

# Racial Differences in Visual Acuity

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CERTAIN VISUAL STANDARDS have been established by the Armed Forces in determining an individual's qualification for military service (1). Consequently, testing of vision constitutes an integral part of the medical examinations conducted by the Armed Forces examining stations.

The current visual standards with respect to induction or enlistment for military service are expressed in terms of distant vision. The following procedures are prescribed by the Army regulations in regard to testing visual acuity (1):

Visual acuity will be determined at a distance of 20 feet or the mirror equivalent under standard conditions of illumination. The illumination of the target chart shall be between 12- and 18-foot candles. This degree of illumination may be obtained by a 200-watt lamp, 5 feet diagonally from the 20/20 line in the target, and incident to this part of the chart at an angle of 45°. All lamps must be shielded from the direct vision of the examinee by an opaque shade. The individual to be tested, if wearing glasses, will remove them before entering the examining room, and then will be seated without viewing the test chart. Individuals awaiting the test must be kept out of hearing distance. The examiner holds the occluder and covers the candidate's left eye, while instructing the examinee to keep both eyes open without squinting. The occluder must not be permitted to touch any part of the eye to be shielded, but will be held in contact with the side of the nose. The examinee is then directed to begin with the first (visible) line and to read as many as possible. The acuity for the left eye is then tested, using a different chart or by having the examinee read the lines backward. An individual who normally wears glasses is tested again with them in place, following the same procedure. Where there is a suspicion that the examinee has memorized the charts, he is directed to read the letters or targets

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in reverse order or will be shown a different chart. The individual is expected to read the letters promptly. No precise time limit will be applied, but 1 or 2 seconds per letter is ample time. When an individual fails a letter or target, he will not be asked to read it again. If the individual is a rapid reader and his mistakes are obviously careless ones, he will be cautioned to "slow down" and the test will be repeated on another chart. Vision is recorded in the form of a fraction. The upper number is the distance in feet from the target, and the lower number is the value of the smallest test chart line read correctly. Thus a person reading the 30-foot test chart line at a distance of 20 feet is given a score of 20/30. A score of 20/20 indicates the person reads test chart line marked 20 at a distance of 20 feet. Similarly, 20/200 means that person reads only the test chart line marked 200 from a distance of 20 feet.

The findings of the visual testing are recorded on the examinee's medical examination report (Standard Form 88, item 59), for each eye separately. Both the examinee's uncorrected and correctable distant vision are recorded, in Snellen notation. The following analysis of racial differences in visual acuity is based on these findings.

## The Sample

The analysis deals with Selective Service registrants examined by the Armed Forces examining stations during the 21-month period from January 1957 through September 1958. The stations are required to submit to the Office of the Surgeon General, Department of the Army, a copy of the medical examination report of each registrant disqualified by them for military service and of each qualified registrant inducted into the Army.

During this period, 50 percent of the submitted medical reports were coded for use in the study. To assure randomness, the sample was selected by taking all reports of the disqualified registrants whose Selective Service

number assigned to them by their local boards ended in an odd digit, and all reports of the inducted registrants whose Armed Forces service number ended in an odd digit. The sample included some 276,000 medical reports. The medical and personal data coded from these reports were put on punchcards.

Visual data, involving one or both eyes, were missing on 2.0 percent of the medical examination reports of disqualified registrants (2.1 percent for whites and 1.8 percent for Negroes) and on 0.2 percent of those of inducted registrants (0.2 percent for whites and 0.3 percent for Negroes). Eliminating these, the final sample used in the analysis comprised some 273,000 medical reports of registrants with known distant vision. These reports were distributed as follows by race and military qualification of the examinees:

Race	Disqualified	Inducted	Total
White (non-Negro) -----	109,516	111,794	221,310
Negro -----	36,893	14,389	51,282
Total -----	146,409	126,183	272,592

These examinees presented a young population: the mean age (as of last birthday) of the white examinees was computed as 21.8 years, and that of the Negro as 21.6 years. Somewhat more than one-half of both white and Negro examinees were 22 years of age (table 1).

#### Data Tabulated and Adjusted

From the coded visual data the following cross-tabulations were prepared for each of the four groups—white disqualified, white inducted, Negro disqualified, Negro inducted:

Uncorrected vision of right eye by uncorrected vision of left eye.

Uncorrected vision of right eye by correctable vision in the same eye.

Uncorrected vision in left eye by correctable vision in the same eye.

To carry out the analysis of the total examined groups by race, the cross tabulations of the disqualified examinees, by race, had to be combined with those of the inductees who were taken as representative of the total qualified group.

These cross-tabulations indicated differences in distant vision between races, as well as be-

**Table 1. Percentage distribution of registrants examined for military service by age and race, January 1957–September 1958**

Age <sup>1</sup>	White	Negro
All ages-----	100.0	100.0
Under 18-----	0.8	1.0
18-----	6.6	9.3
19-----	7.7	7.6
20-----	5.7	4.9
21-----	17.5	19.3
22-----	53.3	53.0
23-----	5.2	3.2
24-----	1.9	.9
25-----	1.2	.6
26-----	.1	.2
Mean age (years)-----	21.8	21.6

<sup>1</sup> As of last birthday.

SOURCE: Medical examination reports (Standard Form 88) of registrants examined for military service by the Armed Forces examining stations.

tween disqualified and inducted examinees within each race. Because of these differences, it was necessary, prior to combining the distributions, to ascertain that these groups are properly represented for analysis. This was done on the basis of monthly reports, Summary of Registrant Examinations for Induction (DA Form 316), submitted by each Armed Forces examining station in addition to the individual medical reports. From these monthly reports, the following ratios of disqualified to qualified registrants (excluding disqualifications for administrative, primarily moral, reasons) were established for this period of January 1957 through September 1958: White, 2,031 qualified and 1,000 disqualified; Negro, 555 qualified and 1,000 disqualified. The examinees disqualified for administrative reasons were excluded because no medical data are available for most of them.

The ratios of inductees to those disqualified in our study were obviously different from the ratios derived from the monthly reports. These differences stem from the fact that the medical reports of qualified registrants are received only for those who are inducted. Certain numbers of those who qualify enlist prior to induction; others may not be called up at all. The medical reports of these qualified registrants are not available. Hence, it was

necessary for proper evaluation of the data to weight the separate cross-tabulations to agree with the ratios obtained from the monthly reports. The weighting actually resulted in multiplying the cross-tabulations of the white inducted registrants by 1.99 and those of the Negro inductees by 1.42, cell by cell, and then combining these adjusted cross-tabulations with the corresponding cross-tabulations of the disqualified examinees. Obviously, the assumption was made that the distributions of all qualified registrants by visual acuity were the same as those who were qualified and inducted, a reasonable assumption.

### Uncorrected Distant Vision

From the combined (weighted) cross-tabulations of uncorrected vision by right and left

eyes, separate cross-tabulations were derived for white and Negro examinees (table 2). The distributions are shown to a base of 100,000 for white and 10,000 for Negro examinees. The difference in the bases is due to the difference in the total numbers involved.

Vision marked in the table as less than 20/400 includes light perception; blind includes missing eye. No persons blind in both eyes are indicated by the table, since such persons are ordinarily screened out by the local boards before being forwarded to the examining stations.

These distributions clearly reveal relatively poorer distant vision for the white than for the Negro examinees. For instance, as shown in table 2, 69 percent of the white examinees had 20/20 uncorrected bilateral vision compared

**Table 2. Distribution of registrants examined for military service by uncorrected distant vision in right and left eyes, by race, January 1957-September 1958**

Vision in left eye <sup>1</sup>	Vision in right eye <sup>1</sup>										
	20/20	20/30	20/40	20/50	20/70	20/100	20/200	20/400	<20/400	Blind	Total
<i>White</i>											
20/20-----	69,348	2,289	380	212	270	152	235	281	104	104	73,375
20/30-----	2,576	4,259	615	220	219	102	127	82	32	14	8,246
20/40-----	416	559	920	273	240	91	77	46	17	5	2,644
20/50-----	228	223	223	557	251	94	75	23	11	2	1,687
20/70-----	326	228	228	214	996	299	183	55	24	4	2,557
20/100-----	189	120	101	94	269	1,015	389	92	31	3	2,303
20/200-----	295	126	75	86	183	303	2,282	370	114	8	3,842
20/400-----	349	99	43	30	67	77	322	1,957	649	5	3,598
<20/400-----	130	40	18	13	26	29	114	678	569	4	1,621
Blind-----	84	12	5	2	5	4	6	4	5	-----	127
Total <sup>2</sup> -----	73,941	7,955	2,608	1,701	2,526	2,166	3,810	3,588	1,556	149	100,000
<i>Negro</i>											
20/20-----	8,217	195	28	15	14	7	14	18	12	11	8,531
20/30-----	220	412	41	14	11	5	3	4	2	1	713
20/40-----	33	49	78	16	12	3	2	2	1	-----	196
20/50-----	17	16	16	38	12	4	1	1	1	-----	106
20/70-----	18	12	10	9	53	13	5	2	1	-----	123
20/100-----	9	5	4	3	9	38	11	1	2	-----	82
20/200-----	13	5	2	1	4	7	66	8	4	-----	110
20/400-----	18	3	1	1	2	1	5	30	14	1	76
<20/400-----	12	2	1	1	1	1	3	15	13	-----	49
Blind-----	11	2	-----	-----	-----	-----	1	-----	-----	-----	14
Total <sup>3</sup> -----	8,568	701	181	98	118	79	111	81	50	13	10,000

<sup>1</sup> Snellen notation.

<sup>2</sup> Base used is 100,000.

<sup>3</sup> Base used is 10,000.

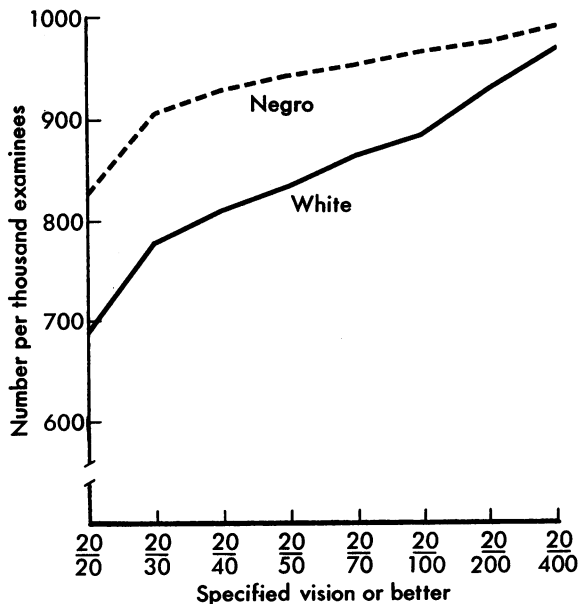
SOURCE: Medical examination reports (Standard Form 88) of registrants examined for military service by the Armed Forces examining stations.

with 82 percent of the Negro examinees. This fact of comparatively poorer vision of the white examinees is more distinctly shown in table 3 and figure 1, derived from table 2.

Uncorrected vision of less than 20/40 is ordinarily taken as point of departure to indicate defective vision. Table 3 shows that 81 percent of the white examinees had 20/40 vision or better in each eye, or 87 percent had such vision or better in at least one eye. The corresponding data for the Negro examinees indicate 93 percent having 20/40 vision or better in each eye, and 96 percent having such vision or better at least in one eye. In other words, 19 percent of the white examinees had less than 20/40 vision in the worse eye, or 13 percent in the better eye. Of the Negro examinees, only 7 and 4 percent had less than 20/40 vision in the worse or better eye, respectively.

Similar differences by race have been indicated by previous studies (2-4). The first (2), relating to low-income farm families, revealed such differences for each age group, within the age range from 5 to 65 years and over. These findings seemed to suggest that these differences could be primarily genetic (or racial) in origin. On the other hand, there are indirect

**Uncorrected distant vision, both eyes, in registrants examined for military service, by race, January 1957-September 1958**



**Table 3. Distribution of registrants examined for military service by specified uncorrected distant vision or better, by race, January 1957-September 1958**

Snellen notation	Number per 1,000 examinees <sup>1</sup>			
	In each eye		At least in one eye	
	White	Negro	White	Negro
20/20 or better.....	693	822	780	888
20/30 or better.....	784	904	850	947
20/40 or better.....	814	927	874	962
20/50 or better.....	833	941	889	969
20/70 or better.....	863	956	910	978
20/100 or better.....	888	966	929	984
20/200 or better.....	932	979	961	993
20/400 or better.....	971	989	994	993

<sup>1</sup> Derived from table 2.

indications that these differences may be environmental in origin. Studies of inductees (5,6) indicate a certain association between mental group and defective vision. It seems that the higher the mental group, the larger the relative proportion of individuals with defective vision. (These studies indicated for the higher mental groups I and II, as determined by the Armed Forces Qualification Test, proportionally more in physical categories B and C, which consist principally of inductees with defective vision.) All in all, however, it still remains an open question whether these racial differences in visual acuity are genetic in origin, or are the results of later environmental development, or are due to both.

### Correctability Potentials

The visual standards of this period have been expressed in terms of both uncorrected and correctable vision. With respect to correctable vision, the minimum visual requirements for acceptance into military service were correctable vision of 20/40 in one eye and 20/70 in the other eye, 20/30 in one eye and 20/100 in the other eye, or 20/20 in one eye and 20/400 in the other eye (1).

In addition to these minimum requirements, standards of correctable vision have been also established for profiling (grading) those whose correctable distant vision is above the minimum

requirements. There are three grades to this profiling, ranging from grade 1, the highest, to grade 3, the lowest. A general discussion of profiling is presented by the author in another article (7). During this period, grade 1, for instance, required correctable vision of 20/20 in one eye and 20/30 in the other eye. By these various profiling visual standards, the Army regulations thus provided for recording the highest possible correctable distant vision. Toward this end, each Armed Forces examining station has been equipped with a large trial lens-set. However, there might have been cases, especially if the minimum visual requirements were met, in which the medical examiner could have recorded the distant vision, as corrected by the examinee's own glasses, as correctable vision, without further testing. This could have led in some cases to understating correctability. Notwithstanding this fact, the correctable vision as recorded on the medical examination reports may, by and large, be taken as a reliable index of potential correctability.

In combining the cross-tabulations of uncorrected by correctable distant vision of the disqualified examinees with those of the inducted examinees for the purpose of obtaining corresponding distributions relating to the total examinees, the tabulations were weighted in the same manner as the cross-tabulations of uncorrected distant vision by right and left eyes. From the combined cross-tabulations of uncorrected versus correctable distant vision, probabilities of correctability were initially computed separately for the right and left eyes. A statistical evaluation of these separate probabilities indicated no significant differences between them. In other words, there is an equal chance for a specified defective vision to be corrected to a specified better vision, irrespective of whether it is that of the right or left eye. The probabilities of correctability (table 4) were hence computed by combining the weighted cross-tabulations of uncorrected versus correctable vision of the right eye with those of the left eye. These probabilities are presented sep-

**Table 4. Probabilities of correctability of a given distant vision to a given correctable distant vision, but not better, by race, January 1957–September 1958**

Best correctable distant vision <sup>1</sup>	Uncorrected distant vision						
	20/40	20/50	20/70	20/100	20/200	20/400	<20/400
<i>White</i>							
20/20-----	0. 686	0. 590	0. 611	0. 595	0. 610	0. 578	0. 322
20/30-----	. 270	. 296	. 235	. 217	. 199	. 232	. 223
20/40-----	. 044	. 079	. 087	. 092	. 072	. 066	. 089
20/50-----		. 035	. 032	. 030	. 024	. 020	. 036
20/70-----			. 035	. 040	. 030	. 026	. 036
20/100-----				. 026	. 029	. 017	. 021
20/200-----					. 036	. 025	. 026
20/400-----						. 036	. 024
<20/400-----							. 223
Total-----	1. 000	1. 000	1. 000	1. 000	1. 000	1. 000	1. 000
<i>Negro</i>							
20/20-----	. 636	. 450	. 501	. 490	. 497	. 385	. 088
20/30-----	. 309	. 371	. 271	. 205	. 172	. 224	. 119
20/40-----	. 055	. 115	. 124	. 145	. 113	. 109	. 104
20/50-----		. 064	. 048	. 039	. 033	. 041	. 049
20/70-----			. 056	. 059	. 062	. 047	. 033
20/100-----				. 062	. 054	. 050	. 035
20/200-----					. 069	. 079	. 040
20/400-----						. 065	. 040
<20/400-----							. 492
Total-----	1. 000	1. 000	1. 000	1. 000	1. 000	1. 000	1. 000

<sup>1</sup> Snellen notation.

SOURCE: Medical examination reports (Standard Form 88) of registrants examined for military service by Armed Forces examining stations.

arately by race. More details with respect to the interpretation of these probabilities are given in another paper by the author (8).

While the analysis of the uncorrected vision by race clearly indicated much better vision for the Negro examinees, the probabilities of correctability point curiously in the opposite direction. For instance, for white examinees, the column labeled 20/100 uncorrected vision (table 4) indicates that the probability of having this vision corrected to as high as 20/20 is 0.595; to not better than 20/30, 0.217; to not better than 20/40, 0.092, and so forth. In other words, one may expect that 59.5 percent of the white examinees having 20/100 uncorrected distant vision are likely to have their vision corrected to as high as 20/20; 21.7 percent, to not better than 20/30; and 9.2 percent, to not better than 20/40. Altogether, 90.4 percent of the white examinees with 20/100 uncorrected vision can expect to have their vision corrected to 20/40 or better. The remainder, 9.6 percent, cannot expect to have their 20/100 vision corrected to as high as 20/40.

For Negro examinees, the column labeled 20/100 distant vision shows that 49.0 percent of them may be expected to have their vision corrected to as high as 20/20; 20.5 percent, to not better than 20/30, and 14.5 percent, to not better than 20/40. Altogether 64.0 percent of the Negro youths with 20/100 uncorrected distant vision may be expected to have their vision corrected to not better than 20/40, a manifestly lower percentage than for white examinees.

Analogous lower probabilities of correctability are indicated for Negro examinees by each column of table 4. As far as could be determined, this finding is not known to the literature. Our data provide no clue as to the cause of these differentials.

### Summary

This study deals with uncorrected and correctable distant vision of Selective Service registrants examined for military service during the 21-month period from January 1957 through September 1958.

The data were abstracted from the medical examination reports (Standard Form 88) of the examinees. It was a sample (50 percent) study comprising some 273,000 reports.

The analysis was carried out by race, involving some 222,000 medical reports of white (denoting non-Negro) examinees, and 51,000 such reports of Negro examinees.

The mean ages (as of last birthday) of these examinees were computed as 21.8 years for the white and 21.6 years for the Negro examinees. Most of the examinees (71 percent of the white and 72 percent of the Negro examinees) were within the 21- to 22-year age group.

Better vision for the Negro than for white examinees was found. For instance, 82 percent of the Negro examinees had 20/20 uncorrected bilateral vision, as compared with 69 percent of the white examinees. On the other hand, the probabilities of correctability of poorer to better vision were lower for the Negro than for the white examinees. For instance, it may be expected that 60 percent of the white youths having uncorrected distant vision of 20/100 could have their vision corrected to as high as 20/20, while the corresponding percentage for the Negro youths is 49. Lower probabilities of correctability were found for the Negro youths in each of the visual readings of 20/40 and lower.

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