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Enlisted Women in the Marine Corps: First-Term Attrition and Long-Term Retention

Aline O. Quester

With

Greg W. Steadman

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Enlisted Women in the Marine Corps: First-Term Attrition and Long-Term Retention

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With

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Force Structure and Acquisition Division



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ABSTRACT

This research memorandum provides an overview of gender differences in the continuation rates for enlisted Marines. It also contains a detailed analysis of first-term attrition for female recruits with four-year obligations accessed in FY 1981 through FY 1985. In this analysis, female first-term attrition probabilities are modeled as a function of background characteristics at entry into the Marine Corps.

EXECUTIVE SUMMARY

This research memorandum focuses on the continuation behavior of female enlisted Marines. While it finds that female continuation patterns are often similar to those found for all Marines (or for male Marines), it also identifies some distinct gender differences in continuation behavior. The first major gender difference is in the timing of separations from the Marine Corps.

- Over the first term of service, female non-end-of-active service (non-EAS) attrition rates are about 1.5 times male attrition rates.
- Over the long term, female enlisted Marines have higher retention rates than male Marines. For example, for FY 1979 non-prior-service (NPS) accessions:
 - At 60 months of service, 22.9 percent of the female and 18.4 percent of the male accessions were still in the Marine Corps.
 - At 114 months of service, 12.0 percent of the female and 8.7 percent of the male accessions were still in the Marine Corps.

Because the long-term continuation rates for females are very high, the number of senior female enlisted Marines has grown rapidly. In March 1983, there were 385 female Staff Sergeants and 121 female Gunnery Sergeants; by March 1990, these numbers had more than doubled (to 789 Staff Sergeants and 260 Gunnery Sergeants). To manage the career force effectively, Marine Corps planners need to be aware of these large gender differences in voluntary, long-term continuation behavior.

After this overview of gender differences in timing of separations from the Marine Corps, this research memorandum examines gender differences in first-term attrition reasons.¹ Approximately one-third of the reasons for female Marine first-term attrition are pregnancy or parenthood. In fact, if pregnancy/parenthood separations are ignored, the first-term attrition rates of male and female Marines are very similar.

First-term attrition rates for all NPS female accessions with four-year obligations who entered the Marine Corps in the FY 1981 through FY 1985 period were tabulated. These rates are examined by reason (pregnancy/parenthood, physical disability/severance pay, and other reasons) and by the women's age at entry into the Marine Corps. Several general patterns are established. First, the risk of attrition

1. All discussion of first-term attrition in this research memorandum refers to non-EAS attrition.

for pregnancy/parenthood is highest for recruits accessed at young ages and falls continuously as age at accession increases. Second, attrition rates for reasons of physical disability severance-pay separations are almost double for women accessed at age 24 or older. Attrition rates for all other reasons are also higher for women accessed at age 24 or older. The overall first-term attrition rate for women, then, is lowest for women accessed into the Marine Corps when they are 21 to 23 years old. Restricting accessions from the highest attrition-risk groups (those under 18 years of age or over 23 years of age) would reduce overall first-term attrition. The reduction, however, would be small because less than 15 percent of female accessions fall in these age groups.

Finally, an attempt is made to model first-term attrition for enlisted Marine Corps women more precisely. Three attrition equations, each utilizing the same explanatory variables, are estimated. The three equations are overall attrition, attrition for reasons of pregnancy/parenthood, and attrition for all reasons other than pregnancy/parenthood. The overall finding is that the variables that are important in explaining overall male first-term attrition are also important in explaining female first-term attrition for reasons other than pregnancy/parenthood.¹ Female attrition for pregnancy/parenthood is much more difficult to relate to background characteristics; in fact, about the only statistically significant background characteristic, other than race, that differentiates those Marines who separate for reasons of pregnancy/parenthood and those who do not is the age at entry into the Marine Corps.²

The relationships between attrition and age at entry into the Marine Corps discussed above are confirmed by the statistical model.

Additionally, female recruits who enter the Marine Corps with higher Armed Forces Qualification Test scores, with longer periods of time in the Delayed Entry Program, or into an aviation program have lower overall first-term attrition rates. Virtually all the effect these factors have on lowering overall first-term attrition, however, arises from their effect on lowering the probability of attrition for reasons *other than pregnancy/parenthood attrition*. And, all other factors being equal, black and Hispanic female accessions have considerably lower attrition rates than non-black/non-Hispanic female accessions. Educational background (high school diploma graduate versus high school non-diploma graduate with certificate) does not appear to be a statistically significant factor in attrition probabilities for female Marines.

1. The strength of background characteristics in differentiating recruit attrition risk, however, is considerably weaker for female than for male recruits.

2. Background characteristics refer to characteristics like age or educational background that were recorded in the recruit's record at the time of enlistment.

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INTRODUCTION

Recent findings concerning gender differences in survival patterns for enlisted Marines have prompted further questions and additional investigation. Specifically, previous work established that, although first-term survival rates for male Marines significantly exceed the survival rates for female Marines, female survival rates usually exceed the male rates if survival is measured from the point of entry into the second or later term of service. In brief, relative to male losses, female losses are concentrated in the first term of service: if female Marines successfully complete the first term of service, they are more likely to be retained into the second term of service than are their male counterparts.

Figures 1 and 2 illustrate the survival behavior (through June of 1989) for two different recruit cohort groups. Figure 1 displays the survival patterns for non-prior-service (NPS) four-year obligers accessed in FY 1984. At 51 months of service (a length of service that exceeds the first-term obligation), about the same proportion of female as male recruits was still in the Marine Corps. Figure 2 displays the survival behavior, through 114 months of service, for all FY 1979 NPS accessions. At 114 months of service, a higher proportion of female than male accessions was still in the Marine Corps.¹

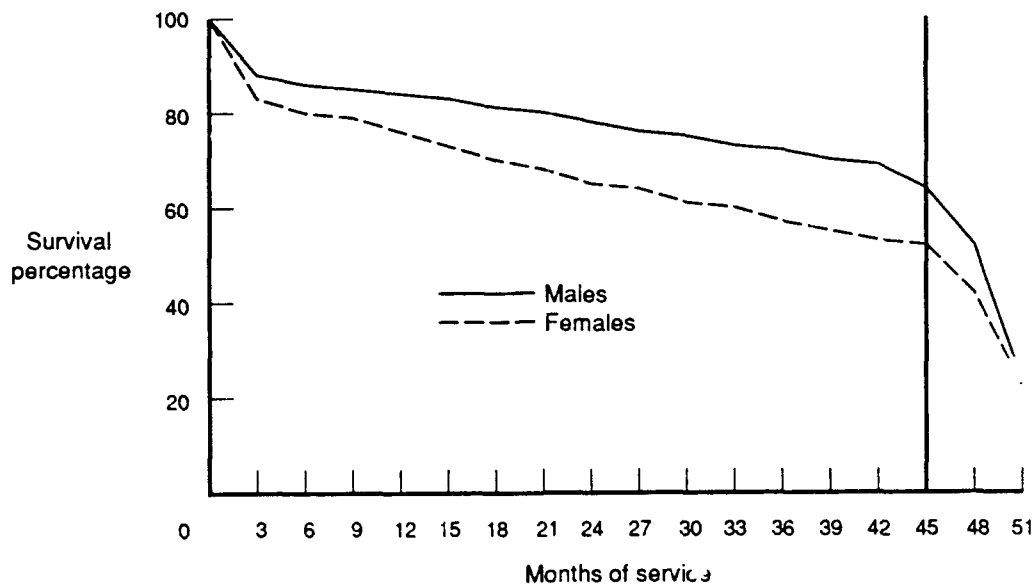
The high long-term survival rates for female Marines suggest that they find attractive career opportunities in the Marine Corps. Indeed, in the past seven years the number of female Staff and Gunnery Sergeants has more than doubled. The very high non-end-of-active-service (non-EAS) first-term attrition rates for female recruits, however, caused some concern. While perhaps not surprising given the "non-traditional" nature of a Marine Corps job, first-term attrition for female Marines appeared to merit further exploration.²

There has been substantial research on how recruit background characteristics affect attrition probabilities, but this work has generally examined overall attrition patterns (see [1] through [6]). Since over 90 percent of Marines are male, the patterns identified for attrition would be dominated by male behavior.³ No work focusing exclusively on the attrition of female Marines has been identified. Yet there are reasons to believe that there might be different patterns (and relationships) by gender indicated by differences in reasons for attrition.

1. These survival patterns are monitored through June of 1989. Survival patterns for recruits accessed in FY 1980, FY 1981, and FY 1982 are illustrated in appendix A. The patterns are similar to those discussed in the main text. Appendix A also provides information by racial/ethnic background.

2. First-term attrition in this research memorandum refers to non-EAS attrition only.

3. Since such a high proportion of Marines are male, some studies have restricted the analysis to males.



NOTE: In FY 1984 there were 32,467 male and 1,875 female NPS accessions with four-year enlistment contracts.

Figure 1. FY 1984 four-year NPS obligors: survival rates for males and females by months of service

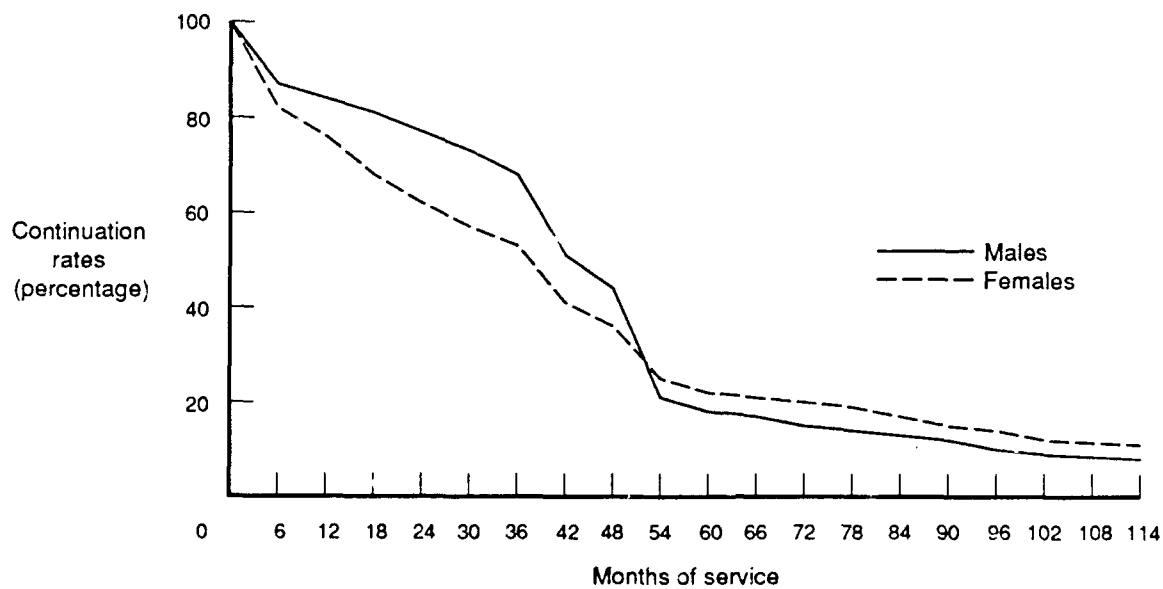


Figure 2. Continuation rates for all NPS Marine recruits in FY 1979

As an indication of the differences in reasons, approximately one-third of female first-term attrition is due to pregnancy and parenthood.¹ Male attrition rates for parenthood are negligible, and male and female first-term attrition for reasons *other than pregnancy/parenthood* is similar. For example, for NPS accessions with four-year obligations who entered the Marine Corps in the FY 1981 through FY 1985 period, the first-term attrition rates for reasons other than pregnancy/parenthood were 33 percent for males and 31 percent for females.

At least two previous studies had tried to utilize the male statistical attrition models for samples of female Marines [5 and 6]. While these attempts showed that many of characteristics associated with differential attrition risks for males also were associated with differential attrition risks for females, the characteristics were generally poorer predictors of attrition risk for women than for men. Finally, some recent research on female first-term attrition patterns in the Navy had suggested that age at accession was an important indicator of attrition risk for women [7].

AN EXAMINATION OF THE FACTORS ASSOCIATED WITH FEMALE FIRST-TERM ATTRITION

Previous work at CNA established non-prior-service accession (NPS) cohort files for Marines accessed since FY 1979 [8]. These files are supported by CNA and kept current. For this analysis of female attrition patterns, the records of all female NPS accessions with initial contracts of four years were extracted from the cohort file.² Information on the recruit's background characteristics, the characteristics of the Marine's accession into the Marine Corps, and the separation reason, if applicable, were examined.

Because recent analysis of Navy women had shown that younger accessions had consistently higher attrition rates than women accessed over the age of 20, the first analysis was a careful look at Marine Corps attrition patterns by age at accession. This examination was done in the context of other work for the Marine Corps, in particular in the context of work on separations with severance pay for reasons of physical disability [9].³

1. About 90 percent of female attrition due to pregnancy/parenthood is from separation codes for pregnancy.

2. NPS female accessions with four-year contracts represented about 75 percent of female accessions in this period.

3. Marines separated as physical disability severance-pay separations receive a lump-sum separation payment of 2 months of basic pay for each year of service (maximum of 24 months' basic pay). In FY 1989 there were 3,025 enlisted physical disability severance-pay separations in the Marine Corps at a cost of \$23 million.

Table 1 illustrates the overall first-term attrition percentages for the 8,151 NPS female accessions in FY 1981 through FY 1985. Almost half of these Marines (47.3 percent) separated before completion of their initial enlistment contract. About a third of the female attrition was for pregnancy or parenthood reasons (16.4 percent of the accessions). Attrition because of a physical disability severance-pay separation is not large (1.6 percent of the accessions), but it is especially costly. The percentage of accessions separated for all other reasons was 29.3 percent.

Table 1. Attrition patterns by reason and accession age

Age (years)	Number of observations	Total first-term attrition (percent)	Pregnancy/ parenthood attrition (percent)	Physical disability severance pay attrition (percent)	All other reasons: attrition (percent)
17	644	50.3	18.9	1.4	30.0
18-20	5,567	47.6	17.3	1.4	28.9
21-23	1,303	44.0	14.1	1.6	28.3
24-25	387	49.1	12.1	3.1	33.9
26+	<u>250</u>	48.0	9.2	3.6	35.2
Total	8,151	47.3	16.4	1.6	29.3

Information on attrition by age of accession is also provided in table 1. Very young recruits (those accessed at 17 years of age) and older recruits (those accessed over 23 years of age) have the highest first-term attrition rates. The lowest overall attrition rate (44 percent) is for women who were 21 to 23 years old at accession. While there are these fairly substantial differences in overall attrition by accession age, there are even larger differences in the reasons for attrition by accession age. Younger accessions are consistently more likely not to complete the first term for reasons of pregnancy/ parenthood. The percentage of accessions who separate prematurely for reasons of pregnancy or parenthood is 18.9 percent for 17-year-old accessions, falling to 9.2 percent for accession 26 years or older. In contrast, the attrition percentages for reasons of physical disability (with severance pay) increase with age of accession, from 1.4 percent of 17-year-old accessions to 3.6 percent of accessions 26 years or older.

Attrition rates for all other reasons follow a more complicated pattern. These rates are relatively high for 17-year-old accessions and for accessions 24 years or older.

What inferences might be drawn from table 1? First, the Marine Corps's primary concern is to access successful recruits--those who will complete the first term of service. Thus, the concern is with overall attrition risk and not with the particular characteristics of that attrition. However, some forms of attrition are more costly to the Marine Corps--in particular, attrition separatees who receive severance pay. Women accessed into the Marine Corps over 23 years of age have high overall attrition rates as well as about double the average risk of a physical disability severance-pay separation. The other age group with particularly high overall attrition is 17-year-old accessions; these very young women are additionally the group most likely to separate for reasons of pregnancy/parenthood. Restricting female accessions to individuals between the ages of 18 and 23 would almost certainly reduce attrition. The reduction in overall first-term attrition, however, would be small because there are small numbers of accessions in these age groups.¹

Further investigations are important. In particular, these relationships need to be validated within a model that controls for other characteristics associated with differential attrition risk.

A MODEL OF FEMALE FIRST-TERM ATTRITION

To further verify these relationships, female first-term attrition models were estimated for overall attrition, for attrition for reasons of pregnancy/parenthood, and for attrition for reasons other than pregnancy/parenthood.² In addition to age at accession, the following variables were included in the models:

- High school diploma graduate (HSDG)
- Armed Forces Qualification Test (AFQT) category

1. Table 1 shows 1,281 accessions in these age groups, but these are all accessions with four-year obligations in the FY 1981 to FY 1985 period. In FY 1989, 154 women 17 years of age and 91 women 24 years and over were accessed into the Marine Corps.

2. There are insufficient numbers of first-term separations for physical disability with severance pay to warrant separate analysis. Reference [9], however, did perform an extensive analysis for physical disability severance-pay separations and was unable to find any characteristic other than age at accession for women that was systematically associated with higher probabilities of eventual physical disability severance-pay separations. In the remaining analysis in this paper, physical disability severance-pay attrition was grouped with "attrition for other reasons."

- Months in Delayed Entry Program (DEP)
- Indicator variables
 - Married or dependents at accession (NOT SINGLE)
 - Year of accession (YEAR 1982, YEAR 1983, etc.)
 - Enlistment program (AVIATION, GROUND)
 - Failure to meet in-service height/weight standards (HEIGHT-WEIGHT)
 - Racial/ethnic background (RACE).

Past research on attrition (primarily focused on male accessions) has found strong negative relationships between HSDG and DEP status and first-term attrition. Smaller negative relationships have been found between AFQT scores and attrition. Because the primary focus of this new research was on female attrition (both for reasons of pregnancy/parenthood and for other reasons), it was decided to add a control variable for whether the individual was married or had dependents at the time of entry into the Marine Corps.¹ Additionally, indicator variables were included for the accession year, for individuals who entered the Marine Corps not meeting the in-service weight requirement for their height, and for different racial/ethnic backgrounds.²

An appropriate functional form for a statistical model to estimate attrition is discussed in appendix B. The text of the paper will simply review the findings obtained from the statistical model.

ESTIMATION RESULTS

Table 2 details the statistically significant associations estimated in the three attrition models (overall first-term attrition, first-term attrition for pregnancy/parenthood, and first-term attrition for reasons other than pregnancy/parenthood).³ The results are reported as partial derivatives, and all partial derivatives are calculated at the mean of

1. Most females entering the Marine Corps are single without dependents. For these 8,151 female accessions analyzed here, 96 percent were single, without dependents, at entry into the Marine Corps.

2. The racial/ethnic categories were black, Hispanic, and non-black/non-Hispanic. The small number of individuals identifying themselves as black Hispanics were coded as blacks. Since the Marine Corps identifies black Hispanics as Hispanics, future work will code these individuals as Hispanic.

3. The complete logit estimates are found in appendix C.

Table 2. Partial derivatives for attrition: statistically significant associations^a

	First-term attrition	First-term attrition for pregnancy/ parenthood	First-term attrition for reasons other than pregnancy/ parenthood
Age 17	.084*** (3.32)	.054*** (2.92)	Not significant
Age 18-20	.042*** (2.58)	.034*** (2.67)	Not significant
Age 24 or over	.049** (1.99)	-.041** (-1.97)	.078*** (-3.29)
AFQT category I	-.061** (-2.20)	Not significant	-.085*** (-3.29)
AFQT category II	-.047*** (-2.60)	Not significant	-.056*** (-3.36)
Aviation program	-.082*** (-4.43)	-.042*** (-2.95)	-.041** (-2.38)
Months in DEP	-.012*** (-6.78)	Not significant	-.010*** (-6.36)
Black	-.197*** (-13.26)	-.090*** (-7.39)	-.117*** (-8.42)
Hispanic	-.130*** (-3.53)	Not significant	-.148*** (-3.92)
Overweight at entry	Not significant (1.35)	.042**	(2.02)
Mean attrition rate	.473	.165	.308

NOTE: Three asterisks means statistically significant at 1-percent level (two-tailed test). Two asterisks means statistically significant at 5-percent level (two-tailed test).

a. The complete logit estimates are found in table C-1 in appendix C. The partial derivatives reported here hold all other variables constant at their mean values. The numbers in parentheses are t-statistics. Observations are all NPS female accessions in FY 1981 through FY 1985 with four-year initial enlistment contracts (n = 8,151).

the data. For example, table 2 reports for overall first-term attrition a partial derivative of $-.012$ for months in the DEP, suggesting that an additional month in the DEP is associated, on average, with a 1.2 percentage point drop in the first-term attrition rate.¹ Table 2 is additionally useful for the information it provides on whether the explanatory variable impacts first-term attrition through attrition for reasons of pregnancy/parenthood or attrition for other reasons.

Effects of Age at Entry Into the Marine Corps

Based upon age at accession, recruits were divided into four age categories: 17, 18 to 20, 21 to 23, and 24 or older. When estimating a set of categorical variables such as accession age, it is necessary to omit one of the categories. In this case, the omitted category was 21 to 23 years. Thus, the interpretation of the estimated effect of age on attrition probability is the probability *relative* to that for 21- to 23-year-old accessions. Thus, relative to 21- to 23-year-old accessions, table 2 shows all other accession age groups to average higher probabilities of first-term attrition.

Table 3 translates the model estimates for first-term attrition into attrition probabilities for female recruits of different accession ages, DEP stays, and AFQT score categories. For AFQT category I female recruits who entered the Marine Corps after four months in the DEP, the estimates for first-term attrition are 48 percent for 17-year-old accessions, 44 percent for 18- to 20-year-old accessions, 39 percent for 21- to 23-year-old accessions, and 44 percent for accessions over 23 years of age. Similar differences in estimated attrition probabilities by age for women entering the Marine Corps are found within the other AFQT categories.

For women accessed 20 years and younger, the statistical differences in their higher attrition arise because of higher probabilities of pregnancy/parenthood attrition (see table 2). For women who enter the Marine Corps at 24 years of age or older, the higher overall attrition is a result of the combination of a *lower* probability of pregnancy attrition and a *considerably higher* probability of attrition for other reasons. Thus, the findings in the statistical model support the tabulations reported in table 1.²

1. Partial derivatives hold all other variables constant (in a statistical sense). Thus, the interpretation is that two individuals, possessing the average values for the other explanatory variables, but differing by one month in DEP length, would average 1.2 percentage points difference in their first-term attrition percentage.

2. Again, however, the *number* of female accessions who are in the especially high-attrition-risk age groups (17 years old and over 23 years old) are small. Thus, restricting female accessions to 18- to 23-year olds would only reduce overall female first-term attrition by 1 percentage point.

Table 3. Predictions for first-term attrition^a

	Accession age (years)			
	17	18-20	21-23	24+
DEP stay - four months				
AFQT category I	.48	.44	.39	.44
AFQT category II	.49	.45	.41	.46
AFQT category IIIA	.54	.50	.46	.51
No DEP (direct ship)				
AFQT category I	.52	.48	.44	.49
AFQT category II	.54	.50	.45	.50
AFQT category IIIA	.59	.55	.50	.55

a. These attrition predictions hold all other explanatory variables at their mean values. The estimating equation is found under the attrition column of table C-1 in appendix C.

Educational Background and AFQT Category

Currently, female accessions into the Marine Corps are virtually all regular high school diploma graduates (HSDGs). During the FY 1981 to FY 1985 period, however, about 10 percent of female accessions did not have regular high school diplomas. Most of these non-HSDGs, however, were high school graduates (HSGs) with some kind of alternative certificate.¹ Given the considerable evidence that HSDG accessions have much lower attrition rates than alternative certificate graduates or nongraduates, the finding that, for female Marines, HSDG status is unrelated to attrition risk was surprising to the study team (see [1] through [6] for Marine Corps studies). There was, however, no systematic relationship between first-term attrition and educational background for women with four-year obligations who entered the Marine Corps in FY 1981 through FY 1985 (and, thus, there is no entry on table 2 for HSDGs).

Although these female four-year obligors were over 75 percent of the Marine Corps enlisted female accessions from FY 1981 through FY 1985, it was felt important to further verify this "non-finding" for educational credentials and subsequent attrition risk for Marine Corps women. Thus, table 4 reports accessions and 33-month attrition rates, by educational background, for all NPS female Marines who entered in the FY 1979 through

1. In today's taxonomy, these women were Tier II accessions.

FY 1986 period (17,430 accessions).¹ The 33-month attrition rate for the 15,598 HSDGs was 41.9 percent, actually higher than the 38.4 percent rate for the 1,694 HSGs without regular diplomas but with some type of certificate (CERT). The small number of female non-HSG accessions had a 33-month attrition rate of 52.3 percent.

Table 4. Thirty-three-month percentages for all NPS female Marines accessed from FY 1979 through FY 1986^a

	Number of accessions	Attrition rate
HSDG	15,598	41.9
CERT	1,694	38.4
Non-HSG	<u>109</u>	52.3
Total	17,430	41.6

a. Thirty-three month attrition rates are utilized because of the popularity of the three-year enlistment contract in the early 1980s.

While educational background does not appear to be an important determinant of attrition differences among female Marines, tables 2 and 3 show statistically significant differences in overall first-term attrition by AFQT category. Within accession age group and DEP status, the attrition model predictions in table 3 show similar results for AFQT category IIIA and category IIIB recruits. The model predicts 5 to 6 percentage points lower attrition for AFQT scorers in categories I and II than in category III. The reduction in overall attrition associated with high scores on the AFQT, however, arises solely from the reductions in attrition for reasons other than pregnancy or parenthood (see table 2).

Delayed Entry Program

As has been found in other studies that were not restricted to females, longer periods in the DEP are associated with lower attrition

1. The data for this table were produced with the Marine Corps Interactive Database (MCAID) system (see [8]). It should be noted that the study team was unable to find any previous analysis restricted to Marine Corps women that identified a relationship between HSDG status and first-term attrition risk.

probabilities [2, 4, 6]. These relationships hold for overall attrition and for attrition for reasons other than pregnancy/parenthood. Within accession age and AFQT category, table 3 shows about 4 percentage points difference in predicted attrition for those with no time in DEP versus those with four months in DEP.

Other Characteristics

Four-year obligors entered the Marine Corps in FY 1981 through FY 1985 under three main programs: aviation, ground, or as open contracts. The statistical model reported in appendix C includes indicator variables for both the aviation program and the ground program, and thus the estimated program effects should be interpreted as relative to the omitted program (open contracts). Only the aviation program variable was statistically significant. Recruits who entered under this program had lower overall first-term attrition rates as well as lower attrition rates for each of the two attrition subcategories.¹

Black and Hispanic women are also estimated to have substantially lower first-term attrition rates than non-black, non-Hispanic women Marines. All other factors constant, black female Marines are estimated to have first-term attrition rates almost 20 percentage points lower than for non-black females.²

Finally, there is some evidence that the small numbers of women who entered the Marine Corps at a weight in excess of the in-service standard for their height are higher attrition risks. This indicator variable, however, only achieves statistical significance in the equation for first-term attrition for reasons other than pregnancy/parenthood. Entering the Marine Corps at a weight that exceeds the in-service requirement for one's height is considerably more common for male than for female Marines. Additionally, the attrition impact is considerably larger for men than for women (see [4] and [5]).

1. These results are similar to the findings for male Marines.

2. These substantially lower first-term attrition rates for black women are found for all recruit cohorts since at least FY 1979. The results from the model (holding all other characteristics constant at average values), however, overstate the average attrition differences between black and non-black female Marines. Particularly with respect to AFQT category, black female Marines are under-represented in the low-attrition-risk/top-AFQT-scorer category. Actual average differences in first-term attrition percentages for black and non-black female Marines are about 16 to 17 percentage points. Table C-4 in appendix C provides the variable means for the entire sample and for the different racial/ethnic subcategories.

SUMMARY AND CONCLUSIONS

This research memorandum has focused on the continuation behavior of female enlisted Marines. While it has found that female continuation patterns are often similar to those found for all Marines (or for male Marines), it has also identified some distinct gender differences in continuation behavior. The first major gender difference is in the timing of separations from the Marine Corps.

- Over the first term of service, female non-EAS attrition rates are about 1.5 times male attrition rates.
- Over the long term, female enlisted Marines have higher retention rates than male Marines. For example, for FY 1979 NPS accessions:
 - At 60 months of service, 22.9 percent of the female and 18.4 percent of the male accessions were still in the Marine Corps.
 - At 114 months of service, 12.0 percent of the female and 8.7 percent of the male accessions were still in the Marine Corps.

Because the long-term continuation rates for females are very high, the numbers of senior female enlisted Marines has grown rapidly. In March, 1983, there were 385 female Staff Sergeants and 121 female Gunnery Sergeants; by March, 1990, these numbers had more than doubled (to 789 Staff Sergeants and 260 Gunnery Sergeants).

Aside from gender differences in timing of separations from the Marine Corps, this research found gender differences in first-term attrition reasons. Approximately one-third of the reasons for female Marine first-term attrition are pregnancy or parenthood. Yet, if pregnancy/parenthood separations are ignored, the first-term attrition rates of male and female are very similar.

First-term attrition rates for all NPS female accessions with four-year obligations who entered the Marine Corps in the FY 1981 through FY 1985 show several general patterns. First, the risk of attrition for pregnancy/parenthood is highest for recruits accessed at young ages and falls continuously as age at accession increases. Second, attrition rates for reasons of physical disability severance-pay separations are almost double for women accessed at age 24 or older. Attrition rates for all other reasons are also higher for women accessed at age 24 or older. The overall first-term attrition rate for women, then, is lowest for women accessed into the Marine Corps when they are 21 to 23 years old.

The first-term attrition models for enlisted Marine Corps women showed that the variables that are important in explaining overall male

first-term attrition are also important in explaining female first-term attrition for reasons other than pregnancy/parenthood.¹ Female attrition for pregnancy/parenthood is much more difficult to relate to background characteristics. In fact, about the only statistically significant background characteristic, other than race, that differentiates those Marines who separate for reasons of pregnancy/parenthood and those who do not is the age at entry into the Marine Corps.

The relationships among attrition and age at entry into the Marine Corps discussed above are confirmed by the statistical model.

Additionally, female recruits who enter the Marine Corps with higher AFQT scores, longer periods of time in the DEP, or into an aviation program have lower overall first-term attrition rates. Virtually all of the effect of these factors on lowering overall first-term attrition, however, arises from the effect they have on lowering the probability of attrition for reasons *other than pregnancy/parenthood attrition*. And, all other factors equal, black and Hispanic female accessions have considerably lower attrition rates than non-black/non-Hispanic female accessions. Educational background (HSDG versus CERT) does not appear to be a statistically significant factor in attrition probabilities for female Marines.

1. The strength of background characteristics in differentiating recruit attrition risk, however, is considerably weaker for female than for male recruits.

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- [3] CNA Memorandum 74-3024, *Personal Characteristics and Military Manpower Quality*, by William H. Sims, Dec 1974 (05743024)
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1. The numbers in parentheses are internal CNA control numbers.

APPENDIX A

CONTINUATION PATTERNS FOR NPS MALE AND FEMALE MARINES
ACCESSED IN FY 1980, FY 1981, AND FY 1982

APPENDIX A

CONTINUATION PATTERNS FOR NPS MALE AND FEMALE MARINES ACCESSED IN FY 1980, FY 1981, AND FY 1982

Figures A-1 through A-3 illustrate male and female continuation patterns for NPS accessions in FY 1980, FY 1981, and FY 1982, respectively. These continuation patterns are similar to those discussed in the text.

Table A-1 provides information on long-term continuation rates (84 months of service) by accession year, gender, and racial/ethnic background. Within every racial/ethnic group, female Marines have higher survival rates at 84 months of service than do male Marines. The persistently high survival rates for black female Marines are particularly noteworthy.

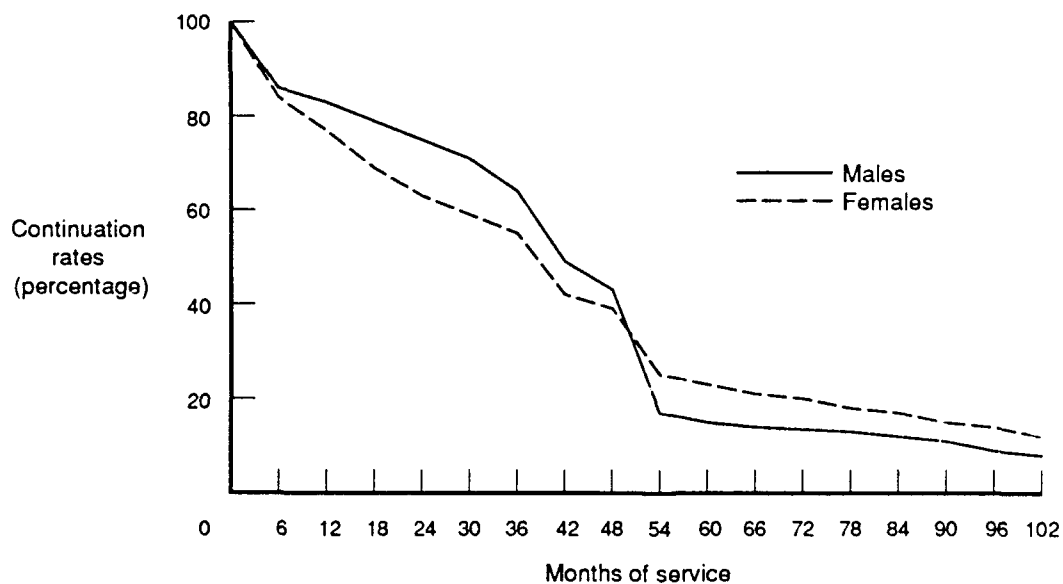


Figure A-1. Continuation rates for all NPS Marine recruits in FY 1980

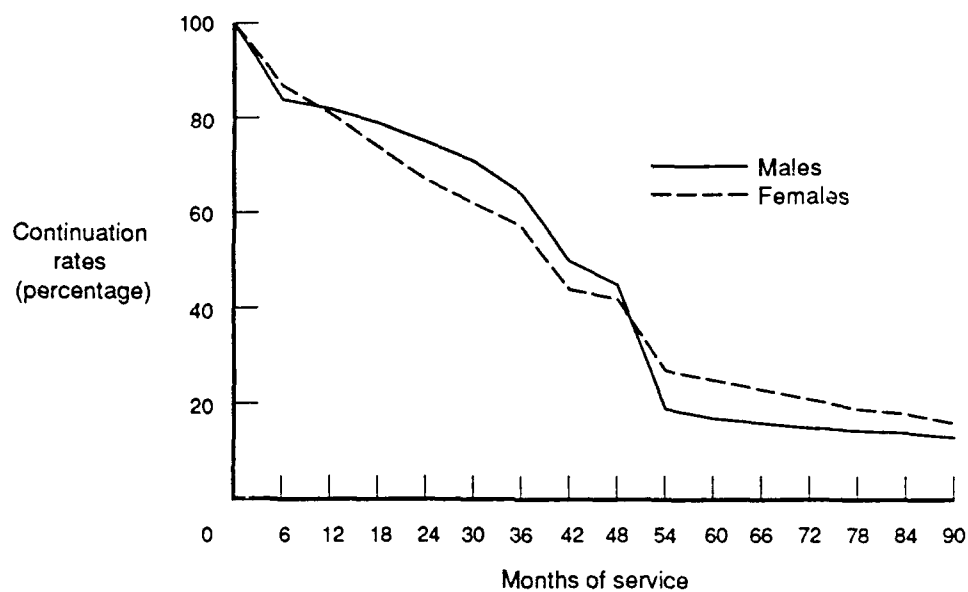


Figure A-2. Continuation rates for all NPS Marine recruits in FY 1981

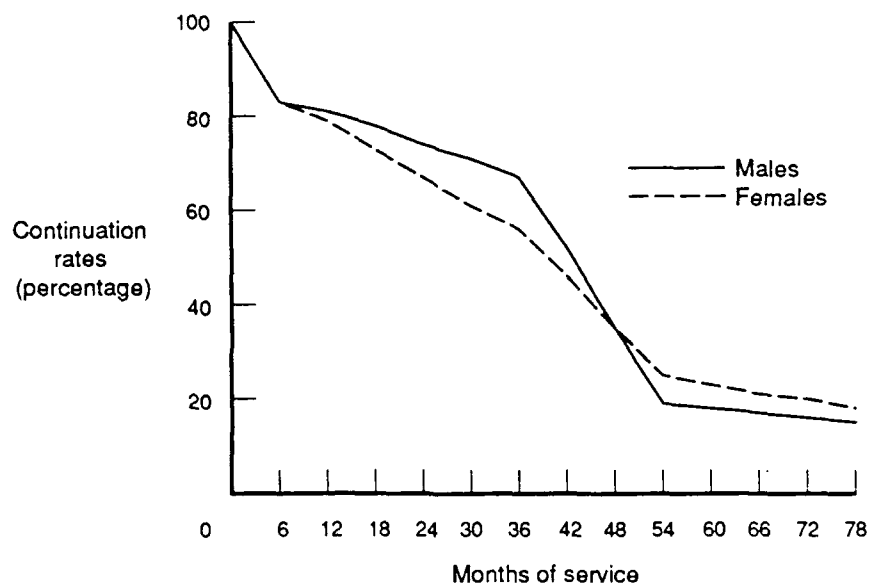


Figure A-3. Continuation rates for all NPS Marine recruits in FY 1982

Table A-1. Percentage of NPS accessions remaining in the Marine Corps at 84 months of service by fiscal year of accession, gender, and racial/ethnic background

		All males ^a	Black males	Hispanic males	Non-black/ non-Hispanic males	All females	Black females	Hispanic females	Non-black/ non-Hispanic females
FY 1979									
	Number accessions	37,408	10,425	2,252	24,729	2,237	564	106	1,567
	Percent surviving	13.1	15.1	14.7	12.2	17.5	28.4	18.9	13.5
FY 1980									
	Number accessions	38,864	8,998	1,996	27,861	2,265	490	84	1,691
	Percent surviving	12.2	15.6	15.4	10.9	16.7	28.8	15.5	13.2
FY 1981									
	Number accessions	37,745	6,615	1,515	29,602	2,294	426	76	1,792
	Percent surviving	14.2	19.3	15.8	13.0	18.4	30.3	19.7	15.5
FY 1982									
	Number accessions	34,693	5,948	1,230	27,512	2,276	439	47	1,790
	Percent surviving	14.4	20.7	16.6	13.0	16.2	26.7	25.5	13.4

a. The "all male" column includes a small number of individuals for whom statistics on racial/ethnic background were not available.

APPENDIX B
LOGIT CURVE ESTIMATION

APPENDIX B

LOGIT CURVE ESTIMATION

THE BINOMIAL LOGIT: A MODEL FOR BINOMIAL OUTCOMES

When the dependent variable is binomial (0,1, for example, do not attrite = 0 and attrite = 1), the binomial logit is an appropriate estimator. Binomial logit regression analysis estimates the following relationship:

$$P(\text{attrite}) = (1 + e^{-B'x})^{-1} ,$$

where P is the probability, B' is a row vector of coefficients, and x is a column vector of variables. Figure B-1 shows an example of a logit curve.

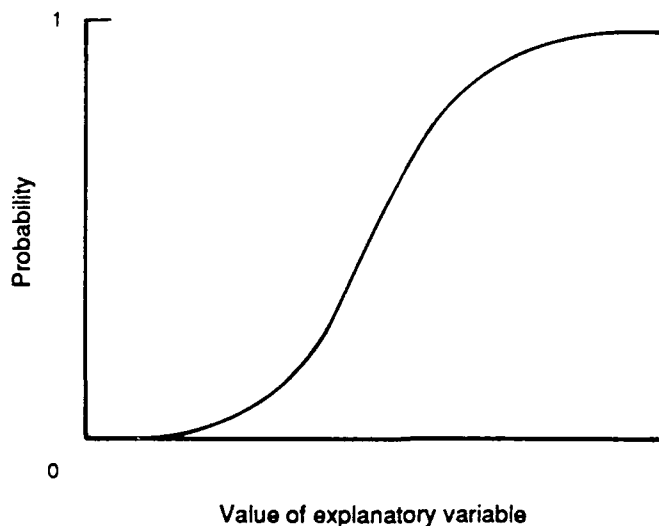


Figure B-1. Example of a logit curve

The partial derivative of the logit function at the mean of the function is as follows:

$$\frac{\partial P}{\partial x_i}(\bar{P})(1 - \bar{P})B_i \quad ,$$

where i is the i th variable and $\bar{P}$ is the sample mean or proportion. The following equations illustrate this result:

$$P = (1 + e^{-B'x})^{-1}$$

$$1 - P = (e^{-B'x})(1 + e^{-B'x})^{-1}$$

$$\frac{\partial P}{\partial x_i} = - (1 + e^{-B'x})^{-2} (-B_i e^{-B'x})$$

$$= (1 + e^{-B'x})^{-1} \frac{(B_i)(e^{-B'x})}{(1 + e^{-B'x})}$$

$$= P(B_i)(1 - P)$$

$$= B_i(P)(1 - P) \quad .$$

THE MULTINOMIAL LOGIT: A MODEL FOR MULTIPLE CHOICES

When the dependent variable has more than two outcomes, the multinomial logit may be the appropriate estimator.¹ Here, for example, it is used for three outcomes: 0 = do not attrite, 1 = attrite for reasons of pregnancy/parenthood, and 2 = attrite for reasons other than pregnancy/parenthood. To estimate the model, normalization is necessary. It is

1. See chapter 20 in William H. Greene, *Econometric Analysis*, New York: Macmillan, 1990, for a more complete discussion.

convenient to normalize on the choice coded as zero. Then the multinomial logit probabilities are:

$$P(y = j) = \frac{e^{\beta'_j x}}{1 + \sum_{k=1}^2 e^{\beta'_k x}}$$

$$P(y = 0) = \frac{1}{1 + \sum_{k=1}^2 e^{\beta'_k x}} .$$

β' is a row vector of coefficients for the outcome specified by the subscript, x is a column vector of variables, j identifies the particular outcome, and k indexes the set of outcomes.

The coefficients estimated by the multinomial logit model are not readily interpretable, and, indeed, the partial derivatives may not even have the same sign as the coefficients. The partial derivatives are:

$$\frac{\partial P_j}{\partial x} = P_j \left[\beta_j (1 - P_j) - \sum_{k, \text{not } j} P_k \beta_k \right] .$$

The sign reversal arises when the second term is larger than the first term.

Tables C-1 through C-4 in appendix C detail the empirical results.

APPENDIX C

LOGIT COEFFICIENT ESTIMATES AND
MEAN VALUES FOR THE VARIABLES IN THE ANALYSIS

APPENDIX C

LOGIT COEFFICIENT ESTIMATES AND MEAN VALUES FOR THE VARIABLES IN THE ANALYSIS

Tables C-1 and C-2 detail the binomial and multinomial logit coefficient estimates for the attrition equations. While the coefficient estimates for the binomial logit equation can be translated into partial derivatives at different points on the probability distribution by multiplying them by the appropriate $p(1 - p)$, the same is not true for the multinomial logit coefficients. These coefficients are not easily interpretable, and the partial derivatives may change sign (see appendix B). Table C-3 compares the empirical results for the partial derivatives for the binomial and multinomial logit specifications. For statistically significant variables, the partial derivatives are virtually identical in the two specifications. Table C-4 reports the variable means for the different racial/ethnic subgroups.

Table C-1. Binomial logit coefficient estimates for female attrition equations^a

	Attrition	Attrition for pregnancy/ parenthood	Attrition for reasons other than pregnancy/ parenthood
Constant	.187 (1.60)	-1.575*** (-9.94)	-.523*** (-4.18)
Year82	-.050 (-.68)	-.115 (-1.20)	.022 (.28)
Year83	-.035 (-.46)	-.261*** (-2.61)	.135 (1.63)
Year84	.001 (.01)	-.313*** (-3.26)	.206** (2.63)
Year85	.082 (1.09)	-.105 (-1.09)	.167** (2.04)
Age 17	.338*** (3.32)	.391*** (2.92)	.137 (1.26)
Age 18-20	.170*** (2.58)	.244*** (2.67)	.042 (.59)
Age 24 or over	.197** (1.99)	-.296** (-1.97)	.366*** (3.55)
HSDG	.051 (.72)	-.007 (-.07)	.064 (.82)
AFQT category I	-.246** (-2.20)	.184 (1.24)	-.400*** (-3.29)
AFQT category II	-.190*** (-2.60)	.072 (.72)	-.261*** (-3.36)
AFQT category IIIA	.015 (.21)	.155 (1.55)	-.080 (-1.03)
Aviation program	-.329*** (-4.43)	-.308*** (-2.95)	-.193*** (-2.38)
Ground program	-.053 (-1.06)	.055 (.83)	-.098* (-1.81)

Table C-1. (Continued)

	Attrition	Attrition for pregnancy/ parenthood	Attrition for reasons other than pregnancy/ parenthood
Overweight for height	.128 (1.35)	-.100 (-.75)	.199** (2.02)
Months in DEP	-.047*** (-6.78)	-.011 (-1.16)	-.049*** (-6.36)
Married or dependents at accession	-.044 (-.38)	.173 (1.16)	-.166 (-1.33)
Black	-.789*** (-13.26)	-.655*** (-7.39)	-.551*** (-8.42)
Hispanic	-.523*** (-3.53)	.048 (.26)	-.696*** (-3.92)
Number of observations	8,151	8,151	8,151
Average attrition	.473	.165	.308
Chi-square	280.6	122.4	182.0

NOTES: Three asterisks means statistically significant at 1-percent level (two-tailed test). Two asterisks means statistically significant at 5-percent level (two-tailed test). One asterisk means statistically significant at 10-percent level (two-tailed test).

a. Numbers in parentheses are t-statistics.

Table C-2. Multinomial logit coefficient estimates for female attrition equations^a

	Attrition for pregnancy/parenthood	Attrition for reasons other than pregnancy/parenthood
Constant	-.979 (-5.90)	-.197 (-1.50)
Year82	-.117 (-1.17)	-.008 (-.09)
Year83	-.233 (-2.21)	.078 (.90)
Year84	-.258 (-2.56)	.142 (1.73)
Year85	-.042 (-.41)	.157 (1.82)
Age 17	.489 (3.46)	.258 (2.24)
Age 18-20	.286 (3.00)	.109 (1.48)
Age 24 or over	-.166 (-1.06)	.334 (3.10)
HSDG	.018 (.18)	.068 (.84)
AFQT category I	.034 (.22)	-.394 (-3.09)
AFQT category II	-.031 (-.22)	-.269 (-3.31)
AFQT category IIIA	.139 (1.32)	-.045 (-.56)
Aviation program	-.410 (-3.78)	-.285 (-3.39)
Ground program	.018 (.25)	-.094 (-1.64)

Table C-2. (Continued)

	Attrition for pregnancy/parenthood	Attrition for reasons other than pregnancy/parenthood
Overweight for height	-.023 (-.16)	.194 (1.87)
Months in DEP	-.031 (-3.23)	-.056 (-7.04)
Married or dependents	.122 (.79)	-.135 (-1.03)
Black	-.906 (-9.94)	-.735 (-10.90)
Hispanic	-.203 (-1.06)	-.748 (-4.08)
Chi-square	358.4	358.4
Number of observations	8,151	8,151

a. t-statistics in parentheses.

Table C-3. Comparison of estimated partial derivatives: binomial and multinomial logit specifications^a

	<u>Attrition for pregnancy/parenthood</u>		<u>Attrition for reasons other than pregnancy/parenthood</u>	
	Binomial logit	Multinomial logit	Binomial logit	Multinomial logit
Age 17	.054 (2.92)	.053 (2.67)	Not significant	
Age 18-20	.034 (2.67)	.033 (2.47)	Not significant	
Age 24 or over	-.041 (-1.97)	-.039 (-1.78)	.078 (3.55)	.079 (3.27)
AFQT category I	Not significant		(-.085) (-3.29)	-.085 (-3.03)
AFQT category II	Not significant		-.056 (-3.36)	-.055 (-3.08)
Aviation programs	-.042 (-2.95)	-.041 (-2.71)	-.041 (-2.38)	-.040 (-2.15)
Months in DEP	Not significant		-.010 (-6.36)	-.010 (-5.89)
Black	-.090 (-7.39)	-.086 (-6.73)	-.117 (-8.42)	-.112 (-7.41)
Hispanic	Not significant		-.148 (-3.92)	-.149 (-3.71)
Overweight at entry	Not significant		.042 (2.02)	.042 (1.83)

a. t-statistics in parentheses.

Table C-4. Mean values for racial/ethnic subgroups

	Total	Not black/ not Hispanic	Black	Hispanic
Accession age				
17	.08	.08	.09	.09
18-20	.68	.68	.67	.71
21-23	.16	.16	.16	.14
24+	.08	.08	.08	.06
HSDG	.88	.88	.86	.93
Aviation program	.12	.14	.07	.12
Ground program	.35	.35	.35	.33
Open program ^a	.53	.51	.58	.55
AFQT category I	.06	.08	.01	.01
AFQT category II	.43	.47	.30	.37
AFQT category IIIA	.37	.34	.49	.42
AFQT category IIIB ^a	.20	.19	.21	.21
DEP participation	.81	.82	.81	.79
Months in DEP	3.91	3.97	3.71	3.64
Not single	.04	.04	.03	.03
Overweight for height	.06	.06	.06	.08
Attrition percentage	47.3	51.0	34.3	40.2
Pregnancy/parenthood	16.4	18.0	10.4	19.1
For reasons other than pregnancy/ parenthood	30.9	33.0	23.9	21.1
Number of observations	8,151	6,286	1,666	199

a. These categories were omitted from the regressions.