0/30	0/47	0/29	1/19	0/14	0/11	1/150
STRABISMUS	0/30	1/47	1/29	1/19	0/14	0/11	3/150
NEAR COVER TEST	3/26	2/43	3/24	3/16	1/13	0/8	12/130
ESOPHORE	0/26	0/43	2/24	0/16	0/13	0/8	2/130
EXOPHORE	3/26	1/43	1/24	2/16	1/13	0/8	8/130
STRABISMUS	0/26	1/43	0/24	1/16	0/13	0/8	2/130
RETINOSCOPY	5/31	7/47	3/29	2/19	5/15	3/11	24/152
HYPEROPE	4/31	1/47	2/29	1/19	2/15	1/11	11/152
MYOPE	1/31	1/47	1/29	1/19	1/15	1/11	6/152
ASTIGMATISM	0/31	1/47	0/29	0/19	1/15	0/11	2/152
ANISOMETROPIA	0/31	0/47	0/29	0/19	0/15	0/11	0/152
TWO OR MORE	0/31	3/47	0/29	0/19	1/15	1/11	5/152
		H, AST H, AST M, AST			M, H	H, AST	
HEALTH	2/30	3/45	1/27	1/19	1/15	0/11	8/147
REFERRAL	5/30	8/46	7/29	3/16	5/15	4/10	32/146

Table 1

1993 DATA TABLE

AGE	7	8	9	10	11	12	TOTAL
NUMBER TESTED	n=26	n=39	n=24	n=28	n=21	n=14	n=152
DISTANCE VISUAL ACUITY	0/26	3/39	1/24	3/28	3/21	1/14	11/152
NEAR VISUAL ACUITY	0/26	1/39	0/24	4/28	3/21	1/14	9/152
DISTANCE COVER TEST	0/26	2/39	0/24	1/28	0/21	0/14	3/152
ESOPHORE	0/26	1/39	0/24	1/28	0/21	0/14	2/152
EXOPHORE	0/26	1/39	0/24	0/28	0/21	0/14	1/152
STRABISMUS	0/26	0/39	0/24	0/28	0/21	0/14	0/152
NEAR COVER TEST	0/22	3/36	0/24	3/28	1/21	1/14	8/145
ESOPHORE	0/22	1/36	0/24	2/28	0/21	0/14	3/145
EXOPHORE	0/22	2/36	0/24	1/28	1/21	1/14	5/145
STRABISMUS	0/22	0/36	0/24	0/28	0/21	0/14	0/145
RETINOSCOPY	3/26	7/39	3/24	5/28	4/21	4/14	26/152
HYPEROPE	0/26	2/39	0/24	3/28	2/21	1/14	8/152
MYOPE	1/26	3/39	1/24	1/28	0/21	2/14	8/152
ASTIGMATISM	1/26	2/39	2/24	1/28	2/21	1/14	9/152
ANISOMETROPIA	0/26	0/39	0/24	0/28	0/21	0/14	0/152
TWO OR MORE	1/26	0/39	0/24	0/28	0/21	0/14	1/152
	H, AST						
HEALTH	0/26	3/39	1/24	1/28	1/21	1/14	7/152
REFERRAL	3/24	12/38	4/24	8/27	5/20	5/14	37/147

Table 2

1994 DATA TABLE

AGE	7	8	9	10	11	12	TOTAL
NUMBER TESTED	n=17	n=63	n=50	n=27	n=28	n=11	n=196
DISTANCE VISUAL ACUITY	2/17	6/63	4/49	4/27	3/28	3/11	22/195
NEAR VISUAL ACUITY	5/16	7/63	3/49	3/27	5/28	3/11	26/194
DISTANCE COVER TEST	3/17	2/61	2/50	3/27	1/28	1/11	12/194
ESOPHORE	2/17	0/61	0/50	0/27	0/28	0/11	2/194
EXOPHORE	0/17	1/61	1/50	2/27	0/28	1/11	5/194
STRABISMUS	1/17	1/61	1/50	1/27	1/28	0/11	5/194
NEAR COVER TEST	1/15	2/53	4/46	3/23	4/26	0/10	14/173
ESOPHORE	1/15	0/53	0/46	0/23	2/26	0/10	3/173
EXOPHORE	0/15	2/53	2/46	3/23	1/26	0/10	8/173
STRABISMUS	0/15	0/53	2/46	0/23	1/26	0/10	3/173
RETINOSCOPY	8/17	15/63	12/50	7/27	8/28	5/11	55/196
HYPEROPE	1/17	8/63	5/50	2/27	1/28	1/11	18/196
MYOPE	3/17	3/63	4/50	3/27	3/28	0/11	16/196
ASTIGMATISM	3/17	2/63	3/50	2/27	1/28	1/11	12/196
ANISOMETROPIA	0/17	0/63	0/50	0/27	1/28	0/11	1/196
TWO OR MORE	1/17	2/63	2/50	0/27	2/28	3/11	10/196
	H, AST	H, AST H, ANISO	M, AST H, ANISO		M, AST H, AST, ANISO	H, ANISO M, H, AST H, ANISO	
HEALTH	1/17	9/63	3/50	2/27	4/28	1/11	20/196
REFERRAL	8/17	16/62	15/49	9/25	6/26	5/11	59/190

Table 3

DATA TABLE
COMBINED TOTALS

AGE	7	8	9	10	11	12	TOTAL
NUMBER TESTED	n=74	n=149	n=103	n=74	n=64	n=36	n=500
DISTANCE VISUAL ACUITY	4/73	15/147	8/102	10/73	8/64	6/35	51/494
NEAR VISUAL ACUITY	7/73	9/149	3/100	7/74	10/64	6/34	42/494
DISTANCE COVER TEST	3/73	5/147	4/103	6/74	2/63	1/36	21/496
ESOPHORE	2/73	1/147	1/103	1/74	1/63	0/36	6/496
EXOPHORE	0/73	2/147	1/103	3/74	0/63	1/36	7/496
STRABISMUS	1/73	2/147	2/103	2/74	1/63	0/36	8/496
NEAR COVER TEST	4/63	7/132	7/94	9/67	6/60	1/32	34/448
ESOPHORE	1/63	1/132	2/94	2/67	2/60	0/32	8/448
EXOPHORE	3/63	5/132	3/94	6/67	3/60	1/32	21/448
STRABISMUS	0/63	1/132	2/94	1/67	1/60	0/32	5/448
RETINOSCOPY	16/74	28/149	18/103	14/74	17/64	12/36	105/500
HYPEROPE	5/74	11/149	7/103	6/74	5/64	3/36	37/500
MYOPE	5/74	7/149	6/103	5/74	4/64	3/36	30/500
ASTIGMATISM	4/74	5/149	5/103	3/74	4/64	2/36	23/500
ANISOMETROPIA	0/74	0/149	0/103	0/74	1/64	0/36	1/500
TWO OR MORE	2/74	5/149	2/103	0/74	3/64	4/36	16/500
HEALTH	3/73	15/147	5/101	4/74	6/64	2/36	35/495
REFERRAL	16/71	36/146	26/102	20/68	16/61	14/35	128/483

Table 4