

# Attrition of Military Enlistees with a Medical Waiver for Myopia, 1999–2001

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**Background:** Military service requires physical fitness, including vision within set standards. Premature attrition inflicts a considerable manpower and fiscal burden upon the military. **Methods:** We conducted a retrospective cohort survival analysis of newly enlisted military personnel who entered active duty with a medical waiver for myopia between January 1, 1999, and December 31, 2001. Premature attrition rates, both medical and overall, were compared with those for a matched, fully qualified, comparison group. **Results:** New enlistees with a waiver for myopia had the same probability of remaining on active duty through the first 2 years of service as did fully qualified peers. Enlistees with a waiver for myopia also had a low probability of an early medical discharge for myopia. **Conclusion:** The results of this study tend to validate the current branch-specific myopia waiver processes. They also provide evidence that current myopia accession criteria may be too restrictive and in need of policy review.

## Introduction

Myopia, commonly known as nearsightedness, is one of the most frequent causes of correctable vision loss throughout the world. It develops as a result of abnormal lengthening of the eye, steepening of the cornea, or crystalline lens changes.<sup>1</sup> These conditions cause light to be focused in front of the retina, rather than directly on it, resulting in a blurred image.

Usually developing between the ages of 6 and 14 years, myopia is a common finding among young adults and is estimated to affect 20 to 30% of the U.S. population, with 2 to 3% being classified as having high myopia. In addition to the human cost of visual disability, there is a profound economic cost to society. In the United States, for example, the treatment of myopia costs an estimated \$250,000,000 per year.<sup>1</sup> Genetic and environmental factors play key roles in the development of myopia.<sup>2</sup> Therefore, risk factors include a family history of myopia, with strong anecdotal evidence suggesting extensive amounts of reading or computer use.

Currently, there are no effective means for preventing the progression of myopia, although two studies, the Contact Lens and Myopia Progression Study and the Correction of Myopia Evaluation Trial, have demonstrated techniques to mildly retard myopic progression.<sup>3,4</sup> Treatments such as eyeglasses, contact

lenses, and laser vision correction are available to refractively correct myopia and to improve vision. Nevertheless, some people with myopia are unable to have their vision fully corrected.

Refractive error is measured in diopters, with myopia being designated with a minus sign that indicates divergent optical properties of a lens. Classifying the degree of myopia can be ambiguous, but there are generalities. Mild myopia is considered  $-0.25$  to  $-1.5$  D, moderate myopia  $-1.5$  to  $-6.0$  D, and high myopia  $-6.0$  D or more.<sup>1</sup> Pathological myopia is a condition of severe myopia and is very progressive. Pathological myopia may lead to degenerative visual complications resulting from structural damage induced by the lengthening of the eyeball. These changes may include choroidal neovascularization and retinal detachment.<sup>5</sup> Refractive error worse than  $-8.0$  D in any meridian is referred to as high myopia until degenerative changes occur. However, retinal disease, cataracts, glaucoma, and other associated threats to vision can be seen in patients with moderate as well as high myopia.<sup>1,6</sup>

## Military Accessioning and Myopia

Accessing healthy recruits is the foundation of successful military initial entry training and is ultimately a key contributor to soldier readiness. An important component of this philosophy is the need to recruit and to access soldiers with vision within Department of Defense (DoD) accession standards. Health standards for the selection of recruits serve to reduce premature medical attrition and are contained in DoD Instruction 6130.4, Criteria and Procedure Requirements for Physical Standards for Appointment, Enlistment, or Induction in the Armed Forces.<sup>7</sup> The accession standard for myopia (International Classification of Diseases, 9th Revision, code 367.1) within DoD Instruction 6130.4 is included under the heading of refractive error. The causes of rejection for appointment, enlistment, or induction regarding these conditions are stated as follows: "Current refractive error or history of refractive error before refractive surgery manifest by any refractive error in spherical equivalent of worse than  $-8.00$  or  $+8.00$  D (in any meridian) is disqualifying."<sup>7</sup>

The January 2005 DoD Instruction 6130.4 added stable visual acuity 6 months after refractive surgery as qualifying for accession. In the past, refractive surgery has been restricted to adults  $>18$  years of age. Refractive surgery for treatment of myopia is becoming more common and is expected to be more common in adolescents. A recent review found preliminary data that refractive surgery is successful in children, with a complication rate similar to that for adults.<sup>8</sup> As surgical techniques improve, it is reasonable to expect that higher ranges of myopia and more adolescents with stable myopia will be candidates to receive refractive surgery. Adolescents with disqualifying myopia may increasingly turn to refractive surgery to join the mili-

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The views expressed are those of the authors and should not be construed as representing the positions of the Department of the Army or the Department of Defense.

This manuscript was received for review in September 2005 and was accepted for publication in January 2006.

tary. However, adolescents may continue to progress in myopia following surgery and thus still retain a refractive error.

Although DoD Instruction 6130.4 lists the health-related requirements for entry into military service, each branch of service has the authority to grant waivers on a case-by-case basis. Waivers are granted to applicants with a disqualifying medical condition who are deemed capable of military service, and they are granted individually within each branch of service. A designated medical official reviews the medical record and any available consultation and testing results and makes a recommendation to grant or to deny a waiver. Myopia is one of the leading medical conditions for which military recruits receive a waiver, constituting ~10% of all approved waivers. During the time period from 1999 to 2001, nearly 4,000 medical waiver approvals for myopia were granted to enlistees in the four military services (Army, Navy, Marine Corps, and Air Force). During this same period, 29 existed prior to service (EPTS) medical discharges were granted for myopia and 122 EPTS discharges were given for "uncorrectable to standard distant or near visual acuity."<sup>9</sup>

A case series review of myopia EPTS discharges from 2000 to 2002 was recently completed by the Accession Medical Standards Analysis and Research Activity. Of the 143 such discharges that occurred during this time period, ~49% of subjects were found to have disqualifying high myopia (greater than -8.0 D) in the better eye and 65% in the worse eye. In terms of visual acuity, ~15% of subjects had worse than 20/30 visual acuity in the better eye and worse than 20/70 in the worse eye and therefore were outside the visual acuity accession standard. EPTS myopia was a relatively rare cause of EPTS discharges, accounting for 0.7% during this period.<sup>9</sup>

It is not known whether new enlistees entering active duty with a waiver for myopia are experiencing a greater rate of premature discharge, compared with others. However, given the fact that recruiting, screening, and training costs in fiscal year 2003 were approximately \$35,000 per enlistee (B Clark, personal communication),<sup>10</sup> it is essential to determine whether the overall premature discharge rate and EPTS medical discharge rate of new enlistees who were granted waivers for myopia are greater than or comparable to the rates for fully qualified enlistees.

The published literature on myopia in the military is scant. However, the development of linked DoD databases allows for focused research regarding this type of statistical analysis. These DoD databases have been used to evaluate a variety of other medical conditions. The goal of this study was to determine whether new enlistees who entered active duty in the Army, Navy, Air Force, or Marine Corps between January 1, 1999, and December 31, 2001, with a medical waiver for myopia experienced a greater rate of premature discharge, compared with a demographically matched, fully qualified, comparison group. The hope is that the accession policymakers and service waiver authorities can use the results of this study to help determine whether the current myopia standard for new recruits is valid or needs revision.

## Methods

We conducted a retrospective cohort survival analysis of newly enlisted recruits who entered active duty in the Army, Navy, Air Force, or Marine Corps between January 1, 1999, and December 31, 2001. The study group included new enlistees

who entered active duty with a medical waiver for myopia and with no other disqualifying medical condition. A pool of potential comparison subjects consisted of all first-time enlisted accessions during 1999 to 2001, excluding those with waivers for any medical condition(s). The fully qualified group was randomly selected from the comparison pool with matching according to age (within 1 year), month entering active duty, branch of service, race (African American, Caucasian, or other), and gender, at a ratio of approximately three fully qualified subjects to each myopia waiver subject.

The primary outcome was a survival analysis comparing those with a waiver for myopia with fully qualified enlistees without a waiver. This time-to-event analysis was conducted by using the Kaplan-Meier method. A significance level of 0.05 was used. We compared the waiver group and fully qualified group by using the log-rank test for survival curves based on branch of military service, combined service, and gender. Individual survival evaluation began with an enlistee's documented gain date and ended with the enlistee's individual loss date from active service or, if this did not occur, with censoring at the date the study ended (December 31, 2001).

Applicants with an approved accession medical waiver were identified through data provided by the service-specific waiver authorities. Accession (gain) data from the Defense Manpower Data Center were used to develop the comparison subject pool and as the primary source of gain date and demographic information on all study subjects. Active duty discharge (loss) data from the Defense Manpower Data Center and EPTS discharge data from U.S. Military Entrance Processing Command were used to determine outcomes for the study subjects.

To gain some perspective on waiver decision criteria being used for myopia, detailed records on all accession medical waiver considerations by the Navy and Marine Corps waiver authority were reviewed. Features of the approved waivers were compared with those of the disapproved waivers with respect to clinical and other differences. SPSS software (SPSS, Chicago, Illinois) was used to conduct all statistical analyses.

## Results

### Study Group

A total of 1,589 enlistees from the four Armed Services was granted an accession waiver for myopia and subsequently accessed onto active duty during the study period; the comparison group consisted of 4,736 fully qualified enlistees. Table I shows the distribution of these subjects according to several demographic factors. The waiver group was predominantly Army, Caucasian, male, and in the 17- to 20-year age group. The matched comparison group was virtually identical with respect to the demographic factors listed.

Also shown in Table I is the distribution of subjects who were ultimately discharged within the first 2 years of service. The numbers of losses in the two subject groups closely mirrored the 3:1 fully qualified subject:case subject ratio. This trend was also observed within the majority of subgroups analyzed. As expected, the all-cause (medical and/or administrative causes) attrition rate was higher among enlistees who entered active duty earlier in the study period, because those enlistees had more time in service and thus more time at risk for attrition.

TABLE I

DISTRIBUTION OF ALL SUBJECTS AND THOSE DISCHARGED WITHIN THE FIRST 2 YEARS OF SERVICE ACCORDING TO DEMOGRAPHIC FACTORS, 1ST MYOPIA WAIVER GROUP AND FULLY QUALIFIED GROUP

Characteristics	No. (%)			
	Myopia Waiver		Fully Qualified	
	All	Discharged	All	Discharged
Branch of service				
Army	798 (50.2)	154 (50.2)	2,377 (50.2)	455 (52.2)
Navy	462 (29.1)	91 (29.6)	1,372 (29.0)	267 (30.6)
Marines	218 (13.7)	37 (12.1)	654 (13.8)	93 (10.7)
Air Force	111 (7.0)	25 (8.1)	333 (7.0)	57 (6.5)
Race				
Caucasian	1,144 (72.0)	228 (74.3)	3,423 (72.3)	657 (75.3)
African American	260 (16.4)	47 (15.3)	772 (16.3)	156 (17.9)
Other	185 (11.6)	32 (10.4)	541 (11.4)	59 (6.8)
Age				
17-20 years	1,077 (67.8)	209 (68.1)	3,229 (68.2)	586 (67.2)
21-23 years	327 (20.6)	60 (19.5)	980 (20.7)	198 (22.7)
24-26 years	111 (7.0)	25 (8.1)	329 (6.9)	51 (5.8)
≥27 years	74 (4.7)	13 (4.2)	198 (4.2)	37 (4.2)
Gender				
Male	1,198 (75.4)	208 (67.8)	1,151 (24.3)	593 (68.0)
Female	391 (24.6)	99 (32.3)	3,585 (75.7)	279 (32.0)
Year of enlistment				
1999	572 (36.0)	158 (51.5)	1,703 (36.0)	420 (48.2)
2000	501 (31.5)	93 (30.3)	1,495 (31.6)	319 (36.6)
2001	516 (32.5)	56 (18.2)	1,538 (32.5)	133 (15.3)

**Survival Analysis**

Figure 1 shows the estimated survival curves for all myopia waiver subjects and for the matched fully qualified subjects. This analysis considered all premature losses from military service, whether or not they were related to visual acuity status. The estimated survival functions can be seen to be nearly identical between the two subject groups. Estimated survival at 1 year after the beginning of service was ~82% among the waiver subjects and the matched, fully qualified group. At 2 years, the percentages were still nearly identical at 78% for the waiver and fully qualified groups. Not surprisingly, the two curves were not significantly different by the log-rank test ( $p = 0.45$ ).

All-cause attrition rates were also compared between the two subject groups separately according to service and gender and showed no statistically significant difference. For example, Army enlistees with a waiver for myopia had a survival pattern that was not statistically different from that of their fully qualified

Army counterparts ( $p = 0.79$ ). The same was true for the Navy, Marine, and Air Force subjects ( $p = 0.94$ ,  $p = 0.34$ , and  $p = 0.30$ , respectively).

Male subjects with a waiver for myopia had a survival pattern similar to that of the fully qualified male subjects ( $p = 0.75$ ), and female subjects with a waiver were similar to fully qualified female subjects ( $p = 0.86$ ). It should be noted that, in all of the subgroups defined by one of the matching variables (e.g., service), the waiver group and the comparison group were still matched with respect to the other matching variables.

**EPTS and Myopia Waivers**

The results regarding EPTS conditions for enlistees granted a myopia waiver versus the fully qualified comparison group are presented in Table II. Of note, only 1.1% of the myopia waiver subjects (18 of 1,589 subjects) were ultimately given EPTS discharges for eye-related conditions, and some of those subjects might have had true pathological myopia. Among those subjects

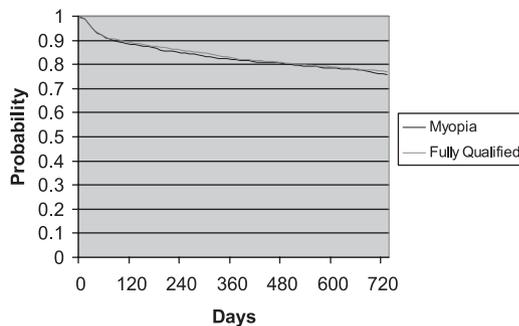


Fig. 1. Estimated retention probabilities for myopia waiver group versus fully qualified comparison group. Survival curves were not significantly different by the log-rank test ( $p = 0.45$ ).

TABLE II

EPTS DISCHARGES, ACCORDING TO MEDICAL CONDITIONS, FOR MYOPIA WAIVER GROUP AND FULLY QUALIFIED GROUP, IN ALL BRANCHES OF SERVICE

	No. (%)	
	Myopia Waiver (n = 1,589)	Fully Qualified (n = 4,736)
Myopia	3 (0.19)	1 (0.02)
Eyes (other)	15 (0.94)	5 (0.11)
Other	59 (3.7)	166 (3.5)
Total	77 (4.8)	172 (3.6)

were only three for whom myopia itself was listed as the primary cause for discharge, although seven other discharges were coded as being for nonspecific visual acuity decrements, which might have included myopia. In any event, <1% of the subjects who entered service with a waiver for myopia were discharged as a direct result of their myopia.

The numbers of EPTS discharges for eye-related conditions in the matched comparison group were quite small. These EPTS discharges occurred among a group of newly enlisted individuals who had recently been screened for visual acuity; some had been selectively examined for other eye conditions during their Medical Entrance Processing Station accession physical examinations and were not disqualified. Accordingly, the comparison group would be expected to have few eye-related conditions that would result in medical discharge so early in service. It should be kept in mind that the reporting of EPTS data to U.S. Military Entrance Processing Command is not mandated by regulation but is done on a voluntary basis. Several data examinations have indicated underreporting over time and across services.<sup>5</sup> However, the extent of underreporting observed is not such that it would be expected to meaningfully alter the aforementioned observations.

### Review of Selected Navy and Marine Corps Myopia Waiver Applications

The results of the random record review of 50 U.S. Navy Bureau of Medicine-approved and -disapproved waiver applications are shown in Table III. On average, visual acuity was better and spherical refraction lower in approved versus disapproved waiver applications. This held true for both eyes (with better and worse visual acuity) but to a greater degree for the eye with better acuity. These results must be interpreted cautiously because of the relative size of the variance (SD) of the observations presented. A generally similar finding was observed in terms of measured spherical refraction (diopters) for the better and worse eyes. High myopia in the worse eye was ~1.7 (95% confidence interval, 1.4–2.5) times more common in disapproved than approved applications.

TABLE III

SELECTED VISUAL CHARACTERISTICS IN APPROVED AND DISAPPROVED NAVY AND MARINE CORPS WAIVER APPLICATIONS

	Approved Waiver (n = 50)	Disapproved Waiver (n = 50)
Visual acuity <sup>a</sup> (best eye) (mean ± SD)	20.5 ± 3.5	27 ± 12.4
Visual acuity <sup>a</sup> (worst eye) (mean ± SD)	31.2 ± 38.6	40 ± 38.4
Diopters <sup>b</sup> (best eye) (mean ± SD)	-7.26 ± 1.71	-9.04 ± 2.94
Diopters <sup>b</sup> (worst eye) (mean ± SD)	-7.45 ± 1.68	-9.41 ± 1.61
No. with high myopia (best eye) (%)	19 (44.2)	36 (76.6)

Some applicant records had missing data on visual characteristics.

<sup>a</sup> Visual acuity is reported as the smallest letter size that can be seen at a test distance of 20 feet.

<sup>b</sup> Diopters are the measure of refractive error.

## Discussion

The findings of this study tend to validate the current method for approving myopia waivers. Within the DoD and all branches of service, there was no significant difference in all-cause attrition rates between the group that received waivers for myopia and the group that was deemed fully qualified without a waiver. When the same comparison was restricted to a particular service or gender, those with a myopia waiver were found to have similar survival rates as their matched, fully qualified counterparts. Moreover, <1% of subjects with myopia waivers experienced myopic complications serious enough to result in early discharge.

There is currently no standard process or practice guidelines regarding how waivers are granted within and between the branches of service. Medical professionals within each branch make waiver decisions on a case-by-case basis, with periodic solicited advice from consultants. The end result of this waiver process for myopia, as evaluated in this study, is that these enlistees have the same chance of remaining on active duty as their fully qualified peers.

The Bureau of Medicine waiver review provides evidence for some general criteria, as opposed to specific criteria used by the Navy to make decisions. The majority of approved waiver cases had better-eye visual acuity of 20/30 or better and a spherical refraction of -11.0 D or less. The majority of disapproved cases had visual acuity of 20/50 or worse in the eye with better visual acuity or between 20/30 and 20/50 and a spherical refraction of -15.0 D or greater. The differences in visual acuity and refraction between approved and disapproved waiver cases were generally less significant clinically in the better eye than in the worse eye. The degree to which these observed criteria apply to the other branches of service is not known.

One limitation of this study is that the amount of myopia for which a waiver was given was not considered in the survival analysis. There is a considerable range regarding degrees of myopia, which could affect the likelihood of premature discharge. In addition, there were no defined waiver criteria for myopia across branches of service or over the study period. These limitations together resulted in heterogeneity in terms of myopia severity and might have biased the analysis toward a finding of no difference in survival rates between groups.

Another limitation is that this study did not examine morbidity or cost as outcomes. Although it would be surprising to find substantial medical or other costs as a result of myopia, compared with other conditions that require intense and prolonged treatment, such a study would be required to fully confirm the appropriateness of current waiver procedures. Data regarding outpatient clinic visits, inpatient hospital stays, and eyeglass prescriptions were not collected for both study groups and therefore could not be compared. An additional issue that was not considered in accessing enlistees with high degrees of myopia onto active duty was potential restriction for particular military occupations.

The final limitation concerns the EPTS discharge data. The diagnostic accuracy of EPTS cases has not been systematically validated for specific conditions. In addition, the completeness in reporting EPTS discharges has varied dramatically over time and across branches of service.<sup>5</sup>

The results of this study suggest that the current DoD myopia

accession standards may be too restrictive. It is common knowledge that the military faces a continual struggle to enlist an adequate number of competent qualified service members. A less-restrictive myopia accession criterion would be expected to result in fewer vision disqualifications of applicants, to avoid the time- and resource-intensive waiver process, and to allow more individuals with myopia to enlist for military service.

Before any such modification, additional study would be prudent, particularly a cost-benefit analysis assessing the overall implications of such a change. Additional factors, such as effects on morbidity, combat readiness, and current and future manpower requirements, must be carefully analyzed before any changes in accession criteria are implemented.

### Acknowledgments

We thank Cara Olsen for statistical consultation, CPT Amy Millikan for editorial assistance, 2LT Megan Kloetzel, MSIV, and 2LT Kevin Taylor, MSIV, for assistance with the EPTS case series review, 2LT Peter Matos for assistance with the Bureau of Medicine waiver review, James W. Stout, OD, for review of the article, and the DoD Medical Personnel Steering Committee and the DoD Accession Medical Standards Working Group for their support of the research.

This study was performed within the Accession Medical Standards Analysis and Research Activity, funded by DoD Health Affairs.

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