

Attrition of U.S. Military Enlistees with Waivers for Hearing Deficiency, 1995–2004

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Background: Hearing deficiency is the condition for which accession medical waivers are most commonly granted. The retention of individuals entering service with a waiver for hearing deficiency has not been previously studied. **Methods:** Military retention among new enlistees with a medical waiver for hearing deficiency was compared with that among a matched comparison group of fully qualified enlistees. Comparisons according to branch of service over the first 3 years of service were performed with the Kaplan-Meier product-limit method and proportional-hazards model. **Results:** Army subjects had significantly lower retention rates than did their fully qualified counterparts. In the adjusted model, Army and Navy enlistees with a waiver for hearing deficiency had a significantly lower likelihood of retention than did their matched counterparts. **Discussion:** The increased likelihood of medical attrition in enlistees with a waiver for hearing loss provides no evidence to make the hearing accession standard more lenient and validates a selective hearing loss waiver policy.

Introduction

The U.S. military depends on a constant input of healthy and physically fit individuals. Unfortunately, the prevalence of noise-induced hearing threshold shifts is estimated to be 15.5% (95% confidence interval, 13.3–17.6%) for 12- to 19-year-old individuals in the United States, based on data from the Third National Health and Nutrition Examination Survey.¹ Military applicants who at least superficially meet entrance criteria undergo an extensive screening procedure that includes administrative (background check and vocational aptitude testing), physical (height, weight, and body fat as needed), and medical components. The medical accession standards, including those for hearing, are contained in Department of Defense Instruction 6130.4.² Although some applicants are disqualified during the military entrance processing stations medical examination, each service retains the authority to grant accession waivers for disqualifying medical conditions, on an individual basis. Once disqualified individuals are granted waivers, they are qualified as fit for enlisted service. Over the past 10 years, hearing defi-

ciency was the most common condition for which waivers were granted, representing slightly more than 10% of all accession medical waivers.³

The Department of Defense Hearing Conservation Program requires a baseline audiogram for enlistees entering service.⁴ The purpose of this reference audiogram is to serve as a benchmark for comparison with periodic audiograms obtained during the period of service. This active surveillance process is intended to reveal sentinel events, to allow intervention to prevent service-connected, noise-induced hearing loss.⁵ Service members can suffer noise-induced hearing loss to such an extent that their retainability in service is affected. When hearing loss is discovered, through audiometric surveillance or otherwise, the service members become subject to physical evaluation, to determine whether they should be medically discharged from service. As opposed to the single induction standard, each service has its own standards for medical fitness for retention, including hearing.^{5–7} Even if service members with hearing loss are retained on active duty, they are eligible for future Veterans Affairs disability payments upon separation from service. Hearing loss and associated sequelae are the second most prevalent cause for Veterans Affairs disability payments to veterans (M. Wells, personal communication).

The baseline audiogram may be obtained before, during, or after basic training. If a hearing loss is sufficient to preclude retention in service, then it is classified as existing before service.⁸ On average, 74 service members receive existing-before-service discharges because of hearing loss each year.³ The Navy and Marine Corps are disproportionately represented in these discharges, relative to the number of accessions per year per branch of service. This is expected, however, because these services uniformly perform baseline audiograms during enlistee medical in-processing, whereas, during the period of this study, only Fort Sill, Oklahoma (artillery school), obtained baseline audiograms for enlistees in the Army.⁹

The purpose of this study was to compare the performance, in terms of retention, of active duty individuals with waivers for a hearing condition with that of other enlistees. In particular, their likelihood of retention over time ("survival") was compared with that of a matched group of fully qualified enlistees with no medical waivers. The study attempts to provide evidence for or against the hearing accession standard and selective hearing loss waiver policy.

Methods

All active duty enlistees who began service in calendar years 1995 to 2004 after receiving an accession medical waiver for hearing deficiency were included as case subjects. A matched comparison group was selected from among all fully qualified

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(i.e., no medical waiver needed) enlistees, at a 3:1 ratio (control subjects). The matched factors were gender, age, race, branch of service, month and year of beginning active duty, and Armed Forces Qualification Test percentile score (a measure of cognitive ability). These factors have been shown to be predictors of attrition.³ All subjects were monitored prospectively for attrition until December 31, 2004, or the completion of 4 years of service, whichever came first. Attrition over time was first compared between the hearing waiver and fully qualified groups by using the Kaplan-Meier method. This analysis was performed separately according to service, and all-cause attrition was used as the endpoint. A proportional-hazards model with time-dependent covariates was then applied. In addition to the matched factors, this model controlled for education, marital status, and body mass index.

The time-dependent model was first used with all causes of early attrition as the outcome. This model was then separately calculated by restricting attrition to that related to medical conditions; that is, only those losses that were officially attributed to medical causes were treated as attrition in this analysis. Losses attributable to administrative or other nonmedical reasons were treated as censored observations at the time of loss.

Results

More than 1.5 million active duty enlistments occurred during 1995 to 2004. Of these, >6,000 required an accession medical waiver because of hearing deficiency. Table I shows the demographic distributions of those with waivers for hearing deficiency, with the demographic distributions of all enlistees. Those with waivers for hearing deficiency were significantly ($p <$

0.01) more male, older, and more Caucasian than the general military population. Previous studies showed these factors to be predictors of attrition.³ Therefore, selection of a matched comparison group was important to nullify the effects of these factors.

The counts and percentages of new accessions granted a waiver for hearing deficiency were highest for the Army (3,674; 0.65%), followed by the Navy (1,605; 0.39%) and the Marine Corps (584; 0.23%). There were only 78 waivers (0.03%) for hearing in the Air Force. A matched sample of 17,982 control subjects (Army, 10,986; Navy, 4,752; Marine Corps, 2,019; Air Force, 225) was selected from enlistees who did not require any accession medical waiver.

Kaplan-Meier survival curves comparing military retention probabilities between subject groups are shown in Figures 1 to 4. It can be seen that the likelihood of staying in the service varied across the services. Army enlistees with a waiver for hearing deficiency had a likelihood of retention that was significantly and uniformly lower than that of their matched counterparts ($p < 0.01$, using Wilcoxon, log-rank, and likelihood tests). Among Navy subjects, the retention probability was lower for the enlistees with waivers than for the qualified enlistees early in service time but the difference did not remain as service time increased; therefore, overall retention rates for the two subject groups were not significantly different.

Retention probability for Marine Corps enlistees with waivers for hearing deficiency visually appeared lower than that for fully qualified recruits, but the difference was not statistically significant. There was almost no difference in early attrition rates for the Air Force subject groups, and the overall difference was not statistically significant.

TABLE I

DEMOGRAPHIC DISTRIBUTION OF ENLISTEES GRANTED A WAIVER FOR HEARING DEFICIENCY VERSUS ALL ENLISTEES; 1995-2004

	Army		Navy		Marine Corps		Air Force	
	Hearing Deficiency	All						
No. (%) ^a	3,674 (0.65)		1,605 (0.39)		684 (0.23)		78 (0.03)	
Gender (%)								
Female	10.1	19.6	9.1	17.0	5.1	6.9	15.4	25.0
Male	89.9	80.4	90.9	83.0	94.9	93.1	84.6	75.0
Age (%)								
17-20 years	54.5	66.5	63.6	74.5	74.9	83.4	62.8	74.4
21-22 years	17.2	14.8	14.8	12.9	14.0	9.7	16.7	15.0
≥23 years	28.3	18.7	21.6	12.5	11.1	6.9	20.5	10.6
Race (%)								
Other	10.5	9.9	17.3	12.7	10.4	12.3	10.3	9.2
African American	11.1	21.1	11.1	20.3	5.7	11.8	7.7	16.7
Caucasian	78.4	69.0	71.6	67.0	83.9	75.9	82.1	74.2
BMI (%)								
Heavy (>30)	7.5	7.0	3.4	3.7	7.3	5.9	1.3	0.8
Light (<20)	11.4	12.4	13.9	13.2	11.3	11.8	24.4	14.9
Overweight (25-30)	32.0	29.7	32.7	31.4	30.3	28.6	26.9	26.7
Perfect (20-25)	49.2	50.9	50.0	51.6	51.2	53.8	47.4	57.6
AFQT (%)								
1 and 2	33.7	37.5	33.6	37.6	32.7	37.9	55.1	47.4
3	59.0	54.5	55.3	52.7	60.1	54.8	41.0	45.3
4 and 5	7.3	8.0	11.1	9.6	7.2	7.3	3.8	7.3

^a Counts and percentages of hearing deficiency among all enlistees entering active duty.

BMI, body mass index (weight, in pounds, divided by height, in inches, squared and multiplied by 703); AFQT, Armed Forces Qualification Test (grouped by nationally normed percentile groups: 1 = 93-99%, 2 = 65-92%, 3 = 50-64%, 4 = 30-49%, 5 = 1-29%).

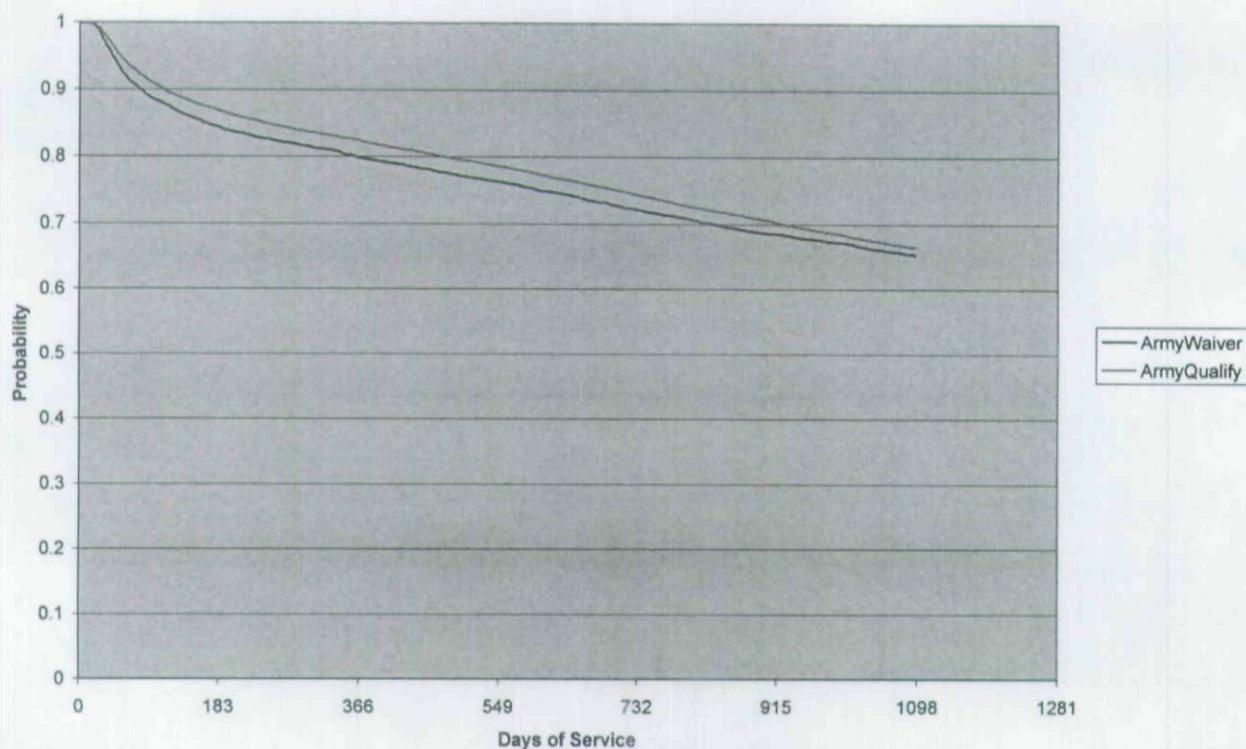


Fig. 1. Military service survival likelihood of Army enlistees with a hearing waiver, compared with fully qualified enlistees (all $p < 0.01$).

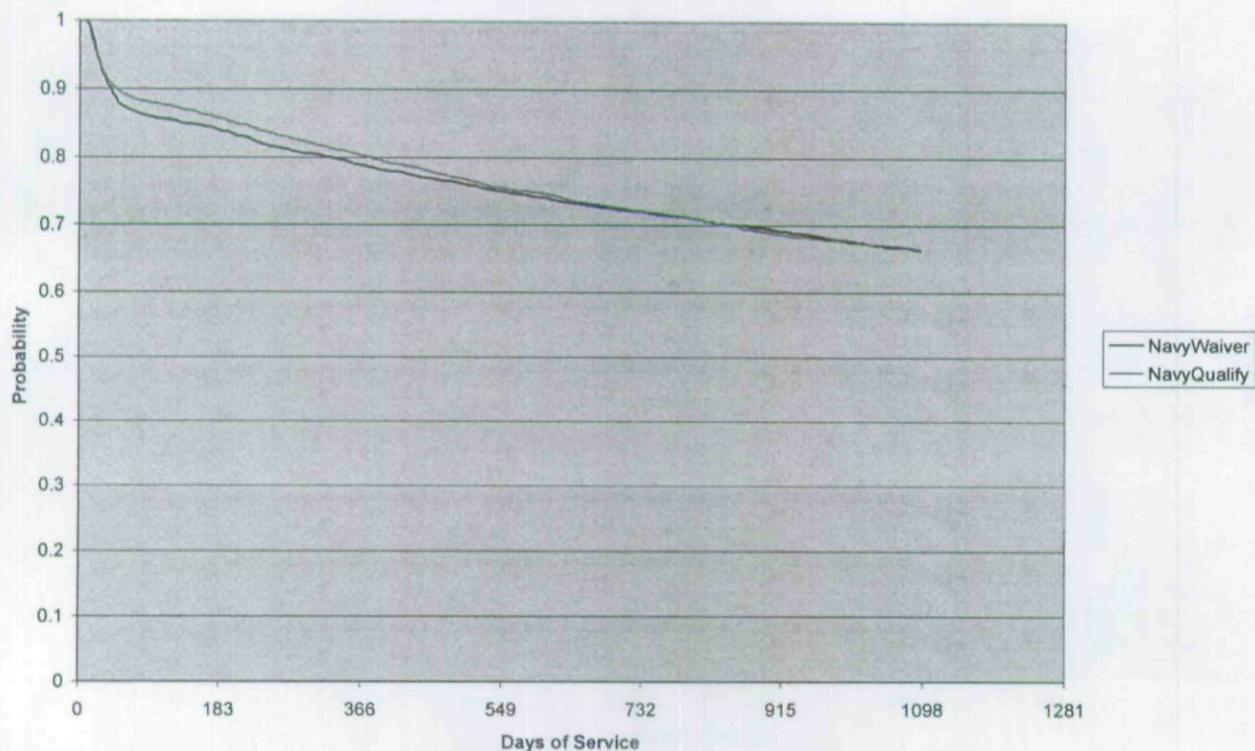


Fig. 2. Military service survival likelihood of Navy enlistees with a hearing waiver, compared with fully qualified enlistees (all $p > 0.30$).

With the exception of the Air Force subjects, it can be seen that the retention probabilities for all subjects decreased most sharply during the first few months of service. This appeared to be especially so for subjects with a waiver for hearing deficiency, raising the possibility that any effect of hearing deficiency on attrition likelihood is not constant over time. Accordingly, a

proportional-hazards model with time-dependent covariates was applied to account for additional attrition factors while allowing for the possibility of a changing influence of hearing waiver on attrition risk over time.

Table II shows the effects of having a waiver for hearing deficiency on total and medical attrition early in service, using

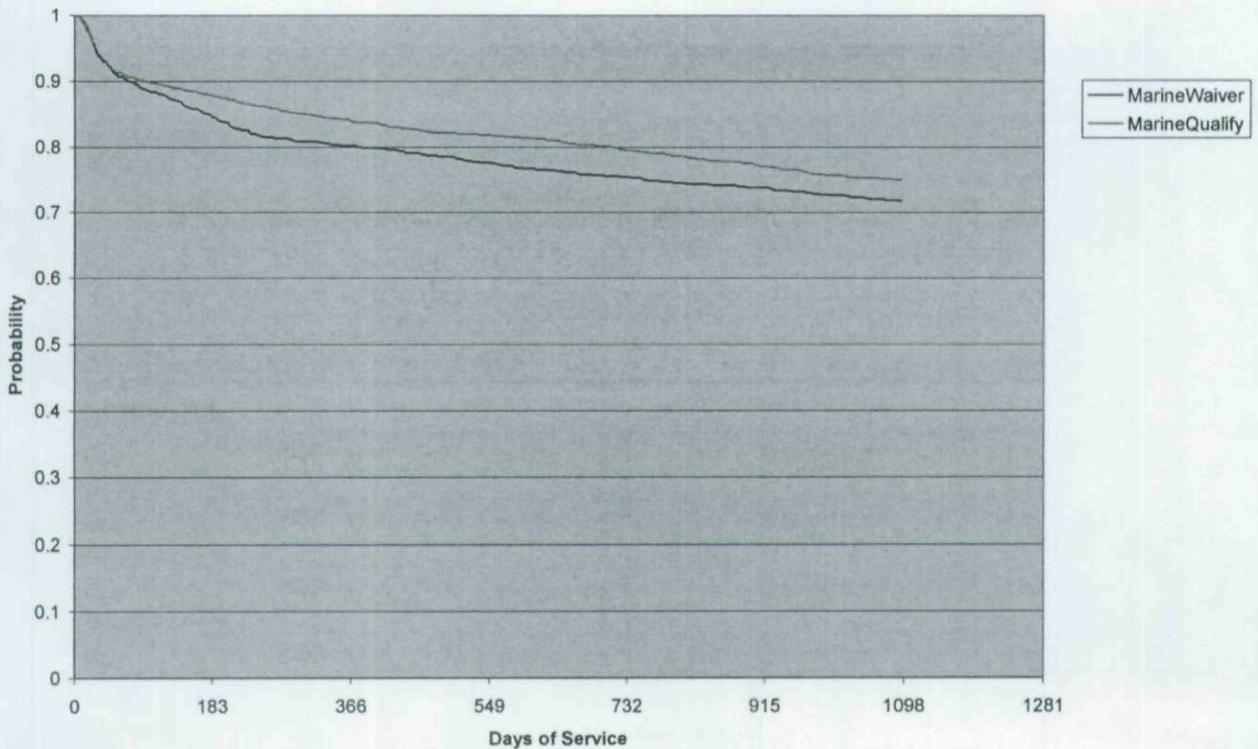


Fig. 3. Military service survival likelihood of Marine Corps enlistees with a hearing waiver, compared with fully qualified enlistees (all $p > 0.13$).

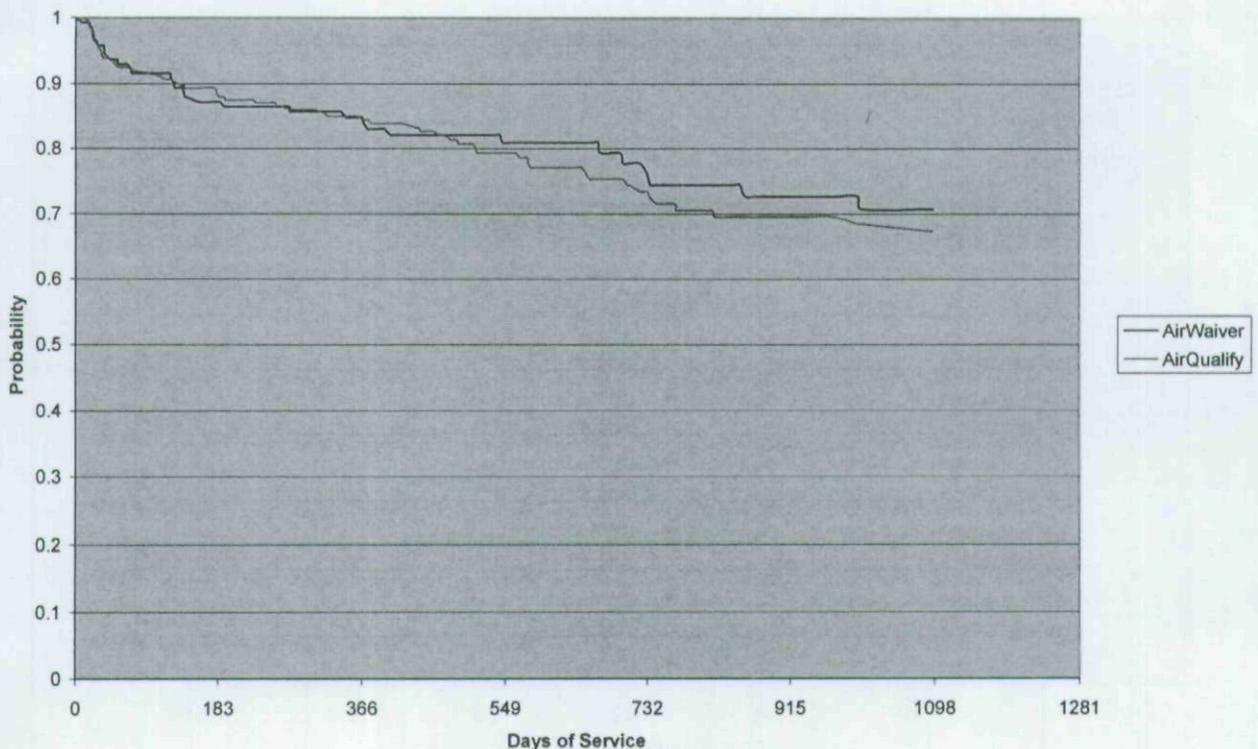


Fig. 4. Military service survival likelihood of Air Force enlistees with a hearing waiver, compared with fully qualified enlistees (all $p > 0.60$).

the time-dependent model and controlling for additional attrition-related factors. Also shown is the effect of time in service on the influence of a hearing waiver on attrition. It can be seen that, for total attrition, Army enlistees with a waiver for hearing deficiency had significantly increased likelihood of attrition, relative to their fully qualified counterparts, as evi-

denced by the positive coefficient and small p value. In addition, it can be seen from the negative coefficient for the time dependency factor, and its corresponding p value, that the effect of a hearing waiver on attrition likelihood diminished over time among Army enlistees and this diminution was statistically significant.

TABLE II
HEARING WAIVER EFFECT OVER TIME IN SERVICE

Attrition Type	Service	Factor	Coefficient	<i>p</i>
Total	Army	Hearing waiver	0.38	0.01
		Time	-0.06	0.03
	Navy	Hearing waiver	0.42	0.02
		Time	-0.06	0.10
	Marine Corps	Hearing waiver	-0.21	0.49
		Time	0.07	0.23
	Air Force	Hearing waiver	-0.40	0.72
		Time	0.02	0.92
Medical	Army	Hearing waiver	0.44	0.02
		Time	-0.07	0.04
	Navy	Hearing waiver	1.14	<.0001
		Time	-0.14	0.02
	Marine Corps	Hearing waiver	0.71	0.09
		Time	-0.13	0.11
	Air Force	Hearing waiver	1.71	0.35
		Time	-0.25	0.45

Among Navy subjects, the likelihood of attrition was seen to be greater among enlistees with a waiver for hearing deficiency, although the effect of this factor did not change significantly over time. Finally, no statistically significant difference in attrition was seen between Marine Corps or Air Force enlistees and their matched counterparts.

When the outcome was restricted to losses attributed to medical reasons, it was seen that the influence of a hearing deficiency waiver remained significant among Army enlistees, again with an effect diminishing over time. The likelihood of medical

reason-related attrition among Navy waiver subjects was also significantly high, with the effect of hearing deficiency diminishing significantly over time.

Medical attrition among Marine Corps enlistees with a hearing deficiency waiver was borderline significantly high, with no significant change in this effect over time. There was no statistically significant difference in attrition likelihood between the Air Force subject groups.

Figure 5 shows estimated all-cause attrition hazard ratios as a function of time for subjects with hearing waivers versus fully qualified subjects according to service, and Figure 6 shows analogous results for medical reason-related attrition. For all-cause attrition, the hazard ratio for hearing deficiency over time was uniformly higher among Navy subjects than among those of the other services, with Army subjects next. Although the results for the other two services appear inverted from what would be expected, it should be kept in mind that attrition was not significantly related to hearing waiver status for those two services.

Figure 6 shows analogous results for medical reason-related attrition. Again it can be seen that the hazard ratio over time was uniformly higher for the Navy subjects than for the Army subjects. The hazard ratio curves for the Army and Marine Corps were quite similar to one another, although, as mentioned above, the hazard ratio for the Marine Corps was only marginally significant, because of the smaller sample size for this service.

Discussion

The likelihood of early attrition, both all-cause and medical reason-related, is noticeably higher among enlistees entering

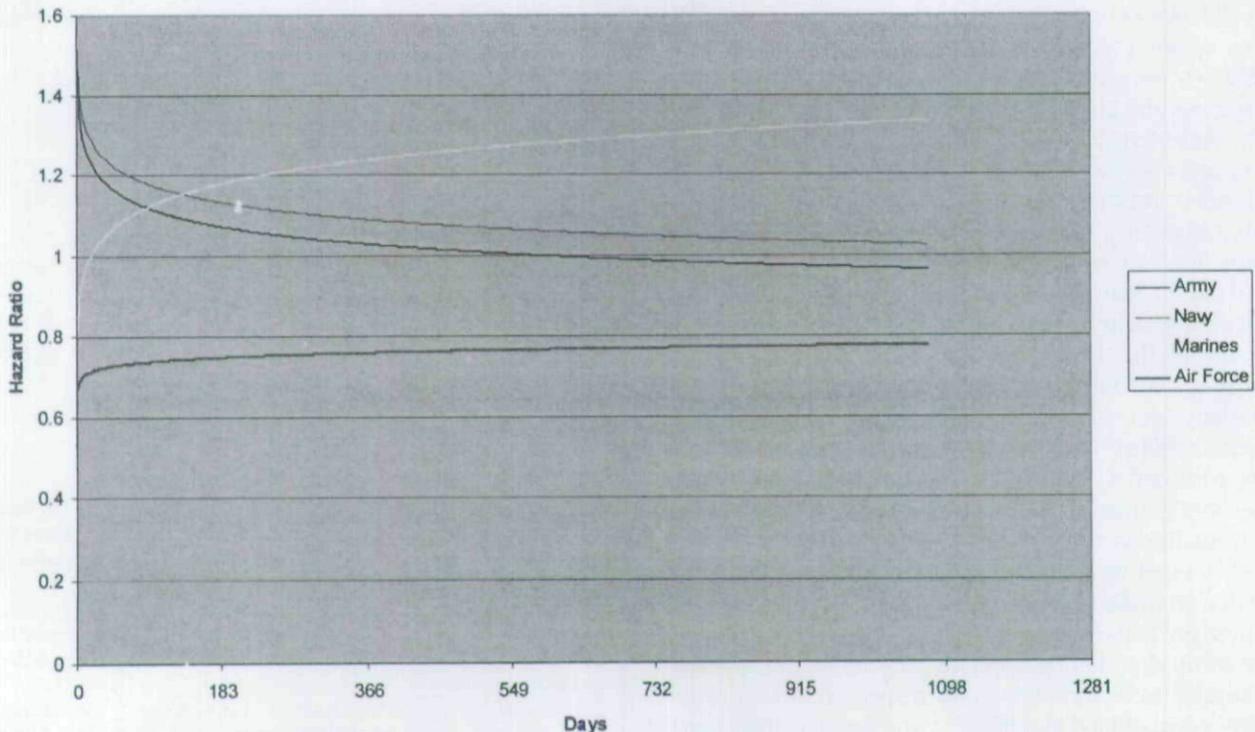


Fig. 5. Hazard ratios for discharges, according to time of service, for enlistees with hearing waivers and fully qualified enlistees.

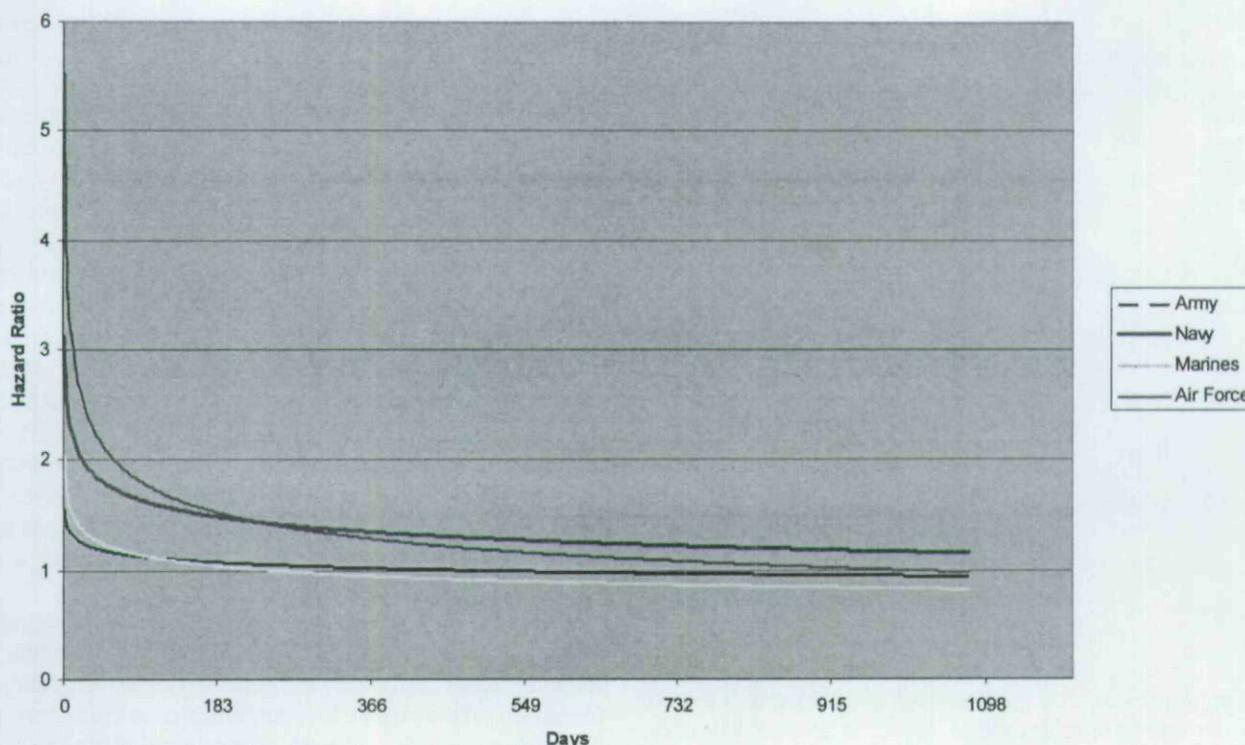


Fig. 6. Hazard ratios for medical discharges, according to time of service, for enlistees with hearing waivers and fully qualified enlistees.

the Army and the Navy with an accession medical waiver for hearing deficiency than among a matched sample of fully qualified enlistees entering these services without needing a waiver. A marginally significant difference in medical attrition was observed among subjects entering the Marine Corps, and the Air Force had too few subjects for comparison. The magnitude of these differences (<5%) was relatively small from both medical and manpower perspectives.

Although the current study shows an association between hearing loss and attrition, there are some caveats. Most importantly, the criteria for granting a waiver vary across branches of service and may vary over time within a branch of service. Also, the hearing waiver group was considered as a homogeneous group, rather than the effect on attrition of various degrees of hearing disability within this group being considered. A previous study of Marine Corps and Navy hearing loss waiver applications showed that the majority of applicants failed only one of the four hearing standards in Department of Defense Instruction 6130.4 and the majority of the approved waiver subjects had a hearing threshold within 10 dB of the particular failed frequency standard.¹⁰ Additionally, this study considered only the primary condition for which a waiver was granted. In some instances, two or more disqualifying conditions are identified for an applicant, and any waiver granted would cover all such conditions. Restricting attention to those with waivers for hearing only could refine attrition predictions by eliminating the potential effects of other medical conditions. Finally, the impact on readiness attributable to hearing loss, with respect to factors such as military occupational qualification and deployability, was not considered in this study.

The finding of an increase in the likelihood of attrition for enlistees with a waiver for hearing loss in the two largest branches provides no evidence to make the hearing accession standard more lenient. Furthermore, the finding provides evidence for a selective hearing loss waiver policy. Future studies should include a cost-effectiveness analysis of various waiver criteria, which would consider the readiness requirements of each branch as well as the costs of long-term hearing disability resulting from military-related noise exposure among at-risk enlistees with preexisting hearing loss.

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