RESULTS OF DISTANCE VISION TESTS IN A RURAL POPULATION[1]

by RALPH E. WHEELER, M. D.

DISTANCE vision testing by the Snellen chart is generally included in the health examination and in the school medical examination in particular. A number of studies have been based upon the data secured from routine tests of this sort, but these have largely been limited to certain restricted age or occupational groups and very little has appeared on distance vision testing among rural inhabitants.

The Snellen test chart is the conventional one having nine lines of letters each line containing letters of a single size, the sizes being graded from large (three and one-half inches high) at the top to quite small ones (about one-quarter of an inch high) on the bottom line. The few persons able to read the line with the smallest letters have exceptionally keen vision and are rated 20/10. Not infrequently the next larger line can be read, and individuals able to do this are rated 20/15. The third line from the bottom is here regarded as the limit of normal and is rated 20/20. Those unable to read this last but able to read the fourth or fifth line (20/30 and 20/40, respectively) are here regarded as having moderately defective distance vision. Individuals able to read only the fifth line (20/50) and successively larger types (20/70, 20/100, and 20/200), together with those unable to read even the largest letters (these latter were collectively rated less than 20/200), are regarded as having markedly defective distance vision.

The distance between the test chart and the examinee was always twenty feet, and the vision of each eye was tested and recorded separately. In the group whose data are here discussed, the vision

[1] From the Milbank Memorial Fund.

Acknowledgment is made of the cooperation extended by the Cattaraugus County Department of Health. For material aid in preparing the paper, the author is indebted to Mrs. Mary M. Fowler. Dr. Dorothy Shaad very kindly offered critical comment.

was thus tested first without glasses and subsequently with glasses, where these were worn for distance vision at the time of the clinic visit.[2]

The data presented here were obtained from the medical examination records of a group of persons of all ages in a rural area in Cattaraugus County in western New York State. The characteristics of the area and the method of obtaining a sample of the population for examination are described elsewhere;[3] it suffices here to note that the examinees came from rural farm and small village homes, and included children and adults of both sexes. There are certain selective factors in the group as a whole, but these are regarded as not appreciably affecting the representativeness of the distance vision findings.

Of a total of 1,224 individuals examined, vision data are available on 965. The 258 for whom no record is available were chiefly children under five years of age, so that the earliest age for which examinations were obtained is five years.[4] Of the 966 records, there are 585 upon which data are complete enough for the purposes of the present paper. The factor of selection for completeness of data is not regarded as affecting the representativeness of the smaller sample as the records cover all persons seen at the clinic over a period of nearly three years and, insofar as they may be compared with the data of the discarded records, show no significant differences.

Data are given, then, on the records used here for the visual per-

[2] It was pointed out by Dr. Shaad that, where children wearing glasses are being tested, there is likely to be a period of defective accommodation immediately after putting on glasses, so that vision should be tested *first* with glasses and subsequently without them. Failure to adopt this routine with children may lead to a worse rating for the vision with glasses than the child actually should have.

[3] Wheeler, Ralph E.: Impairments in a Rural Population. The Milbank Memorial Fund *Quarterly*, July, 1937, xv, No. 3, pp. 248-261.

[4] A number of children under five were tested, but even when they were cooperative the results of the test were frequently inconsistent and therefore not recorded. Older children unfamiliar with the alphabet were tested by the Snellen test with E's in various positions. Examinees were observed carefully while the test was in progress to prevent conscious or inadvertent evasions.

formance of each eye separately, and for each eye with and without glasses where these were worn habitually.

Unfortunately, it was not possible to arrange a consultation with an oculist for each case found to have defective distance vision, so that useful information as to the causes of the defects found is not at hand. Only the data on defects from all causes, therefore, may be used.

In a summary study of defects,[5] certain data, chiefly from the findings of the second examiner, were detailed. These reveal a number of facts already established for urban populations but, as far as can be ascertained, not well defined for rural ones. The first is that the percentage of persons with all forms of defective distance vision (20/30 or worse) in one eye or both, and without glasses (where these are habitually worn), rises from 26 per cent at ages 5-14 years to 87 per cent[6] at ages above 60 years. This rise is, of course, to some extent a result of the aging process. The second fact is that males in general show lower rates than females throughout the greater part of the life span.

The previously published data were part of a general discussion of the basic physical findings of a population and did not cover such facts as the extent to which correction of distance vision defects was obtained by glasses or the extent to which there may be inequalities of vision between the two eyes. The present study will complete the earlier data in these respects and draw certain conclusions about the testing of vision as applied to the routine health examination.

The data are here offered on an age- and sex-specific basis because of the variations in prevalence with these two factors. Two categories of defective vision, as measured by the Snellen test, are

5 Wheeler, Ralph E.: Impairments in a Rural Population. IV. Prevalence of Impairments by Age and Sex. The Milbank Memorial Fund *Quarterly*, April, 1938, xvi, No. 2, pp. 192-217.

6 The actual figures were 21.4 per cent for males and 31.2 per cent for females in the youngest age group, and 88.6 per cent for males and 86.1 per cent for females in the oldest age group.

also presented: "All degrees" is a comprehensive one, including both moderate and marked, as defined above: "marked degrees" includes the ratings from 20/50 to less than 20/200. In Table 1, the prevalence of these degrees of defect is shown for the examined group in two ways: the first counts among the defective those with defective vision who were substantially improved by wearing glasses (uniformly without glasses), and the second counts among the defective only those having the respective degree despite the correction of glasses if these were worn (with glasses, when worn). A final column shows the proportions wearing glasses for the correction of distance vision at the time of examination.

Table 1. Percentage of examined persons with all degrees of visual defect measured by the Snellen chart, and with marked degrees only, tested without glasses and with glasses when these were worn.

Age Group	Number Examined	All Degrees[1]		Marked Degrees Only[2]		Per Cent Wearing Glasses[3]
		Uniformly Without Glasses	With Glasses When Worn	Uniformly Without Glasses	With Glasses When Worn	
	MALES					
Total	272	40.4	39.0	23.2	19.1	6.2
5-14	70	21.4	21.4	7.1	7.1	—
15-29	59	22.0	22.0	11.9	11.9	—
30-44	52	30.8	30.8	13.5	11.5	7.7
45-59	47	57.4	51.1	34.0	23.4	17.0
60+	44	88.6	86.4	63.6	52.3	11.4
	FEMALES					
Total	313	49.5	46.0	29.1	21.4	15.0
5-14	74	31.2	31.1	8.1	6.8	1.4
15-29	85	34.1	32.9	22.4	17.6	7.0
30-44	61	44.3	42.6	16.4	11.5	9.8
45-59	57	78.9	70.2	49.1	40.4	29.8
60+	36	86.1	75.0	77.8	47.2	47.2

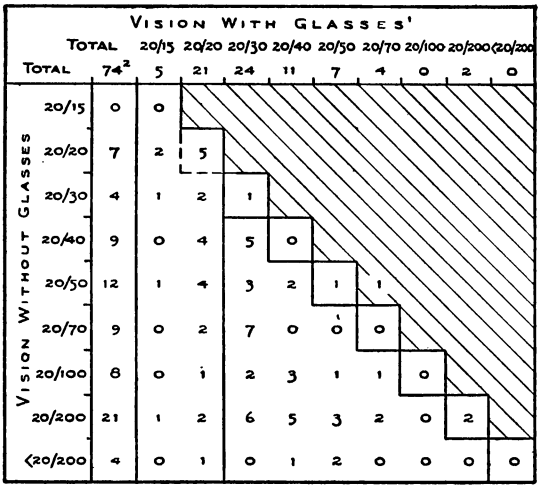
[1] Vision of one or both eyes 20/30 or worse.
[2] Vision of one or both eyes 20/50 or worse.
[3] Wearing glasses for distance vision at the time of clinic examination.

It is evident that, through the greater part of the life span, the factor of correction by the use of glasses does not very materially affect the proportions classed as having defective vision in this rural population. The chief reason for this is, probably, that relatively few persons wear glasses compared to the number in need of them. This must remain a hypothesis because the exact proportion of all defects of distance vision due to refractive errors, and therefore remediable by glasses, is not known. There is a simple test which could and should be added to the routine medical examination of distance vision and which would clarify this uncertainty to some extent, namely, the pinhole test.[7] Unfortunately, however, it was not included in the examining routine of the group whose findings are presented here. However, the differences are not entirely attributable to failure to obtain glasses when needed, for a number of examinees wore glasses but did not secure the maximum benefit from them.

The distribution of all persons wearing glasses when they came to the clinic is shown according to degree of visual acuity, with and without glasses, in Figure 1. This figure shows a number of facts about the degree of correction achieved by wearing glasses for distance vision in this population. The shaded area above the diagonal squares represents distance vision made worse by the wearing of glasses. Only one person appears here. The area within the squares on the diagonal shows the number of persons whose vision, as measured by the Snellen test, was unchanged by wearing glasses. The five persons with 20/20 vision, both with glasses and without,

7 If, by the regular Snellen test, a patient is found to have errors in the neighborhood of 20/30 or worse, the examinee should be given a card with a pin-hole in it and asked to read the Snellen test chart again, with each eye separately sighting it through the pinhole. The test is not an infallible one, but the majority of persons showing improvement of visual acuity with it have correctable refractive errors. Little time is consumed in making this extra test, and the further information it gives on the prognosis of visual conditions alone makes it an important adjunct to the routine. The procedure has long been a part of the ophthalmological examination. For data on the usefulness of this test, as a part of the routine health examination, the author is indebted to Dr. R. Townley Paton and to Dr. Dorothy Shaad.

may have been wearing glasses for astigmatism or some other refractive error not involving central visual acuity, so that only four persons may properly be counted here. The number under the diagonal of squares, showing vision with glasses of 20/30 or worse (to the right of the perpendicular between 20/20 and 20/30), is the group wearing glasses presumably for the correction of defects of distance vision but not achieving full correction; this group numbers forty-three individuals. Those to the left of the perpendicular and including the five having 20/20 vision with and without glasses are the number credited with securing full correction from the wearing of glasses. The percentages which these figures are of the total number wearing glasses are shown in Table 2.



¹ Vision as of one or both eyes.

² Ten persons examined with and without glasses, by another examiner, have been included in this table.

Fig. 1. Number of all examined persons wearing glasses for distance vision, having specified vision with and without glasses.

The data shown in Figure I and Table 2 are for the vision of one or both eyes; that is, individuals are rated as having the degree of visual acuity found for the eye with the least vision when there is

Table 2. Number and percentage of persons receiving stated grade of visual aid from glasses.

	Total Wearing Glasses	Unimproved or Made Worse	Somewhat Improved But Not Fully	Fully Corrected (At Least to 20/20)
Number	74	5[1]	43	26
Per Cent	100.0	6.8	58.1	35.1

[1] Excluding five with 20/20 vision where glasses were used apparently to correct astigmatism.

a discrepancy. When individuals are rated as of the visual acuity of the best eye, the figures are somewhat changed. *Unimproved or made worse* then becomes 5.4 per cent; *somewhat but not fully improved* becomes 36.5 per cent; and *fully improved* becomes 58.1 per cent. Possibly the fairest way of presenting these data would be an average of the two sets of figures, when they would read successively 6.1, 47.3, and 46.6 per cent.

The ideal, of course, would be to have glasses, if worn at all, fully correct the defect in question, but such an ideal is not always attainable even with the best care available, and this may well account in part for the not too favorable distribution shown in Figure 1. Another reason may be that glasses were not checked periodically to ensure the need for further correction. This point was not covered by the history taking so that no data are available to confirm or disprove it. Finally, it is known that only a small proportion of persons in the study area secured glasses on the prescription of an oculist, and it is believed that this is also true of the group here presented.

The data previously published[8] for visual findings without glasses are all based upon the findings for one or both eyes, individuals being rated, as in the foregoing correction analysis, on the basis of the vision of the eye with the least vision where there is a discrepancy between the findings in the two eyes. This is probably more justifiable as a mode of presentation in the case of visual defects than it is in the estimation of the extent to which correction has been achieved by the wearing of glasses. There are, however, one or two facts about discrepancies in vision which are revealed by a comparison of the visual performance of the two eyes considered separately. Table 3 shows the percentages of persons with defective distance vision in one eye only or in both. The proportion of persons showing defects in one or both eyes is uniformly greater than that with defects in both eyes because a certain number of persons may have

[8] Wheeler, Ralph E.: *op. cit.*

Age Group	Number Examined	All Degrees		Marked Degrees Only	
		One or Both Eyes	Both Eyes	One or Both Eyes	Both Eyes
	MALES				
Total	272	40.4	29.8	23.2	12.1
5-14	70	21.4	8.6	7.1	—
15-29	59	22.0	10.2	11.9	1.7
30-44	52	30.8	19.2	13.5	3.8
45-59	47	57.4	48.9	34.0	19.1
60+	44	88.6	81.8	63.6	47.7
	FEMALES				
Total	313	49.5	38.1	29.1	23.1
5-14	74	31.2	20.3	8.1	4.0
15-29	85	34.1	24.7	22.4	21.2
30-44	61	44.3	30.0	16.4	8.3
45-59	57	78.9	61.4	49.1	35.1
60+	36	86.1	83.3	77.8	72.2

[1] All percentages based on performance without glasses when these were worn

Table 3. Percentages of examined persons with all degrees of visual defect and marked degrees only, compared as to defects in one or both eyes, and in both eyes only.[1]

a defect in one eye and good or only moderately defective vision in the other. The differences diminish with increasing age because the aging process often affects the vision of the best eye. Evidently, however, these differences are not equally distributed between the two sexes. The differences between rates for one or both eyes and both eyes are not so marked for males and females with all degrees of defect as they are for males and females with marked degrees. Thus, the rate for marked degrees of visual defect in both eyes for males (12.1 per cent) is only half that for one or both (23.2 per cent), while the corresponding rates for females are much more nearly equal (23.1 and 29.1 per cent). As the age distribution of male and female examinees is not dissimilar, the conclusion may be drawn that the more marked degrees of visual defect are more

likely to be bilateral among females. A similar conclusion was reached by Collins[9] from an analysis of Snellen test data for school children.

DISCUSSION AND CONCLUSIONS

The routine medical examination is well designed for detecting pathological form but poorly designed for detecting pathological function. As defects—even serious defects—of function may precede or exist independently of manifest changes in the size, shape, or general appearance of an organ, the medical examination stands badly in need of supplementation with tests of function. The Snellen test is one of the few functional tests already in routine use. It is, unfortunately, not a comprehensive test of vision or even of distance vision, as some persons show a fairly good performance over the short period of the test and have difficulty in using the eyes similarly for a longer period; also, central vision is measured almost exclusively.

The detailed analysis of vision may require more extensive testing than the results would warrant or than the routine examination could accommodate, but the supplementing of the present Snellen test with the pinhole test, mentioned above, would appear to be well worth while, when some degree of visual defect is encountered with the former. Directly or indirectly, defects of vision may have quite as much significance for the individual as other defects whose discovery arouses more apprehension. Cancers of the eye and other serious progressive conditions are, fortunately, rare, but their detection on routine examination requires some supplementing of the usual procedure. One useful supplement is, of course, the ophthalmoscopic examination, but this may not be very satisfactory unless the pupil is dilated—hardly a practical routine measure. The pinhole test will be found useful in such cases, and even the more common disorders can be better diagnosed and recommendations

9 Collins, S. D.: The Eyesight of the School Child as Determined by the Snellen Test. *Public Health Reports,* United States Public Health Service, November 28, 1924, xxxix, No. 48, pp. 3013-3027.

for correction reinforced if the regular Snellen test is supplemented as suggested.

The data on the prevalence of inequality of vision in the two eyes suggests that there is some factor which makes males not only less prone than females to have defective vision but less likely to have it bilaterally in marked degree. The latter fact may be due to the more frequent occurrence of injuries affecting the vision of one eye among males.

The need of adults for efficient distance vision varies with occupation and other considerations, so that the low proportion found in Table 1 to have adequate correction is not necessarily unfortunate. On the other hand, it is very probable that more school children need glasses for correction than have them, according to these figures.