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Attrition or Retention? Exploring 4-Year and 6-Year Outcomes Among Navy Enlisted Sailors

December 2024

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Prepared for the Naval Postgraduate School, Monterey, CA 93943.

ACQUISITION RESEARCH PROGRAM
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ABSTRACT

In this thesis, I estimate 4-year attrition and 6-year retention outcomes among Navy enlisted Sailors, examining patterns by demographics, pre-accession, and occupational characteristics. Using longitudinal data for Sailors accessing the Navy between fiscal years 2012–2017 and observed annually until separation or September 2023, I estimate logistic regressions and Kaplan-Meier Survival curve analysis using Cox Proportional Hazard Model to identify predictors of Sailors' attrition and retention behaviors. Results for 4-year attrition models show that women with either very high (college) or low (GED) educational attainment and Sailors in technical and mechanical occupational ratings have higher attrition rates compared to their counterparts. Six-year retention models show that Hispanics, racial minorities, and enlisted Sailors in Information Warfare and Admin & Supply broad occupational ratings are statistically more likely to retain past the initial 6 years of active-duty service. Accession waivers do not show a difference in attrition or retention outcomes, although I did not examine waivers by different categories. The absence of data on 4-, 5-, and 6-year initial enlistment obligations limits the ability to fully distinguish attrition and retention patterns across various contract lengths. However, the findings reveal characteristics policymakers can focus on for potential policy adjustments aimed at improving retention and attrition for Sailors to support the Navy.

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LIST OF ACRONYMS AND ABBREVIATIONS

AFQT	Armed Forces Qualifications Test
ASVAB	Armed Service Vocational Aptitude Battery
CA2P	Command Advance to Position
CNA	Center of Naval Analyses
CNO	Chief of Naval Operations
CNRC	Commander, Navy Recruiting Command
DEP	Delayed Entry Program
DMAP	Detailing Marketplace Assignment Policy
DMDC	Defense Management Data Center
DoD	Department of Defense
FY	Fiscal Year
GENDET	General Detail Apprentices
MEPS	Military Entrance Processing Station
NEC	Navy Enlisted Classification
NF	Nuclear Field
NRC	Navy Recruiting Command
NTAG	Navy Talent Acquisition Group
PQS	Personnel Qualification Standard
PRIDE	Personalized Recruiting for Immediate and Delayed Enlistment
RTC	Recruit Training Command
TAOC	Talent Acquisition Onboarding Center
TIS	Time in Service

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I. INTRODUCTION

The Navy is facing a well-known crisis in recruiting and retention. According to an article in *NavyTimes,* for fiscal year (FY) 2024, the Navy obtained less than 70 percent of the required recruiting goals for the first half of the year (Stancy, 2024). Moreover, recruiting and retaining minorities and women has been a major issue for years. Former Chief of Naval Operations (CNO) Admiral Mike Gilday ordered Task Force One Navy to survey Sailors to address any differences in retention for different groups represented within the Navy. Results from the survey show that although recruitment of women and minorities has improved over the years, retaining this diverse pool of Sailors is an issue (Martinez, 2021). With the newer generations feeling less compelled to join the military, recruitment and retention are top priorities to ensure the Navy is properly manned to be mission-capable and operationally ready.

The Navy has implemented a number of changes in its policies to help increase recruitment and retention: enlistment and re-enlistment bonuses, raising the maximum enlistment age, and relaxing the requirement of having a high school diploma to enlist to help increase recruitment and retention (Stancy, 2024). To support these recent adjustments aimed at boosting recruitment and retention, it is also crucial to identify the characteristics predicting early attrition among Sailors. This, in turn, allows the Navy to design policy adjustments that address the specific areas that are associated with high attrition (lower retention). Adding to prior studies, this thesis uses more recent data to identify areas of recruitment and retention challenges by examining pre-accession and post-accession factors that predict attrition, with the goal of providing insights to the Navy policymaker regarding mitigating early attrition and attracting and retaining a talented, diverse pool of candidates to serve in the Navy.

A. PURPOSE AND APPROACH

In this thesis, I explore the patterns in attrition at the 4-year mark and retention at the 6-year mark among Navy enlisted Sailors. Using longitudinal data on enlisted Navy cohorts during fiscal years 2012 through 2017, observed annually until fiscal year 2023 or

until separation. The study uses a combination of multivariate logistic regressions and Kaplan-Meier Survival Curves using Cox Hazard Models to identify statistically significant predictors for attrition at the 4-year mark and retention at the 6-year mark.

The study focuses on differences in 4-year attrition rates across various demographic groups- specifically among racial minority groups, genders, Hispanics and different occupational ratings. I aim to show how racial minorities, Hispanics and females are progressing in 4-year and 6-year periods compared to nonracial minorities. I also aim to show whether occupational ratings are related to attrition. I tailor my scope to these specific career milestones due to the limitation on my dataset with the absence of initial service obligation lengths for enlisted Sailors. The goal of this thesis is to identify the characteristics that predict early attrition within these more recent cohorts of Sailors and diverse occupational rating groups. Calling attention to early attrition patterns and providing insights into finding ways to mitigate these patterns to influence and guide future Sailors to continue to serve our great nation.

B. RESEARCH QUESTIONS

In my thesis I aim to address the following research questions.

1. How do 4-year attrition and 6-year retention patterns differ by gender, Hispanics, and racial minority groups across various occupational ratings among Navy enlisted Sailors?
2. What pre-accessing and accession characteristics (demographic, educational, rating, occupational category) best predict 4-year attrition and 6-year retention outcomes?

C. DATA AND APPROACH

The data set for this study comes from the Defense Management Data Center (DMDC) and includes administrative longitudinal records on 188,937 unique active Navy enlisted Sailors who entered the service between fiscal years 2012 and 2017. The data records annual observations for each Sailor from entry into the DEP, through DEP completion, accession into the Navy, and up to fiscal year 2023 or until separation,

whichever comes first. To ensure the data depict an accurate representation of the Navy, the data set includes several consecutive cohorts of Navy accessions to avoid potential biases by observing any single potential outlier cohort.

The main outcome variables in my analysis focus on 4-year attrition and 6-year retention. They are estimated using logistic regression. The 4-year attrition outcome measures whether a Sailor separates from active-duty service prior to completing 48 months of active-duty service since the shortest initial obligation is 4 years (48 months). While Sailors can sign up for a 4-,5-, or 6-year initial obligations, there is no variable in the data set to allow me to differentiate between these different lengths of initial contract. Hence- for retention, I measure it using a 6-year retention outcome, which captures whether a Sailor continues active-duty service past 6 years and 6 months or 78 months of active-duty service. Promotion is not an outcome I can observe due to insufficient detail in the dataset on promotion timelines and criteria. The independent, explanatory variables include pre-accession and post-accession factors, such as gender, marital status, race, number of dependents, citizenship status, education level, and occupational ratings, with a focus on racial minority groups and gender disparities in Navy enlisted Sailors.

D. ORGANIZATION OF THE THESIS

The rest of the thesis is five chapters. Chapter II sets the contexts by presenting the basics of recruiting, the demographic makeup of the Department of Defense, and institutional details on key concepts such as attrition, retention, and promotion. Chapter III reviews previous studies on Navy enlisted attrition, with a particular focus on racial minority groups, gender differences within career progression, and the Delayed Entry Program. Chapter IV describes the data used in this study and provides the summary statistics from the analysis. Chapter V presents the methodology, expanding on the multivariate and survival analysis. Lastly, Chapter VI wraps with the conclusion and recommendations for future research.

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II. HISTORY OF MILITARY RECRUITING CRISIS

In this chapter, I provide the context of my analysis by presenting different aspects of the Navy and Recruiting and an overview of recent history regarding the recruiting crisis in the Navy and in the military. Next, I provide insight into Navy recruiting, the Delayed Entry Program, and attrition and retention incentives. I conclude with a summary of the chapter.

The U.S. military faces a significant recruiting crisis across the various branches. Among the evolving and increasing operational demands and geopolitical domain, the Navy's ability to attract and retain qualified personnel is critical during these times. External factors contributing to this crisis include a national labor shortage, inflation, and the lingering effects of the COVID-19 pandemic (Kube & Boigon, 2022). The COVID-19 pandemic created many issues in recruiting by limiting in-person recruiting efforts, ultimately reducing the visibility of our armed forces and the potential career opportunities it has for prospective recruits. Along with the external factors mentioned, attracting racial minorities to join and gender differences across the services are also prime factors that are contributing to the recruitment and retention issues.

Historically, racial minorities and women have been the underrepresented groups in the military (Council on Foreign Relations, 2023). Over the decades, the U.S. military has taken steps to increase the representation of racial minorities and women, but this recruiting crisis is hindering efforts to continue to build a more inclusive and representative force. The Navy's struggle to effectively attract and retain diverse demographics not only affects enlistment numbers but also impacts the Navy's readiness to meet national security objectives. This chapter provides details on the demographic profile of the Department of Defense, followed by an overview of Navy recruiting practices and a description of the recruiting regions. It then describes the Delayed Entry Program (DEP), what DEP attrition and first-term attrition are, and discuss retention incentives. To close, the chapter offers a recap of the insights discussed.

A. DEPARTMENT OF DEFENSE DEMOGRAPHIC PROFILE

According to the Department of Defense (DoD) *2022 Demographic Profile*, the DoD is composed of approximately 81.8 percent of enlisted members (1,067,756); of that, 82.5 percent (1,075,753) of the active-duty military members are made up of men, with female representation in the DoD active-duty force sitting at 17.5 percent (228,966) (Office of the Under Secretary of Defense for Personnel and Readiness, 2022). The *2022 Demographic Profile* indicates that for the U.S. Navy, males make up 79.4 percent of the enlisted population, while females make up 20.6 percent (Office of the Under Secretary of Defense for Personnel and Readiness, 2022).

Given these demographics, there is a considerable gender gap between enlisted men and women in the U.S. Navy. This gap is prominently observed in promotion rates as enlisted men achieve senior leadership roles more frequently than enlisted women. Although these numbers may seem small, the report further illustrates that the representation of females has increased steadily since 2005, with female representation then being 14.3 percent and male representation at 85.7 percent (Office of the Under Secretary of Defense for Personnel and Readiness, 2022). Although the Navy has successfully increased the representation of enlisted women, women remain largely underrepresented overall. Furthermore, the report also indicates that women are overrepresented in junior grades and underrepresented in senior enlisted leadership positions (Office of the Under Secretary of Defense for Personnel and Readiness, 2022). In the ranks of E1 to E4, women comprise 23.4 percent of the force; in the ranks of E5 to E6, women comprise 19.62 percent of the force. Finally, in the ranks of E7 to E9, women comprise 13.38 percent of the force (Office of the Under Secretary of Defense for Personnel and Readiness, 2022).

Statistics from the *Demographic Profile 2022* report show of the DoD population, the largest proportion of active-duty members self-report as White (68.8 percent). Additionally, the report notes that Black or African American members represent 17.3 percent, and Native Hawaiian or Other Pacific Islander, American Indian or Alaska Native, and Multi-racial members all represent less than 4.0 percent. As highlighted by the report, for the Navy, 39.5 percent of all active duty enlisted members make up the portion of

active-duty personnel who self-identified within racial minority groups, marking the highest percentage out of all enlisted members across various service branches. Currently, from the Demographic Profile 2022, the total percentage of Navy active duty enlisted members in racial minority groups is at its lowest point since 2010. Although racial diversity exists more among our enlisted service members, the percentages of each are still low. The demographic report illustrates the Navy's enlisted personnel are 1.9 percent American Indian or Alaska Native, 6.2 percent Asian, 19.7 percent Black or African American, 1.3 percent Native Hawaiian or Other Pacific Islander, and 6.6 percent Multi-racial. Hispanic or Latinos represent 17.6 percent of the Navy (Office of the Under Secretary of Defense for Personnel and Readiness, 2022).

B. NAVY RECRUITING

The Navy's current recruiting process consists of many elements designed to attract the highest achieving and most diverse pool of candidates. Our recruiters are placed in various locations to engage and recruit potential applicants. Once an applicant expresses interest in joining, they'll contact their local recruiter where they will go through an initial interview and conduct an enlistment screening test. From there, if the applicant meets the preliminary entrance qualifications, they will schedule a job interest review to complete their official Armed Service Vocational Aptitude Battery (ASVAB) test and visit the Military Entrance Processing Station (MEPS). At MEPS, the applicant will complete processing. They will conduct their physical exams with medical, meet with a job counselor (classifier) to conduct interviews, and lastly perform their enlistment ceremony (United States Navy, 2021).

To optimize recruitment efforts across the country, the Navy Recruiting Command (NRC) has strategically placed Navy Talent Acquisition Groups (NTAGS) into regions. The regional structure is illustrated in Figure 1, the NRC-approved map, which details the specific geographical areas that each NTAG is responsible for and the corresponding Talent Acquisition Onboarding Centers (TAOC) that are within them.

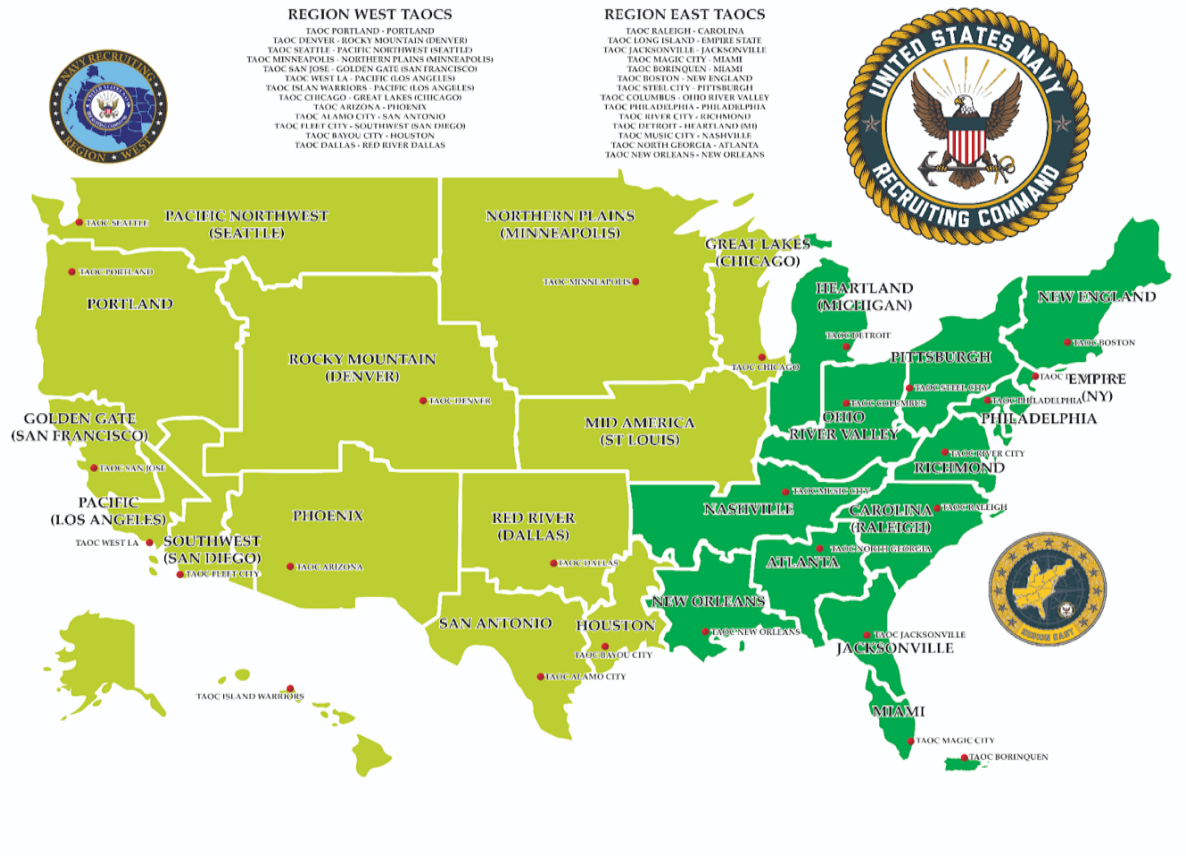

Figure 1. NRC Approved Map. Source: United States Navy Recruiting Command (n.d.).

Within the recruitment process, NTAGs are responsible for the management of recruitment offices within their designated areas. In my view, the Navy effectively tailors its recruitment strategies to its unique demographics across the U.S. to recruit the best and the brightest in their local area. Supporting the NTAGs are TAOCs, which, instead of having recruiting districts, the centers subdivide the regions to ensure there is complete coverage and support across the nation. The NTAGs and TAOCs work in tandem to streamline the recruiting process, ensuring they are meeting the Navy Recruiting Command (NRC) mission of recruiting "the highest caliber Sailor to meet the needs of the Fleet" (Commander, Navy Recruiting Command, n.d.).

C. DELAYED ENTRY PROGRAM AND DELAYED ENTRY PROGRAM ATTRITION

After the recruit's initial screening process and their completion of the enlistment ceremony, the recruits enter the Delayed Entry Program (DEP). This program is designed for all military branches to utilize during the recruitment process for those applicants who want to serve but are not qualified yet to serve in the Armed Forces, as well as those recruits who are preparing for their upcoming transition to the Recruit Training Command (RTC). The program is designed to promote what the Navy is about and assist those applicants who are not yet qualified to get qualified so they can serve in the U.S. Navy. Applicants would consider entering DEP if they are

> not of age to sign the legally binding contract, have not graduated high school and are working on your GED still, do not meet height and weight standards to enter basic training or have legal/medical issues that may require you to set a later ship date for boot camp. (Veteran.com, 2022)

While in DEP, recruits are considered inactive reservists, but at any time, the recruit can withdraw from the program as long as it is before the graduation date of boot camp. This period in DEP assists with developing a foundation for the recruits by providing them with initial training, guidance, and mentorship from their recruiters. DEP serves as an important period in a candidate's recruiting process because it allows them to have time to mentally prepare and solidify their commitment to joining the military service.

Although a recruit is placed in DEP and is projected to be shipped to RTC, the recruiting process does not end there. Although recruiting is a major issue, another critical challenge that the Navy faces is managing attrition rates. Attrition is "normally defined as the failure of an individual to complete his or her current term of enlistment due to a variety of reasons including misconduct, inaptitude, family hardship, desertion, and physical or psychological disqualification" (Griffin, 1981, p. 9). For the purpose of this thesis, I examine DEP attrition, first-term attrition, and any attrition across various career stages.

DEP attrition is described as those individuals who have signed initial contracts and have been placed in DEP but did not ship to boot camp because they chose to drop out of the program (Baykiz, 2007, p. 7). (See Chapter III for a review of previously researched

data on DEP attrition.) Since recruiters cannot enforce an obligation on an applicant, this type of attrition is a concern for the Navy due to the impact on the overall recruitment goals and the increased pressure it places on recruiters to find new applicants to fill those gaps and meet operational needs. Identifying characteristics that can be possible triggers leading to DEP attrition can help mitigate and decrease DEP attrition. Addressing these triggers early on is important for improving retention rates and ensuring that recruits successfully and seamlessly transition from DEP to active duty.

D. FIRST TERM ATTRITION

First-term attrition is defined as "failing to complete the contracted first-term enlistment term" (Larson & Kewley, 2001, p. 5). This form of attrition is a critical concern for the Navy since we need to ensure we are filling the E-1 through E-4 at-sea billets and maintaining an overall readiness of the force. (See Chapter III for more detailed data on first-term attrition.) Additionally, first-term attrition is very costly. Losing a Sailor who just received training in FY 2008 produced estimated costs of "$209 million to $220 million ($245 million to $258 million in 2019 terms)" (Marrone, 2022, p. 1). Considering the rising costs in today's economy, it is likely that these expenses have increased substantially. These financial challenges call attention to the importance of addressing first-term attrition and identifying the characteristics that lead to early attrition to help mitigate and prevent early separation to ensure the Navy's investments in personnel yield long-term returns.

While determining ways to manage attrition is an important part of the Navy's personnel strategy, retention is also just as important to ensure we are maintaining a ready and capable fighting force. Serbu (2024) reported that "the Navy is still shrinking despite some improvements in recruiting figures" (para. 5). To maintain a ready and capable force, the Navy is offering selective reenlistment bonuses, suspending high-year tenure, and changing how Sailors advance (Mongilio, 2023). For FY24, retention rates across the board were successful. The Chief of Naval Personnel (CNP), Vice Admiral Rick Cheeseman, was interviewed with Federal News Network, where he spoke about retention and stated, "For those with zero to six years of service, we're at about 117% of our goal. For six to 10 years

of service, it's 100%" (Serbu, 2024, para. 16). Although the efforts of retaining Sailors in the service are succeeding, the Navy is still struggling to maintain manning billets, specifically billets on ships. As noted by Serbu (2024), "Over the past year, the Navy has had on average, about 18,000 unfilled positions on its ships. The reason is straightforward: there simply aren't enough Sailors in the service because of ongoing recruiting challenges" (para. 1). The ongoing recruiting challenges signify that there are not enough new Sailors entering our service to keep up with the pace and demands of the expanding operational domain and the increasing mission requirements. Ensuring we are discovering ways to address the factors that influence a Sailor's decision to continue service is particularly crucial to ensuring the Navy is reducing turnover and maintaining operational readiness.

E. RETENTION INCENTIVES

To assist with the recruiting and retention issues, the Navy has implemented several new policies to provide Sailors with more opportunities for promotion. Effective 01 June 2024, "NAVADMIN 111/24 announced the implementation of Command Advance to Position (CA2P) for Navy-wide execution for advancement to E-5 and E-6" (MyNavyHR, 2024a). This change allows for Sailors who are not a part of the Detailing Marketplace Assignment Policy (DMAP) rating described in references (b) through (f) to be able to participate in this program as another way of advancing (MyNavyHR, 2024b). The program allows a Sailor to "fill vacant billets by recommending a Sailor at the command to advance to the billet's pay grade" (MyNavyHR, 2024b).

Effective 01 July 2024, changes were made to the apprentice (E-1 to E-4) advancements, changing it into a time-in-service (TIS) based construct. TIS requirements to advance from E-1 through E-4 are as follows: "E-1 – E-2: 9 months TIS, E-2 – E-3: 18 months TIS, and E-3 – E-4: 30 months TIS" (MyNavyHR, 2024a). Additionally, the Navy has also increased reenlistment bonuses, adjusted physical fitness requirements, and adjusted retention bonuses for certain ranks/ratings who choose to stay on active duty. These changes to promotion policies do away with the older requirements of mandatory advancement exams to proceed to the next pay grade, allow for commands to fill gapped billets using their own Sailors, and provide incentives to all Sailors to ensure that motivated

and deserving Sailors are promoted accordingly and rewarded for their continued dedication to serve.

F. SUMMARY

The Navy is facing a significant recruiting crisis that is tested by the challenges previously discussed. In my view, these factors appear to contribute to the challenges of attracting recruits, particularly those in underrepresented groups such as racial minorities and women, and may also hinder the Navy's ability to retain personnel effectively. The Navy's current recruitment process, managed by NTAGs and TAOCs, is designed to help achieve a diverse force. While the Navy has made strides to address retention issues through various incentives, it still must contend with DEP attrition and first-term attrition, highlighting the importance of addressing the root cause of attrition and developing new avenues to support and promote our Sailors to maintain a ready and capable force.

I have discussed the issue of underrepresentation among racial minority groups and women, provided an overview of the recruitment process, and described DEP attrition, first-term attrition, and retention incentives. In this study, I analyze the pre-accession and post-accession factors that best predict attrition to develop a comprehensive analysis of how these factors affect Navy enlisted racial minority groups and women across various career stages and occupational ratings. Chapter III presents a comprehensive literature review covering relevant research on gender and racial minority group differences, occupational assignments, and various attrition periods, including DEP, RTC, and First term attrition.

III. LITERATURE REVIEW

This literature review assesses studies on Navy enlisted attrition, focusing on key factors that contribute to disparities. This chapter begins by examining studies on gender and racial differences in attrition, with literature showing a mixture of factors- such as race, ethnicity, gender, and occupational assignment- as contributing factors to these disparities. Bowers (2015) and Robinson (2023) highlighted lower first-term attrition for Hispanic Sailors and higher first-term attrition for women. Next, I review attrition patterns within the Delayed Entry Program (DEP) and Recruit Training Command (RTC), for which prevalent literature emphasizes the importance of pre-enlistment characteristics in predicting early attrition. This is followed by an analysis of studies on how occupational assignments impact attrition rates, showing that occupational assignments significantly influence attrition rates. The chapter concludes with a summary of the major insights from these studies and discusses how my research will build upon and expand their findings.

A. RACIAL MINORITY GROUP DIFFERENCES IN ATTRITION

Many articles have studied differences in attribution by race and gender. For example, Bowers (2015, p. 1) "uses a quantitative approach to analyze pre-accession characteristics and early career factors, and their effect on the first-term attrition, retention, and promotion rates" between Hispanic and non-Hispanic Navy enlisted Sailors. Using longitudinal "data from the Personalized Recruiting for Immediate and Delayed Enlistment (PRIDE), which is merged with personnel data from the Defense Manpower Data Center (DMDC)" on non-prior service active-duty accessions between 2001–2009 followed annually up to fiscal year 2013 or until separation, Bowers (2015, p. 2) found that Hispanics have a lower likelihood to attrite within 45 months of service. Additionally, the study found that

> being White and Hispanic is estimated to reduce the likelihood of being a first-term attrite by 3.7 percentage points compared to being White and non-Hispanic. It is ethnicity, rather than race, that is found to be important in estimating first-term attrition. (Bowers, 2015, p. 70)

In Bowers's (2015) analysis, performance is measured through attrition and retention outcomes among Hispanic and non-Hispanic Sailors. Based on these criteria, the attrition and retention metrics demonstrate that Hispanic Sailors performed somewhat better than those who were non-Hispanic Sailors. Additionally, his study found that "Hispanics are more likely to enlist with an alcohol/drug waiver" (Bowers, 2015, p. 97) when compared to non-Hispanics. The data from 2001 through 2003 defined Sailors as either Hispanic or White, while data from 2004 through 2009 defined Sailors with both a race and ethnicity following the federal definition change reclassifying Hispanic from a race to an ethnicity in 2003. To determine the effects of this change, a restricted model containing Sailors from fiscal years 2004 through 2009 found that being classified as both having a "racial demographic and having Hispanic as the ethnicity was statistically significant at the 95 percent or greater confidence level for all race and ethnicity interaction variables" (Bowers, 2015, p. 70). When Hispanic was defined as a race within the model, the study found that "being Hispanic decreases retention for four- and six-year obligors" (Bowers, 2015, p. 96). Likewise, Condon and Eckenrode (2006, p. 77) found that recruits who identified within an ethnic group were found to be less likely to attrite, and Blacks and Asians were less likely to attrite.

While Bowers's (2015) analysis suggests that being Hispanic is correlated with outcomes such as lower attrition rates during the first term and slower promotion rates compared to those who are non-Hispanic Sailors, it is important to acknowledge the potential limitations in interpreting the relationship between being classified as Hispanic and attrition, retention, and promotion as a direct causal factor. Omitted variables such as socioeconomic background or access to resources that were not included in the models- yet may be correlated with both Hispanic identity and attrition, retention, and promotion- must be taken into account. These factors could influence the observed data, and it is important when interpreting these results to understand the potential impact to avoid associating the results solely with Hispanic identity.

B. FIRST-TERM ATTRITION AND CAREER PROGRESSION

Using a similar approach and dataset as Bowers, Robinson (2023) focused on analyzing first-term career progression between Navy enlisted men and women. Her study found that "women are more likely to separate from the Navy before the conclusion of their first term enlistment contract compared to enlisted men" (Robinson, 2023, p. 71). In her analysis, attrition, and retention, are determined using several models. Controlling for only demographic characteristics within the first-term attrition model, Robinson (2023) found that women are five percentage points more likely to attrite from the Navy prior to completing their first term compared to their male counterparts. However, among those who stayed, women were "more likely to remain on active-duty at least three months longer on their four-year obligation" (Robinson, 2023, p. 71). In terms of pre-enlistment factors, Robinson (2023) controlled for two pre-enlistment factors: Armed Forces Qualifications Test (AFQT) scores and education levels. These pre-enlistment factors did not significantly increase or decrease attrition or retention among enlisted women.

Marrone (2020) took a different approach in his study on first-term attrition. The study used data regarding the Army, Air Force, Marine Corps, and Navy service branches' accessions from fiscal year 2002 through 2013. Marrone (2020) found that among the four services, women are more likely to attrite in the Army. In the Navy, recruits who didn't have a high school diploma were more likely to attrite, and married Sailors are more likely to attrite within the first 12 months of service (Marrone, 2020). Additionally, the analysis predicts up to 60 percent of those who would and would not attrite based on the characteristics of the individuals at the time of accession. The study shows that including all available characteristics of an individual in the model will result in better predictions than just focusing on single characteristics.

To predict the probability of a recruit attriting, Marrone uses probit regressions with a focus on sensitivity and specificity to bring light to how useful the predictions are and how well the models read. Marrone linked the accession data to local unemployment data from each recruit's home county. Marrone (2020) found in the sensitivity and specificity analysis that geographic and unemployment variables possessed relatively high sensitivity and low specificity, while medical variables contained low sensitivity and high specificity.

These variables were found to have the least amount of ability to distinguish between attriters and non-attriters. Additionally, the study found that test scores alone can predict approximately half of attriters and non-attriters accurately across all service branches due to having a 50 percent to 60 percent sensitivity and specificity. This approach to using specificity and sensitivity helps understand the reliability and precision of the model. Marrone's (2020) findings suggest that targeting recruitment for certain individuals who possess certain characteristics, rather than looking at the broader scope, may reduce overall recruitment numbers.

In summary, these studies on first-term attrition and career progression highlight the disparities in attrition rates and promotion paths for service members. Based on the prior literature, my thesis will include current data and controls for various demographic and occupational variables to better understand the influence these variables have on attrition and retention. Robinson (2023) identified higher attrition rates among women, with occupational assignments contributing to these gender-based disparities in attrition risk. Marrone (2020) provided additional insights with a broader scope examining characteristics of attrition across service branches, noting factors such as education and marital status may have on attrition outcome. Marrone's use of the sensitivity and specificity analysis emphasizes that considering the broader population demographics can enhance the accuracy in predicting attrition.

C. DEP AND RTC ATTRITION

Beyond first-term attrition and career progression, examining attrition within the Delayed Entry Program (DEP) and Recruit Training Command (RTC) provides insights into the early stages where enlisted Sailors are most susceptible to separating from the Navy. Neuhalfen (2007) analyzes Personalized Recruiting for Immediate and Delayed Enlistment (PRIDE) records containing 459,273 DEP records from FY 1998–2005 to explore factors leading to DEP attrition. Neuhalfen (2007) found that attrition increases with an individual's length of stay in the DEP program. The study found attrition rates were considerably higher for those individuals who were in school—whether high school or college—while, in DEP when compared to those individuals in DEP who were not in

school. Neuhalfen (2007, p. 127) also found that "women in traditional ratings averaged a longer time in DEP (163 days) compared with their counterparts in nontraditional ratings (121 days)."

Shifting focus from DEP attrition to RTC attrition, Condon and Eckenrode (2006) used data from Personalized Recruiting for Immediate and Delayed Enlistment (PRIDE) containing 216,028 recruits who had an assigned military occupation (rating), nine years of education or more, and who entered the RTC from fiscal years 2000 through 2004. The study found that women are more likely to attrite than men and high school graduation is one of the leading indicators for determining the likelihood of a recruit being successful in the service. Using multivariate logistic regression analysis, the study found that many attriters share similar characteristics such as gender, age, race, AFQT scores, and the fiscal year the individual accessed (Condon & Eckenrode, 2006).

The studies on attrition within the DEP and RTC highlight key factors that influence early separation among Navy Enlisted Sailors. Neuhalfen (2007) identifies that longer DEP duration and having occupational assignments such as the Nuclear Field (NF) impact attrition rates. Condon and Eckenrode (2006) brought insights into finding characteristics like gender, race, and educational background that are leading to attrition within the RTC. Together, these studies lay a foundation for understanding attrition factors in the DEP and RTC.

D. OCCUPATIONAL ASSIGNMENT AND ATTRITION

While DEP and RTC attrition highlights important pre-service factors, analyzing how occupational assignments impact a Sailor and first-term attrition is also important. Using data from the Defense Manpower Data Center (DMDC) on 177,790 male enlisted personnel who are first-term, non-reservist enlisted Sailors who began active-duty service between 1996–2000 calendar year, Carroll (2008) found that occupational assignments strongly correlate with the likelihood of increased attrition during the first term. The study found that minorities who are in non-technical occupational assignments have a decreased probability of attriting when compared to those who are minorities in a technical occupation. Lastly, the analysis created racial and ethnic subgroups. Among these groups,

Carroll (2008, p. 77) found that "non-Hispanic Whites and, to the greater extent, non-Hispanic Asians in the Chinese, Japanese, and Indian ethnic subgroups are more likely to complete the first enlistment term if they were assigned to a technical occupation." Additionally, Bowers' (2015, p.96) analysis shows Hispanics have a 2.1 percent higher likelihood of enlisting in the Navy as an "undesignated" rating and have a 1.62 percent higher likelihood of enlisting as a Hospital Corpsman.

Robinson's (2023) study also highlights how occupational ratings contribute to gender disparities in attrition and career progression. Robinson's (2023) analysis demonstrates that when comparing attrition across occupational differences, a 5.5 percentage point difference between genders occurs. Occupational rating groups not only affect the gender gap but also statistically contribute to first-term attrition among enlisted Sailors. This is the largest gender difference Robinson identified, representing an 18 percent higher attrition rate among female enlisted Sailors, given an overall mean attrition rate of 31 percent.

Additionally, the study found Sailors in administrative ratings are more likely to leave before the end of their first-term enlistment contract compared to those Sailors who are in "Aviation Maintenance, Aviation Support, Shipboard Maintenance, Intelligence, and Cryptology ratings" (Robinson, 2023, p. 73). The study also shows that Sailors in the Nuclear Field ratings are more likely to leave the Navy before the end of their first-term enlistment compared to other fields (Robinson, 2023, p. 71). When looking at retention among enlisted Sailors, Robinson (2023) found that Sailors in Undesignated, Shipboard Engineering, Aviation Support, and Shipboard Maintenance ratings are all less likely to remain on active-duty service past their initial enlistment contract when compared to Sailors in administrative ratings. Conversely Neuhalfen (2007) found that the Nuclear Field (NF) program was the only statistically significant enlistment program that shows significantly lower DEP attrition when compared to those who were General Detail Apprentices (GENDETs). According to the study, time in DEP was highly correlated with attrition rates for women in "both traditional and nontraditional occupations" (Neuhalfen, 2007, p. 198).

E. SUMMARY

The literature on Navy enlisted attrition largely focuses on specific career stages or demographic groups. Collectively, these researchers provide a foundation for understanding attrition patterns and factors. However, they do not remove race and gender as casual factors due to their correlational nature. Building on these insights, my research will use current data to examine attrition across various career stages, racial minority groups, gender, and occupational ratings in a longitudinal analysis of Navy enlisted Sailors, aiming to identify how these factors influence attrition and retention patterns and provide possible insights for recruitment and retention.

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IV. DESCRIPTION OF DATA AND SUMMARY STATISTICS

In this chapter, I describe the data sources and summary statistics used to analyze the career progression of Navy enlisted Sailors. I begin by detailing the data and its source. Next, I outline the dependent and independent variables I use to identify the factors contributing to attrition and retention. Lastly, I summarize the statistics for the regression samples to depict the summary of how key dependent variables such as attrition and retention impact the career progression of Navy enlisted Sailors.

A. DATA

The data for this study was obtained from the Defense Manpower Data Center (DMDC), the primary data collection center for the Department of Defense (DoD). The DMDC serves as "the central source for identifying, authenticating, authorizing, and providing information on personnel during and after their affiliation with the DoD" (Defense Manpower Data Center, n.d.). To address the research questions, I requested individual-level administrative data for five consecutive cohorts of naval enlisted personnel. These cohorts were selected based on the desire to observe them sufficiently after accession to capture attrition and retention patterns on enlisted men and women in the United States Navy. Multiple cohorts are chosen to avoid the influence of outlier cohorts that may not accurately represent the broad range of enlisted personnel in the Navy.

The dataset includes longitudinal data files, capturing the individual's characteristics from entry into DEP, through DEP completion, and accession into the Navy, observed annually, until separation or until September 2023. Variables within the dataset include demographic characteristics (gender, race/ethnicity, marital status, citizenship status, dependent status), and professional characteristics (ratings, occupational category, date of accession, rank, waivers, time in service, AFQT scores). The raw data was provided in long format and contains a total of 1,043,816 person-year observations of enlisted, officer, reservist, and a mixture of service branches across all cohorts from FY2012 through FY2017. A total of 68,598 observations were dropped from the dataset to ensure a focused sample of active component-Navy enlisted Sailors. First, 28,618 observations were

dropped for individuals not affiliated with the Navy, excluding those in the Coast Guard, Army, Air Force, and Marine Corps. Next, 7,267 observations were dropped for personnel who, while in DEP, were not affiliated with the Navy and not signed as regular active duty. Next, 227 observations were dropped for personnel who were not classified as regular active duty. Additionally, 5,899 observations were dropped for personnel not enlisted. Lastly, 26,587 duplicated person-year records were removed.

After transforming the dataset from long to wide and removing all variables that were not needed for this thesis, the master file contains 188,937 person-year observations of active enlisted Sailors who entered service during fiscal years 2012–2017. To identify which Sailor belonged to which entry cohort, I created individual cohorts in the master file. Variables are created to identify marital status, race, ethnicity, gender citizenship status, country of origin, education level, total count of entry waivers (medical, conduct, or dependent), and occupational rating groups.

B. DESCRIPTION OF VARIABLES

A description of the dependent and independent variables used in this analysis is presented below.

1. Dependent Variables

I examine the career progression among men, women, and racial minority groups across different Navy occupational ratings. The dependent variables I focus on in this thesis are 4-year attrition and 6-year retention. These definitions for 4-year attrition and 6-year retention are shown in Table 1.

Table 1. Description and Definition of Dependent Variables

Dependent Variables	
Variable Name	**Definition**
4-year Attrition	A binary indicator that takes on the value of 1 if the Sailor separated before 48 months, otherwise 0
6-year Retention	A binary indicator that takes on the value of 1 if the Sailor remained on active-duty service for greater than 78 months, otherwise 0

a. Attrition at 4 years

As Larson & Kewley (2001) defines first-term attrition, a Sailor is considered a first-term attriter if they did not complete their initial enlisted term. While I cannot distinguish the 4-year, 5-year, or 6-year obligers in my dataset, here I define the *4-year attrition* as a binary indicator taking a value of 1 if the Sailor separated from active-duty service before 48 months and 0 otherwise.

b. 6-year Retention

For this thesis, retention is defined as whether Sailors are retained on active duty 6 months passed the 72-month mark. Ideally, one would capture retention right at the end of the initial active-duty obligation of a Sailor to provide insight into reenlistment behaviors. However, given that such distinction for the different initial obligations' length is not feasible in my dataset, for the retention analysis, I define 6-year retention as a binary indicator that takes on the value of 1 if a Sailor stays more than 78 months and a value of 0 otherwise.

2. Independent Variables

The independent variables in this analysis include pre-accession and post-accession characteristics. The variables in the dataset include demographic characteristics, pre-accession characteristics, professional characteristics, occupational rating groups, and

cohort year. Table 2 depicts the variables used in the analysis and defines them respectively.

Table 2. Description and Definition of Independent Variables

Independent Variables	
Variable Name	**Definition**
Demographics	
Male (Reference Group)	=1 if the Sailor is male, otherwise 0
Female	= 1 if the Sailor is female, otherwise 0
Single (Reference Group)	= 1 if the Sailor is not married at accession, otherwise 0
Married	= 1 if the Sailor is married at accession, otherwise 0
No Dependents (Reference Group)	= 1 if the Sailor has no dependents, otherwise 0
Dependents	= 1 if the Sailor is has dependents, otherwise 0
U.S. Citizenship (Reference Group)	= 1 if the Sailor is a citizen, otherwise 0
No Citizenship	= 1 if the Sailor is a non-citizen, otherwise 0
Non-Racial Minority Group (Reference Group)	= 1 if the Sailor is not in a racial minority group, otherwise 0
Racial Minority Group	=1 if the Sailor is in a racial minority group, otherwise 0
White (Reference Group)	= 1 if race is White, otherwise 0
American Indian / Alaska Native	= 1 if race is American Indian or Alaskan Native, otherwise 0
Asian	= 1 if race is Asian, otherwise 0
Black / African American	= 1 if race is Black or African American, otherwise 0
Native Hawaiian / Pacific Islander	= 1 if race is Native Hawaiian or Pacific Islander
Other Race	= 1 if race is not White, American Indian / Alaska Native, Asian, Black / African American, or Native Hawaiian / Pacific Islander, otherwise 0
Hispanic	= 1 if ethnicity is coded as Hispanic Origin
Not of Hispanic Origin (Reference Group)	= 1 if ethnicity is coded as Not Hispanic Origin, otherwise 0
Unidentified Hispanic	= 1 if declined to respond ethnicity or missing ethnicity, otherwise 0

Independent Variables	
Variable Name	**Definition**
Pre-Accession Characteristics	
Average-level AFQT (Reference Group)	= 1 if scored within category 3A or 3B, otherwise 0
Above Average AFQT	= 1 if scored within category 1 or 2, otherwise 0
Below Average AFQT	= 1 if scored within category 4A, 4B, or 4C, otherwise 0
High School Diploma (Reference Group)	= 1 if has a High School Diploma, otherwise 0
College Degree	= 1 if has a College Degree, otherwise 0
Some College	= 1 if completed some sort of college time, otherwise 0
GED/Similar Certification Program	= 1 if received GED/similar certification, otherwise 0
HS Drop Out	= 1 if a HS drop out, otherwise 0
Unidentified School Status	= 1 if school status is Unidentified, otherwise 0
Waiver Status Characteristics	
Waiver	= 1 if came in with an accession waiver, otherwise 0
No Waiver (Reference Group)	= 1 if they did not come in with an accession waiver, otherwise 0
Occupational Rating Groups	
Aviation (Reference Group)	= 1 if enlisted in an Aviation rating, otherwise 0
Executive Support	= 1 if enlisted in an Executive Support rating, otherwise 0
Undesignated	= 1 if enlisted as undesignated, otherwise 0
Information Warfare	= 1 if enlisted in an Information Warfare rating, otherwise 0
Nuclear Field	= 1 if enlisted in a Nuclear Field rating, otherwise 0
Shipboard Maintenance	= 1 if enlisted in a Shipboard Maintenance rating, otherwise 0
Shipboard Engineering	= 1 if enlisted in a Shipboard Engineering rating, otherwise 0
Shipboard Operations	= 1 if enlisted in a Shipboard Operations rating, otherwise 0
Supply and Support Services	= 1 if enlisted in a Supply or Support Service rating, otherwise 0
Ordinance, Law and Weapons	= 1 if enlisted in an Ordinance, Law or Weapons rating, otherwise 0

Independent Variables	
Variable Name	**Definition**
Medical	= 1 if enlisted in a Medical rating, otherwise 0
SEABEE Construction	= 1 if enlisted in a SEABEE or Construction rating, otherwise 0
Submarine	= 1 if enlisted in a Submarine field rating, otherwise 0
Special Operations and Warfare	= 1 if enlisted in a Special Warfare or Operations rating, otherwise 0
Unidentified	= 1 if occupation is coded as unidentified, otherwise 0
Broad Occupational Category	
Technical & Mechanical Group (Reference Group)	= 1 if enlisted in Aviation, Ship Maintenance, Shipboard Engineering, Nuclear Field, or Construction, otherwise 0
Operations & Combat Group	= 1 if enlisted in Shipboard Operations, Ordinance, Law, and Weapons, Submarine, or Special Operations and Warfare, otherwise 0
Admin & Supply Group	= 1 if enlisted in Executive Support, Supply, Medical, Undesignated, or Unidentified, otherwise 0
Information Warfare Group	= 1 if enlisted in Information Warfare, otherwise 0
Cohort Year	
Cohort 2012 (Reference Group)	= 1 if accessed in FY 2012, otherwise 0
Cohort 2013	= 1 if accessed in FY 2013, otherwise 0
Cohort 2014	= 1 if accessed in FY 2014, otherwise 0
Cohort 2015	= 1 if accessed in FY 2015, otherwise 0
Cohort 2016	= 1 if accessed in FY 2016, otherwise 0
Cohort 2017	= 1 if accessed in FY 2017, otherwise 0

The occupational rating groups are described and grouped in accordance with the Rating Community and Career Navy Enlisted Classification (NEC) Codes Chapter 4 (MyNavyHR, 2023) and NEC's (TorqWorks, n.d.). These ratings signify the specialized job the Sailor will do while serving in the Navy and receive it upon meeting all eligibility requirements at MEPS to serve in the Navy. Additionally, it should be noted that while Sailors entering the service either entered with a rating or were considered "undesignated

in" the master file dataset containing 188,937 unique Sailors, 1,309 were described as unidentified ratings and were grouped in their group.

There are a total of 15 occupational rating groups, including the following: Aviation, Executive Support, Information Warfare, Nuclear Field, Undesignated, Shipboard Maintenance, Shipboard Engineering, Shipboard Operations, Supply and Support Services, Ordinance, Law, and Weapons, Medical, SEABEE Construction, Submarine, Special Operations and Warfare, and Unidentified. Appendix A details each occupational group, which only represents the ratings that were included within the master file dataset. I consolidated the 15 occupational rating groups into four major groups- Technical and Mechanical, Operations and Combat, Information Warfare, and Administrative and Supply. These groups were based on their functional similarities and overarching roles within the Navy. The goal of the grouping was to simplify the analysis by focusing on broader categories of occupational functions while preserving the distinct characteristics of each occupational rating group.

C. SUMMARY STATISTICS

Summary statistics of the mean and standard deviation are provided below for the sample. Using my dependent variables – *4-year attrition and 6-year retention*, I look at the statistics for gender, occupational rating groups, racial minority groups, and Hispanics/ non-Hispanics, and compare the career progression between them for the enlisted population in my study.

1. Dependent Variables

Below I provide the summary statistics for my outcome variables, 4-year attrition and 6-year retention.

a. Attrition at 4-Years

Table 3 presents the mean and standard deviation for the attrition measure which captures whether Sailors attrited before completing 48 months of active-duty service. The summary statistics show that, on average, 29 percent of Sailors in this sample attrite before

their 48 months of service is complete. For males, the attrition rate is 28 percent, while for females, the attrition rate is slightly higher, at 31 percent, with the difference being statistically significant. Figure 2 compares the mean 48-month attrition rates for genders by cohort. The figure illustrates the consistent gender gap trend between male and female Sailors across the years, with female Sailors having consistently higher attrition rates than male Sailors.

Table 3. Mean and Standard Deviation for 4-Year Attrition Rate for Full Sample and Gender

Variable	**Sample Mean N = 188,937 (SD)**	**Male Mean N = 144,429 (SD)**	**Female Mean N = 44,508 (SD)**	**Female – Male Differences in Sample Mean**
4-year Attrition	0.29 (0.45)	0.28 (0.45)	0.31 (0.46)	0.03***
*** Statistically Significant at the 99.9% Confidence Interval				

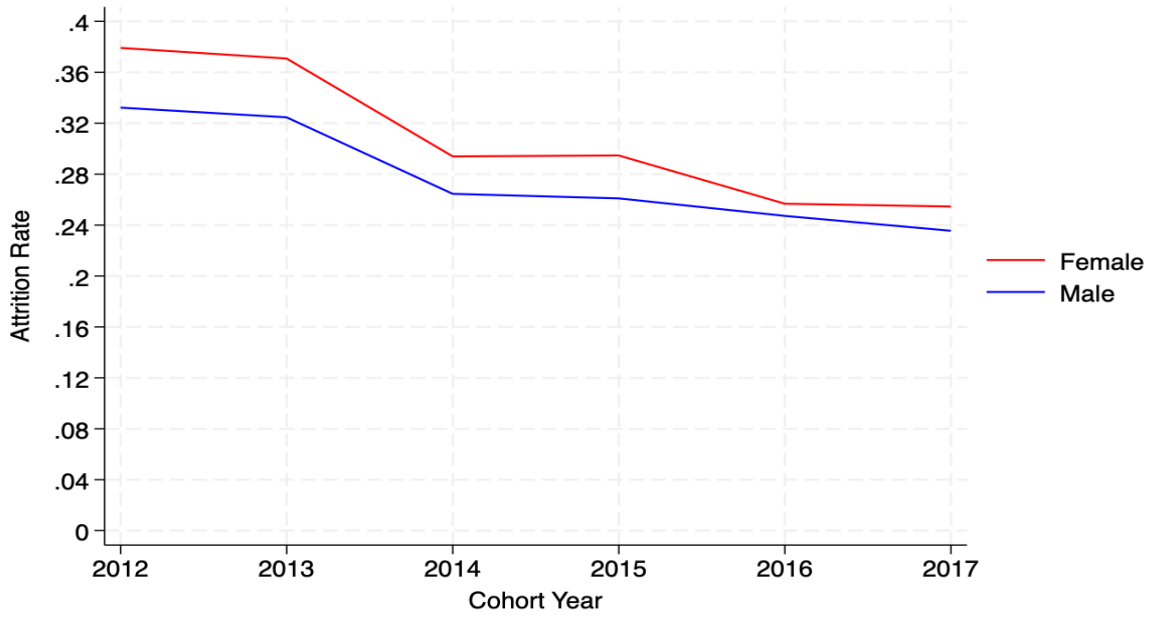


Figure 2. 4-Year Mean Attrition Rate for each Cohort by Gender

Table 4 and Figure 3 depict the mean and standard deviation 48-month attrition rate for racial minority groups. Results show that those Sailors who identify within a racial minority group have a lower mean attrition rate, at 27 percent, when compared to those Sailors who identify in a non-racial minority group, at 29 percent, indicating that racial minority groups are staying past the 4-year mark. Table 5 and Figure 4 depict the mean and standard deviation for the 48-month attrition rate for each occupational group. Results show that those classified with the Technical and Mechanical group for their occupational specialty had the highest mean attrition rate of 32 percent, while those in the Operations and Combat group had the lowest mean attrition rate of 21 percent, indicating those who were in the Technical and Mechanical occupational groups are attriting the most before the 48-month mark. Table 6 and Figure 5 depict the mean and standard deviation for the 48-month attrition rate for Hispanic and non-Hispanic Sailors. Results show that non-Hispanic Sailors have a higher mean attrition rate, 29 percent, compared to those who are Hispanic, at 27 percent, indicating Hispanics are staying in longer past the 4-year mark.

Table 4. Mean and Standard Deviation 4-Year Attrition Rate for Full Sample and Racial Minority Groups

Variable	**Sample Mean N = 188,937 (SD)**	**Racial Minority Group Mean N = 49,581 (SD)**	**Non-Racial Minority Group Mean N = 139,356 (SD)**	**Racial Minority Group – Non-Racial Minority Group Differences in Sample Mean**
4-year Attrition	0.29 (0.45)	0.27 (0.44)	0.29 (0.46)	-0.02***
*** Statistically Significant at the 99.9% Confidence Interval				

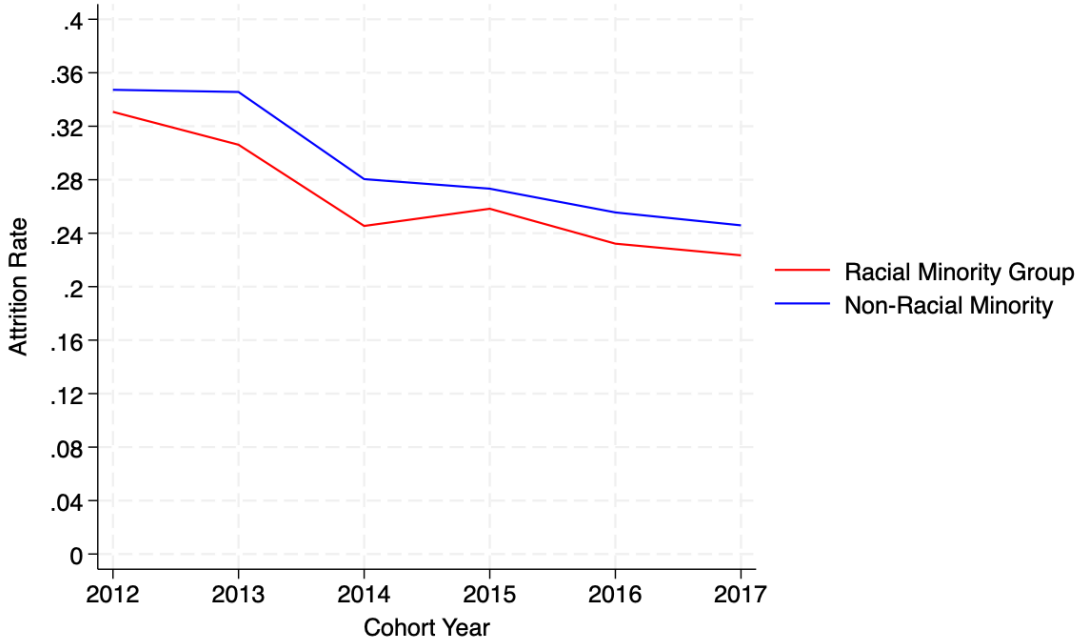


Figure 3. 4-Year Mean Attrition Rate for each Cohort by Racial Minority Group

Table 5. Mean and Standard Deviation 4-Year Attrition Rate for Occupational Rating Groups

Broad Occupational Category	**Number of Observations, N Mean 4-Year Attrition (SD)**	**Broad Occupational Category**	**Number of Observations, N Mean 4-Year Attrition (SD)**
Tech & Mechanical	N = 96,361 0.32 (0.47)	**Ops & Combat**	N = 40,504 0.21 (0.41)
Information Warfare	N = 17,330 0.22 (0.42)	***Admin & Supply***	N = 50,927 0.25 (0.43)

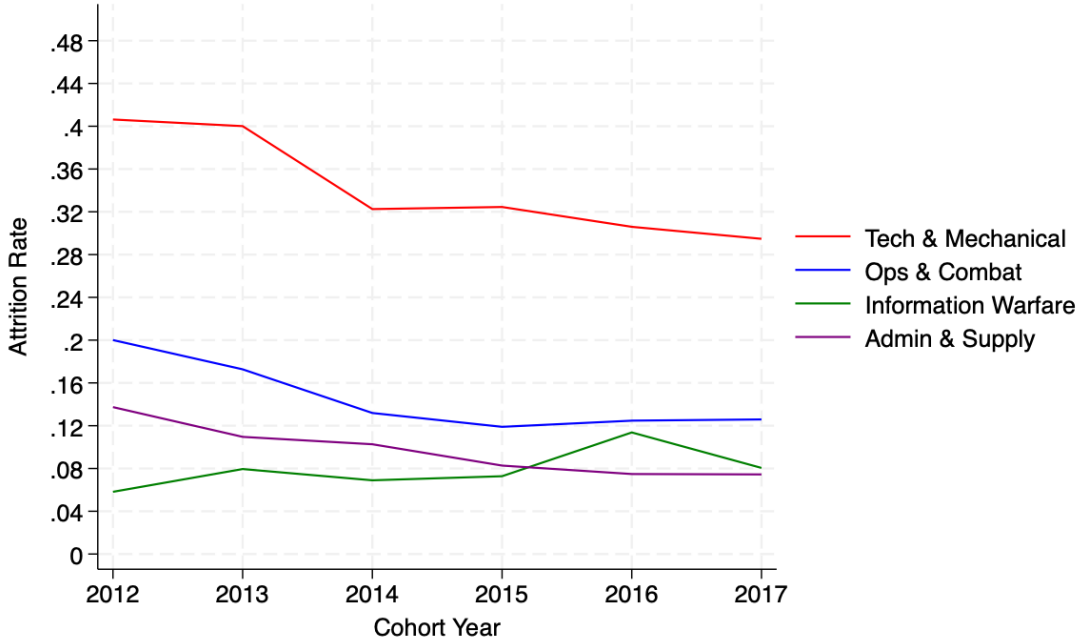


Figure 4. 4-Year Mean Attrition Rate for each Cohort by Occupational Rating Groups

Table 6. Mean and Standard Deviation for 4-Year Attrition by Hispanic/ Non-Hispanic

Variable	**Sample Mean N = 188,937 (SD)**	**Hispanic Mean N = 24,438 (SD)**	**Non-Hispanic Mean N = 164,499 (SD)**	**Racial Minority Group – Non-Racial Minority Group Differences in Sample Mean**
4-year Attrition	0.29 (0.45)	0.27 (0.44)	0.29 (0.45)	-0.02***
*** Statistically Significant at the 99.9% Confidence Interval				

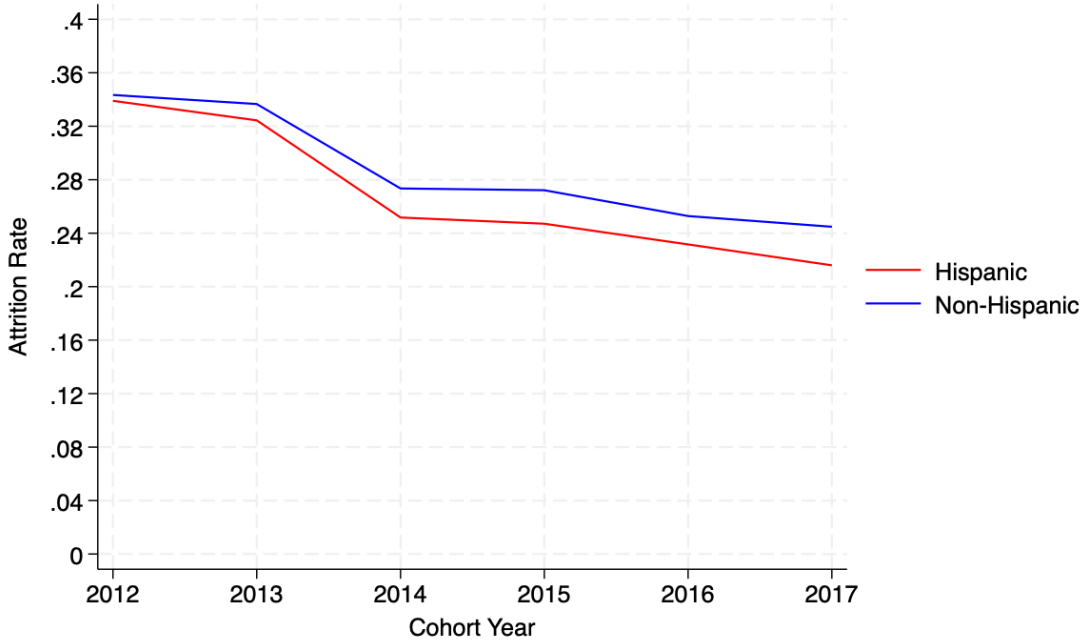


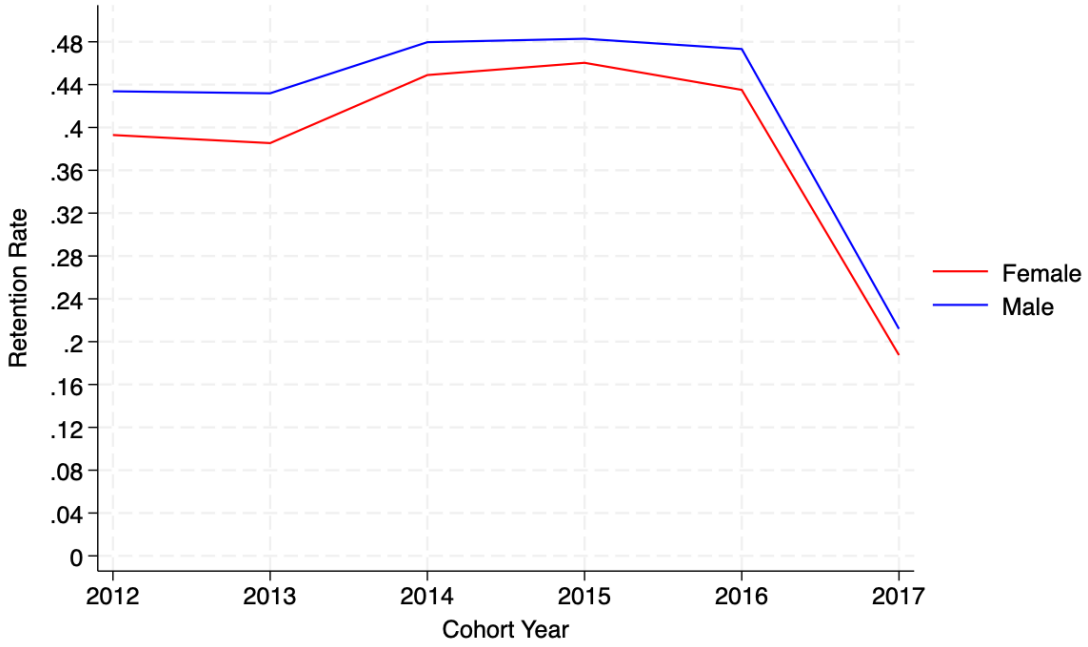
Figure 5. 4-Year Mean Attrition Rate for each Cohort by Hispanic/ Non-Hispanic

b. 6-year Retention

Table 7 presents the mean and standard deviation 6-year retention rates for the full sample and by gender. Given that for the entire sample, the mean retention rate was 41 percent, less than half of the sample opted to continue service after the 78-month mark. Additionally, results show that males are more likely to continue service past 78 months than females. Men have a mean retention rate of 42 percent, and women have 38 percent, which is statistically significant. Figure 6 depicts the mean retention rate by gender per cohort year. Results show a difference between males and females, with males having a higher retention rate than females across each cohort year, with both genders following a similar trend over time. The drastic drop during the cohort year 2017 is due to the data not observing that cohort for the full amount of time.

Table 7. Mean and Standard Deviation Retention Rate at 6-Years for Full Sample and Gender

Variable	Sample Mean N = 188,937 (SD)	Male Mean N = 144,429 (SD)	Female Mean N = 44,508 (SD)	Female – Male Differences in Sample Mean
6-year Retention	0.41 (0.49)	0.42 (0.49)	0.38 (0.49)	-0.04***
*** Statistically Significant at the 99.9% Confidence Interval				



Note: The drastic drop during Cohort 2017 is due to the data not observing that cohort for the full amount of time.

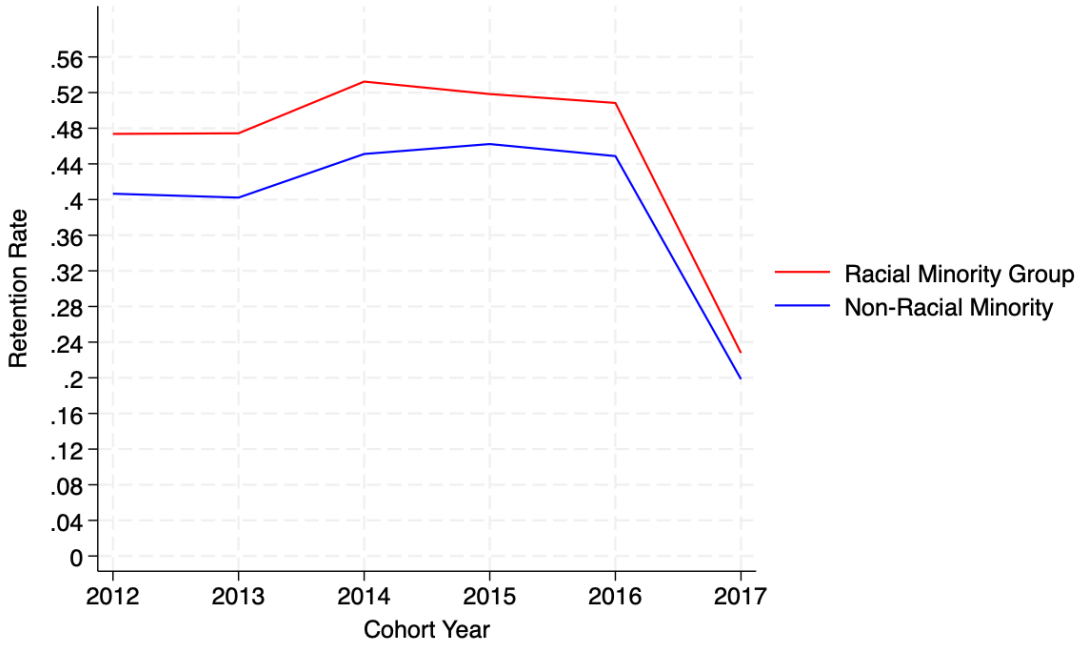
Figure 6. 6-Year Mean Retention Rate for each Cohort by Gender

Table 8 and Figure 7 presents the mean and standard deviation 6-year retention rates for racial minority groups. Results show racial minority groups having a higher mean retention rate at the 6-year mark, with a 46 percent mean attrition rate, while those in non-racial minority groups have a lower mean retention rate, at 39 percent. This indicates that those in racial minority groups are shown to be retained longer than those who are in non-

racial minority groups. Figure 7 shows the difference between racial minority groups and non-racial minority groups, with racial minority groups having higher retention rates across cohort years when compared to those in non-racial minority groups. Both groups follow a similar trend of gradually increasing retention rates from 2012 to reaching a peak around 2014–2015. The drastic drop during the cohort year 2017 is due to the data not observing that cohort for the full amount of time.

Table 8. Mean and Standard Deviation Retention Rate at 6-Years by Racial Minority Groups

Variable	**Sample Mean N = 188,937 (SD)**	**Racial Minority Group Mean N = 49,581 (SD)**	**Non-Racial Minority Group Mean N = 139,356 (SD)**	**Racial Minority Group – Non-Racial Minority Group Differences in Sample Mean**
6-year Retention	0.41 (0.49)	0.46 (0.50)	0.39 (0.48)	0.07
*** Statistically Significant at the 99.9% Confidence Interval				



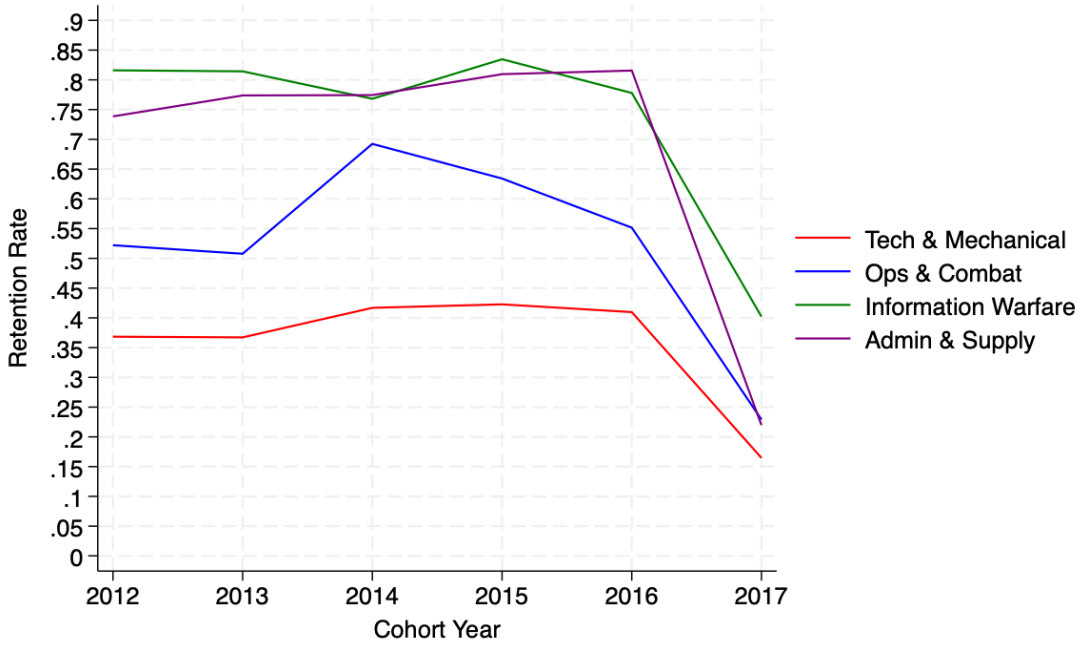
Note: The drastic drop during Cohort 2017 is due to the data not observing that cohort for the full amount of time.

Figure 7. Retention Rate for Each Cohort by Racial Minority Group

Table 9 and Figure 8 present the mean and standard deviation 6-year retention rates for the occupational rating groups. Results show that those Sailors in the Information Warfare ratings had the highest mean 6-year retention rate, at 53 percent, out of the 4 occupational rating groups. This indicates that those Sailors in the Information warfare ratings are staying in longer than those Sailors who are in the other 3 occupational groups. The second occupational group that is right behind Information warfare are those Sailors in the Operations and Combat ratings, with a mean retention rate of 45 percent. Figure 8 shows the difference between the 4 occupational groups, depicting Information warfare with the highest retention rate, and the Technical and Mechanical group with the lowest retention rate. The drastic drop during the cohort year 2017 is due to the data not observing that cohort for the full amount of time.

Table 9. Mean and Standard Deviation for 6-Year Retention by Occupational Rating Groups

Broad Occupational Category	Number of Observations, N Mean 6-Year Retention (SD)	Broad Occupational Category	Number of Observations, N Mean 6-Year Retention (SD)
Tech & Mechanical	N = 96,361 0.38 (0.49)	**Ops & Combat**	N = 40,504 0.45 (0.49)
Information Warfare	N = 17,330 0.53 (0.49)	***Admin & Supply***	N = 50,927 0.43 (0.49)



Note: The drastic drop during Cohort 2017 is due to the data not observing that cohort for the full amount of time.

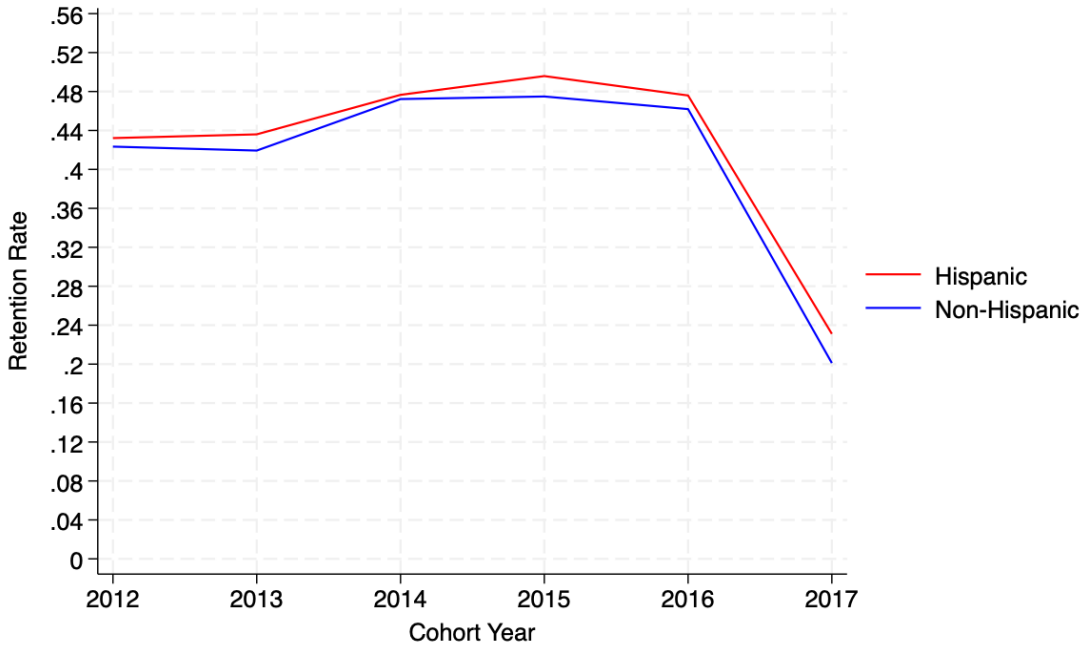
Figure 8. 6-Year Mean Retention Rate for each Cohort by Occupational Rating Group

Table 10 and Figure 9 present the mean and standard deviation 6-year retention rates for Hispanic and non-Hispanic Sailors. Results show the difference in mean retention rates as fairly close, with Hispanic Sailors having a mean retention rate of 42 percent and

non-Hispanic Sailors having a mean retention rate of 41 percent. Although the rates are close, Hispanics seem to be remaining in service longer than non-Hispanic Sailors and is statistically significant. Figure 9 depicts these close results, showing the difference between Hispanic and non-Hispanic Sailors very small but statistically significant retention rates, both share a similar trend followed by a sharp drop in 2017. The drastic drop during the cohort year 2017 is due to the data not observing that cohort for the full amount of time.

Table 10. Mean and Standard Deviation for Retention at 6-Years by Hispanic / Non-Hispanic

Variable	**Sample Mean N = 188,937 (SD)**	**Hispanic Mean N = 24,438 (SD)**	**Non-Hispanic Mean N = 164,499 (SD)**	**Hispanic – Non- Hispanic Differences in Sample Mean**
6-year Retention	0.41 (0.49)	0.42 (0.49)	0.41 (0.49)	0.01***
*** Statistically Significant at the 99.9% Confidence Interval				



Note: The drastic drop during Cohort 2017 is due to the data not observing that cohort for the full amount of time.

Figure 9. 6-Year Retention Rate for each Cohort by Hispanic / Non-Hispanic

2. Independent Variables

Table 11 provides a comprehensive overview of the summary statistics for the independent variables used in this analysis, overall, and for 4-year attritors and non-attriters. It depicts the statistically significant differences in sample means among those who attrite at the 4-year mark and those who do not attrite. With a sample size of 188,937, women make up 24 percent of the overall sample, while males make up 76 percent. Attrites are two percentage points more likely to be women than non-attrites. The majority of the Sailors in the sample are not married at accession, with attriters being two percentage points more likely to be not married compared to non-attriters. While most Sailors do not have dependents at entry into the Navy, non-attrited have a slightly higher proportion of Sailors with dependents, at seven percent than attrited before the 4-year mark. The majority of the sample is comprised of those with U.S. citizenship, with attrited Sailors having a statistically significant slightly higher rate of citizenship. Among non-attrited Sailors, 27 percent identify as a Racial minority compared to 25 percent Racial minority among those who attrited. Non-attrites have a one percentage point higher chance they are Hispanic compared to those who attrited.

For pre-accession and enlistment characteristics, differences in AFQT scores are evident, with a significantly higher proportion of non-attriters scoring above average and a significantly higher proportion of attriters scoring average. For education, attriters have a higher proportion of possessing a high school diploma, while non-attriters possess more college degrees. There is a similar proportion between attrited and non-attrited for those with GEDs, and who had some college education. Additionally, majority of the population had no waiver when accessing into the Navy, with the non-attrited having a higher mean of 93 percent compared to 92 percent for the attrited.

For occupational rating groups, the Aviation group showed to have a slightly higher representation among the attrited group than non-attrited, similar to the Shipboard Maintenance, Engineering, and Undesignated groups. Occupational groups that showed no significant difference in means between non-attrited and attrited include Shipboard Operations, Supply and Support services, Unidentified groups, and Sailors in the Technical and Mechanical broader group are equally represented among the attrited and non-attrited

sample. Additionally, Operations and Combat had a large non-attrited mean representation but was not statistically significant.

Cohort years were created to track the progress of each cohort. Results show that there is a large representation in the earlier cohort years, cohort 2012 & 2013, compared to the large representation of the non-attrited in the later years, cohorts 2014 through 2017.

Table 11. Summary Statistics for Full Sample Independent Variables

Variable	**Full Sample Mean N = 188,937 (SD)**	**Non-Attrited Mean N = 134,616 (SD)**	**Attrited Mean N = 54,321 (SD)**	**Attrited – Non-Attrited Differences in Sample Mean**
Demographics				
Female	0.24 (0.42)	0.23 (0.42)	0.25 (0.44)	0.02***
Male	0.76 (0.42)	0.77 (0.42)	0.75 (0.44)	-0.02***
Married	0.06 (0.24)	0.07 (0.25)	0.05 (0.22)	-0.02***
Not Married	0.94 (0.25)	0.93 (0.26)	0.95 (0.23)	0.02***
Dependents	0.07 (0.25)	0.07 (0.26)	0.06 (0.23)	-0.01***
No Dependents	0.93 (0.25)	0.93 (0.26)	0.94 (0.23)	0.01***
Citizenship	0.96 (0.19)	0.96 (0.20)	0.98 (0.16)	0.02***
Non-Citizenship	0.04 (0.19)	0.04 (0.20)	0.02 (0.16)	-0.02***
Non-Racial Minority Group	0.74 (0.44)	0.73 (0.44)	0.75 (0.43)	0.02***
Racial Minority Group	0.26 (0.44)	0.27 (0.44)	0.25 (0.43)	-0.02***
White	0.62 (0.49)	0.61 (0.49)	0.63 (0.48)	0.02***
Black / African American	0.19 (0.39)	0.19 (0.39)	0.19 (0.39)	0.00***
Asian	0.05 (0.21)	0.05 (0.22)	0.03 (0.18)	-0.02***

Variable	**Full Sample Mean N = 188,937 (SD)**	**Non-Attrited Mean N = 134,616 (SD)**	**Attrited Mean N = 54,321 (SD)**	**Attrited – Non-Attrited Differences in Sample Mean**
American Indian / Alaskan Native	0.02 (0.13)	0.02 (0.13)	0.02 (0.14)	0.00***
Hawaiian / Pacific Islander	0.01 (0.01)	0.01 (0.10)	0.01 (0.08)	0.00***
Other Race	0.11 (0.32)	0.12 (0.32)	0.13 (0.33)	0.01***
Hispanic	0.13 (0.34)	0.13 (0.34)	0.12 (0.33)	-0.01***
Not Hispanic Origin	0.83 (0.38)	0.82 (0.38)	0.84 (0.37)	0.02***
Unidentified Hispanic	0.04 (0.21)	0.05 (0.21)	0.04 (0.20)	-0.01***
Pre-Accession Characteristics				
High School Diploma	0.86 (0.34)	0.86 (0.34)	0.88 (0.33)	0.02***
College Degree	0.07 (0.26)	0.08 (0.27)	0.05 (0.23)	-0.03***
Some College	0.01 (0.10)	0.01 (0.10)	0.01 (0.11)	0.00***
GED/Similar Certification Program	0.03 (0.16)	0.03 (0.16)	0.03 (0.18)	0.00***
Non-Graduate/Drop Out	0.01 (0.07)	0.005 (0.07)	0.01 (0.07)	0.01***
Unidentified School Status	0.02 (0.13)	0.02 (0.13)	0.01 (0.12)	-0.01***
Above Average AFQT	0.55 (0.50)	0.58 (0.49)	0.49 (0.50)	-0.09***
Average AFQT	0.44 (0.50)	0.42 (0.49)	0.50 (0.50)	0.08
Below Average AFQT	0.0002 (0.01)	0.0002 (0.01)	0.0003 (0.02)	0.0001***
Unidentified AFQT	0.003 (0.06)	0.004 (0.06)	0.004 (0.06)	0.00***
Waiver Status Characteristics				
Waiver	0.08 (0.27)	0.08 (0.27)	0.07 (0.26)	-0.01***

Variable	**Full Sample Mean N = 188,937 (SD)**	**Non-Attrited Mean N = 134,616 (SD)**	**Attrited Mean N = 54,321 (SD)**	**Attrited – Non-Attrited Differences in Sample Mean**
No Waiver	0.92 (0.27)	0.92 (0.27)	0.93 (0.26)	0.01***
Occupational Rating Groups				
Aviation	0.23 (0.43)	0.23 (0.42)	0.27 (0.45)	0.04***
Executive Support	0.03 (0.19)	0.04 (0.20)	0.03 (0.16)	-0.01***
Information Warfare	0.09 (0.29)	0.09 (0.30)	0.07 (0.26)	**-0.02*** **
Nuclear Field	0.05 (0.25)	0.08 (0.28)	0.02 (0.14)	-0.06***
Undesignated	0.06 (0.25)	0.06 (0.24)	0.09 (0.29)	0.03***
Shipboard Maintenance	0.11 (0.33)	0.10 (0.30)	0.17 (0.38)	0.07
Shipboard Engineering	0.07 (0.27)	0.07 (0.26)	0.09 (0.30)	0.02***
Shipboard Operations	0.03 (0.19)	0.04 (0.19)	0.04 (0.19)	0.00***
Supply and Support Services	0.07 (0.26)	0.07 (0.25)	0.07 (0.26)	0.00***
Ordnance, Law, and Weapons	0.12 (0.34)	0.14 (0.35)	0.11 (0.32)	-0.03***
Medical	0.08 (0.29)	0.12 (0.32)	0.03 (0.18)	0.01***
SEABE Construction	0.02 (0.15)	0.03 (0.17)	0.01 (0.10)	-0.02***
Submarine	0.02 (0.19)	0.05 (0.21)	0.01 (0.11)	-0.04***
Special Operations and Warfare	0.01 (0.12)	0.02 (0.14)	0.001 (0.03)	-0.02***
Unidentified	0.01 (0.08)	0.01 (0.08)	0.01 (0.09)	0.00***
Broad Occupational Groups				
Technical & Mechanical	0.50 (0.50)	0.49 (0.50)	0.57 (0.50)	0.08
Operations & Combat	0.20 (0.41)	0.24 (0.42)	0.16 (0.37)	-0.08***

Variable	**Full Sample Mean N = 188,937 (SD)**	**Non-Attrited Mean N = 134,616 (SD)**	**Attrited Mean N = 54,321 (SD)**	**Attrited – Non-Attrited Differences in Sample Mean**
Admin & Supply	0.20 (0.44)	0.28 (0.45)	0.23 (0.42)	-0.05***
Information Warfare	0.10 (0.29)	0.09 (0.29)	0.07 (0.26)	-0.02***
Cohort Years				
Cohort 2012	0.17 (0.38)	0.16 (0.37)	0.21 (0.40)	0.05***
Cohort 2013	0.19 (0.40)	0.18 (0.38)	0.23 (0.42)	0.05***
Cohort 2014	0.16 (0.37)	0.17 (0.37)	0.15 (0.36)	-0.02***
Cohort 2015	0.17 (0.37)	0.17 (0.38)	0.16 (0.36)	-0.01***
Cohort 2016	0.14 (0.35)	0.15 (0.35)	0.12 (0.33)	-0.03***
Cohort 2017	0.16 (0.34)	0.18 (0.38)	0.14 (0.34)	-0.04***
*** Statistically Significant at the 99.9%				

D. SUMMARY

In conclusion, the data chapter provides a comprehensive look at the data, variables, and summary statistics of the Navy enlisted personnel demographics, occupational distributions, attrition at four years, and retention patterns across genders, racial minority groups, and Hispanic/non-Hispanic Sailors. Attrition and retention data by cohort year and gender show varied differences in mean attrition and retention between genders, not accounting for any differences in characteristics of male and female Sailors. Females have higher attrition rates before the 4-year mark. Males have higher retention rates at the 6-year active-duty mark. Additionally, racial minority groups are shown to have lower attrition rates at the 4-year mark and higher retention rates at the 6-year mark. Furthermore, Sailors in the Information Warfare occupational rating group have the highest mean 6-year retention rate, while Sailors in the Technical and Mechanical rating group have the highest mean attrition rate at the 4-year mark. Lastly, Hispanic Sailors have the lowest mean 4-year attrition and 6-year retention rates.

V. MULTIVARIATE AND SURVIVAL ANALYSIS/EVALUATION OF RESULTS

This chapter details the methodology used in this thesis and discusses the findings from the analysis. It begins with the assessment of multivariate logistic regression models to examine the factors predicting attrition at the 4-year mark and retention at the 6-year mark, focusing on demographic, pre-accession, occupational rating groups, and cohort year-based predictors. The chapter concludes with a survival analysis using Cox Hazard Model to explore attrition at 4-year and retention at 6-year trends between racial minority groups, Hispanics and non-Hispanics, and broad occupational rating groups.

A. MULTIVARIATE LOGISTIC REGRESSION ANALYSIS

I use logistic regression analysis to examine how pre-accession and post-accession characteristics predict outcomes of attrition at 4 years and retention at 6 years, respectively, for Navy enlisted Sailors. Each model focuses on whether factors such as racial minority group status, Hispanic ethnicity, gender, or occupational rating groups are significant predictors of these outcomes. Two regression specifications are estimated for each outcome to estimate the relation between these characteristics and the 4-year attrition and 6-year retention outcomes, respectively. The first model incorporates demographics, pre-accession, and waiver status characteristics. The second model controls for demographics, pre-accession, and waiver status characteristics. The second model controls for broad occupational ratings. Both models include year-group fixed effects to account for any unobserved factors associated with attrition and retention outcomes for Sailors who accessed the Navy in a given year.

Both models use binary dependent variables, attrition at 4 years (*4-year Attrition)* and retention at 6 years (*6-year Retention).* The basic structure for the logistics regression models is presented below in equation (1) obtained from (Dr. Yu-Chu Shen, supplemental reading for class MN4110, 2017, p. 135).

$$(1)\ Prob(y = 1|x_1, \ldots, x_k) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 x_1 + \cdots + \beta_k x_k + u)}}$$

Due to the binary nature of the outcome variables, using a logit model directly models the probability of the event- attrition or retention- occurring and provides these results as interpretable log odds. All models are estimated using Stata version 18.0.

B. RESULTS

Logistic regression results for attrition at 48 months and 78-month retention are explained below.

1. 4-Year Attrition Rate Models

Table 12 presents the results for attrition at 4-years model 1 and model 2 used in this analysis. The logistic regression analysis identifies key predictors of 4-year attrition among the Navy enlisted Sailors in this dataset, encompassing demographic, pre-accession, and occupational characteristics. Racial and ethnic differences in attrition are present when comparing these groups to Sailors identified as White. While all racial minority groups show low attrition odds, out of the four racial minority groups, Asians and Hawaiian / Pacific Islanders came out with the lowest odds of attrition. Asians are shown to have a 30.9 percent (Model 2) reduction in odds of attrition. While Hawaiian / Pacific Islanders possessed 36.6 percent lower odds of attriting in both Model 1 and 2, compared with Whites. Hispanic background is also a strong predictor of differences in attrition outcomes. Hispanics are shown to have 14.7 percent (Model 2) lower odds of attriting when compared to Sailors who are not of Hispanic origin. These findings suggest that racial minority groups are less likely to attrite at the 4-year mark when compared to their White counterparts.

For gender, females are shown to have higher odds of attriting before the 4-year mark compared to men. In model 1, females exhibited 13.5 percent higher odds of attriting in model 1 and 12.8 percent higher odds in model 2; both were statistically significant. For marital status, those who are married were shown to have lower odds of attriting compared to those who were not married. However, in model 1, those married are shown to have 11.6 percent lower odds of attriting and be statistically significant. When incorporating occupational groups in model 2, the effect was no longer statistically significant and fell to 9.9 percent lower odds. This could indicate that the omission of occupation groups may exaggerate the difference in attrition between married and single Sailors in Model 1.

Meanwhile, compared to those who do not have dependents, having dependents has 11.3 percent lower odds of attriting in Model 2, indicating the potential stabilizing influence a family has on a service member and their responsibilities.

Pre-accession characteristics contained strong predictors of attrition. Sailors who scored above average on their AFQT had 29.8 percent (Model 1) and 27.5 percent (Model 2) lower odds of attriting compared to those who scored an average on the AFQT. Educational achievements further contributed to differences in attrition, as Sailors who possessed a college degree or completed a portion of college were significantly less likely to attrite, while those Sailors who possessed a GED faced 34 percent (Model 2) higher odds of attriting. Unlike Robinson (2023) analysis, these results in AFQT and educational levels are shown to be strong predictors of attrition.

Lastly, the broad occupational rating groups are shown to be the strongest predictor of attrition at the 4-year mark. Compared to Sailors in the Technical & Mechanical group, those in the Operations and Combat group have 45.4 percent lower odds of attriting at the 4-year mark, while Sailors in the Information Warfare group have a 37.9 percent reduction in attrition odds. Those Sailors in the Administration & Supply group had the lowest odds of a 35.6 percent reduction in attrition risk. Cohort effects revealed a downward trend for both Model 1 and 2 in attrition odds over time. Cohort 2017 showed 42 percent (Model 2) lower attrition odds compared to Cohort 2012. These findings suggest that external factors may be positively influencing retention in the more recent years for these Sailors.

Table 12. Logistic Regression Result for Attrition at 4-Years

Variable Name	**Model 1**	**Model 2**
Demographics		
Gender Groups (Male is reference)	1.000	1.000
Female	1.135***	1.128***
	(0.014)	(0.014)
Marital Groups (Not	1.000	1.000

Variable Name	Model 1	Model 2
Married is reference)		
Married	0.884*	0.901
	(0.056)	(0.057)
Dependent Status (No Dependents is reference)	1.000	1.000
Dependents	0.904	0.887*
	(0.055)	(0.054)
Citizenship Status (Citizen is reference)	1.000	1.000
Non-Citizenship	0.686***	0.652***
	(0.022)	(0.022)
Race Groups (White is reference)	1.000	1.000
American Indian / Alaskan Native	0.993	0.989
	(0.038)	(0.038)
Asian	0.681***	0.691***
	(0.020)	(0.020)
Black / African American	0.863***	0.878***
	(0.012)	(0.013)
Hawaiian / Pacific Islander	0.634***	0.634***
	(0.036)	(0.037)
Other Race	0.981	0.985
	(0.016)	(0.016)
Hispanic Status(Non-Hispanic is reference)	1.000	1.000
Hispanic	0.850***	0.853***
	(0.013)	(0.014)

Variable Name	Model 1	Model 2
Unidentified Hispanic Status	0.898***	0.892***
	(0.023)	(0.023)
Pre-Accession Characteristics		
AFQT Groups (Average AFQT score is reference)	1.000	1.000
Above Average AFQT	0.702***	0.725***
	(0.008)	(0.008)
Below Average AFQT	0.958	0.944
	(0.317)	(0.314)
Educational Groups (HS Diploma is reference)	1.000	1.000
College Degree	0.775***	0.826***
	(0.017)	(0.018)
Some College	1.166***	1.179***
	(0.054)	(0.055)
GED / Similar	1.338***	1.340***
	(0.040)	(0.040)
Drop Out	1.095	1.094
	(0.078)	(0.079)
Unidentified School Status	0.869***	0.878**
	(0.036)	(0.037)
Waiver Characteristics		
Waiver Status (No Waivers is reference)	1.000	1.000
Has Waivers	0.983	0.984
	(0.020)	(0.020)
Broad Occupational Category		
Occupational Group	1.000	1.000

Variable Name	Model 1	Model 2
(Technical & Mechanical is reference)		
Operations & Combat		0.546***
		(0.008)
Information Warfare		0.621***
		(0.012)
Admin & Supply		0.644***
		(0.008)
	Cohort Years	
Cohort Groups (Cohort 2012 is reference)	1.000	1.000
Cohort 2013	0.942***	0.913***
	(0.015)	(0.015)
Cohort 2014	0.699***	0.686***
	(0.012)	(0.012)
Cohort 2015	0.690***	0.676***
	(0.012)	(0.012)
Cohort 2016	0.623***	0.623***
	(0.012)	(0.012)
Cohort 2017	0.583***	0.580***
	(0.010)	(0.010)
Observations	188,937	188, 937
Pseudo R-squared	0.017	0.029

2. 6-Year Retention Rate Models

Table 13 presents the results for 6-year retention model 1 and model 2 used in this analysis. The logistic regression analysis identified key predictors of 6-year retention among Navy personnel, with differences across the demographic, pre-accession, and

occupational variables. Racial and ethnic groups retention patterns demonstrate notable disparities. Sailors in the Hawaiian / Pacific Islander group showed to have the strongest retention odds with a consistent 55 percent greater odds of retainment in Models 1 and 2 than White Sailors. Black / African American Sailors additionally had consistent results in both models with 32 percent higher odds of retention, while Asians showed a consistent 41 percent odds of having higher retention compared to Whites. Hispanic Sailors also demonstrated a statistically significant predictor of retention, having approximately 15 percent higher odds of retention compared to non-Hispanic Sailors. These findings suggest that racial minority groups are being retained longer than non-racial minority groups but warrant further examination of external influences influencing these outcomes.

Gender is noted as a key predictor, with females having a consistent 15.3 percent reduction in odds of staying past 78 months in Models 1 and 2 compared to males, suggesting that gender-specific barriers may be present for long-term service. Marital status showed those Sailors who are married to have 13.9 percent higher odds of remaining in service in Model 1 but became statistically insignificant in Model 2 after incorporating occupational roles, dropping to 11.8 percent of increased retention odds compared to single Sailors. Those Sailors with dependents showed to have consistently higher odds of retainment (18.1 percent Models 1 and 21.6 percent Model 2) compared to those who do not have dependents, suggesting that family obligations strongly influence long-term retention. Citizenship status possessed statistically significantly higher odds, with non-citizenship status having 55 percent higher odds of retention at the 6-year mark compared to citizens, reflecting possible incentives to encourage extended service for non-citizens.

The pre-accession factors of AFQT scores and education levels are shown to have a significant role on retention. Sailors who scored above average on the AFQT are found to have 14.1 percent higher odds of retaining longer than those who scored average on the AFQT in Model 1 but decreased odds to 5.3 percent after accounting for occupational groups in Model 2, indicating the relationship between an above average AFQT score and retention is partly influences by occupational role assignment. Educational attainment showed a pattern, with Sailors who possessed a college degree having higher odds of retention (22.3 percent Model 1 and 14.9 percent Model 2) compared to those who had a

high school diploma, while Sailors who had either some college (11.5 percent Model 2) or possessed a GED (16.1 percent Model 2) had lower odds of retention. This suggests that those Sailors who went through the non-traditional path for education may be experiencing challenges that are affecting them to remain in service.

Lastly, occupational rating groups made a huge impact on the odds of retention. Results show that Sailors in the Information Warfare ratings had more than double the odds ratio of those in the Technical and Mechanical ratings. The Operations and Combat ratings follow right after with 60.7 percent higher odds of retention at the 6-year mark compared to the Technical and Mechanical ratings. Administrative and Supply demonstrated a retention advantage just to the extent of the others, with 34.6 percent higher odds of retention. Given that all groups had a positive effect on retention, this suggests that ratings assigned to Sailors matter and strongly influence retention outcomes. Lastly, retention odds varied among the cohort years, with a steady increase in retention odds between the cohort years 2013–2015 and a sharp decline in retention odds in the cohort year 2017. This drastic drop is due to the cohort year not being observed for the full term, as mentioned in Chapter IV.

Table 13. Logistic Regression Results for Retention at 6-Years

Variable Name	**Model 1**	**Model 2**
Demographics		
Gender Groups (Male is reference)	1.000	1.000
Female	0.847***	0.847***
	(0.010)	(0.010)
Marital Groups (Not Married is reference)	1.000	1.000
Married	1.139*	1.118
	(0.065)	(0.064)
Dependent Status (No	1.000	1.000

Variable Name	Model 1	Model 2
Dependents is reference)		
Dependents	1.181**	1.216***
	(0.065)	(0.067)
Citizenship Status (Citizen is reference)	1.000	1.000
Non-Citizenship	1.424***	1.550***
	(0.038)	(0.042)
Race Groups (White is reference)	1.000	1.000
American Indian / Alaskan Native	1.009	1.013
	(0.037)	(0.037)
Asian	1.416***	1.410***
	(0.034)	(0.034)
Black / African American	1.327***	1.319***
	(0.017)	(0.017)
Hawaiian / Pacific Islander	1.553***	1.555***
	(0.074)	(0.075)
Other Race	1.080***	1.081***
	(0.016)	(0.017)
Hispanic Status(Non-Hispanic is reference)	1.000	1.000
Hispanic	1.148***	1.151***
	(0.017)	(0.017)
Unidentified Hispanic Status	1.107***	1.114***
	(0.025)	(0.026)
Pre-Accession Characteristics		
AFQT Groups (Average	1.000	1.000

Variable Name	Model 1	Model 2
AFQT score is reference)		
Above Average AFQT	1.141***	1.053***
	(0.012)	(0.011)
Below Average AFQT	1.146	1.161
	(0.358)	(0.364)
Educational Groups (HS Diploma is reference)	1.000	1.000
College Degree	1.223***	1.149***
	(0.023)	(0.022)
Some College	0.887**	0.885**
	(0.039)	(0.039)
GED / Similar	0.835***	0.839***
	(0.025)	(0.025)
Drop Out	0.895	0.890
	(0.062)	(0.062)
Unidentified School Status	1.157***	1.147***
	0.835***	0.839***
Waiver Characteristics		
Waiver Status (No Waivers is reference)	1.000	1.000
Has Waivers	1.094***	1.095***
	(0.020)	(0.020)
Broad Occupational Category		
Occupational Group (Technical & Mechanical is reference)	1.000	1.000
Operations & Combat		1.607***
		(0.020)
Information Warfare		2.207***

Variable Name	Model 1	Model 2
		(0.039)
Admin & Supply		1.346***
		2.207***
	Cohort Years	
Cohort Groups (Cohort 2012 is reference)	1.000	1.000
Cohort 2013	1.000	1.025
	(0.016)	(0.016)
Cohort 2014	1.230***	1.246***
	(0.020)	(0.020)
Cohort 2015	1.261***	1.275***
	(0.020)	(0.021)
Cohort 2016	1.189***	1.174***
	(0.020)	(0.020)
Cohort 2017	0.357***	0.348***
	(0.006)	(0.006)
Observations	188,937	188, 937
Pseudo R-squared	0.036	0.048

C. SURVIVAL ANALYSIS USING COX PROPORTIONAL HAZARD MODEL

In addition to the logistic regression analysis, I also conducted a Cox Proportional Hazard Model and Kaplan-Meier Survival Curve analysis to examine the relationship between the time-to-event data (attrition at 4 years) and the following predictive variables: female, racial minority, Hispanic, and broad occupational category. The purpose of choosing these variables is to assess how these demographics and occupational rating groups relate to attrition at 4 years. The basic structure for the Cox Proportional Hazard

model is presented below in equation (2) obtained from (Statistical Tools for High-throughput Data Analysis, n.d.).

$$(2)\ h(t) = h_0(t) \times \exp(b_1x_1 + b_2x_2 + \cdots + b_px_p)$$

The Cox model can add insights into the factors influencing the likelihood of attrition at 4 years, over time, from accession to the 48-month mark. Hazard ratios greater than 1 indicate an increased risk of attrition at 4 years, while a hazard ratio less than one suggests a reduced risk of attrition at 4 years. To complement the findings of the hazard model, I used Kaplan-Meier Survival curves to provide a visual representation of the survival probabilities over the specified time period of attrition at the 4-year mark. With the combination of these two methods, I am able to depict the results on how the predictive factors are influencing attrition at 4 years among these enlisted Sailors.

1. 4-Year Attrition Survival Curves

I created Kaplan-Meier survival curves to depict the survivability of the enlisted Sailors for attrition at the 4-year mark. Results show in Figure 10 shows that males have a higher survivability than women, with males less likely to attrite at the 4-year mark compared to women. These findings align with the Cox hazard model since women have a higher likelihood of attriting at the 4-year mark compared to men. Figure 11 presents the results for the survivability among racial minority groups. Due to the small population within the American Indian/Alaskan Native and Hawaiian/Pacific Islander groups, the groups are consolidated into the curve noted as “Others.” Results show the Asian group to have the highest survival probability out of the four groups, with Whites and Others having very similar survival probabilities. This difference is notable due to the Cox Hazard model validating that Asians are less likely to attrite compared to the White reference group.

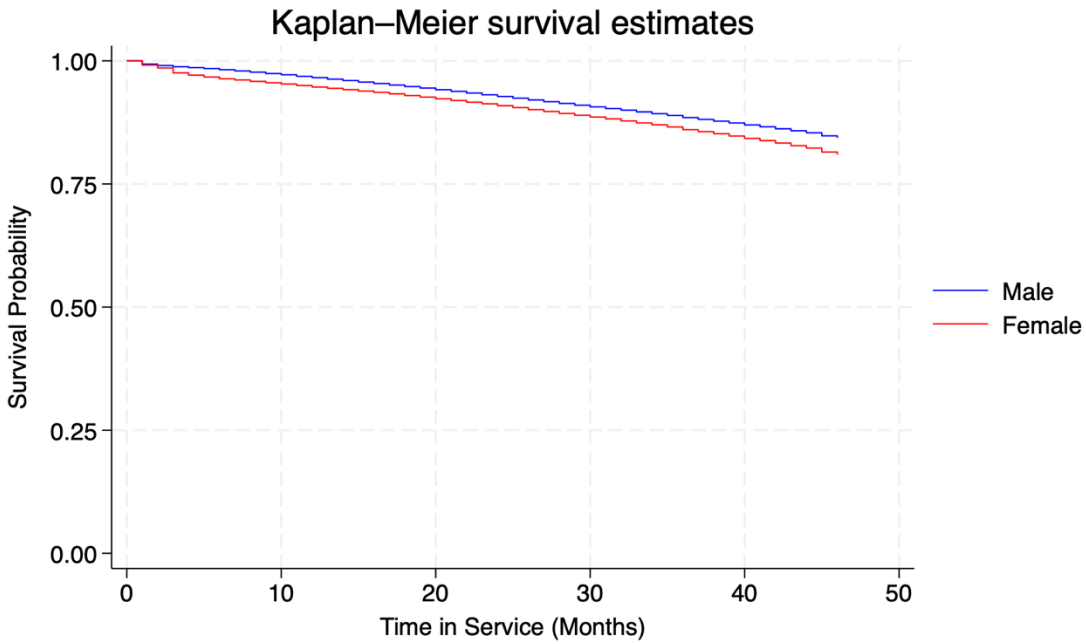


Figure 10. Kaplan-Meier Survival Curve: Attrition by Gender Over 4-Years

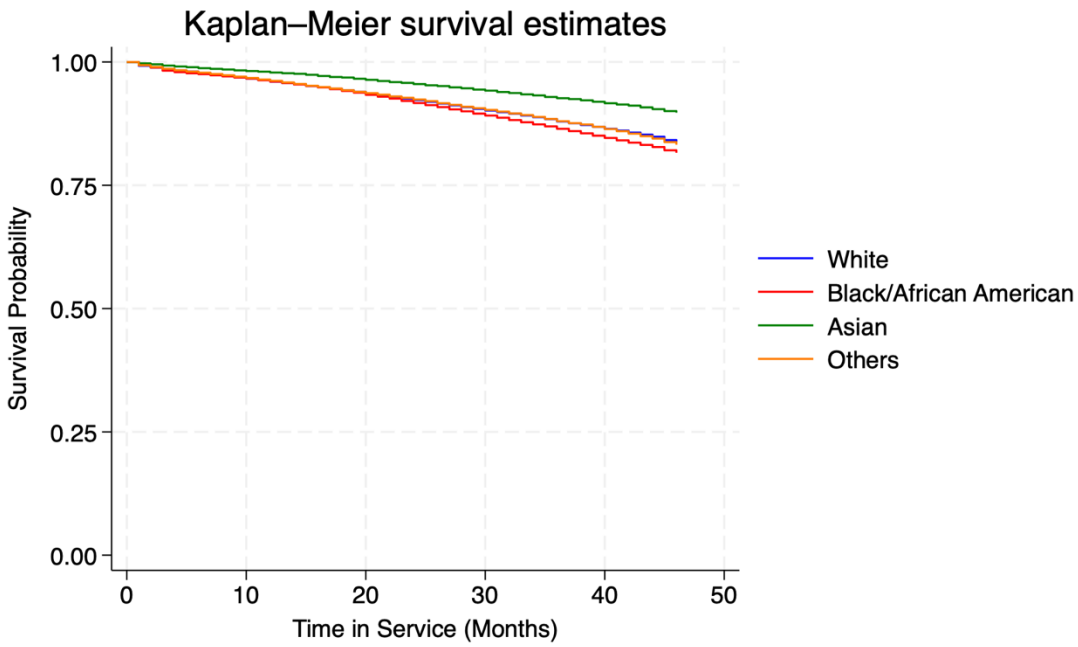


Figure 11. Kaplan-Meier Survival Curve: Attrition by Racial Minority Group Over 4 Years

Additionally, Figure 12 presents the results for survivability among Hispanics at the 4-year mark. Results show Hispanics and those who have an unidentified Hispanic status have consistently higher survivability when compared to non-Hispanics, indicating a reduced risk of attrition for Hispanics and aligning with the Cox Hazard model results. Lastly, the four broad occupational ratings groups produced notable results. Figure 13 presents the results for how each broad occupational rating group's survival probability compares to the Technical and Mechanical reference group. Results show the Information Warfare group having the highest survival probability at the 4-year mark, with Operations and Combat following right behind compared to the other groups. All broad occupational rating groups have higher survival probabilities at the 4-year mark compared to the Technical and Mechanical group, aligning with the Cox model results.

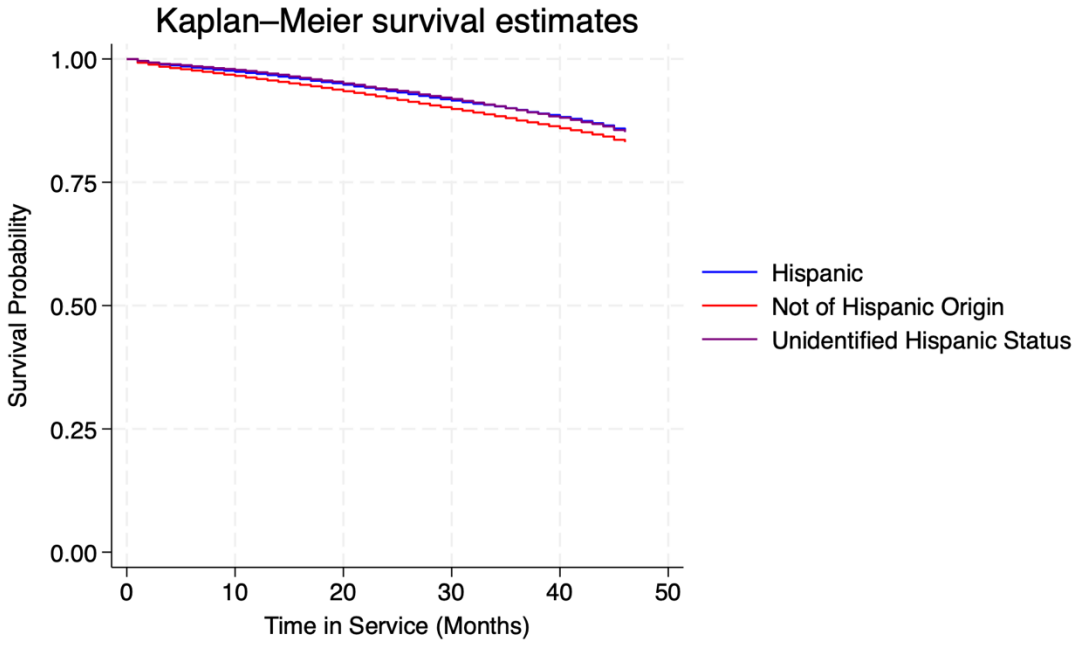


Figure 12. Kaplan-Meier Survival Curve: Attrition by Hispanics Over 4 Years

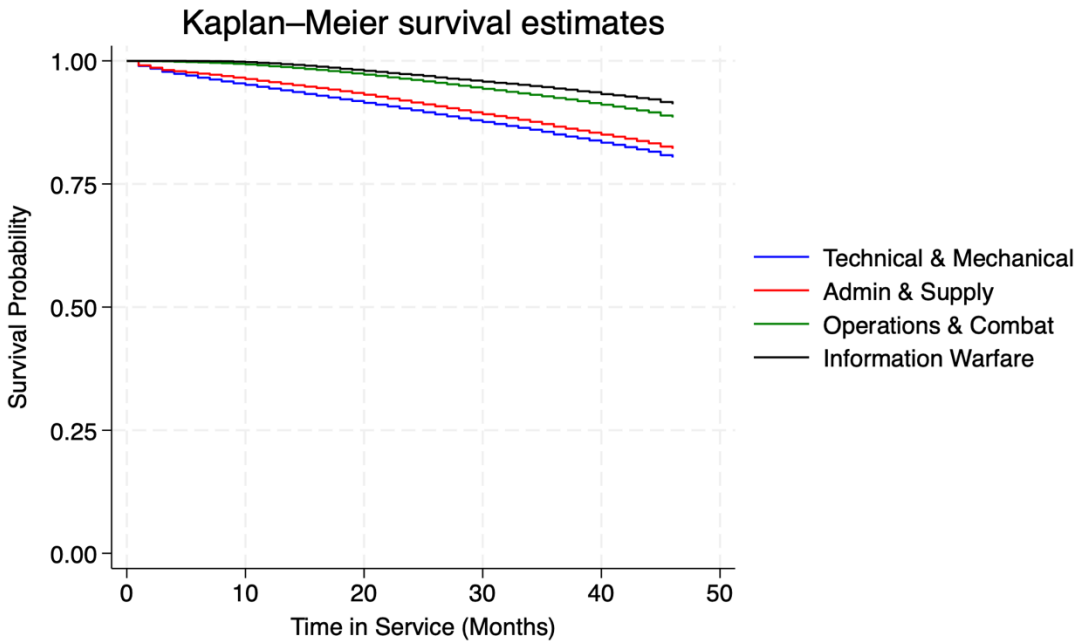


Figure 13. Kaplan-Meier Survival Curve: Attrition by Broad Occupational Rating Groups Over 4 Years

2. 4-Year Attrition Cox Proportional Hazards Regression Models

Table 14 summarizes the Cox Hazard model results for each independent variable, providing insights into the factors influencing attrition at the 4-year mark. Results show that females have a 12% higher risk of attrition at 4 years compared to males. Marital status and dependents are associated with a slightly reduced likelihood of attrition at the 4-year mark at 8 and 9 percent respectively, though having dependents is statistically significant while being married is not. Non-citizenship is a notable demographic factor, significantly reducing the risk of attrition at the 4-year mark by 31 percent.

Among the racial minority groups, Sailors in the Asian and Hawaiian/ Pacific Islanders groups exhibit the lowest risk of attrition with reduced likelihoods of 26 and 32 respectively, both statistically significant. Conversely, Sailors who identify as Black/ African American have a reduced likelihood of attrition of 7 percent, while Sailors in the American Indian / Alaskan Native and Other Race groups showed no statically significant

difference from the reference group. Hispanic Sailors are shown to have 13 percent lower likelihood of attrition at the 4-year mark compared to non-Hispanic Sailors.

Educational attainment demonstrates to be a strong predictor in attrition at 4 years, with those Sailors possessing a college degree at accession having a 16 percent lower likelihood of attriting at the 4-year mark. Conversely, Sailors who only had some college time, received their GED, or dropped out of high school face higher likelihoods of attriting at the 4-year mark. Compared to those Sailors who scored average level on the AFQT, above average AFQT scores show to have a 21 percent lower likelihood of attrition at the 4-year mark, while below average AFQT scores only have a 10 percent lower likelihood of attrition. The four broad occupational rating groups highlight variations with Operations and Combat, Admin and Supply, and Information Warfare all having hazard ratios below 1, indicating lower attrition risks when compared to the Technical and Mechanical reference group. Additionally, cohort years reveal a constant decrease in attrition risks as the years progress, with cohort 2017 having the lowest hazard ratio.

Table 14. Cox Proportional Hazards Regression for Attrition at 4-year Results

Variable Name	Hazard Ratio	95%Confidence Interval	P-value
Gender (Female)	1.12	(1.10, 1.13)	0.00***
Married	0.92	(0.83, 1.02)	0.11
Dependents	0.91	(0.82, 1.02)	0.05***
Non-Citizen	0.69	(0.65, 0.73)	0.00***
American Indian / Alaskan Native	0.98	(0.93, 1.05)	0.65
Asian	0.74	(0.70, 0.77)	0.00***
Black / African American	0.93	(0.91, 0.95)	0.00***

Variable Name	Hazard Ratio	95%Confidence Interval	P-value
Hawaiian / Pacific Islander	0.68	(0.62, 0.76)	0.00***
Other Race	0.99	(0.97, 1.02)	0.75
Hispanic	0.87	(0.85, 0.90)	0.00***
Unidentified Hispanic Status	0.91	(0.88, 0.95)	0.00***
Above Average AFQT	0.79	(0.78, 0.81)	0.00***
Below Average AFQT	0.90	(0.53, 1.52)	0.70
College Degree	0.84	(0.81, 0.87)	0.00***
Some College	1.16	(1.07, 1.24)	0.00***
GED or Similar	1.29	(1.23, 1.35)	0.00***
Drop Out	1.08	(0.97, 1.22)	0.16
Unidentified School Status	0.90	(0.84, 0.97)	0.00***
Waiver	0.99	(0.96, 1.02)	0.57
Operations and Combat	0.61	(0.59, 0.62)	0.00***
Admin and Supply	0.72	(0.70, 0.73)	0.00***
Information Warfare	0.65	(0.63, 0.67)	0.00***
Cohort 2013	0.96	(0.94, 0.99)	0.00***

Variable Name	Hazard Ratio	95%Confidence Interval	P-value
Cohort 2014	0.77	(0.75, 0.79)	0.00***
Cohort 2015	0.76	(0.75 0.79)	0.00***
Cohort 2016	0.72	(0.70, 0.75)	0.00***
Cohort 2017	0.68	(0.66, 0.71)	0.00***

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: Hazard Ratios > 1 indicate an increased risk of attrition at the 4-year mark, while Hazard Ratios < 1 indicate a reduced risk of attrition at the 4-year mark.

VI. CONCLUSION AND RECOMMENDATIONS

In this thesis, I provide an analysis of enlisted Sailors' attrition at the 48-month mark and retention at the 78-month mark to bring insights into the current trends and behaviors of Sailors in support of addressing the Navy's challenges with attrition and retention. To address these challenges, I employ a combination of logistic regression analysis, and survival analysis using the Cox Hazard Model to analyze the demographics, pre-accession, and occupational rating group factors predicting attrition and retention patterns among various subgroups of Navy enlisted Sailors.

Specifically, I investigate how 4-year attrition and 6-year retention patterns differ by gender, Hispanics, and racial minority groups across various occupational ratings among Navy enlisted Sailors, and I test which pre-accessing and accession characteristics (demographic, educational, rating, occupational category) best predict 4-year attrition and 6-year retention outcomes. To address these questions, I use individual-level administrative on Navy enlisted population who accessed during fiscal years 2012 through 2017. The data set is structured as a longitudinal data set, with the Sailors observed annually until fiscal year 2023 or until separation.

The results from my logistics regression analysis show notable differences in attrition at the 4-year mark and retention at the 6-year mark based on demographics such as gender, race, and ethnicity. The Cox Hazard models and the Kaplan-Meier Survival analysis complement the findings of the logit regressions. Specifically, females face a 12.8 percent higher odds of attriting before the 4-year mark, with a hazard ratio of 1.12 and a lower survivability curve compared to males. This suggests females are more likely to leave before the 48-month mark, possibly due to unique external factors that are gender specific and which affect their likelihood of retention. Hispanic Sailors are shown to have roughly 15 percent lower odds of attriting before the 48-month mark, a hazard ratio of 0.87, and higher survivability curve when compared to non-Hispanic Sailors. Results also show after the 6-year mark that Hispanic Sailors only have a slightly higher likelihood of continuing service past the 78-month, suggesting that there is a high possibility that Hispanic Sailors have a stronger long-term retention outcome.

Additionally, for racial minority groups, Asians and Hawaiian/Pacific Islanders emerged to have the lowest odds of attrition at the 4-year mark and a higher survivability curve compared to the non-racial minority group. Results for 6-year retention show racial minority groups to be 6 percent less likely to continue service past the 78-month mark, indicating racial minority groups are more likely to remain in service longer compared to their non-racial minority group counterparts.

Lastly, across the four broad occupational rating groups, notable differences occurred. For attrition at the 4-year mark, Sailors in the Operations and Combat group showed to have 45.4 percent lower odds of attriting at the 4-year mark compared to those in the Technical and Mechanical group. While Sailors in the Admin and Supply group possess the lowest odds of attriting with only 35.6 percent. For retention at the 6-year mark, results show the Information Warfare group to have double the odds of retainment compared to the Technical and Mechanical group, with the Operations and Combat group following having 60.7 percent higher odds of retention at the 6-year mark. The Survival curve analysis using Cox Hazard Model aligned with these results.

To address the second research question, on what pre-accessing and accession characteristics (demographic, educational, rating, occupational category) best predict 4-year attrition and 6-year retention outcomes, the analysis shows that gender, race, and ethnicity were strong predictors of attrition at the 4-year mark and retention at the 6-year mark, findings that align with those from previous studies. Specifically, results show females and racial minority groups to have higher odds of attriting before the 4-year mark when compared to males and non-racial minority groups. Additionally, Hispanics are shown to have higher odds of retainment when compared to non-Hispanics. These findings suggest further exploration of the external factors influencing attrition in females and racial minority groups to identify possible remedies to help improve retention rates among these underrepresented groups.

Unlike previous literature, educational attainment and AFQT scores were shown to be strong predictors of attrition at 4 years. The logistic regression analysis results showed Sailors who have higher levels of education possess a lower likelihood of attriting before the 4-year mark, possibly due to the career progression and opportunities Sailors receive

when having a college education. Results also show occupational rating groups as strong predictors of 6-year retention and 4-year attrition. Sailors in the Admin and Supply rating group were found to have lower attrition risks, while those in the Technical and Mechanical rating group had higher attrition risks, which could be due to external factors influencing attrition. Although I compiled my rating groups into four broad occupational rating groups my results align with previous studies like Bowers (2015) and Robinson (2023).

Accession wavers do not show a difference in attrition or retention outcomes, in my analysis, although I did not examine waivers by different types. Overall, pre-accession and accession characteristics such as demographics, educational attainment, and occupation rating group assignments show to be important factors in predicting 4-year attrition and 6-year retention outcomes. These findings support the importance of improving retention strategies to ensure we are supporting and providing all resources to unrepresented groups to address these disparities and ensure these groups are supported for long-term retention.

A. RECOMMENDATIONS FOR FUTURE WORK

Due to limitation in data, especially on data on the enlisted Sailors' length of initial obligations, I recommend merging the current data set with another data source that provides enlisted Sailors initial contracts to further explore the effects of attrition at the 4-year mark and retention at the 6-year mark. While my analysis provides some answers to those time periods, it does not differentiate Sailors from attriting from the service because of their obligation ending and those who are attriting before completing their initial obligation contract. Having initial obligation contract information will allow for a more detailed analysis of how this observed attrition at 4 years and retention at 6 years are actually influenced by the obligation a Sailor receives at the beginning of their contract. Furthermore, a future study could explore further accession wavers, not in aggregate, but by type, using the most current data available, to document any patterns in outcomes. This type of further study could provide insights to naval policy makers in support of any policy adjustments aimed at improving enlisted Sailors' attrition and retention outcomes.

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APPENDIX. OCCUPATIONAL RATING GROUPS

Occupational Rating Group	Ratings Assigned
Aviation	Aviation Boatswain's Mate-Launching and Recovery (ABE)
	Aviation Boatswain's Mate-Fuels (ABF)
	Aviation Boatswain's Mate (Aircraft Handling) (ABH)
	Aviation Ordnanceman (AO)
	Aviation Machinist's Mate (AD)
	Aviation Electrician's Mate (AE)
	Aviation Structural Mechanic (AM)
	Aviation Structural Mechanic (Safety Equipment (AME)
	Aviation Electronics Technician (AT)
	Aircrewman Mechanical (AWF)
	Aircrewman Operator (AWO)
	Aircrewman Tactical Helicopter (AWR)
	Aircrewman Helicopter (AWS)
	Aircrewman Avionics (AWV)
	Airman Apprentice (AA)
	Air Controlman (AC)
	Naval Aircrewmen (AW)
	Airman Recruit (AR)
	Aviation Support Equipment Technician (AS)
	Aviation Maintenance Administration (AZ)
	Aircrew Survival Equipmentman (PR)

Occupational Rating Group	Ratings Assigned
Executive Support	Legalman (LN)
	Mass Communication Specialist (MC)
	Musician (MU)
	Navy Counselor (NC)
	Personnel Specialist (PS)
	Religious Program Specialist (RP)
	Yeoman (YN)
Information Warfare	Cryptologic Technician Interpretive (CTI) (9CMN)
	Cryptologic Technician Maintenance (CTM)
	Cryptologic Technician Collection (CTR) (771B)
	Cryptologic Technician (Technical Branch) (CTT)
	Cryptologic Technician-Networks (CTN) (H30A)
	Information Systems Technician (IT)
	Intelligence Specialist (IS)
	Aerographer Mate (AG)
	Cyber Warfare Technician (CWT)
	Cyber Defense Analyst (H31A)
	Cyber Threat Emulation Operator (CTEO) (H32A)
Nuclear Field	Electrician Mate, Nuclear (EMN)
	Electronics Technician Mate (ETN)
	Machinist Mate, Nuclear (MMN)
	Culinary Specialist (Submarines) (CSS)
	Nuclear Propulsion and Submarine Disqualification Tracker (9902)

Occupational Rating Group	Ratings Assigned
Undesignated	Airman (AN)
	Seaman (SN)
	Fireman (FN)
Shipboard Maintenance	Boatswain Mate (BM)
	Damage Controlman (DC)
	Electrician Mate (EM)
	Hull Technician (HT)
	Machinery Repairman (MR)
	Interior Communications Electrician (IC)
	Seamen Recruit (SR)
	Seamen Apprentice (SA)
	Sonar Technician -Surface (STG)
	Electronics Technician Communication (ETR)
	Technician (90,91,96)
Shipboard Engineering	Engineman (EN)
	Gas Turned Systems Technician (GS)
	Gas Turbine System Technician-Electrical (GSE)
	Gas Turbine System Technician-Mechanical (GSM)
	Machinist Mate (MM)
	Machinist's Mate, Non-Nuclear, Submarine Weapons (MMW) (4233)
	Fireman Recruit (FR)
	Shipboard, Chemical Biological and Radiological-Defense (CBR-D) Operations and Training Specialist (756B)

Occupational Rating Group	Ratings Assigned
Shipboard Operations	Operations Specialist (OS)
	Quartermaster (QM)
	Surface Rescue Swimmer (801A)
Supply and Support Services	Culinary Specialist (CS)
	Advanced Culinary Techniques and Management (3527)
	Logistics Specialist (LS)
	Retail Specialist (RS) (S00A)
	Ship's Serviceman (SH) (Renamed RS in 2019)
Ordinance, Law, and Weapons	Gunner's Mate (GM)
	Master-at-Arms (MA)
	Mineman (MN)
	Fire Controlman (FC)
	Electronics Technician (ET)
	Fireman Apprentice (FA)
	Fire Control Technician (FT)
	Fire Controlman Aegis (FCA) (1113 ,1148, 1318, 1335, 1337, 1386)
Medical	Hospitalman Apprentice (HA)
	Hospitalman (HN)
	Hospital Recruit (HR)
	Hospital Corpsman (HM)
SEABEE Construction	Builder (BU)
	Construction Electrician (CE)
	Construction Mechanic (CM)
	Constructionman (CN)

Occupational Rating Group	Ratings Assigned
SEABEE Construction	Construction Recruit (CR)
	Constructionman Apprentice (CA)
	Engineering Aide (EA)
	Equipment Operator (EO)
	Steelworker (SW)
	Utilitiesman (UT)
Submarine	Machinist's Mate (Submarine) Auxiliary (MMA) (4231)
	Torpedoman's Mate ™
	Logistics Specialist Submarine (LSS)
	Yeomen Submarine (YNS)
	Electronics Technician Navigation (ETV)
	Information Systems Technician (ITS)
	Missile Technician (MT)
	Sonar Technician Submarine (STS)
	Submarine Vertical Launch System Tube Maintenance Technician (737B)
	SSN/SSBN Weapons Equipment Technician (Q33A)
Special Operations and Warfare	Special Warfare Boat Operator (SB)
	Special Warfare Operator (SO)
	Explosive Ordnance Disposal (EOD)
	Engineering Duty (ED)
	Navy Diver (ND)
Unidentified	ZZZZZZZZ

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