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Preface

This report documents research and analysis conducted as part of a project entitled *Identifying Army Organizational Factors Contributing to Sexual Assault Risk*, sponsored by the Office of the Deputy Chief of Staff, G-1, U.S. Army. The purpose of the project was to identify characteristics of units, installations, and commands that increase or decrease soldiers' risk of sexual assault and sexual harassment.

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Summary

The U.S. Army's Deputy Chief of Staff, G-1, asked the RAND Arroyo Center to extend previous RAND Corporation analyses that produced estimates of sexual assault risk and sexual harassment risk across installations and commands (Morral et al., 2018). To do so, we used U.S. Department of Defense administrative data; Army administrative and personnel data; and survey data from the 2018 Workplace and Gender Relations Survey of Active Duty Personnel (WGRA), 2016 WGRA, and 2014 RAND Military Workplace Study (RMWS) to examine organizational and operational characteristics associated with sexual assault risk and sexual harassment risk among soldiers in the U.S. Army. We summarize selected results in the sections that follow and in Figure S.1.

Total Risk

Our results show considerable variation in total *sexual assault risk*—estimated prevalence of sexual assault—across several stratifications of Army women. Focusing on variation across installations, we found that women at Fort Hood, Fort Bliss, and several other bases faced total sexual assault risk that is higher than the risk faced by the average woman in the Army. For example, we estimated that the total sexual assault risk to Army women at Fort Hood during fiscal year (FY) 2018 was 8.4 percent. By comparison, the average total risk to all women in the Army during this period was 5.8 percent, almost one-third lower. Notably, sexual harassment is more common than sexual assault in the Army, but our results also showed that the risk of sexual harassment is highly correlated with the risk of sexual assault. Thus, bases with high sexual assault risk have high sexual harassment risk, and those with low sexual assault risk have low sexual harassment risk.

Figure S.1
Five Highest Total and Adjusted Sexual Assault Risk Estimates for Army Women at Bases, 2018

NOTE: The arrow in the left graph indicates the average assault risk across the Army. Locations for installations are as follows: Fort Hood: Texas; Fort Bliss: New Mexico and Texas; Fort Riley: Kansas; Fort Campbell: Kentucky and Tennessee; Fort Carson: Colorado.

Adjusted Risk

Fort Hood and Fort Bliss have large numbers of young, unmarried, less-educated, and junior-ranking soldiers, who are known to be at higher risk of sexual assault. This raises the question of whether groups—such as installations—with higher risk estimates have soldiers assigned to them who are at higher risk because of their individual characteristics, or whether their personnel would be expected to experience lower risk if stationed at another base. To evaluate this, we calculated *adjusted risk*: This measures how much higher or lower than expected the risk of sexual assault is for a specific group of soldiers, given the demographic, deployment, and service characteristics of the individual soldiers assigned to that group. This allows us to evaluate risk at a given installation relative to the other installations with similar personnel assigned to them. We estimated that Army women at Fort Hood, for example, had an adjusted risk of 1.7 percent during FY 2018. This indicates that risk to women at Fort Hood was 1.7 percent higher than would be expected based on the personnel characteristics of women assigned to Fort Hood.

High-Risk Commands and Career Fields

By examining total and adjusted risk by additional stratification approaches—namely individual commands and career fields—we were able to establish subpopulations within Fort Hood, Fort Bliss, and other bases where risk is highest and lowest. For instance, two of the five highest adjusted sexual assault risk commands for women across the Army—the 1st Cavalry Division and Headquarters, III Corps—are located at Fort Hood. However, one of the commands associated with lower-than-expected risk for Army women is also based there, namely the 1st Army Division West. Lower-than-expected risk suggests that this command is associated with a protective effect against sexual assault. Among career fields, those associated with the highest adjusted sexual assault risk for Army women—field artillery and engineers—could represent subpopulations at the high risk bases that are exposed to greater than typical risk.

Cluster Characteristics Associated with Risk

We also examined the characteristics associated with variability in risk across stratification approaches. Several cluster characteristics are associated with different adjusted risk for Army women's sexual assault and sexual harassment, and for men's sexual harassment than might be expected. For example, more-positive unit climate and supervisor climate scores are associated with lower adjusted sexual assault and sexual harassment risk among women and lower adjusted sexual harassment risk among men. Higher *operational tempo*—defined as days deployed on a Global War on Terrorism mission—is also associated with higher adjusted sexual assault risk and sexual harassment risk among women and higher sexual harassment risk among men. Higher separation rates are weakly associated with higher sexual harassment risk among women and men. Other cluster characteristics are associated only with women's adjusted risk for sexual assault and sexual harassment. For example, Army women at bases with more civilians face lower adjusted sexual assault and sexual harassment risks. Army women in

environments with higher proportions of combat arms have higher adjusted sexual assault and sexual harassment risks.

Recommendations

- To optimize reductions in Army sexual assault rates, new or supplementary prevention programs that cannot be provided to the entire Army should be targeted to those bases, commands, and CMFs that have large numbers of soldiers and high total sexual assault risk.
- The Army could use routinely collected survey data from the Defense Equal Opportunity Employment Survey or other surveys to more-rapidly identify units, commands, bases, CMFs, or other groups of soldiers with high or rising risk of sexual assault and sexual harassment. The Army should consider investing some resources in developing these surveys to serve this purpose.
- The Army should consider developing climate-improvement interventions for commands, bases, and CMFs with high adjusted sexual assault or sexual harassment risk and poor climate scores. These interventions could be designed to improve features of the climate assessed in the WGRA scales that we used to examine unit and supervisory climate.
- The Army should investigate the differences in soldiers' experiences in similar groups with different risk profiles, such as the 2nd Infantry Division and the 4th Infantry Division, to understand what differences in work life, social life, culture, or climate could be contributing to women's risk exposure. Then, test whether candidate risk factors generalize in explaining differences in risk elsewhere in the Army.
- The Army could conduct case studies of bases where adjusted sexual assault risk to women appears to have changed substantially between 2016 and 2018 and identify candidate causes of these changes. Then, it could test the generalizability of these causes for explaining sexual assault risk among other groups of soldiers across the Army.
- Decisionmakers should share historical sexual assault and sexual harassment risk information with unit commanders. Doing so can forewarn commanders of known problems that are likely to persist within their units. This information can sensitize the commanders to the possible need for special prevention measures and prepare them to address problems quickly.

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Abbreviations

ADMT	Active Duty Master Transaction
AFB	Air Force base
AFQT	Armed Forces Qualifying Test
ASA	Assistant Secretary of the Army
CD	Cavalry Division
CI	credible interval
CMD	command
CMF	career management field
COE	center of excellence
CV	cross validation
DEOCS	Defense Equal Opportunity Employment Survey
Div.	division
DMDC	Defense Manpower Data Center
DoD	U.S. Department of Defense
Exped.	expeditionary
FY	fiscal year
GBM	generalized boosted regression model
GWOT	Global War on Terrorism
HQ	headquarters
JAG	Judge Advocate General
MCC	major command code
MCMC	Markov Chain Monte Carlo
MILRES	military reservation

NNMC	National Naval Medical Center
OPA	Office of People Analytics
OPTEMPO	operational tempo
RMWS	RAND Military Workplace Study
UIC	unit identification code
WGRA	Workplace and Gender Relations Survey of Active Duty Personnel

CHAPTER ONE

Introduction

In 2014, the RAND Corporation's National Defense Research Institute (NDRI) conducted a survey of sexual assault and sexual harassment in the U.S. military, the RAND Military Workplace Study (RMWS), that incorporated a larger number of active component service members than had been included in similar previous survey efforts. For the RMWS, RAND randomly selected 477,513 active component military members from a population of 1,317,561 individuals who met inclusion criteria. Of the 477,513 individuals invited to complete the survey, 145,300 individuals participated. This large number of respondents allowed RAND to conduct analyses of sexual assault risk and sexual harassment risk that had not been possible with previous survey data, including analyses that produced estimates of risk across installations and commands (Morral et al., 2018). Detailed information on the RMWS survey methods and analyses is available in a series of previous RAND reports (Morral, Gore, and Schell, 2014, 2015a, 2015b, 2015c, 2016). In the current project, we extend the approach that RAND developed to consider both sexual assault risk and sexual harassment risk among groups of U.S. Army soldiers in 2016 and 2018, and to assess characteristics of groups of soldiers with especially high or low risk estimates.[1] This information can be used to better target sexual assault and sexual harassment prevention and response efforts, and provides useful insights into where there might be clusters of soldiers with unusually high or low risk of assault and/or harassment.

Factors associated with sexual assault risk and sexual harassment risk in the military have been examined using other methods, including two recent reports that draw on RMWS data on active-duty service members that are of particular relevance to the current effort. One report addressed individual and unit characteristics associated with service members' sexual assault and sexual harassment risk (Schell et al., forthcoming), and the second provided installation and command-level risk estimates of sexual assault and sexual harassment (Morral et al., 2018). We provide brief descriptions of the results from these reports and related previous research in the following sections.

Individual-Level Risk Factors

Sexual Assault

To assess factors associated with sexual assault risk, RAND researchers analyzed the extent to which personnel and unit characteristics improved differentiation between service members

[1] Observed patterns might vary depending on the time of year during which surveys are administered. However, the RMWS and subsequent administrations of the Workplace and Gender Relations Survey of Active Duty Personnel (WGRA) were performed at the same time of year.

who were and were not sexually assaulted in the previous year (Schell et al., forthcoming). These analyses addressed birth demographics, characteristics at the time of military entry, personal and career history characteristics, and recent experiences. These analyses generally combined active component service members across Department of Defense (DoD) branches of service, although some analyses examined risk separately by service branch.

Results showed that birth demographics, which include age and race, accounted for a sizeable proportion of the difference in risk between service members who were and were not sexually assaulted in the previous year. For both men and women, younger age was associated with increased risk for sexual assault, a finding consistent with much previous research (Harned et al., 2002; Kessler, 2013; LeardMann et al., 2013; Millegan et al., 2016; Skinner et al., 2000). In addition, among service women (but not service men), being white was associated with increased sexual assault risk (Schell et al., forthcoming). Previous findings relevant to race-related sexual assault risk have been inconsistent (e.g., Harrell et al., 2009; Littleton et al., 2013).

Examining characteristics at time of entry into the military, RAND found that preservice sexual assault, branch of service, entry type (e.g., enlisted; officer, academy; officer, Reserve Officers' Training Corps [ROTC]; officer, other), and scores on the Armed Forces Qualifying Test (AFQT) differentiated between service members, both men and women, who had and had not been sexually assaulted in the previous year (Schell et al., forthcoming). Reports of experiences consistent with sexual assault prior to joining the military, joining a service other than the Air Force, and joining as an enlisted service member all were associated with higher sexual assault risk estimates. Previous research has also found that prior sexual victimization is associated with future sexual assault victimization (Gidycz et al., 1993; LeardMann et al., 2013). Consistent with RAND's findings, previous studies also have observed differences across military services: those in the Air Force are at lower risk than those in the other military services. These studies have also revealed higher sexual assault risk for enlisted service members compared with officers (Harned et al., 2002; Sadler et al., 2003; Street et al., 2016).

Higher AFQT scores among enlisted personnel were associated with increased sexual assault risk in RAND's analysis, even after controlling for other demographic characteristics. At the same time, those with higher AFQT scores have been found to be less likely to file an official report of their sexual assault (Kessler, 2013). Additional research is needed to better understand the associations among AFQT scores, sexual assault, and reporting among service members.

RAND's analyses of personal and career history characteristics associated with sexual assault risk considered a number of variables, including marital status, number of dependents, education, paygrade, promotion speed, past deployments, and military occupation group (Schell et al., forthcoming). Consistent with previous research, having fewer dependents and having a marital status of "single" were associated with an increased risk of sexual assault among both service men and service women (Kimerling et al., 2007; LeardMann et al., 2013). Having never attended college and slower promotion speed were characteristics that were associated with increased sexual assault risk among service women, and having a lower pay grade was associated with increased sexual assault risk among service men and service women. These findings correspond with previous research and theory that suggest that lower sociocultural and organizational power are associated with increased likelihood of experiencing assault (Harned et al., 2002).

In agreement with some prior research, past deployment was associated with increased sexual assault risk among service members (e.g., LeardMann et al., 2013). RAND also found that serving in combat specialties was associated with increased risk of sexual assault. By contrast, previous research addressing the association between these specialties and sexual assault did not find a significant association (LeardMann et al., 2013). The differences in findings involving military occupational specialties across studies might be the result of differences in how each study categorized or grouped occupational specialties.

Analyzing past-year military experiences, RAND found that serving on a ship in the past 12 months was associated with an increased risk of sexual assault, and serving in a unit with a greater percentage of men was associated with an increased risk of sexual assault for service women but not service men (Schell et al., forthcoming). Previous research also suggests that some military environmental factors are associated with increased likelihood of sexual assault (Sadler et al., 2003). For example, factors associated with sexual assault among women included feeling unsafe because of the number of males in their work area, experiencing hostile work environments, having ranking officers who allowed or initiated sexually demeaning comments and actions, and observing sexual activities in sleeping quarters.

For ease of reference, Table 1.1 summarizes prior findings from the 2014 RMWS on individual risk factors for sexual assault.

In summary, RAND's recent analyses and previous research suggest that sexual assault risk is associated with individual characteristics of members of the military and aspects of military service, such as service branch, occupation, and unit characteristics.

Sexual Harassment

RAND also examined the association of sexual harassment in the past year with individual and service characteristics using the 2014 RMWS data (Morral, Gore, and Schell, 2015a). In most cases, individual and service characteristics found to be associated with sexual assault were also associated with sexual harassment risk because of the high correlation between sexual assault and sexual harassment: Servicemembers who were sexually harassed in the past year experienced substantially higher rates of sexual assault in the past year (Morral, Gore, and Schell, 2015a). This association between sexual harassment and sexual assault risk has been observed in other research as well (e.g., Stander et al., 2018). Moreover, other studies have found strong similarities between risk factors for sexual assault and those for sexual harassment (e.g., Bell et al., 2018; Turchik and Wilson, 2010).

RAND's analyses showed that birth demographics were associated with past-year sexual harassment for service women and service men. Younger age was associated with increased sexual harassment risk for both women and men and risk varied by race (Morral et al., 2018).[2] As with sexual assault risk, experiencing preservice sexual assault, joining a service other than the Air Force, joining as enlisted, and receiving higher scores on the AFQT were all associated with greater risk of sexual harassment for service women and service men. Being single and less educated were characteristics associated with greater risk of past-year sexual harassment for service women.[3] In addition, service women and service men in the E4 paygrade were likely

[2] Among service women, Hispanic and "other" race women but not Asian and Black women were at higher risk for sexual harassment than White women. Among service men, Hispanic, "other" race men, and Asian men but not Black men were at higher risk for sexual harassment than White men.

[3] Multivariate associations adjusted for variables in prior tiers.

Table 1.1
Summary of Recent Findings from the 2014 RMWS on Individual-Level Risk Factors for Sexual Assault

Individual-Level Risk Factors	Service Women	Service Men	Notes
Sexually assaulted in prior year	4.87%	0.95%	
Birth demographics			
Younger age	+	+	Consistent with much of the previous research
White (service women only)	+		Inconsistent findings across literature
Characteristics at time of military entry			
Preservice sexual assault	+	+	Consistent with much of the previous research
Branch of service			Air Force personnel at lower risk
Enlisted (versus officers)	+	+	Consistent with much of the previous research
High AFQT score	+	+	Those with a higher AFQT score also are less likely to report; additional research needed
Personal and career history			
Single	+	+	In line with theory that suggests that lower sociocultural and organizational power are associated with increased likelihood of experiencing assault
Fewer dependents	+	+	
Never attended college	+		
Slower promotion speed	+		
Lower pay grade	+	+	
Past deployment	+	+	Suggested in earlier research
Serving in combat specialties			RAND research did not concur with prior literature that reported increased risk
Recent military experiences			
Serving on a ship in past 12 months	+	+	Previous research also suggests that military environmental factors are associated with an increased likelihood of sexual assault
Greater percentage of men in unit	+		

SOURCES: Results in service women and service men columns are drawn from previous RAND research (Morral, Gore, and Schell, 2015a; Schell et al., forthcoming).
+ indicates a positive relationship between the listed characteristic and sexual assault risk.

to have a higher risk of sexual harassment than those in higher paygrades. Examining recent experiences, serving on a ship in the past 12 months was associated with greater sexual harassment risk for both service women and service men.

Risk Associated with Installations and Commands

In addition to examining individual service member factors associated with sexual assault and sexual harassment risk, RAND has also examined variation in sexual assault and sexual harass-

ment risk associated with service in particular installations and commands (Morral et al., 2018). This earlier work demonstrated that small area estimation techniques could be used to examine variability in installation and command sexual assault and sexual harassment risk across the military services. For these analyses, RAND researchers used RMWS data to estimate sexual assault risk and sexual harassment risk for installations and major commands that had at least 100 service members assigned to them during each month of fiscal year (FY) 2014 and that included at least 50 respondents to the RMWS. Doing so allowed the researchers to produce more-reliable estimates of risk than would have been possible with smaller groups.

To create installation risk estimates, the researchers drew from available Defense Manpower Data Center (DMDC) data on duty unit identification codes (UICs) and postal codes. For commands, they used available duty unit major command code (MCC) data to estimate risks for the Army, Navy, and Air Force.[4] Researchers then separated the risks that appear to be specifically associated with each installation or command—as opposed to risks shared by service members across installations or commands—by first accounting for the risks associated with the characteristics of the personnel assigned to that installation or command. These analyses facilitated consideration of whether installations or commands had different sexual and sexual harassment risk estimates than would be expected based on the characteristics of their personnel. Results from this research demonstrated that sexual assault risk and sexual harassment estimates for relatively small aggregations of personnel could be produced using the RMWS data. Furthermore, these estimates revealed considerable variation of risk across groupings. Importantly, these analyses did not address what might account for variability in adjusted sexual assault risk and sexual harassment risk. These analyses were some of the first of their kind to be used in estimating risk at installations and commands across the active-duty U.S. military (for similar analyses in the civilian context, see Fay, Planty, and Diallo, 2013; and Li, Diallo, and Fay, 2015).

Sexual Assault

When examining sexual assault risk at installations, results tended to show that installations to which higher-risk service members were assigned had higher average risk estimates. After adjusting for the proportion of the total sexual assault risk that was simply the result of the characteristics of the personnel assigned there, several installations showed higher-than-expected risk. In particular, these analyses showed that, among Army women, Fort Drum (New York), Fort Lewis (Washington state), and Okinawa (Japan) showed the highest adjusted risk. Among Army men, Italy (broadly), Fort Drum, and Osan (South Korea) showed the highest adjusted sexual assault risk. Examining large commands, U.S. Forces Command showed the highest command-specific risk for both Army women and Army men (Morral et al., 2018).

Sexual Harassment

Estimates of adjusted sexual harassment risk were highest at Fort Drum, Osan, and Fort Riley (Kansas) among Army women and men. In addition, U.S. Forces Command and U.S. Army Special Operations Command showed the highest adjusted sexual harassment risk estimates among Army women. U.S. Forces Command was also associated with one of the highest adjusted sexual harassment risk estimates among Army men (Morral et al., 2018).

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[4] For the Marine Corps, major command information was not available, so MCC was instead linked to Command Monitored Command Code.

Limitations of Previous Analyses of Risk Among Installations and Commands

RAND's analyses of the RMWS data to estimate adjusted installation risk and command risk provided insights into the distribution of sexual assault risk and sexual harassment risk for active-duty personnel within and across the military services (Morral et al., 2018). However, these analyses did not examine what factors might contribute to higher or lower adjusted risk. Therefore, characteristics that contribute to differences in sexual assault risk and sexual harassment risk at the installation or command level remain unclear. In addition, RAND focused on aggregations of active-duty personnel by large installations and large commands, but examination of alternative personnel groupings might provide additional insights into sexual assault and sexual harassment risk. Furthermore, RAND's analyses were limited to use of FY 2014 data, so variation in risk among installations, commands, or other clusters over time remains unclear.

Content of This Report

This report builds on the methods demonstrated in RAND's earlier analyses of individual, installation, and command sexual assault and sexual harassment risks to provide the U.S. Army with more-actionable information about where sexual assault and sexual harassment risk are highest and lowest in the service, and what characteristics of those groups might be associated with the sexual assault and sexual harassment risks faced by soldiers. In this report, we created more-meaningful clusters to highlight the operational and organizational characteristics of Army units that are most closely associated with sexual assault and sexual harassment risk. These analyses might allow the Army to better advise commanders on how to address sexual assault and sexual harassment risk and might also inform the service's training, prevention, and response efforts.

Organization of This Report

The remaining chapters are organized as follows. In Chapter Two, we review our approach to estimating and analyzing sexual assault and sexual harassment risk among different groupings of soldiers in 2016 and 2018. In Chapter Three, we describe the results of our sexual assault analyses. In Chapter Four, we describe the results of our sexual harassment risk analyses. In Chapter Five, we discuss general conclusions from the project and suggest several approaches that the Army might pursue to better prevent sexual assaults and sexual harassment of its soldiers.

CHAPTER TWO

Approach to Estimating Sexual Assault Risk and Sexual Harassment Risk in the Army

This chapter provides information about the data and analytic approach that we used to create estimates of sexual assault risk. To investigate organizational and operational characteristics associated with sexual assault risk in the Army, we drew from administrative data, responses to the 2016 and 2018 WGRA, and responses to the 2014 RMWS. Because prior work covers the RMWS in detail, we focus only on description of the WGRAs and administrative data.[1] We then discuss our two-stage modeling procedure, which combines a machine-learning algorithm and a Bayesian hierarchical model. Together, these stages estimate total and adjusted sexual assault risk for each of the more than 460,000 active component soldiers in the Army as a function of individual-level and cluster risk factors and then identifies clusters of personnel that have relatively higher or lower risk than their individual risk factors predict.

We were interested in distinguishing the sexual assault risk that all members of the Army face (that is, all women or all men), from the risk soldiers face that might be specific to the installation where they are based, the commands in which they serve, or their job functions. Therefore, we separately estimate two forms of sexual assault risk (or sexual harassment risk): *Total sexual assault risk* for a cluster of soldiers is an estimate of the proportion of soldiers in the cluster who were sexually assaulted during the year preceding the survey. *Adjusted sexual assault risk* for a cluster is an estimate of how much higher or lower sexual assault risk is for cluster members in comparison to the risk that might be expected based on the personnel and service history characteristics of members of the cluster (such as their age, rank, marital status, and other characteristics). If soldiers in a cluster have an adjusted sexual assault risk of 0, that implies that they face the same sexual assault risks as all members of their same gender across the Army. If adjusted risk is greater than 0, this implies there might be risk factors specific to their cluster that are not shared by other soldiers across the Army. By contrast, if adjusted risk is below 0, this implies there might be protective factors specific to the cluster. Similarly, total and adjusted sexual *harassment* risk describe the estimated prevalence of sexual harassment and the portion of that prevalence that is not explained by the personnel and service history characteristics of soldiers in a given cluster.

After estimating cluster-level risk, we then analyze the association between risk and the characteristics of clusters. We provide technical details of our statistical modeling procedures in Appendix A.

[1] The RMWS included 145,300 active-component respondents in the analysis of sexual assault. Detailed information regarding the overall study design of the RMWS is available in Morral, Gore, and Schell, 2014.

Data

Data used for these analyses include survey data from the 2104 RMWS, 2016 WGRA, and 2018 WGRA; DoD administrative data, provided by DMDC; and data from the Total Army Personnel Database.[2] The 2014 RMWS, 2016 WGRA, and 2018 WGRA, assessed past-year gender-related experiences in the active-duty U.S. military, including sexual assault and sexual harassment (Breslin et al., 2019; Davis et al., 2017; Morral, Gore, and Schell, 2014). In the results described in this report, reference to *sexual assault* is based on survey respondents' answers to questions about their experiences, but does not reflect whether a sexual assault was substantiated by an investigation. Specifically, respondents are asked whether anyone did one of a series of sexual or inappropriate things to them that might constitute a sexual assault according to definitions in the Uniform Code of Military Justice (UCMJ). Respondents who indicate they experienced one of these behaviors are then asked follow-up questions designed to establish whether a form of force or coercion was used that meets UCMJ criteria, and then about whether the incident was to gratify a sexual impulse or done to abuse or humiliate the victim, which is the second criterion that is required for an experience to meet UCMJ definitions of a sexual assault. Respondents therefore are not asked if they believe they were sexually assaulted. Instead, they are asked about their experiences, and then categorized as sexually assaulted based on their responses. Similarly, the WGRA is used to infer *sexual harassment* based on survey respondents' answers to questions about their experiences and does not reflect whether sexual harassment was substantiated by an investigation or participants' own categorization of their experiences.

The present analyses include 132,429 active-component respondents from the 2016 WGRA, including 44,782 respondents from the Army (Office of People Analytics [OPA], 2017c).[3] Most respondents to the 2016 WGRA completed the survey in August 2016, although some completed it as early as July 2016 or as late as October 2016. In addition, these analyses included 115,884 active-duty members from the 2018 WGRA, including 28,387 respondents from the Army (Breslin et al., 2019). Detailed information regarding the 2016 and 2018 WGRA survey methodology, including sample design and selection and nonresponse bias, is available in previous reports produced by DoD's OPA (Breslin et al., 2019; Davis et al., 2017; OPA, undated; 2017a; 2017b; 2017c; 2017d). As mentioned previously, we also incorporated information from the RMWS (for additional information on this survey, see Morral, Gore, and Schell, 2014). Each of these surveys had response rates of between 17 percent and 31 percent and used nonresponse weights to reduce nonresponse bias in survey estimates.[4]

The administrative data used in this project included demographics and command structure information for active-duty personnel from the 12-month period preceding each WGRA's

[2] This project was reviewed and found to be in compliance with RAND's Human Subjects Protection Committee requirements.

[3] We include service members from all branches of the military in the first-stage model of risk described later in this chapter. To the extent that risk to soldiers is different than risk to service members in other branches of the military, our model is designed to accurately capture those differences while nevertheless benefiting from the increased precision provided by the larger sample size afforded using all service members. Although the WGRA includes members of the Coast Guard, the analyses did not incorporate information from this service.

[4] In this report, we use an imputation procedure that accounts for nonresponse bias rather than using the sample weights originally developed for the survey, since these were not developed to be representative of the smaller clusters of soldiers for which we are developing sexual assault and sexual harassment risk estimates.

survey completion month. For example, the 12-month period for August responders on the 2016 WGRA covered August 2015 through July 2016, and the period covered August 2017 to July 2018 for August respondents on the 2018 WGRA. For 2016, this included 68,372 women and 406,481 men who were in the active component Army as of April 2016. For 2018, it includes 68,540 women and 393,935 men who were in the active-duty Army in April 2018.

We used these data to link all active component service members to their occupational groups, to the locations to which they were assigned, and to the units in which they served during the one-year period prior to survey participation. For each month in the one-year period of interest, we obtained each service member's duty UIC and their UIC's parent in its chain of command. These command relationships were constructed using data from the Army's Force Management System Website and its Total Army Personnel Database. We obtained information on each soldier's deployment experiences during the study year from DMDC's Contingency Tracking System Global War on Terrorism (GWOT) file.

Statistical Methods

Separate but essentially equivalent statistical models were used to estimate sexual assault and sexual harassment risk. Because the models were nearly identical, we describe here the model for sexual assault risk, noting in footnotes where the sexual harassment risk model differed.

To identify organizational and operational characteristics that are associated with elevated or reduced risk of sexual assault, we developed statistical models of each soldier's risk of sexual assault for the one-year period corresponding approximately with FY 2018 and then aggregated them with risk estimates of other soldiers of the same gender in the same command,[5] location, career field, or other grouping of soldiers. The modeling approach we use to estimate risk of sexual assault is implemented in two stages. First, we use a flexible machine-learning algorithm to estimate sexual assault risk for every service member as a function of individual-level characteristics (e.g., age, paygrade, marital status; see Table 2.1) and cluster-level characteristics (e.g., average age of members within the cluster; see Table 2.2). The cluster characteristics that we analyzed for each service member in the first-stage model included those concerning their duty UIC, installation/postal code, and duty major command. This model allowed us to predict the probability of experiencing sexual assault for every service member.[6]

In the second stage, we fit a Bayesian hierarchical model of sexual assault among Army WGRA respondents; this model incorporates risk predictions from the first-stage model; model-based estimates of each respondent's propensity to respond to the WGRA survey; and separate effects for each of the echelon 1 through 3 commands,[7] each career management field (CMF), and each installation. This model is then used to predict individual level *total sexual*

[5] We estimate sexual assault risk to women and men separately because gender is one of the strongest predictors of risk, and the gender ratio across different groups of soldiers is highly variable. If we did not separately estimate risk to men and women, high risk to women in clusters with many more men than women would be obscured.

[6] Our model produces predictions for survey respondents, those who were sampled but did not respond to the survey, and service members who were not sampled.

[7] These are three different approaches to stratifying by commands, where *echelon 1* refers to major commands. *Echelon 2* refers to the units that report directly to echelon 1 units as well as their subordinate commands. *Echelon 3* refers to units and their subordinate units that report to echelon 2 units.

assault risk for all soldiers in the 2016 and 2018 WGRA sample frames, respectively (all soldiers with rank lower than a general officer who entered the active component at least six months before August of 2016 for the 2016 WGRA or August of 2018 for the 2018 WGRA).

To obtain estimates of *adjusted sexual assault risk*, we subtract from these total sexual assault risk estimates each soldier's expected sexual assault risk on the basis of their personal and service history characteristics, such as their age, rank, marital status, deployment history, and other individual characteristics. These expected risk estimates are based on a version of the stage 1 model that includes all personal and service history characteristics from Table 2.1 but none of the organizational cluster characteristics from Table 2.2.

These estimates of individual-level total and adjusted sexual assault risk are then averaged across members of the same command, force element, or career field to produce cluster-level estimates of total and adjusted sexual assault risk. These averaged risk estimates are weighted by the proportion of the year that each service member was a member of each cluster. That is, the risk estimate for a soldier who spent just one month in a particular geolocation would have one-twelfth the weight of another soldier who spent the entire year in that geolocation.

Our approach to modeling cluster-level sexual assault risk builds on the methods used in our earlier work estimating installation sexual assault risk using the RMWS (Morral et al., 2018), and unpublished work for the Navy and Marine Corps.

Stage 1: Modeling Individual Risk as a Function of Individual-Level and Cluster-Level Personnel Characteristics

Stage 1 models for the 2016 and 2018 Army are nearly identical. In this section, we describe the stage 1 modeling approach for the 2018 Army sample, noting where it differs from the 2016 model. In the first stage of the model, we estimated and optimized the machine learning model of sexual assault risk using 2018 WGRA responses from members of all service branches to maximize the sample size used for estimating the model, while allowing for differences across service by including service branch as a variable in the model, and allowing interactions between service branch and each of the other predictors. The total sample size used to fit the model was 102,096.

In previous work using the 2016 WGRA sexual assault survey data, we considered many candidate predictor variables to examine individual sexual assault risk, both at the individual as well as duty UIC, installation or postal code, and major command level (the full set of predictors considered appears in Appendix A; here, we discuss only those predictors that were retained in the final model). For instance, a soldier's *average cluster age* was calculated three ways, each describing the average age of all members other than the soldier in the soldier's unit, installation, and major command. For each level of clustering used in the Stage 1 model, we averaged each soldier's cluster characteristics in each month of the study period. Through iterative analysis, we eliminated some variables to reduce model complexity and obtain the best fitting. In the following text box, we report the individual variables retained in our final Stage 1 model.

Table 2.1 reports the cluster characteristics and the levels at which they are retained in our final Stage 1 model, in addition to the individual characteristics. In addition to cluster characteristics calculated at the MCC, UIC and ZIP (postal code) levels, some clusters were necessarily calculated within occupational codes, or in the case of civilians on base, at the base level. These are listed as clustered at "other" levels in this table.

Stage 1 Model: Personnel and Service History Variables Retained to Predict Sexual Assault Risk

Age
AFQT score
Average amount of time living on base
Cumulative lifetime months of active federal military service
Education level code (six ordinal categories)
Ethnic affinity code (11 categories)
Gender
Marital status code (three categories)
Months deployed between September 2001 and November 2018
Months deployed between September 2017 and September 2018
Number of changes in UIC/postal code/MCC within year (three variables)
Pay grade (18 categories)
Projected end date for current term of employment
Race indicators (three variables)
Separated from the military by December 2019 (yes/no)
Service branch (four levels)
Strength accounting code (six categories)*
Total number of dependents

NOTE: * = indicates a person's current status (e.g., present for duty, in hospital, absent without leave).

To account for the fact that individuals can move between units within the year and units can move between postal codes or major commands within the year, we computed these variables for each month for each service member.[8] Finally, to prevent overfitting and unintentional modeling of cluster-specific effects, we discretized each person's derived cluster characteristic into quantiles, so each became a numeric variable with a limited number of unique values.[9]

The Stage 1 modeling approach used a machine learning algorithm, referred to as a generalized boosted regression model (GBM) (Friedman, 2001; 2002). GBM is a flexible, automated, data-driven modeling algorithm that can estimate the relationship between an outcome of interest and a large number of covariates of mixed type while also allowing for flexible nonlinear relationships between the covariates and the outcome (Friedman, 2001; Ridgeway,

[8] Cluster characteristics were generally assumed to exclude the individual, so when calculating a cluster characteristic for a given person-month, that person was left out of the calculation. In addition, we explored a set of transformations of monthly cluster characteristics to smooth the data and best predict sexual assault. See Appendix A for details.

[9] We used ventiles for UIC-level variables, deciles for postal code–level variables, and quartiles for MCC-level variables.

Table 2.1
Stage 1 Model: Cluster Characteristics Retained to Predict Sexual Assault Risk, by Level

Characteristic++	Other	MCC Level	UIC Level	Postal Code Level
Attrition index in cluster*			X	
Average age within cluster			X	
Average retention intent			X	X
Average sexual harassment measure for females in cluster+++		X	X	X
Average sexual harassment measure for males in cluster+++		X		X
Average workplace hostility score in cluster			X	X
Average supervisor climate score in cluster**		X	X	X
Average unit climate score in cluster**		X	X	X
Cluster-specific risk of sexual assault for females, 2016		X		X
Cluster-specific risk of sexual assault for males, 2016		X		X
Number of active-duty service members in cluster				X
Number of female respondents in cluster			X	
Primary DoD occupational code	X			
Percentage of members also in individual's primary DoD occupation	X			
Percentage of males also in individual's primary DoD occupation	X			
Percent of cluster that has experienced sexual assault prior to military service			X	X
Percent of cluster that prefers not to answer sexual orientation question		X	X	X
Percent of members within cluster who are male			X	X
Proportion of cluster in middle management leadership (E7 through O4)				X
Proportion of senior officers in cluster who are female***			X	
Proportion of total personnel on base who are civilians	X			

+ This describes the 2018 model. The 2016 model was analogous.
++ Each variable type was computed for three types of clusters: duty UIC, duty installation/postal code, and duty MCC.
+++ In models of sexual harassment risk, these predictors were replaced with average sexual assault risk for females and males in the cluster.
* The attrition index is the number who separated by December 2019, divided by the number who had end dates prior to December 2019. This is not a proportion, and may be greater than 1.
** *Unit climate* is the average of responses by gender to questions regarding the behaviors of military members. Lower values indicate more-negative workplace behaviors, including less support for victims of sexual assault. Supervisor climate is the average of responses by gender to questions regarding how actively supervisors address unprofessional behaviors, sexual harassment, and other negative behaviors. Lower values indicate poorer responses.
*** *Senior enlisted* are defined as having one or more of the following: rank of E7 or greater, ten or more years of service, or being among the enlisted members of the unit in the top 10th percentile for age. *Senior officers* are defined as having one or more of: officers rank of O4 or greater, officers with 10+ years of military service, or officers in the top 10th percentile for officer age in the unit.

1999). We fit a series of GBM models to determine the subset of individual and cluster-level predictors that yield the best model fit, as determined by 10-fold cross validation (CV) (see Appendix A for full details).

Once we had selected the version of each characteristic to include in the model, we fit a series of GBM models, dropping variables that had low relative influence and/or were redundant with other variables. We evaluated model fit by CV error, ultimately determining a best model to use.[10] The resulting model was used to create log-odds predicted probabilities of sexual assault for each person in the full population. To account for uncertainty in the predicted probabilities, we generated ten predictions for each individual using a Bayesian bootstrap (Rubin, 1981; see Appendix A).

Response Propensities

To extrapolate sexual assault risk estimates from the model on survey respondents to all soldiers—including those who did not take the survey—we needed to account for survey response biases. Survey nonresponse bias arises when respondents differ from nonrespondents in systematic ways. To make our prevalence estimates less subject to this bias, we generated an estimate of each service member's propensity to respond to the survey using a GBM model fitted to the data on all those who were surveyed in the 2018 WGRA. In this model, we only included variables that were estimated on the full population to avoid predicting survey nonresponse using information derived from the survey responses from that same survey. The response propensities were used in the second-stage model.

Stage 2: Modeling Individual Risk Using Information About Cluster Membership

After estimating each individual's risk on the basis of their personal characteristics and several characteristics of the units or commands in which they served, the second-stage model used Bayesian hierarchical modeling to estimate how an individual's membership in different clusters affects their total and adjusted sexual assault risk. This model was estimated separately for men and women in the Army and included offsets for the log-odds risk prediction from the first-stage model; a response-propensity spline function to account for how response propensity affects estimated risk; and random effects for clusters, including soldiers' installations, their CMFs, and their command echelons 1 (major command) through 3 (two levels below major command in soldiers' chains of command).

We estimated the parameters of the second-stage model using the Stan package within the R programming language, which provides Bayesian inference for models using Markov chain Monte Carlo (MCMC) methods (Stan Development Team, undated). We specified priors that were relatively uninformative and all prior distributions were assumed independent. Standard convergence diagnostics were conducted and did not indicate any issues with model convergence or poor mixing (further details are available in Appendix A).

Estimating Total Risk and Adjusted Risk

The estimates of sexual assault risk that we obtained from the second stage model provided total risk estimates for each individual. We used these estimates to calculate *total risk estimates for each cluster* by taking a weighted average of the risk predictions for each soldier, weighted

[10] The Stage 1 individual model used shrinkage of 0.003 and required 4,594 iterations. The Stage 1 cluster model used shrinkage of 0.003 and required 4,267 iterations.

by the proportion of time each soldier spent in that cluster.[11] Notably, total risk estimates are strongly influenced by the characteristics of the individual and the personnel that the individual interacts with (e.g., within the individual's clusters). This is our best estimate of the average risk of sexual assault for individuals within that cluster.

However, for some purposes, we want to look at just a component of this total risk estimate. This is because there are two broad conceptual explanations for why a cluster has high total risk: (1) individuals whose personal characteristics put them at high risk regardless of where they would be assigned in that cluster (e.g., the cluster has more young women than average) or (2) individuals in a cluster have higher risk than individuals with the same personal characteristics who were assigned to other clusters. This later component is what we call *adjusted risk* and is computed for each soldier by estimating an expected sexual assault risk using only a soldier's individual characteristics (e.g., age, rank, deployment history, test scores) and comparing that with the soldier's *total risk* estimate, which uses those same individual characteristics, as well as information about the individual's occupation, unit, geographic location, and other cluster characteristics. If their total risk is higher than is typical for soldiers with the same personnel characteristics, their adjusted risk is positive; if it is lower than for other soldiers with the same personal characteristics, it is negative. We can then compute *adjusted risk* for any cluster by taking a weighted average of the *adjusted risk* estimates of all individuals in that cluster, in the same way that we estimated each cluster's total risk. If a cluster's *adjusted risk* is +1 percent, it means that the total sexual assault risk for individuals in that cluster is one percentage point higher, on average, than for soldiers with similar characteristics across the Army; if a cluster's *adjusted risk* is –1 percent, it means that the total sexual assault risk for individuals in that cluster is one percentage point lower, on average, than for soldiers with similar characteristics across the Army.

Technically, to estimate *adjusted risk* for each individual, we first estimated a separate GBM that included only the individual characteristics in the text box at the beginning of this chapter (but not the cluster characteristics in Table 2.1). Thus, we actually produced two types of risk estimates from the first-stage GBMs: one that used all predictors and one that used only the individual characteristics, with these two estimates being produced within each of the ten bootstrap samples. For a survey respondent, we then computed the *adjusted risk* posterior distribution by taking the difference between their final risk estimate from each MCMC of the second-stage model (discussed earlier) and their *adjusted risk* estimate from the reduced GBM first-stage model that corresponds to the same first-stage bootstrap sample (*adjusted risk* = total risk estimate accounting for all predictors minus risk estimate from only personal characteristics).[12]

Estimating the Relationship Between Sexual Assault Risk and Cluster Characteristics

The posterior samples for total risk and adjusted risk from the Bayesian hierarchical model can be summarized in various ways to provide insight into characteristics that are associated with risk and groupings of soldiers that are at high or low risk for sexual assault. Each model

[11] This was done for each MCMC sample to obtain a posterior distribution of total risk.

[12] The computation of adjusted risk for nonrespondents was slightly more complicated because the mean predicted risk for the reduced and full models are not necessarily the same for nonrespondents. For nonrespondents, within every MCMC, we predicted the total risk estimate from the corresponding risk estimate using only individual characteristics. The residuals from this simple model are the adjusted risk estimates for each nonrespondent in each MCMC.

iteration provides one total risk and one adjusted risk estimate for each service member. These individual risk posterior samples can be aggregated to obtain a posterior distribution of cluster-level risk for a given clustering of soldiers (e.g., for a location-based grouping). The posterior distribution of risk for a given cluster can then be summarized by taking the mean and percentiles to obtain a posterior mean and credible intervals (CIs).

We also provide inference on the relationship between sexual assault risk and various cluster characteristics (Table 2.2). For example, we consider the relationship between unit climate in an individual's cluster and the individual's risk of sexual assault. To estimate such relationships, we regressed cluster average unit climate scores onto individuals' sexual assault risk. Because we want to understand which cluster characteristics might account for cluster differences in adjusted sexual assault risk, we expressed the proportion of variance in individu-

Table 2.2
Cluster Characteristics Examined to Explain Differences in Adjusted Risk

Label	Description
Good unit climate	The average response to WGRA unit climate survey questions (question 202 in the 2018 WGRA) provided by members of the same gender in a cluster of soldiers.**
Good supervisor climate	The average response to WGRA supervisor climate survey questions (questions 199, 200, and 201 in the 2018 WGRA) provided by members of the same gender in a cluster of soldiers.***
Separations	The average proportion of soldiers in a cluster across months in 2018 who had separated from the Army without joining the Reserve Component by December 2019, according to records maintained in the DMDC Active Duty Master Transaction (ADMT) file.
Administrative discharges	The proportion of soldiers in a cluster who separated from the Army with a discharge code indicating a failure to adapt to the Army. These codes include alcoholism, drugs, court martial, sexual perversion, character or behavior disorder, unsatisfactory performance, and good of the service. Interservice Discharge codes are drawn from the ADMT file.
Proportion of civilians	Each soldier in a cluster is associated with a base at which the number of soldiers and civilians is recorded in the 2015 Base Structure Report, produced by the Office of the Assistant Secretary of Defense for Sustainment,* the most recent report that includes information about civilian populations at the time of this study. To construct this measure, we take the average proportion of civilians at bases to which each member of a cluster of soldiers is assigned across months in 2018.
Recent transitions	The percentage of a soldiers' UIC that consists of new members, where *new* is defined as someone who is a member of the unit in the current month, but was not a member in the previous month. The average of each soldiers' recent transitions percentage across months of the year is used as the cluster characteristic.
Proportion living on base	We characterize soldiers as living on base in any month if their Basic Allowance for Housing is less than $100 in the DMDC Active Duty Pay File. The *proportion living on base* is the average proportion of members of a cluster living on base across months of the year.
Deployment OPTEMPO	The average number of months deployed during the study year among soldiers in a cluster, calculated from DMDC's Contingency Tracking System GWOT file.
Proportion of combat arms	The average proportion of soldiers in a cluster whose career management fields are combat arms occupations, where CMF codes 11–19 were treated as combat arms occupations.

* See Office of the Assistant Secretary of Defense for Sustainment, undated.

** Example unit climate items include the following: How would you rate the climate in your unit regarding . . . Dealing effectively with adversity or conflict when it occurs? Support for [male/female] victims of sexual assault? Respect service member have for others from diverse backgrounds?

*** Example supervisor climate items include the following: To what extent does your immediate supervisor . . . Encourage members to challenge sexual harassment and gender discrimination when they witness it?, Create a command culture of prevention by encouraging members, witnesses, and bystanders to report situations that could result in harmful outcomes?

als' adjusted sexual assault risk explained by their cluster characteristic (e.g., unit climate) as a fraction of the total variance in adjusted sexual assault risk that cluster membership explains. The resulting ratio describes how much of the differences found between clusters in adjusted sexual assault risk are associated with differences in their cluster characteristics (e.g., unit climate). We examined these associations separately for men and women.

Summary

We used DoD administrative data; survey data from the 2018 WGRA, the 2016 WGRA, and the 2014 RMWS; and Army administrative and personnel data to examine organizational and operational characteristics associated with sexual assault risk in the Army. Using these data, we developed statistical models to create estimates of sexual assault risk over a one-year period. Specifically, we produced two types of estimates for each stratification of soldiers (e.g., by installation, command, occupational group): one estimate is the probability that an individual in that specific cluster experienced a sexual assault in the prior year (total risk); a second estimate (adjusted risk) assesses how much higher or lower than expected the risk of sexual assault is, given the type of personnel assigned to the cluster. We then examined whether there are characteristics of these clusters that are associated with their total and adjusted sexual assault risk.

Throughout this report, we are focused on estimating risk for sexual assault among subsets of soldiers. These estimates have some uncertainty, and the level of uncertainty varies substantially across estimates. To help improve interpretation, we present 80 percent CIs for each estimate: there is an 80 percent chance that the true risk for sexual assault for each cluster of soldiers falls within the stated range. In several places in the text, we focus on results for specific clusters that have a high probability of being at unusually high or low risk for sexual assault. However, because of the uncertainty in estimates, it is possible that some of the clusters that are identified as high risk might not truly have higher than average risk. The results should be interpreted with this uncertainty in mind and with reference to the credible intervals provided. Our goal is to describe the distribution of risk across various clusters of soldiers rather than test specific hypotheses against a set criterion for Type I error (false positives). Relatedly, we perform no adjustment for multiple comparisons because we do not perform any significance tests of specific hypotheses.

CHAPTER THREE

Sexual Assault Risk Results

In this chapter, we describe the results of our analyses on the Army organizational characteristics associated with sexual assault risk in FY 2018, and we also consider stability of risk over time using FY 2016 and FY 2014 data. We begin with an overview of the stratification approaches that we examined for sorting soldiers into different clusters, and we summarize selected results for sexual assault risk by each stratification approach. We also describe results of analyses assessing the characteristics of clusters that were found to have higher or lower adjusted sexual assault risk, and our results addressing stability of risk over time. We provide additional information and results in Appendixes B and C.

We include results involving total and adjusted sexual assault risk estimates. Total sexual assault risk provides an estimate of the proportion of soldiers in a given cluster who were sexually assaulted in the past year (i.e., estimated prevalence). Total risk estimates are heavily influenced by the characteristics of the personnel assigned to particular clusters of soldiers. Adjusted risk can be thought of as the component of soldiers' sexual assault risk that is above or below what would be expected based on their personnel characteristics. In other words, adjusted risk addresses how atypical a group's risk is. Additional results for risk estimates are available in Appendixes B and C.

Approaches to Stratifying Soldiers into Distinct Clusters

To examine features of clusters with higher- or lower-than-expected risk, we needed to identify groups of soldiers whose sexual assault risks differ. In doing so, we sought to identify clusters strongly associated with sexual assault risk because they are likely to offer the best insights into what experiences, environments, duties, or other shared characteristics drive higher sexual assault risk. Therefore, we explored the associations of total and adjusted sexual assault risk with features of clusters using five different approaches to stratifying soldiers. Notably, across stratification approaches, we required that each group contain at least 50 survey respondents and 100 soldiers. Because there are more men than women in the Army, there were fewer groups with sufficient numbers of women to calculate risk estimates than there were for men across the various stratification approaches. We stratified

- By *installation*, using DMDC records indicating the installation or location to which each soldier was assigned in each month of the study year. However, when fewer than 50 survey respondents of a given gender were available for an installation, we could not produce an estimate for that location. Therefore, our analyses often have different num-

bers of clusters for men and women. Location codes with insufficient numbers of soldiers to produce estimates were aggregated by the service or activity most associated with the location. Thus, we have aggregations for soldiers at small Army installations, Air Force installations, Navy installations, National Guard and Reserve installations, foreign installations, and other location codes.

- By *command echelons 1 through 3* (three different approaches to stratifying by command), where *echelon 1* refers to major commands (e.g., U.S. Forces Command, Training and Doctrine Command, or U.S. Army Medical Command), including all the subordinate commands reporting up to the echelon 1 command. *Echelon 2* refers to the units that report directly to echelon 1 units as well as their subordinate commands. Examples of echelon 2 commands include Headquarters (HQ) III Corps, U.S. Army Combined Arms Center, and Army Medical Research and Materiel Command (MRMC). Finally, *echelon 3* refers to units and their subordinate units that report to echelon 2 units. Examples of echelon 3 units include the 1st Army Division, the Maneuver Center of Excellence, and MRMC Korea. At each echelon, commands with too few soldiers or survey respondents of a given gender were aggregated, as were soldiers with missing unit information; separately, soldiers with unit information that appeared not to be valid for the time period that we examined, such as units that had recently been decommissioned or had not yet been created, were also aggregated.
- By *CMF*: The Army organizes occupations within several dozen CMFs. For instance, the CMF *Aviation* includes occupations such as air-traffic controllers, pilots, and maintenance technicians. We examined risk by these broad CMFs when they included large-enough numbers of soldiers to produce stable estimates. We aggregated CMFs with too few soldiers or survey respondents and created a separate cluster for soldiers whose CMF data were missing. A table displaying the original CMF codes and labels and how they were aggregated for this analysis is provided in Appendix D.

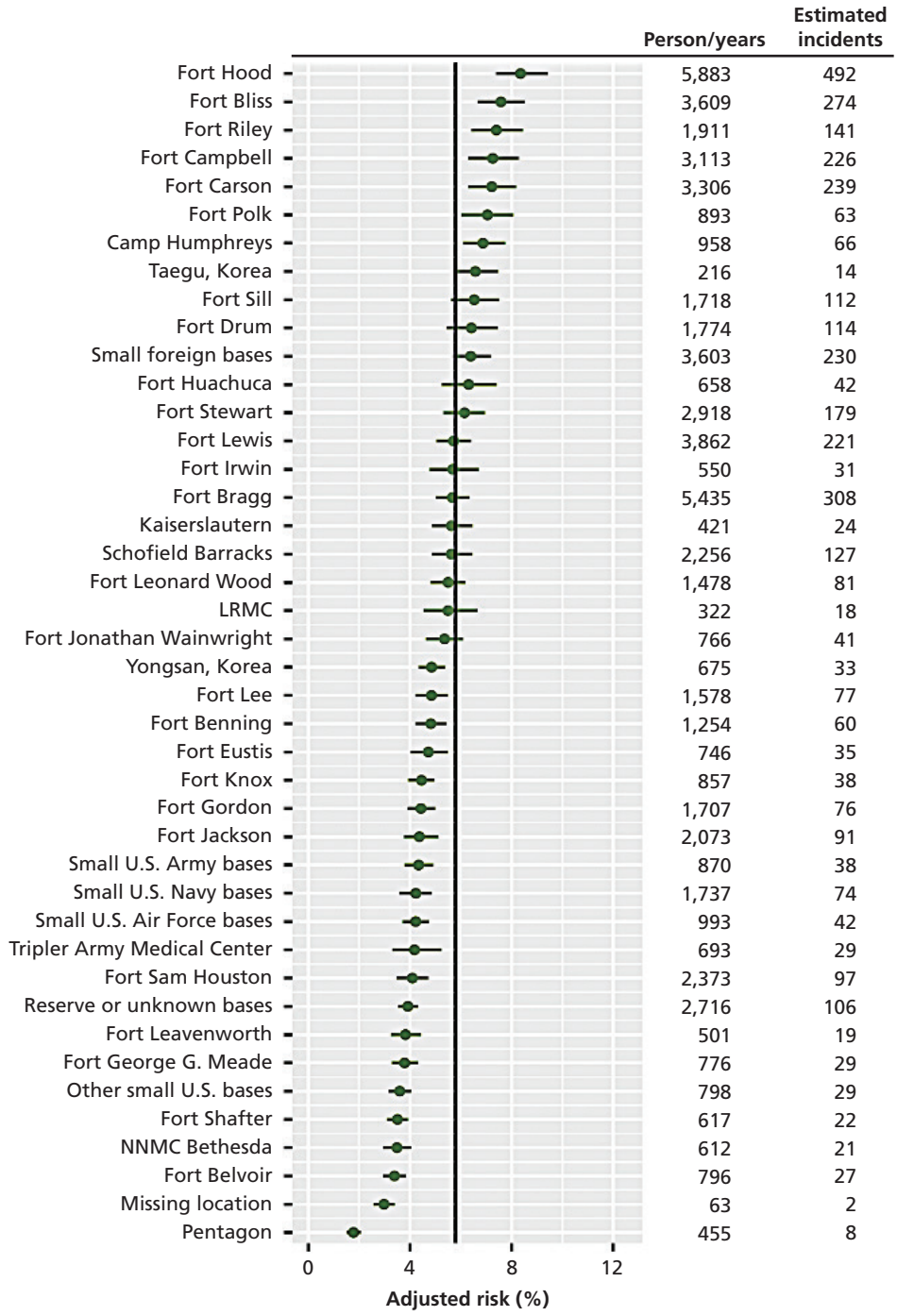
To illustrate the results of these analyses, we begin with an example of total sexual assault risk by installation and highlight the distinction between total and adjusted sexual assault risk. We then briefly describe selected high-level results across stratification types. In Appendix C, we provide information on total and adjusted risk for all clusters and all stratification approaches.

Sexual Assault Risk by Installation Cluster

Total Sexual Assault Risk by Installation

Figure 3.1 provides 2018 total sexual assault estimates for Army women across all installations that meet our minimal size requirements and several aggregations of smaller installations. As mentioned earlier, total sexual assault risk is an estimate of the proportion of Army women at each location who were sexually assaulted during the one-year period from approximately August 2017 to July 2018. During this period, average total risk of a sexual assault to Army women was 5.8 percent, as estimated in the 2018 WGRA (Breslin et al., 2019). In other words, 5.8 percent of Army women were estimated to have experienced sexual assault during the study year. Figure 3.1 provides an estimate of the total sexual assault risk faced by women at each

Figure 3.1
Total Sexual Assault Risk by Installation for Women, 2018



NOTES: LRMC = Landstuhl Regional Medical Center; NNMC = National Naval Medical Center. *Total sexual assault risk* is an estimate of the proportion of service members of a given sex who were sexually assaulted from roughly August of 2017 to July of 2018. *Small U.S. and foreign bases* are aggregations of soldiers serving in installations that are too small for individualized estimates. *Reserve or unknown* and *missing location* are also aggregations of soldiers from multiple locations.

installation, along with 80 percent CIs,[1] which can be used to evaluate the strength of evidence that each estimate is higher or lower than average risk. The average risk to women (5.8 percent across the Army) is indicated by a vertical black line. Where the CIs do not include 5.8 percent, there is an 80 percent or greater probability that the installation's true total risk is greater or less than the Army average for women, depending on which side of the 5.8 percent value the CI lies. We also provide *person-years* in these figures, an estimate of the monthly number of soldiers (women in this case) at each base during the study year. Finally, the figure includes estimates of the total number of sexual assault incidents consistent with the estimated rate of sexual assaults and the number of person years women spent at the installation.[2]

By comparing estimates for installations with highest and lowest sexual assault risk, it is evident that total sexual assault risk is not evenly distributed across installations. Several large installations have total sexual assault risk in the range of 6.8 percent or higher, with CIs suggesting a high probability that these risks are above the average risk of 5.8 percent faced by women across the Army. At the installation with the highest risk, Fort Hood, we estimate that 8.4 percent—about 1 in 12—of the approximately 5,883 Army women who served there during the study year were sexually assaulted, which is about 494 women (8.4 percent * 5,883). In contrast, the Pentagon is associated with the lowest sexual assault risk of 1.8 percent—about one in 50—or about one-third of the average risk among Army women.

This might not be surprising, however, because of the typical characteristics of women who are assigned to Fort Hood, at one extreme, and the typical characteristics of women who are assigned to the Pentagon, at the other. It is likely that women at the Pentagon are, on average, older, more senior-ranking, more highly educated, and might have other personnel characteristics associated with lower total sexual assault risk. To evaluate whether risk is higher or lower than might be expected on the basis of the personnel characteristics of women assigned to a cluster, we need to examine *adjusted* risk, not total risk.

Figure 3.2 describes total sexual assault risk to Army men across installations in FY 2018. In contrast to the results for Army women, only one installation, Baumholder H. D. Smith Barracks, had sexual assault risk with a high probability of being greater than the servicewide average risk to men of 0.64 percent in 2018.[3] However, a majority of installations had risk that was likely to be lower than average risk to men in the Army. As with women, the Pentagon showed the lowest sexual assault risk for Army men, of 0.4 percent.

Total risk estimates like these can be useful for gauging where prevention and response resources might be needed most. They are not useful for understanding whether risk is higher or lower at these locations than might be expected on the basis of the personnel characteristics of soldiers assigned to them. To understand whether there is risk associated with locations or

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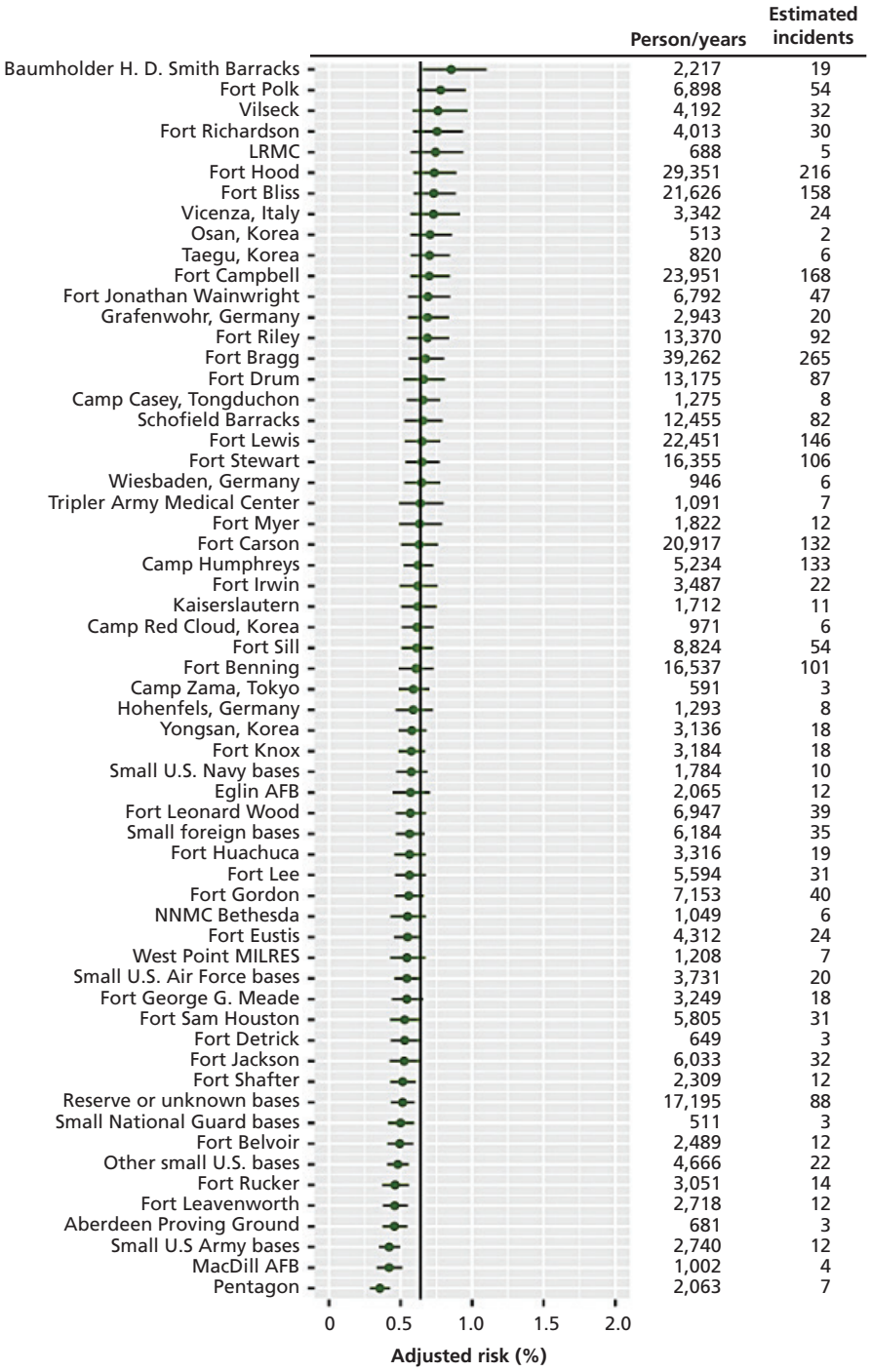
[1] All estimates in this report have some uncertainty, which varies across estimates. This uncertainty is conveyed by the CIs. The 80 percent CI represents the range of values in which the true risk is most likely to be found, given the available data. However, there is a 10 percent chance that the true value will be below the lower value of the 80 percent CI and a 10 percent chance it will be above the upper value.

[2] The estimated number of incidents is calculated as the product of the risk of sexual assault during the year times the number of person-years for each installation or other cluster of soldiers.

[3] The published sexual assault rate for men in the Army in 2018 was rounded to 0.7 percent, using the survey weighting procedures adopted by OPA (Breslin et al., 2019). Using different methods and data, our approach to imputing sexual assault risk arrived at a slightly lower estimate for men in the Army, 0.64 percent, which would round to 0.6 percent. For women, our estimate of 5.83 percent rounds to the same value published by OPA, 5.8 percent.

Figure 3.2
Total Sexual Assault Risk by Installation for Men, 2018



NOTES: AFB = Air Force base; MILRES = military reservation. *Total sexual assault risk* is an estimate of the proportion of service members of a given sex who were sexually assaulted between roughly August 2017 and July 2018.

other clusters that have higher or lower risk than might be expected (based on the personnel characteristics in those clusters), we need to look at adjusted risk.

Adjusted Sexual Assault Risk by Installation

Figure 3.3 lists the installation clusters with the highest and lowest adjusted sexual assault risk for Army women. Throughout this report, we distinguish total and adjusted risk in these figures using green for total risk estimates and gold for adjusted risk estimates. The values listed in this figure represent how much higher (for positive values) or lower (for negative values) sexual assault risk among Army women is at each location than would be expected based on their personnel characteristics. For instance, Fort Hood has an adjusted risk of 1.7 percent. This suggests that an Army woman with demographic and service history characteristics placing her at average sexual assault risk for women in the Army (5.8 percent) would be expected to have a risk closer to approximately 7.5 percent if she were stationed at Fort Hood in 2018 (5.8 percent + 1.7 percent = 7.5 percent).[4]

As seen in Figure 3.3, two large Army installations in Texas, Fort Hood and Fort Bliss, have adjusted sexual assault risk estimates that have a high probability of being greater than zero (i.e., the whole 80 percent CI is greater than zero), suggesting these locations have higher risk than expected for Army women based on the age, marital status, rank, occupations, and other characteristics of women assigned to those locations. In contrast, adjusted risk to women across multiple other installations is lower than would be expected, based on the personnel characteristics of Army women at these installations. In particular, Fort Gordon (Georgia) and Fort Meade (Maryland) show the lowest adjusted sexual assault risk among Army women, suggesting potential protective effects of being stationed in these locations.

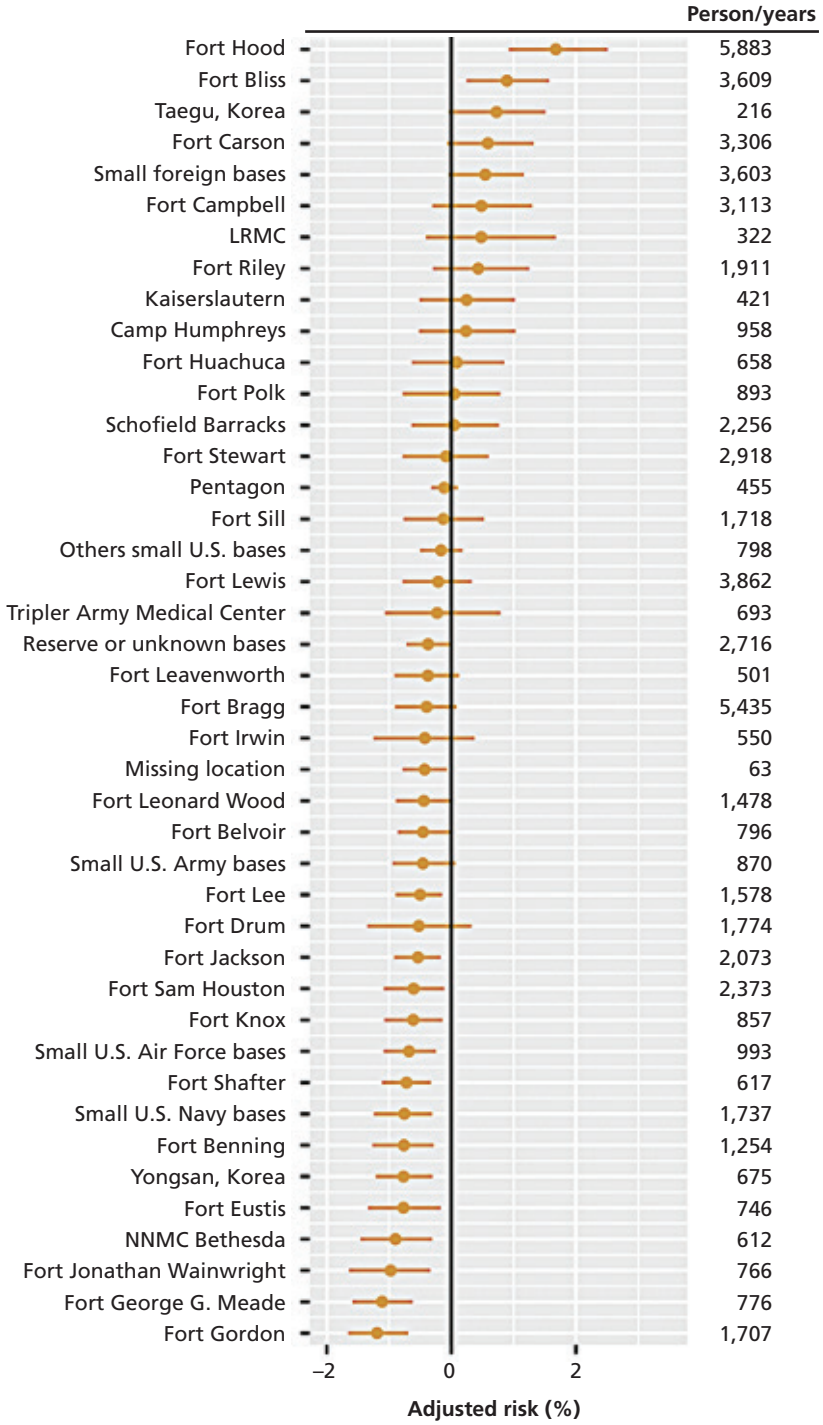
Figure 3.4 presents the installation clusters with the highest and lowest adjusted sexual assault risk for Army men. The three installations or locations that include CIs that are above zero are all locations outside the continental United States. Baumholder H. D. Smith Barracks and Landstuhl Regional Medical Center are in Germany, and the 20th Area Support Group is in South Korea. Only one installation, Fort Rucker (Alabama), is associated with strong evidence of lower-than-expected risk for men.

Sexual Assault Risk by Command Echelon Cluster

In addition to installations, we also examined sexual assault risk at three command echelons, from major commands (echelon 1) through two lower levels of commands (echelons 2 and 3). In this section, we highlight our analyses of echelon 3 commands, because these provided the best differentiation of sexual assault risk of all the command echelons examined. Tables providing total and adjusted risk for all echelons of commands are available in Appendix C (not publicly available).

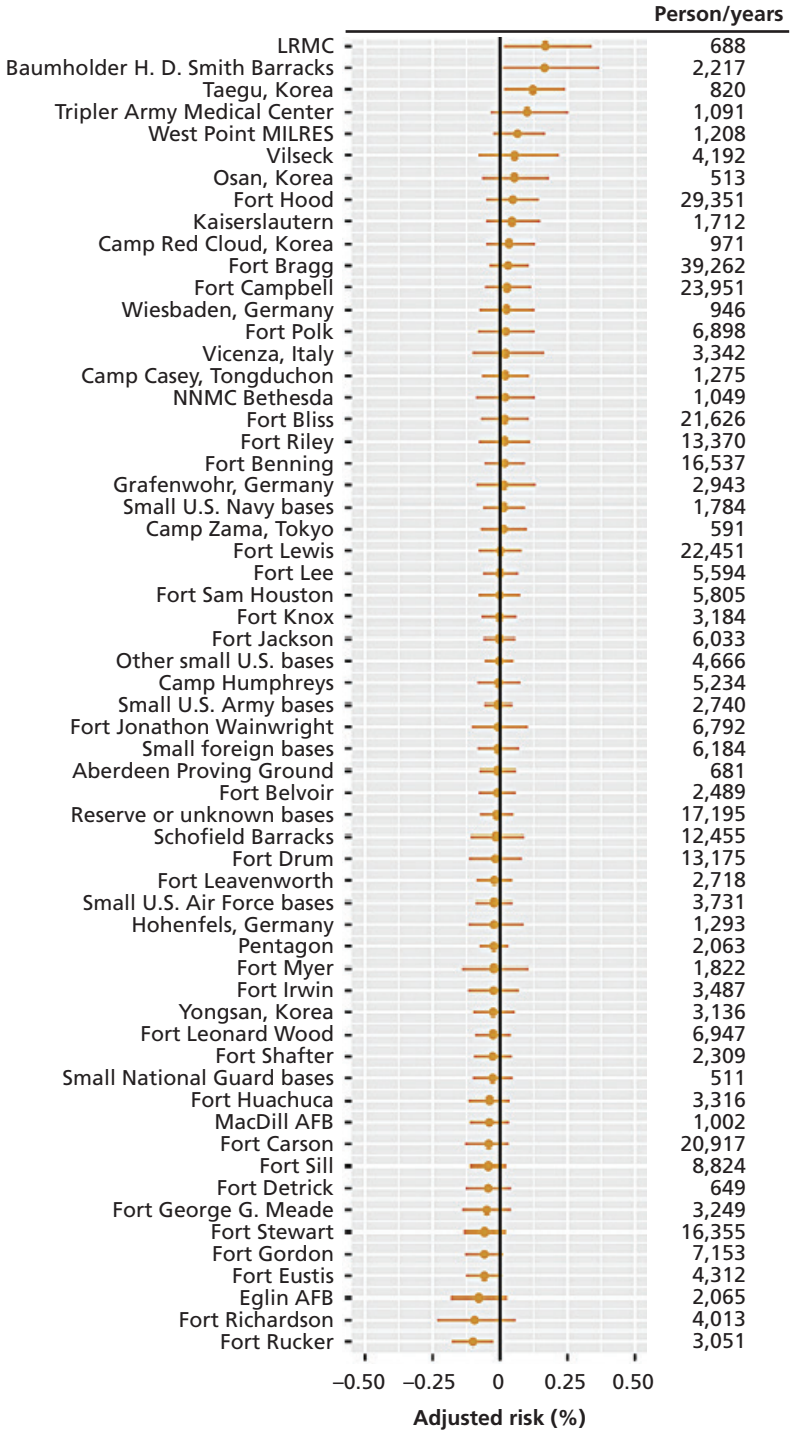
[4] The adjusted rate estimates are measuring risk on a relative rather than absolute level, and all cluster estimates are compared with the same reference value so that these adjusted risk estimates are directly comparable across clusters. However, multiplying this metric by the size of the cluster could be interpreted only if adjusted risk were a ratio-level measurement; that is to say, assessed on an absolute level where the zero value is not an arbitrary analytic choice.

Figure 3.3
Adjusted Sexual Assault Risk by Installation for Women, 2018



NOTE: *Adjusted risk* is the risk of sexual assault greater (or less than) expected for members of the cluster based on their demographic and service history characteristics.

Figure 3.4
Adjusted Sexual Assault Risk by Installation for Men, 2018



NOTE: *Adjusted risk* is the risk of sexual assault greater (or less than) expected for members of the cluster based on their demographic and service history characteristics.

Total Sexual Assault Risk by Command Echelon 3

The total sexual assault risk by echelon 3 commands among women are illustrated in Figure 3.5. Personnel who work in an echelon 1 or 2 unit, such as U.S. Army Europe or III Corps, have the headquarters of those higher echelon commands listed as their echelon 3 commands, so "HQ, U.S. Army Europe" and "HQ, III Corps." As is evident in Figure 3.5, most of the highest-risk commands are combat units, several of which are located at the previously identified installations that are associated with the highest total and adjusted risk estimates among Army women. For example, the 1st Cavalry Division (CD) (9.3 percent total risk) and the HQ, III Corps (8.1 percent total risk) are based or headquartered at Fort Hood, and the 1st Armored Division (8.1 percent total risk) is based at Fort Bliss.

In addition, multiple echelon 3 commands had total sexual assault risk estimates that showed substantially lower-than-average risk for Army women. This included echelon 3 commands focused on personnel issues, such as the U.S. Army's Human Resource Command (1.8 percent total risk) and the Office of the Assistant Secretary of Defense for Manpower and Reserve Affairs (2.1 percent total risk), as well as multiple HQ commands, medical commands, and two Centers of Excellence. Interestingly, the First Army Division West, located at Fort Hood, also showed one of the lowest total sexual assault risk estimates among Army women (2.0 percent total risk) but, as seen in the corresponding person-year estimates displayed in Figure 3.5, the size of this command is substantially smaller than the commands associated with high sexual assault risk at Fort Hood.

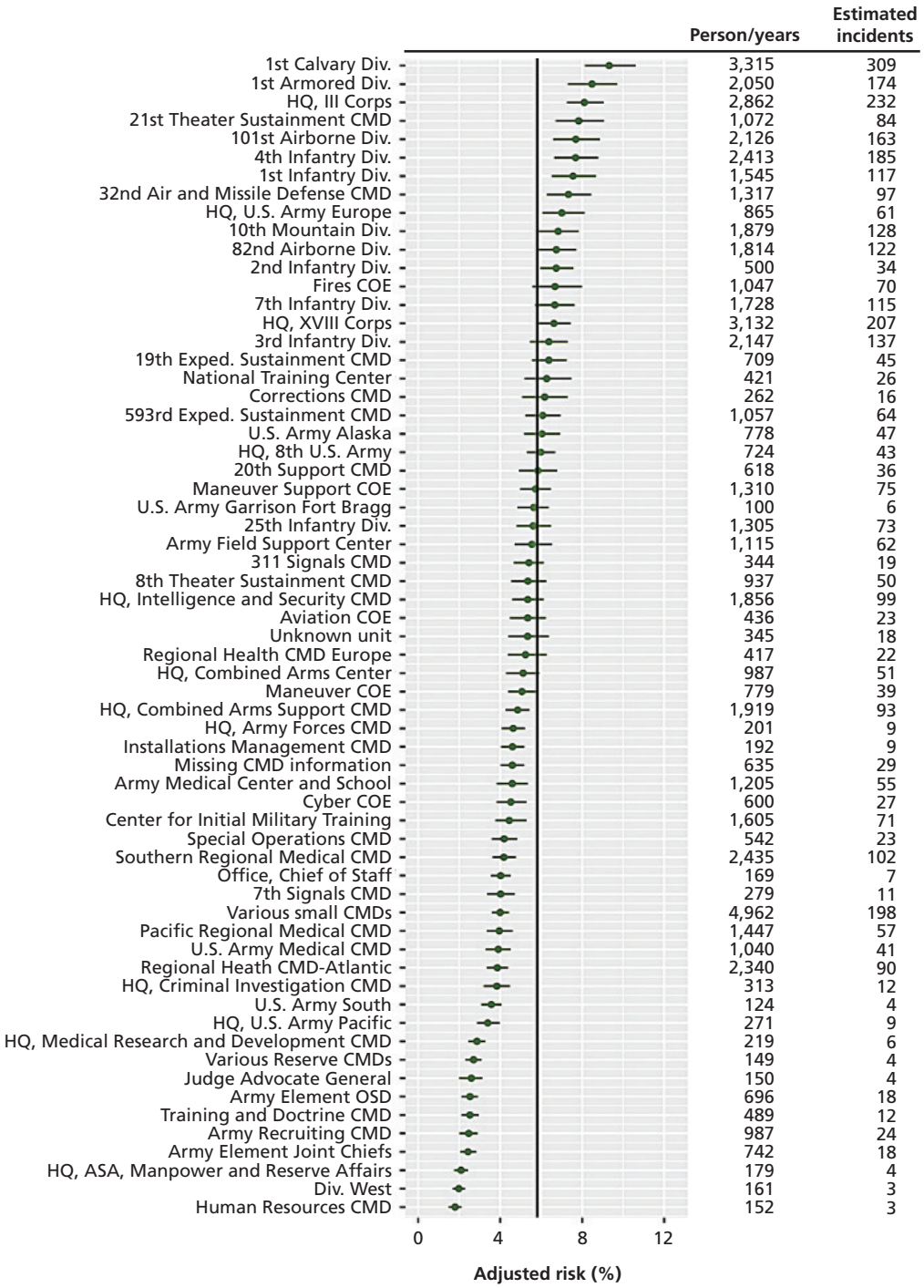
Total sexual assault estimates for men across commands in echelon 3 appear in Figure 3.6. Notably, none of the echelon 3 commands were associated with total sexual assault risk estimates that were highly likely to be above the average total risk of 0.64 percent. These include the 1st Armored Division (0.8 percent total risk), which was also associated with one of the highest total sexual assault risk estimates among Army women. Multiple commands were associated with total sexual assault risk likely to be below the average of 0.64 percent for Army men. Among these are the First Army Division East and West (0.4 percent total risk) and U.S. Army Training and Doctrine Command (0.4 percent total risk). Similar to commands with lower sexual assault risk for women, lower-risk commands for men included multiple HQ units, schools, and centers of excellence.

Adjusted Sexual Assault Risk by Command Echelon 3

As seen in Figure 3.7, the five echelon 3 commands associated with the highest total sexual assault risk among Army women are also associated with the highest adjusted sexual assault risk, although the CI for the 4th Infantry Division includes zero. In other words, even after adjusting for personnel characteristics, these commands continue to display high sexual assault risk among Army women. For example, the 1st CD has an adjusted sexual assault risk estimate of 2.2 percent. This suggests that an Army woman with the demographic and service history characteristics placing her at the average sexual assault risk of women in the Army (5.8 percent) would be expected to have a risk closer to 8.0 percent if she were in the 1st CD (5.8 percent + 2.2 percent = 8.0 percent).

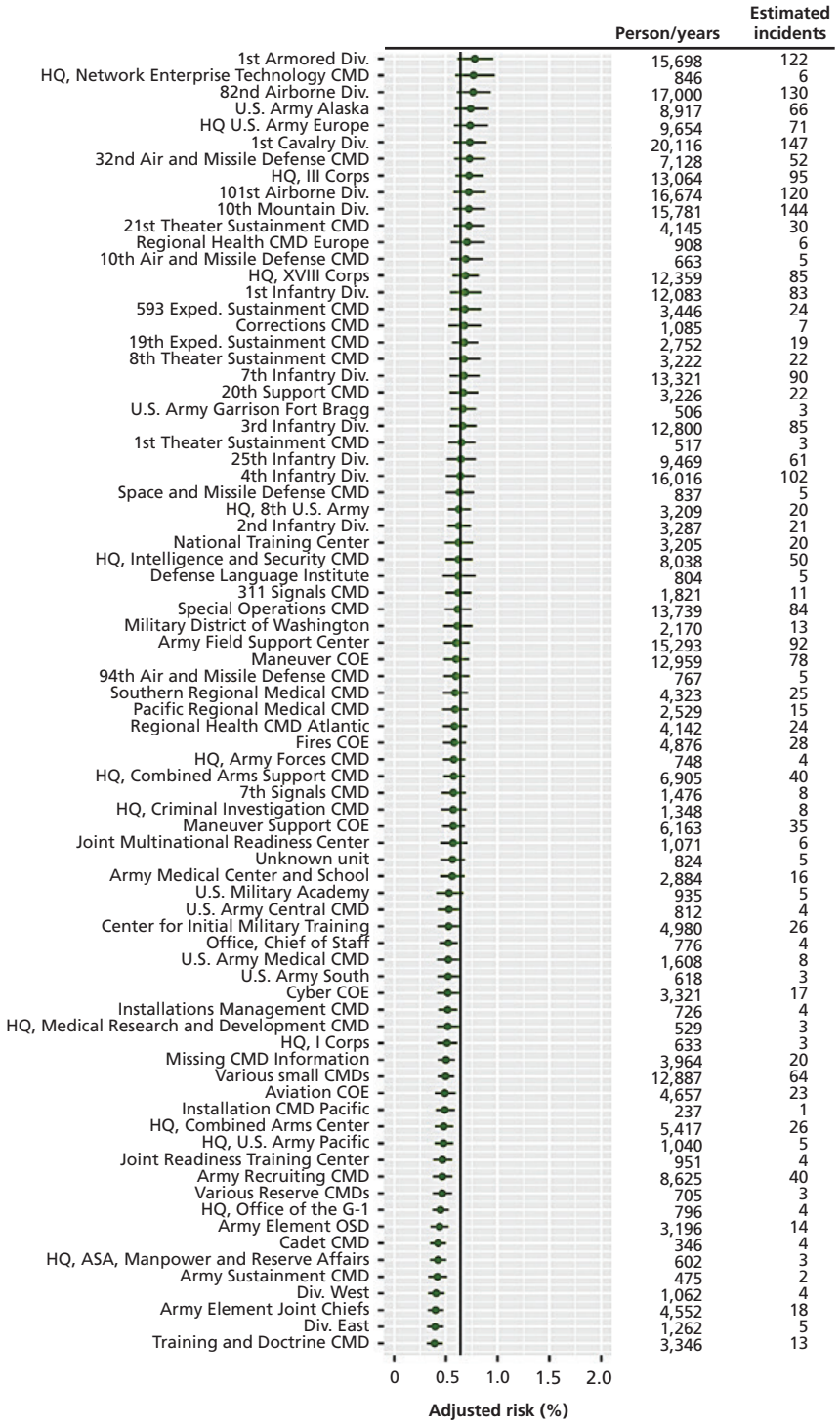
Several medical commands are associated with the lowest adjusted sexual assault risk estimates among Army women. These include, for example, U.S. Army Northern Regional Command (–0.8 percent adjusted risk) and U.S. Army Southern Regional Command (–0.8 percent adjusted risk). The U.S. Army Medical Research and Materiel Command (–0.9 percent adjusted risk) is also among the commands with the lowest adjusted sexual assault risk among

Figure 3.5
Total Sexual Assault Risk by Command Echelon 3 for Women, 2018



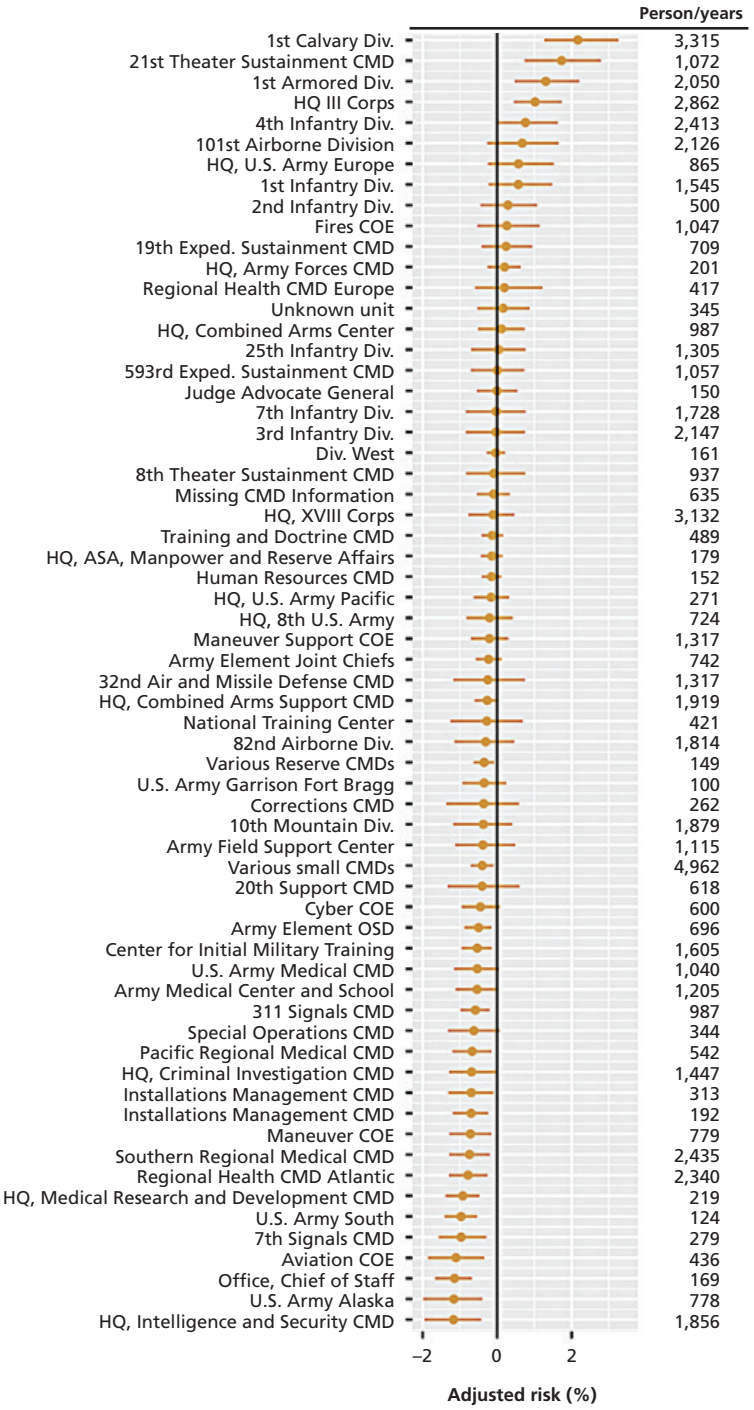
NOTES: ASA = Assistant Secretary of the Army; CMD = command; COE = center of excellence; Div. = division; Exped. = expeditionary. *Total sexual assault risk* is an estimate of the proportion of service members of a given sex who were sexually assaulted between roughly August 2017 and July 2018.

Figure 3.6
Total Sexual Assault Risk by Command Echelon 3 for Men, 2018



NOTE: *Total sexual assault risk* is an estimate of the proportion of service members of a given sex who were sexually assaulted between roughly August 2017 and July 2018.

Figure 3.7
Adjusted Sexual Assault Risk by Command Echelon 3 for Women, 2018



NOTE: *Adjusted risk* is the risk of sexual assault greater (or less than) expected for members of the stratification based on their demographic and service history characteristics.

Army women. The Alaska Command and Installations Command are associated with the lowest adjusted risk, at approximately –1.2 percent each.

Figure 3.8 illustrates adjusted sexual assault risk estimates for men in the Army across echelon 3 commands. None were associated with adjusted sexual assault risk estimates that were highly likely to be above zero. In addition, only two echelon 3 commands are highly likely to be below zero, the U.S. Army Aviation Center of Excellence (–0.1 percent adjusted risk) and the U.S. Army Office of the Deputy Chief of Staff for Personnel (–0.1 percent adjusted risk). As with adjusted risk for installations, these results identify relatively modest differentiation of men's adjusted risk across echelon 3 commands.

Sexual Assault Risk by Soldier Career Management Field Cluster

In addition to installation and command echelons, we examined sexual assault risk across various CMFs, or groupings of professions or military occupation specialties. This included one group for women and one for men, where we aggregated CMFs that had too few soldiers of the same gender to produce individual estimates for each. Appendix D provides a listing of all CMFs and how we aggregated them for the purposes of the analyses described here.

Total Sexual Assault Risk by Career Management Field

Among Army women, several CMFs have total sexual assault risk that is likely to be higher than the average risk to Army women (see Figure 3.9). In particular, Army women in field artillery have the highest total sexual assault risk, 10.6 percent. This is the highest total sexual assault risk for any cluster of women soldiers we evaluated across all approaches to stratifying soldiers into groups, and suggests that approximately 125 women in field artillery were sexually assaulted during the study year. Field artillery was the first combat CMF opened to women, and the only one with sufficient numbers of women to allow estimates of risk by the period covered by this project. Several additional CMFs are also likely to have higher-than-average total risk, including the corps of engineers, air defense artillery, equipment maintenance or repair, intelligence, ammunition, military police, and aviation.

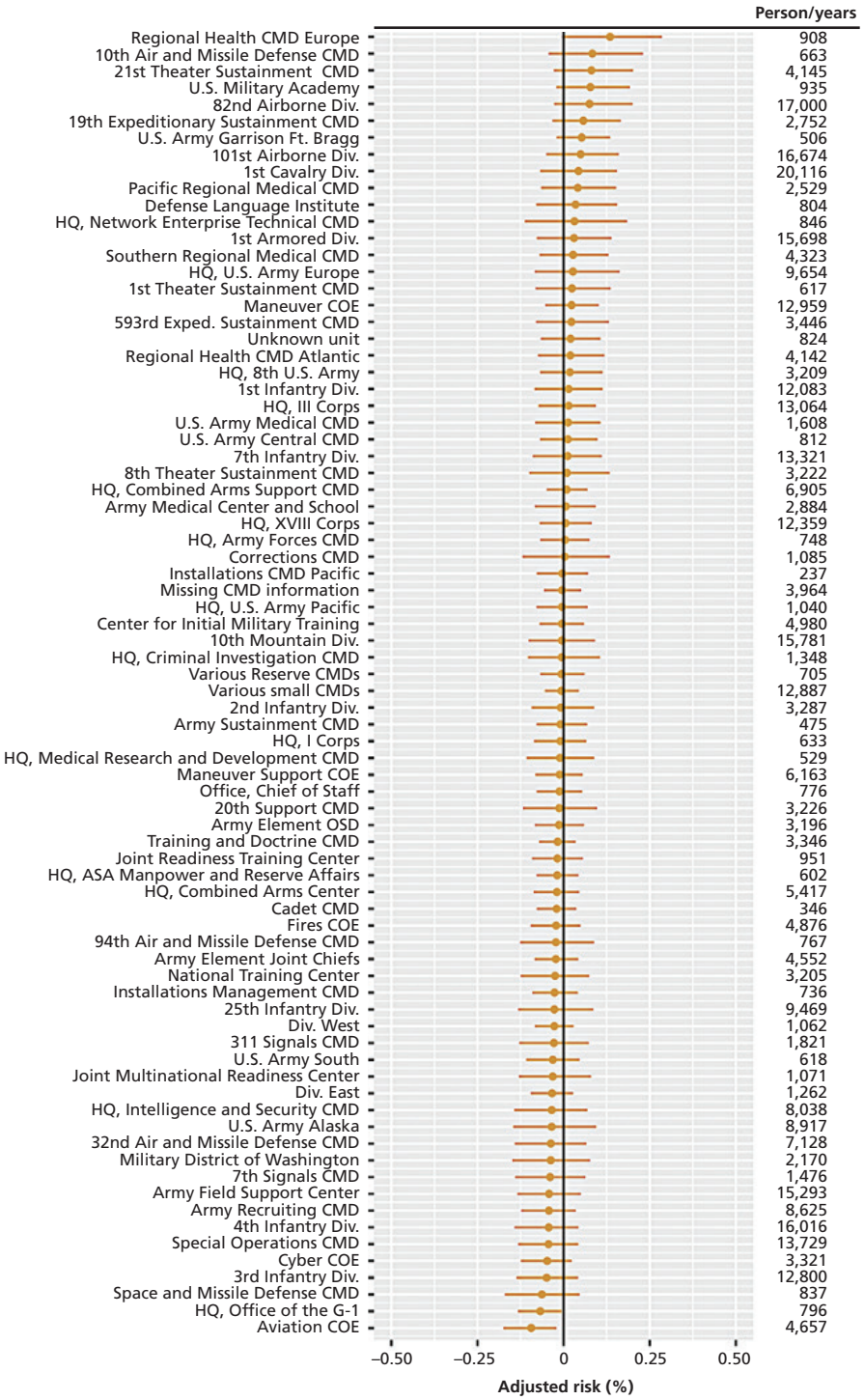
There is also strong evidence that several CMFs are associated with lower-than-average risk to Army women. Recruiting and counseling has the lowest estimated total sexual assault risk among Army women, 1.9 percent. Other CMFs with lower-than-average risk include food safety/veterinary, nurse, logistics, health services, public affairs, financial management, chaplains, paralegal/Judge Advocate General (JAG), and human resources.

Figure 3.10 displays total sexual assault risk estimates by CMF for men. Although there is no strong evidence that any CMF is associated with greater-than-average risk to men, there are many CMFs that are associated with lower-than-average risk. For example, operations support and acquisitions corps, with total sexual assault risk estimates of 0.3 and 0.4, respectively, appear to have particularly low risk. Several others with lower-than-average risk for women are also associated with lower-than-average risk for men, including recruiting and counseling, nurse, health services, logistics, and chaplains.

Adjusted Sexual Assault Risk by Career Management Field

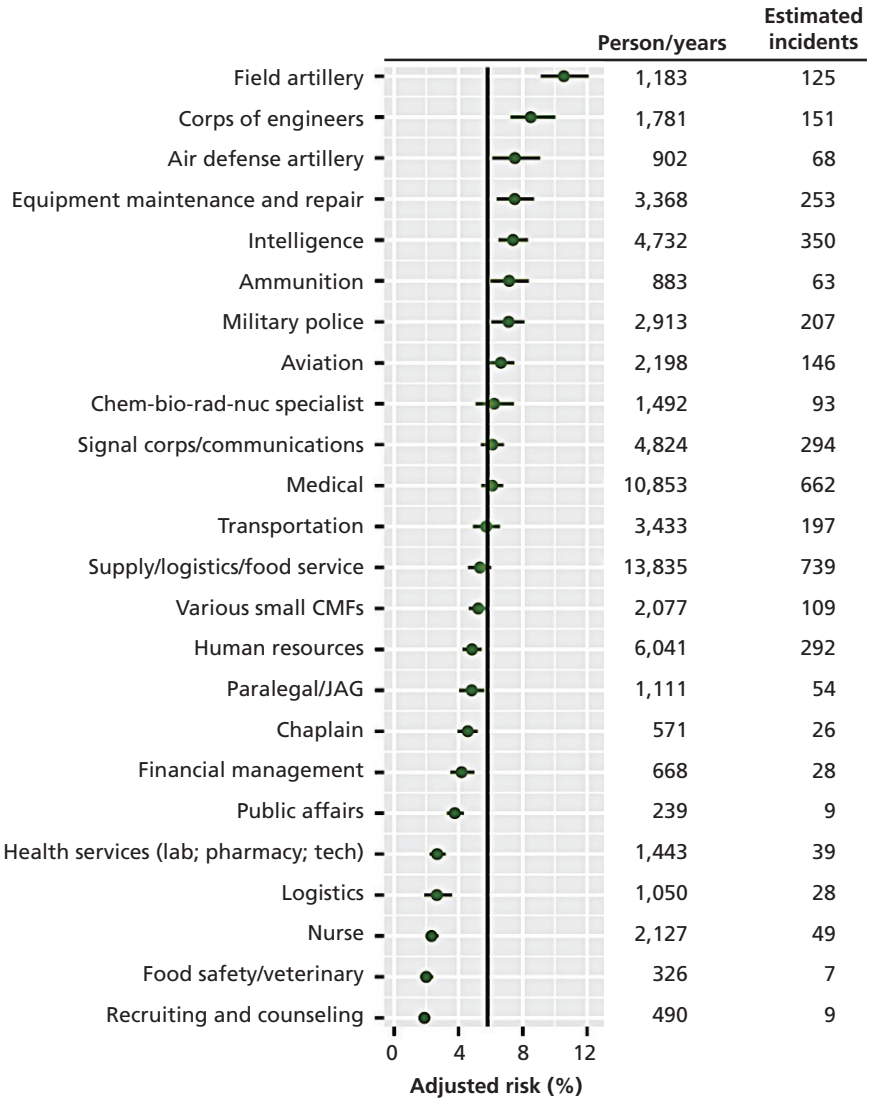
The CMF with the highest total sexual assault risk for Army women, namely field artillery, also has the highest adjusted risk (see Figure 3.11). Risk to women in this CMF is about

Figure 3.8
Adjusted Sexual Assault Risk by Command Echelon 3 for Men, 2018



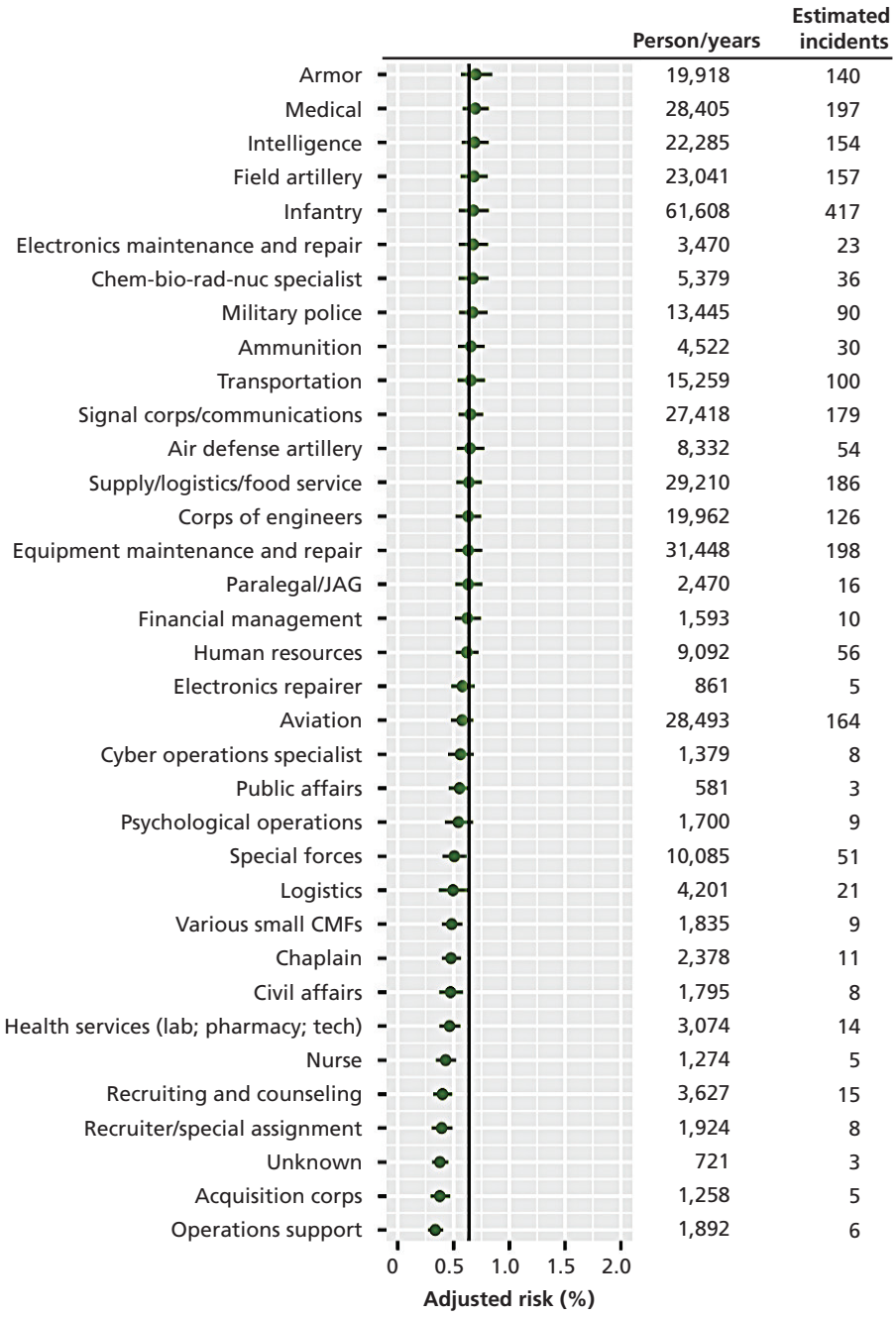
NOTE: *Adjusted risk* is the risk of sexual assault greater (or less than) expected for members of the cluster based on their demographic and service history characteristics.

Figure 3.9
Total Sexual Assault Risk by Soldier Career Management Field for Women, 2018



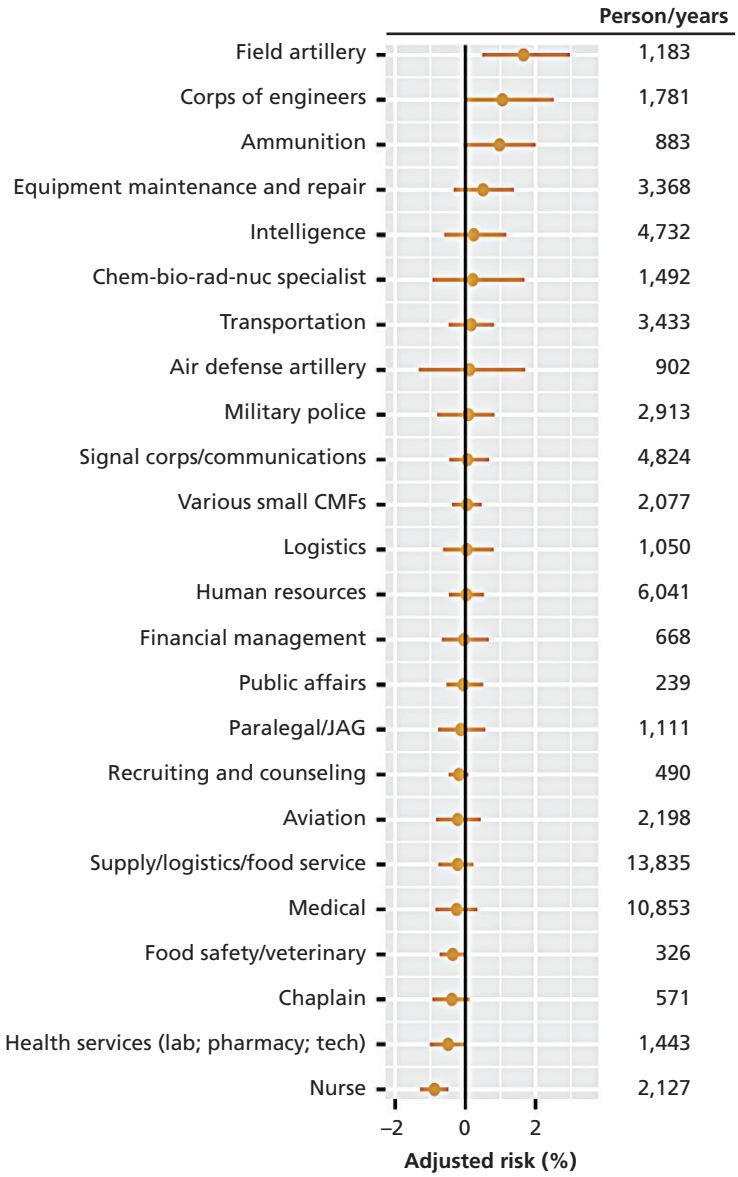
NOTES: Chem-bio-rad-nuc = chemical, biological, radiological, and nuclear. *Total sexual assault risk* is an estimate of the proportion of service members of a given sex who were sexually assaulted between roughly August 2017 and July 2018. Appendix D describes how the labels used in this table correspond with CMF codes and career

Figure 3.10
Total Sexual Assault Risk by Soldier Career Management Field for Men, 2018



NOTES: *Total sexual assault risk* is an estimate of the proportion of service members of a given sex who were sexually assaulted between roughly August 2017 and July 2018. Appendix D describes how the labels used in this table correspond with CMF codes and career descriptions.

Figure 3.11
Adjusted Sexual Assault Risk by Soldier Career Management Field for Women, 2018



NOTES: *Adjusted risk* is the risk of sexual assault greater (or less than) expected for members of the cluster based on their demographic and service history characteristics. Appendix D describes how the labels used in this table correspond with CMF codes and career descriptions.

1.7 percent higher than would be expected based on personnel characteristics. In other words, an Army woman with average total risk (i.e., 5.8 percent) would be expected to have a risk of 7.5 percent (i.e., 5.8 percent + 1.7 percent = 7.5 percent) if she served in field artillery. Several of the lowest adjusted risk CMFs for women involve medical or veterinary occupations, including the two lowest risk CMFs, nurse (–0.9 percent) and health services (–0.5 percent).

No CMFs have adjusted sexual assault risk that is highly likely to be above zero for men, and two are associated with adjusted sexual assault risk that is highly likely to be below zero (Figure 3.12). The aviation and recruiter/special assignment CMFs, however, have a high probability of being associated with lower risk for men than would be expected based on their personnel characteristics.

Cluster Characteristics Associated with Adjusted Sexual Assault Risk Across Stratification Approaches

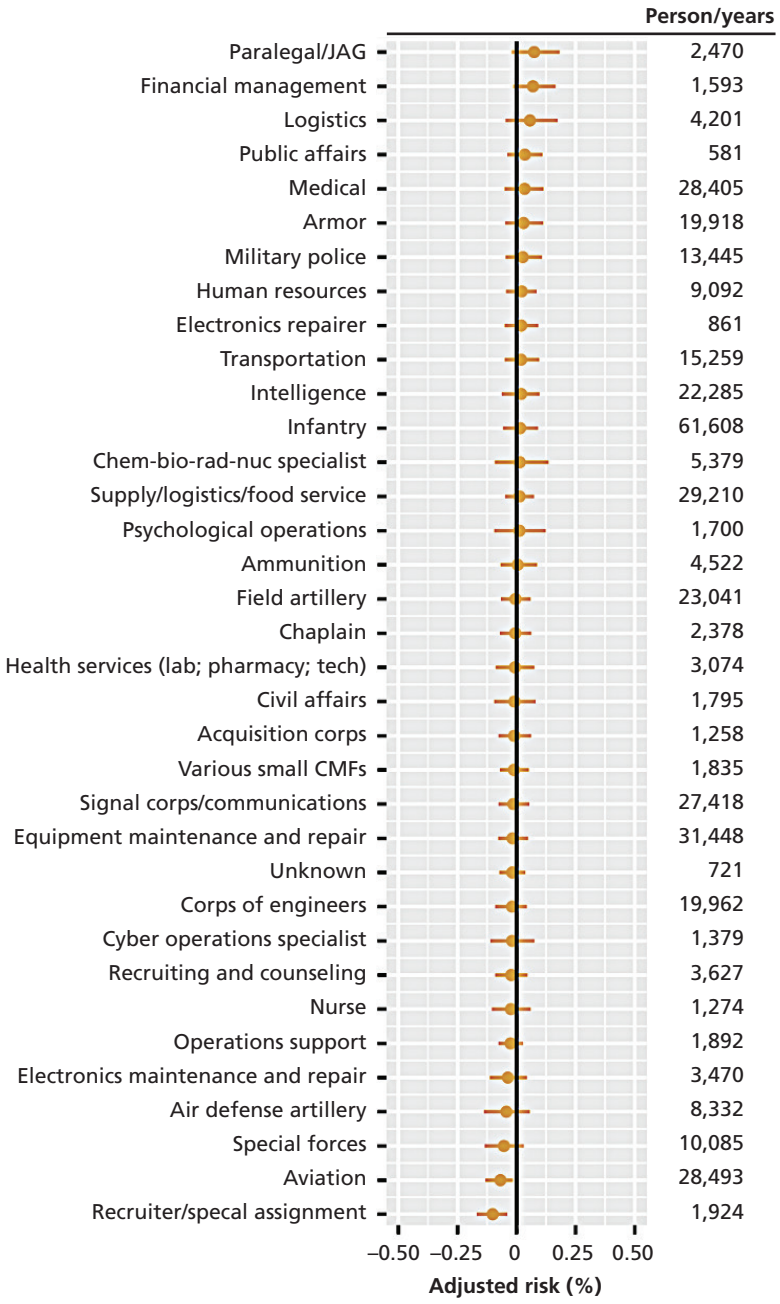
Our findings concerning higher and lower sexual assault risk among different clusters of soldiers raise important questions about what differs between the high- and low-risk clusters. To address these questions, we considered different cluster characteristics that might be associated with the adjusted sexual assault risk. This information could highlight environmental or other characteristics under the control of the Army that could be targeted for intervention to ameliorate sexual assault risk, although these analyses cannot establish whether cluster characteristics associated with sexual assault risk are causing differences in risk. We examine a set of cluster characteristics for which good data is available, and which our Army sponsor believed might be important for distinguishing sexual assault risk.

In this section, we focus on adjusted sexual assault risk, not total risk, because many of the risk factors associated with total risk are well known. These include personnel characteristics, such as the age and rank of personnel in the cluster, their marital status, education level, occupation, and other characteristics discussed in Chapter One. Instead, we wanted to identify characteristics associated with sexual assault risk that is higher or lower than would be expected based on the characteristics of personnel in each cluster, which is measured with adjusted risk.

For each of the stratification approaches, Table 3.1 (women) and Table 3.2 (men) indicate the proportion of variance in adjusted sexual assault risk at the cluster level that is explained by each of the characteristics we considered.[5] In other words, we are estimating how much of the differences in adjusted risk at the cluster level can be accounted for by differences in the cluster characteristics listed in the tables. These tables also indicate the direction of the relationship between each of the cluster characteristics and sexual assault risk. Specifically, this relationship could be: consistently positive (+), indicated by a positive correlation with an 80 percent CI that does not include zero; consistently negative (–), indicated by a negative correlation with

[5] More precisely, we compute the variance in individual sexual assault risk that is explainable by a given cluster characteristic for a given type of stratification (e.g., how much does sexual assault risk vary as a function of the average deployment OPTEMPO, assessed at the installation level) and divide that by the total variance in individual sexual assault risk that can be explained by the stratification variable (e.g., the extent to which risk varies across installations). If variation in sexual assault risk across installations were perfectly correlated with the average deployment OPTEMPO of those installations, this statistic would equal 1. Additional information about how these effect-size metrics were computed is included at the end of Appendix A.

Figure 3.12
Adjusted Sexual Assault Risk by Soldier Career Management Field for Men, 2018



NOTES: *Adjusted risk* is the risk of sexual assault greater (or less than) expected for members of the cluster based on their demographic and service history characteristics. Appendix D describes how the labels used in this table correspond with CMF codes and career descriptions.

an 80 percent CI that does not include zero; or uncertain, indicated by an 80 percent CI that includes zero.

The proportions listed in each column do not add to 100 because the observed bivariate relationships are not independent of each other and might be describing the same or similar sources of variation among cluster characteristics. Because different approaches to stratifying soldiers lead to greater or lesser differentiation of soldiers' risks, the associations of each characteristic to each stratification approach should not be directly compared across these approaches. Instead, numerical comparisons of the explanatory value of each factor should be conducted within stratification approaches (columns in Tables 3.1 and 3.2).

Cluster Characteristics That Account for Adjusted Sexual Assault Risk Across Stratification Approaches for Women

Table 3.1 highlights how well each cluster characteristic explains the variation in Army women's adjusted sexual assault risk across each stratification approach. Three cluster characteristics show fairly consistent negative association with cluster sexual assault risk across stratification approaches: unit climate, supervisor climate, and the proportion of civilians. The negative associations for the climate scores means that clusters with better climate ratings have a lower risk of sexual assault. Point estimates for this association become larger at a higher command echelon so that at the major command level (echelon 1), these characteristics are associated with approximately one-quarter to one-third of the variance in commands' adjusted sexual assault risk. The proportion of civilians working at the installations that soldiers in each stratification are assigned to also has a relatively strong and negative association with adjusted risk across clusters. This suggests that, as the prevalence of civilians in the base environment grows for clusters of Army women, the risk of sexual assault to those clusters declines.

Three other cluster characteristics have a fairly consistent positive relationship with risk at the cluster level, the proportion of women assigned to a base who live on that base, the average deployment OPTEMPO of members of the cluster, and the proportion of the cluster made up of soldiers with combat arms occupations. This suggests the possibility that bases, commands, and CMFs with larger proportions of women who live on a base face higher sexual assault risks than would otherwise be expected given their personnel characteristics. Similarly, more deployments and environments with greater proportions of combat arms occupations are associated with increased adjusted risk for women. Across major commands, these three cluster characteristics are estimated to explain between 10 percent and 30 percent of the variance in an individual's adjusted risk associated with their membership in a major command.

Finally, three characteristics—administrative discharges, separations from the cluster, and recent transitions (churn in cluster personnel)—have a consistently weak and uncertain association with differences in adjusted cluster risk across all stratification approaches. This suggests that, for Army women, clusters where larger numbers of soldiers are being administratively discharged or where there is faster turnover in personnel assigned to a cluster or where a larger fraction of women is being administratively discharged are not clearly associated with elevated or reduced adjusted sexual assault risk.

Cluster Characteristics That Account for Sexual Assault Risk Across Stratification Approaches for Men

Table 3.2 highlights the proportion of variation across clusters in terms of adjusted sexual assault that is associated with each of the cluster characteristics among Army men. In keeping

Table 3.1
Proportion of Variance in Adjusted Sexual Assault Risk Associated with Cluster Characteristics Across Five Stratification Approaches, Women

Characteristic	Soldier CMF	Installation	Command Echelon 3	Command Echelon 2	Command Echelon 1
Proportion living on base	(+) 0.07 (<0.01, 0.17)	(+) 0.07 (<0.01, 0.17)	(+) 0.07 (0.02, 0.15)	(+) 0.11 (0.03, 0.22)	(+) 0.21 (0.07, 0.41)
Proportion of combat arms	0.11 (<0.01, 0.30)	(+) 0.07 (0.01, 0.15)	(+) 0.06 (<0.01, 0.13)	(+) 0.11 (0.01, 0.23)	(+) 0.30 (0.08, 0.55)
Deployment OPTEMPO	0.07 (<0.01, 0.19)	(+) 0.14 (0.05, 0.25)	(+) 0.03 (<0.01, 0.08)	(+) 0.06 (<0.01, 0.13)	(+) 0.10 (0.01, 0.22)
Good unit climate*	(–) 0.13 (0.00, 0.35)	(–) 0.11 (0.03, 0.22)	(–) 0.08 (0.02, 0.15)	(–) 0.14 (0.03, 0.30)	(–) 0.31 (0.09, 0.53)
Good supervisor climate**	(-) 0.10 (<0.01, 0.24)	(–) 0.04 (<0.01, 0.10)	0.02 (<0.01, 0.05)	(–) 0.09 (0.02, 0.17)	(–) 0.26 (0.08, 0.45)
Proportion of civilians	(–) 0.16 (0.01, 0.36)	(–) 0.11 (0.02, 0.24)	(–) 0.11 (0.03, 0.21)	(–) 0.15 (0.04, 0.28)	(–) 0.23 (0.07, 0.42)
Separations	0.04 (<0.01, 0.12)	0.03 (<0.01, 0.08)	0.01 (<0.01, 0.03)	0.02 (<0.01, 0.05)	0.04 (<0.01, 0.12)
Administrative discharges	0.07 (<0.01, 0.19)	0.03 (<0.01, 0.09)	0.02 (<0.01, 0.06)	0.04 (<0.01, 0.10)	0.06 (<0.01, 0.16)
Recent transitions***	0.03 (<0.01, 0.08)	0.03 (<0.01, 0.07)	0.02 (<0.01, 0.06)	0.03 (<0.01, 0.07)	0.04 (<0.01, 0.12)

NOTES: Parentheses under each estimate contain 80 percent CIs. The direction of the association is indicated in parentheses before the estimate: (–) means the 80 percent confidence interval for the slope of the relationship between the cluster characteristic and cluster sexual assault risk is negative and does not include zero, (+) indicates that the slope is positive and the CI does not include 0, and no symbol in parentheses before the estimate indicates a less consistent association between the characteristics and cluster risk (the 80 percent CI for the slope of the relationship includes 0).
* *Good unit climate* is the average of responses among women to questions regarding the behaviors of military members. Higher values indicate more-positive workplace behaviors, including more support for victims of sexual assault.
** *Good supervisor climate* is the average of responses among women to questions regarding how actively supervisors address unprofessional behaviors, sexual harassment, and other negative behaviors. Higher values indicate better responses.
*** *Recent transitions* is the percentage of a cluster's members that are new in an average month.

Table 3.2
Proportion of Variance in Adjusted Sexual Assault Risk That Is Associated with Cluster Characteristics Across Five Stratification Approaches, Men

Characteristic	Soldier CMF	Installation	Command Echelon 3	Command Echelon 2	Command Echelon 1
Proportion living on base	0.04 (<0.01, 0.12)	0.04 (<0.01, 0.10)	(+) 0.04 (<0.01, 0.10)	(+) 0.06 (<0.01, 0.15)	0.07 (<0.01, 0.21)
Proportion of combat arms	0.10 (<0.01, 0.25)	0.08 (<0.01, 0.24)	0.06 (<0.01, 0.16)	0.08 (<0.01, 0.22)	0.11 (<0.01, 0.31)
Deployment OPTEMPO	0.08 (<0.01, 0.23)	0.03 (<0.01, 0.07)	0.03 (<0.01, 0.09)	0.06 (<0.01, 0.16)	0.16 (<0.01, 0.42)
Good unit climate*	0.04 (<0.01, 0.10)	0.03 (<0.01, 0.08)	0.04 (<0.01, 0.10)	0.07 (<0.01, 0.17)	0.12 (<0.01, 0.29)
Good supervisor climate**	0.04 (<0.01, 0.11)	0.02 (<0.01, 0.05)	0.03 (<0.01, 0.07)	0.06 (<0.01, 0.15)	0.11 (<0.01, 0.28)
Proportion of civilians	0.07 (<0.01, 0.19)	0.03 (<0.01, 0.09)	0.03 (<0.01, 0.08)	0.04 (<0.01, 0.09)	0.07 (<0.01, 0.20)
Separations	0.04 (<0.01, 0.10)	0.02 (<0.01, 0.07)	0.01 (<0.01, 0.04)	0.02 (<0.01, 0.05)	0.07 (<0.01, 0.19)
Administrative discharges	0.08 (<0.01, 0.22)	0.09 (<0.01, 0.26)	0.07 (<0.01, 0.19)	0.12 (<0.01, 0.34)	0.21 (<0.01, 0.56)
Recent transitions***	0.07 (<0.01, 0.17)	0.17 (<0.01, 0.47)	0.13 (<0.01, 0.35)	0.15 (<0.01, 0.41)	0.26 (<0.01, 0.72)

NOTES: Parentheses under each estimate contain 80 percent CIs. The direction of the association is indicated in parentheses before the estimate: (–) means the 80 percent CI for the slope of the relationship between the cluster characteristic and cluster sexual assault risk is negative and does not include zero, (+) indicates that the slope is positive and the CI does not include 0, and no symbol in parentheses before the estimate indicates a less consistent association between the characteristics and cluster risk (the 80 percent CI for the slope of the relationship includes 0).
* *Good unit climate* is the average of responses, among men, to questions regarding the behaviors of military members. Higher values indicate more positive workplace behaviors, including more support for victims of sexual assault.
** *Good supervisor climate* is the average of responses among men to questions regarding how actively supervisors address unprofessional behaviors, sexual harassment, and other negative behaviors. Higher values indicate better responses.
*** *Recent transitions* is the percent of the unit's members that are new in an average month.

with the relatively weak differentiation of adjusted sexual assault risk using each of the stratification approaches (discussed earlier in this chapter), it is not surprising that very few of the cluster characteristics appear to explain differences in adjusted risk that is attributable to cluster membership. All of the estimates have confidence intervals that approach zero (meaning that the cluster characteristic is not associated with differences in cluster-level adjusted risk). Moreover, most of the point estimates are quite small. Only two estimates are for a cluster characteristic that has a consistent association with adjusted risk, and both concern the proportion of individuals living on base (at the echelon 3 and 2 levels).

We conclude from this analysis that the very small differentiation in Army men's adjusted sexual assault risk that is offered by the stratification approaches that we examined is not consistently associated with any of the cluster characteristics that we examined, with the possible exception of a small but consistent association suggesting that commands with more men living on base might have higher adjusted risk for men (a relationship also found for Army women with this cluster characteristic).

Stability of Installation Sexual Assault Risk over Time

To examine the stability of sexual assault risk over time, we compared total and adjusted risk for each cluster in FY 2016 with their risks as estimated in FY 2018. As seen in Table 3.3, correlations between FY 2016 and FY 2018 total risk are quite high for men and women across stratification approaches. Indeed, cluster risk in FY 2016 is one of the best predictors of cluster risk in FY 2018 that we examined. This indicates that installations, CMFs, and commands that have low total risk in FY 2016 can be expected to have low risk two years later, and higher-risk clusters can be expected to remain higher risk two years later. Furthermore, these relative rates of risk remain stable despite considerable turnover in personnel for many clusters.

Interestingly, however, adjusted risk shows lower correlations over time. That said, that adjusted risk still exhibits stability in relative rates over time for men and women—and that correlations are high for men—is interesting. For most stratification approaches, we did not see estimates of adjusted risk for men for which there was good evidence of clearly elevated or reduced risk. Nevertheless, the fact that the correlation is relatively strong between FY 2016

Table 3.3
Correlations Between 2016 and 2018 Estimates of Total and Adjusted Sexual Assault Risk, by Stratification Approach and Sex

	Total Risk		Adjusted Risk	
Stratification approach	**Women**	**Men**	**Women**	**Men**
Installation	0.84	0.84	0.49	0.60
Soldier CMF	0.92	0.94	0.42	0.39
Echelon 1 commands	0.82	0.75	0.42	0.17
Echelon 2 commands	0.88	0.79	0.32	0.44
Echelon 3 commands	0.88	0.84	0.46	0.42

and FY 2018 for most stratification approaches indicates that the small differences in adjusted risk that we found for men might be meaningful.

For the installations stratification approach, we can also compare the 2018 estimates of total and adjusted risk with 2014 estimates produced from the RMWS (see Morral et al., 2018). Here again, the correlation of total risk estimates for installations in both waves of estimates was relatively high for total risk (0.87 for women and 0.79 for men), although adjusted risk is more attenuated across this four-year span of time (0.41 for women and 0.27 for men).[6]

Figures 3.13 and 3.14 depict the correlation of FY 2016 and FY 2018 installation-adjusted risk estimates for women and men. Apart from the clear association between the earlier and later estimates, the figures suggest that some installations swung from having relatively low-risk estimates to relatively high-risk estimates (e.g., Landstuhl Regional Medical Center for women and to a lesser extent for men), or the reverse (e.g., Fort Jonathan Wainwright for women). These seemingly large changes in adjusted risk could be an artifact that results from uncertainties in our risk estimates. Alternatively, these changes in risk might reflect real changes in the risk environment at these installations. It could be useful to examine these installations as case studies to generate hypotheses about influences at these bases that might have changed during the interval. Such case studies could help to identify factors that are important differentiators of cluster risk, but which have not yet been isolated. The lower correlations for adjusted risk between 2018 and 2014 make for a less clear visual depiction of that correlation. Nevertheless, figures with all three years (2018, 2016, and 2014) are included in Appendix B for reference.

The correlation in risk estimates is not just limited to the years 2016 and 2018. RAND previously estimated installation and command risk for the Army using 2014 data from the Workplace and Gender Relations Survey, a precursor to the current WGRA survey. Of the seven installations that we found to have higher than average risk for women in 2018, six were also found to have higher than average risk in 2014.

Similarities Between Risk Distributions for Women and Men

Although estimated separately, the distributions of total and adjusted sexual assault risk for men and women show a high level of correspondence: Clusters of soldiers that are associated with high risk for women also tend to be high risk for men, and this is true for nearly all stratifications of soldiers. Table 3.4 describes the correspondence between risk to men and women in terms of how correlated their cluster risk scores are. For total risk, the correspondence is high, ranging from a correlation of 0.78 for soldier CMF clusters to a high of 0.92 for echelon 1 commands. This indicates that clusters that have high total risk for women are quite likely to have high risk for men, and vice versa.

For adjusted risk, correlations are lower—but still moderate to strong—except for CMF, where there is virtually no correlation between adjusted risk for men and women. This means that for most stratifications, there are likely to be risk factors for sexual assault shared by men and women, and these risk factors are different than the risk associated with a soldier's indi-

[6] Because of variations in terms of which installations we could construct risk estimates for in each of the three years we are studying, the number of installations that can be matched to produce these correlations differs for the 2018 to 2016 comparison (n = 41 for women and n = 59 for men), compared with the 2018 to 2014 comparison (n = 30 for women, n = 39 for men).

Figure 3.13
Installation-Adjusted Risk Estimates for 2016 and 2018, Women

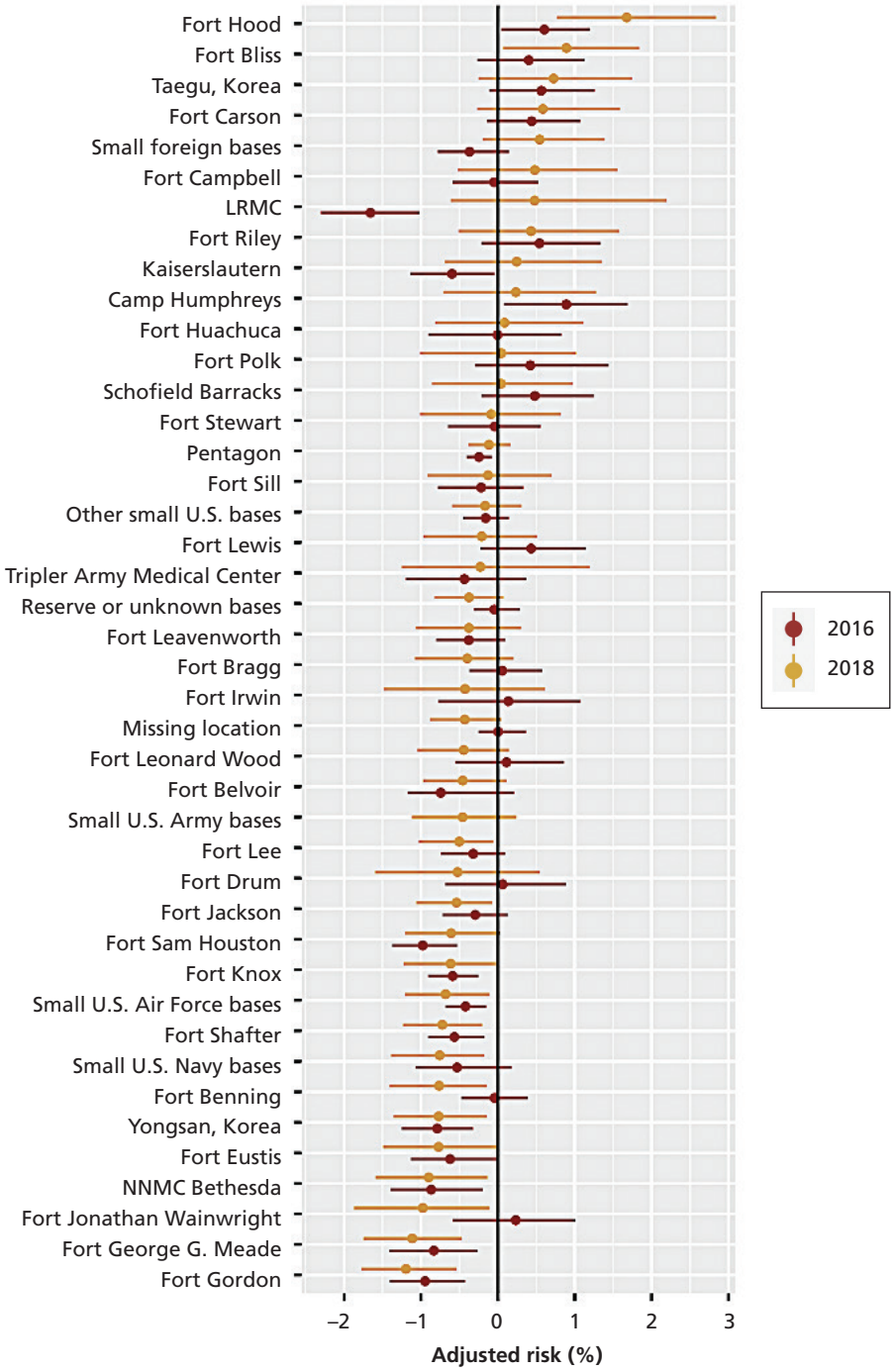


Figure 3.14
Installation-Adjusted Risk Estimates for 2016 and 2018, Men

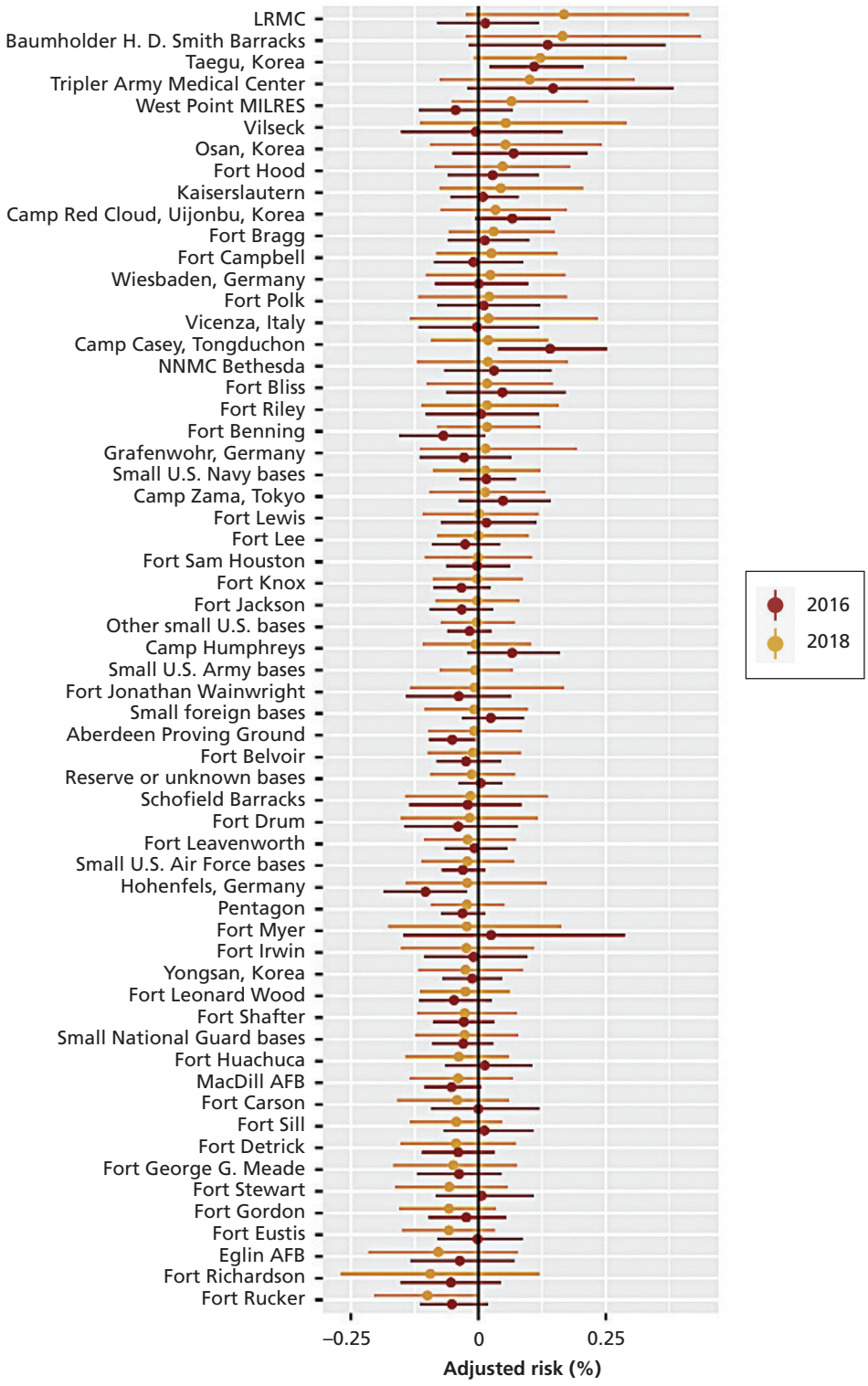


Table 3.4
Correlation Between Men and Women in 2018 Sexual Assault Risk Estimates by Stratification Approach, Total and Adjusted Risk

Stratification approach	Total Risk	Adjusted Risk
Installation	0.81	0.45
Soldier CMF	0.78	–0.04
Echelon 1 commands	0.92	0.58
Echelon 2 commands	0.91	0.50
Echelon 3 commands	0.87	0.45

vidual characteristics, such as their age, rank, officer or enlisted status, education, marital status, or any of the other personnel characteristics for which we can adjust risk scores. The anomalously low correlations between cluster risk for men and women in CMF might reflect the fact that several of the largest CMFs had too few women by FY 2018 for us to estimate risk for women in these clusters. This includes the infantry and armor CMFs.

The fairly strong association between adjusted risk for men and women occurs despite the fact that we identified few clusters for men with adjusted risk estimates that were highly likely to have an adjusted risk different from zero. The fact that estimates of risk for individual installations are not reliably different from the average risk does not imply that that variance in risk across installations is descriptively small or that the variability is not highly associated with other installation characteristics. As seen in the following chapter, adjusted risk estimates for sexual harassment of men are also correlated with men's adjusted sexual assault risk estimates, though in the case of sexual harassment, many more point estimates have strong evidence of being above or below zero.

Summary

In this chapter, we examined how sexual assault risk varies across clusters or groups of soldiers. The stratification approaches that we considered included location, command, and CMF, and we considered both total sexual assault risk and adjusted sexual assault risk. Total risk is an estimate of the proportion of soldiers in a given cluster who were sexually assaulted in the past year, and adjusted risk can be thought of as the component of soldiers' sexual assault risk that is above or below what would be expected given personnel characteristics. For Army women, we found considerable variation in total and adjusted sexual assault risk when stratifying by location and command echelon 3, with less differentiation by CMF. Across stratification approaches, we found less differentiation in sexual assault risk among Army men. This might be in part because of difficulty in establishing reliable estimates among groups of Army men because of the relatively low number of sexual assaults experienced by Army men during the study year. In addition, we assessed whether adjusted sexual assault differences across clusters were associated with other characteristics of those clusters. Several patterns emerged that appear to reflect true underlying associations between cluster characteristics and stratifications. Specifically, among Army women, unit climate, supervisor climate, and the proportion of civilians at the base are consistently negatively associated with sexual assault risk. Proportion

of individuals living on base, deployment OPTEMPO, and proportion of combat arms show relatively consistent positive associations with risk. Among Army men, the characteristics we considered do not appear to be consistently associated with sexual assault risk, with the exception of two negative associations seen among command echelons 2 and 3 for proportion living on base. We provide a more detailed overview of the results and recommendations based on these results in the final chapter.

CHAPTER FOUR

Sexual Harassment Risk Results

In this chapter, we describe the results of our analyses of Army organizational characteristics associated with sexual harassment risk in FY 2018. During this period, the total average risk of a sexual harassment to Army women was 24.4 percent and to Army men was 6.5 percent,[1] as estimated in the 2018 WGRA (Breslin et al., 2019). Adjusted sexual harassment risk indicates that the risk associated with each cluster of soldiers is not explained by the personnel characteristics that we considered (see Chapter Two). For these analyses, we used the same stratification approaches as those used to examine sexual assault risk, namely installation, command echelons 1 through 3, and soldier CMF (see Chapter Three). Finally, we again consider the characteristics of clusters associated with adjusted sexual harassment, and we examine the stability of sexual harassment risk over time. We provide additional information and results in Appendix C, which is not publicly available.

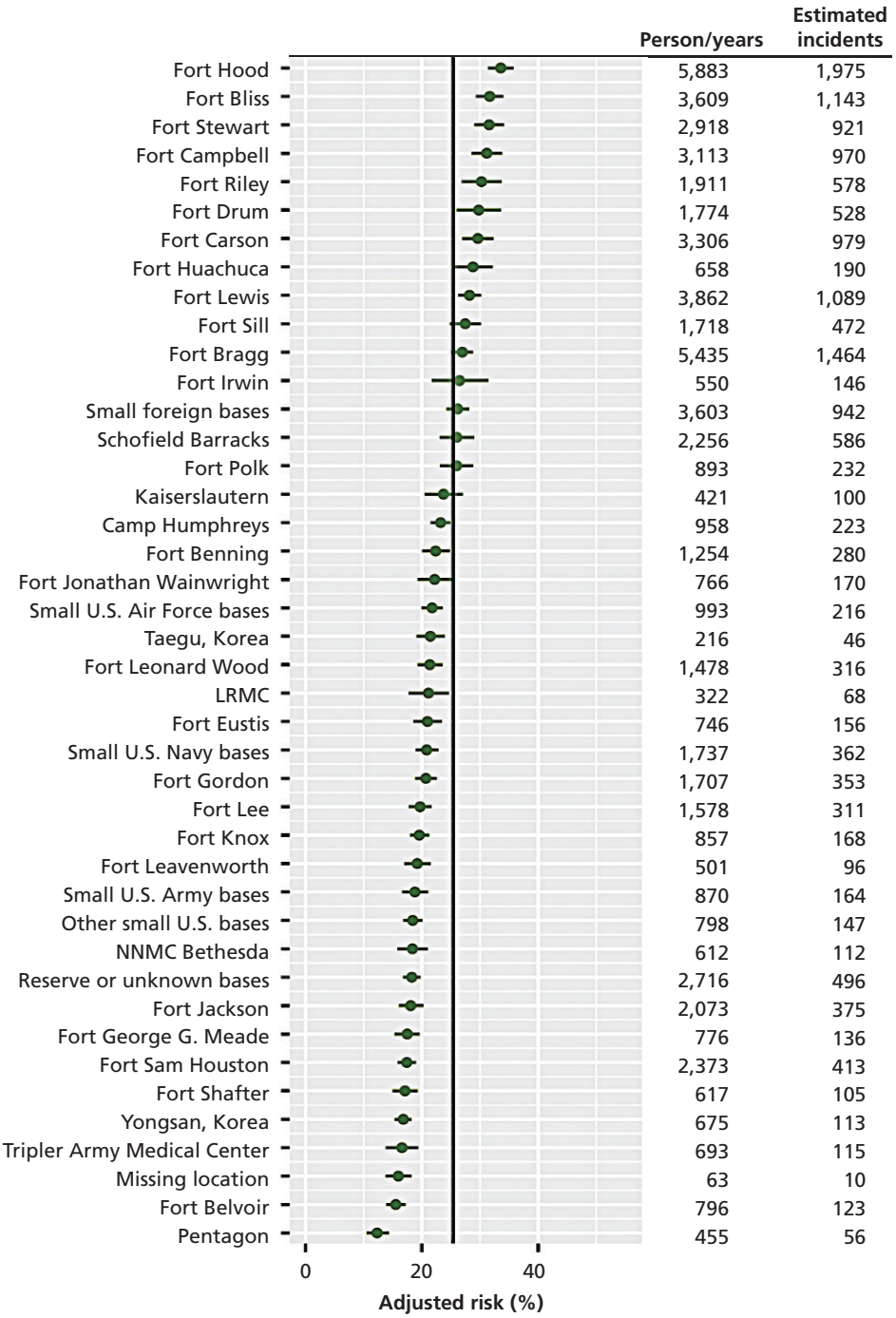
Notably, sexual harassment risk is highly correlated with sexual assault risk for all stratifications of soldiers and for men and women. Indeed, for total sexual harassment risk, the lowest such correlation is 0.85 (for the correlation of women's total sexual assault and total sexual harassment risk across echelon 2 commands), and the highest is 0.97 (total risk to women across CMF clusters). With correlations this high, there is little additional information about risk offered by total sexual harassment risk beyond what we already know from total sexual assault risk (see Chapter Three). The clusters that are high (or low) on one will be high (or low) on the other.

To illustrate this point, Figure 4.1 describes total sexual harassment risk by installation for women. Of the seven installations with the highest total estimates of sexual harassment risk, five are also among the seven locations with the highest total sexual assault risk (see Figure 3.1), and all are among the 15 highest sexual assault risk locations. Similarly, of the ten lowest total harassment risk locations, seven locations have the lowest total sexual assault risk, and nine are among the 15 lowest adjusted sexual assault risk locations.

Because of this high level of overlap between total sexual assault risk and total sexual harassment risk, we will not summarize findings on total sexual harassment in this chapter. Instead, we will focus on adjusted sexual harassment risk, for which correlations with adjusted sexual assault risk remain high (ranging from 0.46 to 0.75 across stratifications for men and women), although they are not so high that the cluster rankings for adjusted harassment risk

[1] The published 2018 sexual harassment rate for women in the Army was 24.3 percent, using the survey weighting procedures adopted by OPA (Breslin et al., 2019). Using different methods and data, our approach to imputing sexual harassment risk arrived at a slightly higher estimate for women in the Army, 24.4 percent. For men, our estimate of 6.5 percent is larger than the 6.0 percent estimate published by OPA.

Figure 4.1
Total Sexual Harassment Risk by Installation for Women, 2018



NOTE: *Total sexual harassment risk* is an estimate of the proportion of service members of a given sex who were sexually harrassed between roughly August 2017 and July 2018.

simply reproduce those for sexual assault. Complete total sexual harassment estimates for all stratifications of soldiers is available in Appendix C (not publicly available).

Adjusted Sexual Harassment Risk by Installation

Figure 4.2 summarizes the adjusted sexual harassment risk estimates by installation for Army women. As was the case with adjusted sexual assault risk, Fort Hood and Fort Bliss are among the installations with the highest adjusted sexual harassment risk. In the case of Fort Hood, these results suggest that a woman with average sexual harassment risk of 24.4 percent might be expected to have a risk of 29.9 percent if she were assigned to Fort Hood (24.4 percent + 5.5 percent = 29.9 percent). All five installations with the highest adjusted sexual harassment risk have a large number of personnel assigned to them. Even the smallest, Fort Stewart (Georgia), is still larger than any of the 18 installations found to have lower risk than expected given the personnel characteristics of soldiers assigned to them. Among these lower-risk bases are three in South Korea, several medical facilities, and the cluster of soldiers comprising all women serving at locations too small for individualized estimates to be calculated.

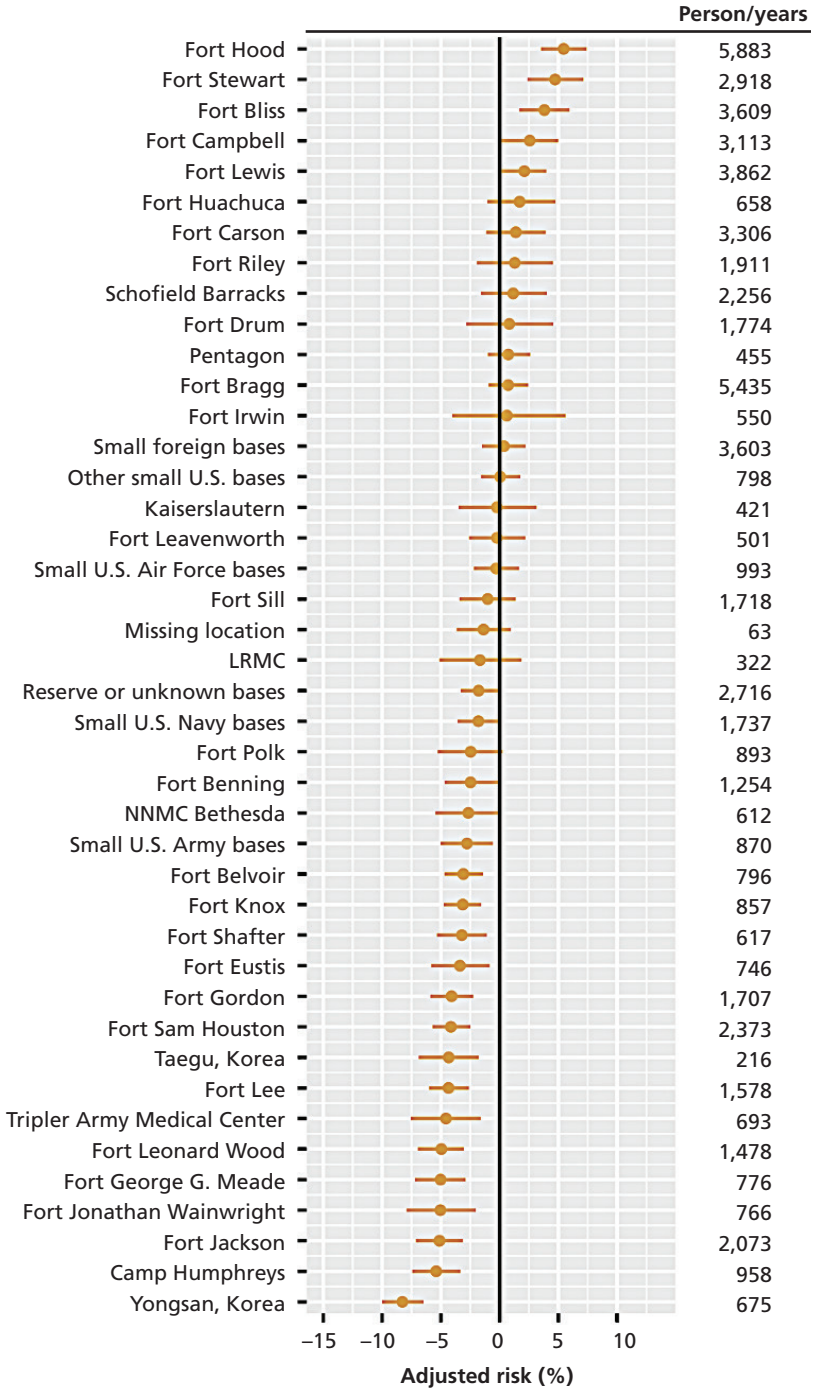
Figure 4.3 describes adjusted sexual harassment risk for Army men across installations. Only Baumholder Smith Barracks provides strong evidence for higher risk than expected based on the characteristics of soldiers assigned there, and it was also the only base with a higher-than-expected risk of sexual assault for men. This base and three other of the highest-risk locations are located in Germany. All but four of the installations with evidence of lower-than-expected risk were also among those with lower-than-expected sexual harassment risk for women. An exception is Fort Stewart, which had higher-than-expected risk for women.

Adjusted Sexual Harassment Risk by Command Echelon 3

Eleven echelon 3 commands are associated with greater risk to Army women than expected based on the characteristics of women assigned to them (see Figure 4.4). Apart from a few headquarters commands, including Army Forces Command, Army Special Operations Command, and soldiers working in I Corps HQ, the commands with higher-than-expected sexual harassment risk for women are dominated by infantry, armored, and cavalry divisions. In contrast, few combat commands appear among the echelon 3 commands with lower-than-expected sexual harassment risk, with the exception of the 2nd Infantry Division and the Eighth Army, both of which are based in Korea. Instead, these lower-risk commands include multiple medical commands, schools and training commands, headquarters activities, and combat support commands.

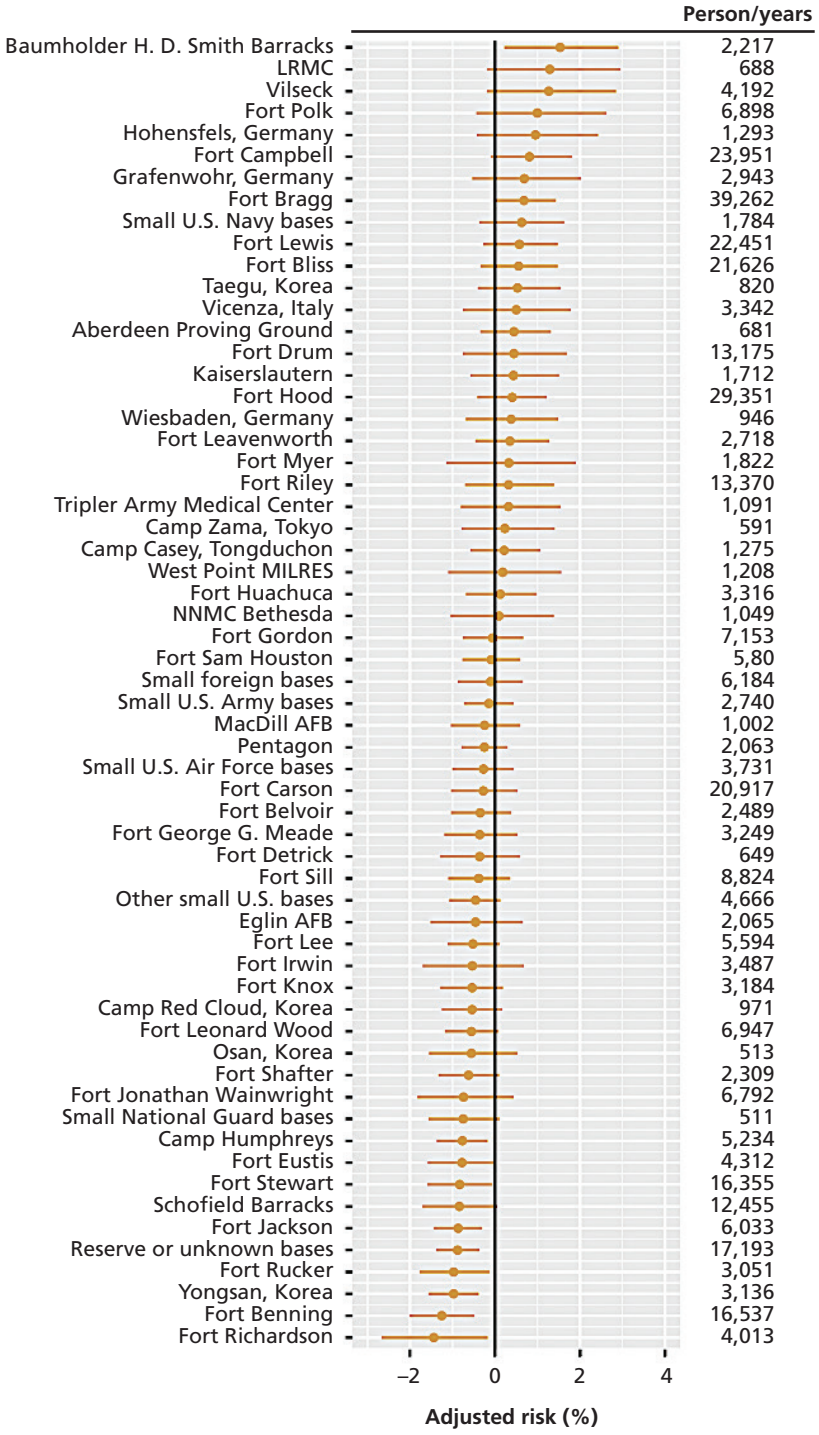
Only two echelon 3 commands are associated with higher-than-expected sexual harassment risk for Army men, and the commands with the highest point estimates for adjusted sexual harassment risk are not as clearly dominated by combat commands as was true for women (see Figure 4.5). Indeed, the highest adjusted risk location for men is the Defense Language Institute, and two of the combat commands associated with highest adjusted risk for women are likely to have lower-than-expected risk for men, such as the 3rd and 25th Infantry Divisions. Similar to women, the lower-risk commands include several training commands and the Recruiting Command.

Figure 4.2
Adjusted Sexual Harassment Risk by Installation for Women, 2018



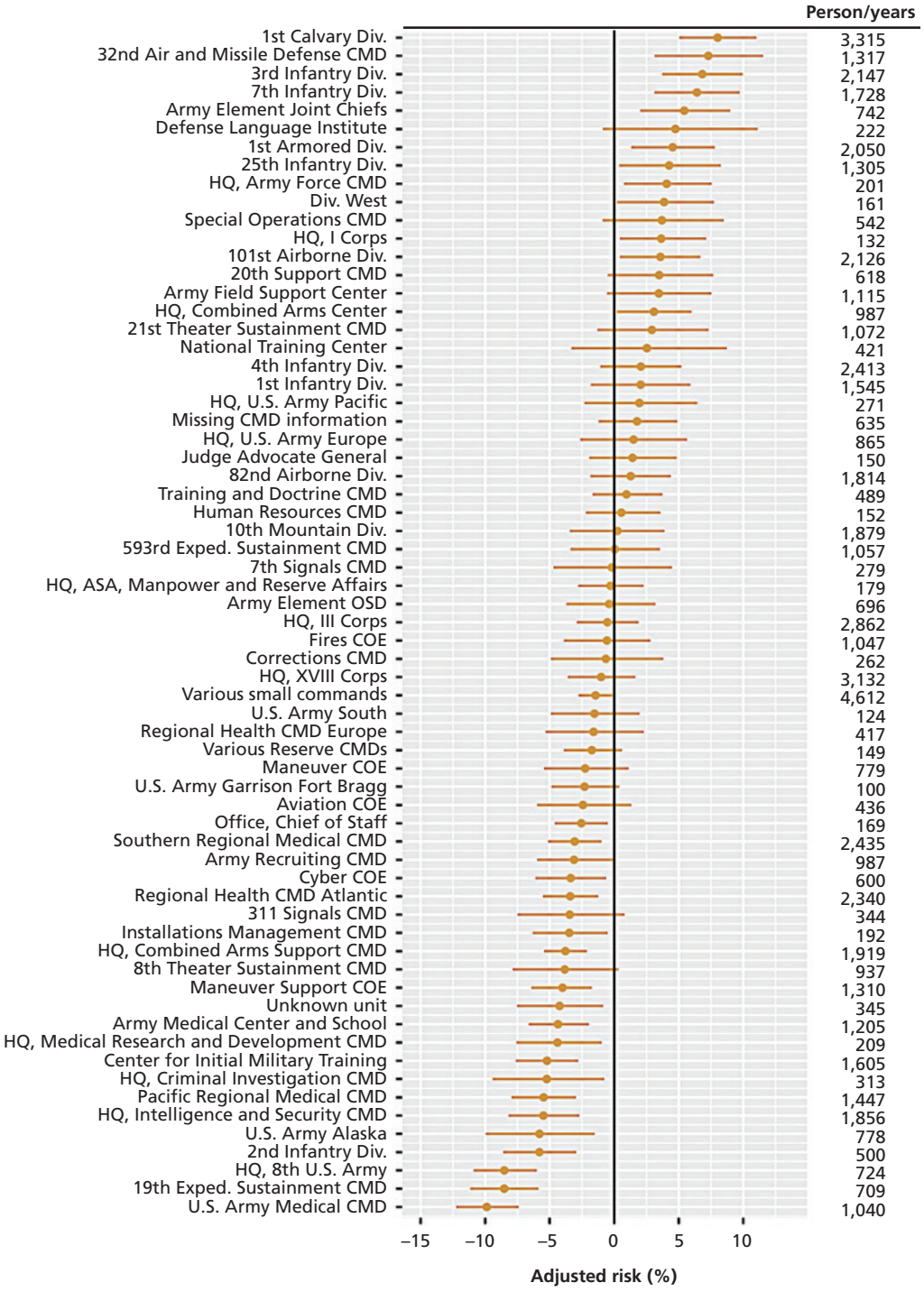
NOTE: *Adjusted risk* is the risk of sexual harassment greater (or less than) expected for members of the cluster based on their demographic and service history characteristics.

Figure 4.3
Adjusted Sexual Harassment Risk by Installation for Men, 2018



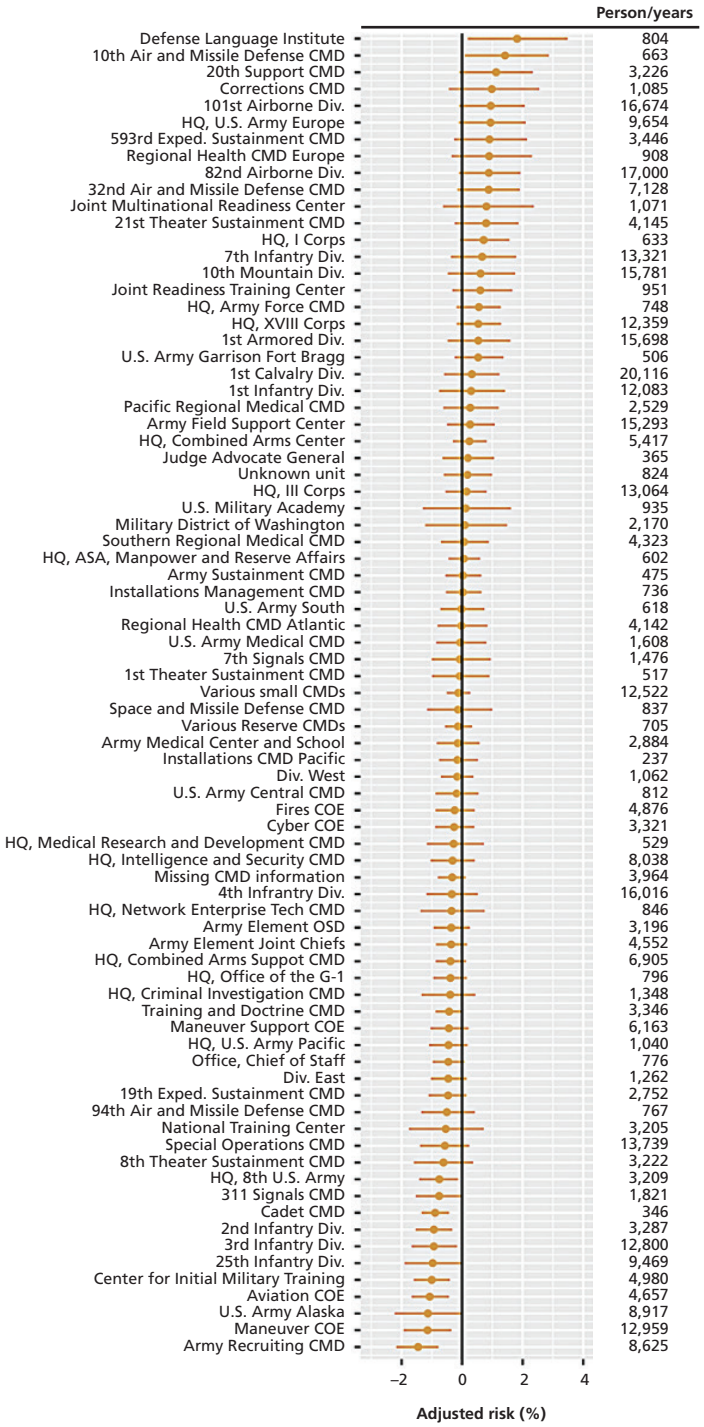
NOTE: *Adjusted risk* is an estimate of the proportion of service members of a given sex who were sexually assaulted between roughly August 2017 and July 2018.

Figure 4.4
Adjusted Sexual Harassment Risk by Command Echelon 3 for Women, 2018



NOTE: *Adjusted risk* is the risk of sexual harassment greater (or less than) expected for members of the cluster based on their demographic and service history characteristics.

Figure 4.5
Adjusted Sexual Harassment Risk by Command Echelon 3 for Men, 2018



NOTE: *Adjusted risk* is the risk of sexual harassment greater (or less than) expected for members of the cluster based on their demographic and service history characteristics.

Adjusted Sexual Harassment Risk by Soldier Career Management Field

Field artillery was the single CMF found to have higher-than-expected sexual assault risk for Army women, and it is similarly the CMF with the highest adjusted sexual harassment risk for women (see Figure 4.6). With an adjusted risk of 8.4 percent, this implies that women who would otherwise have average sexual harassment risk in the Army might be expected to have risk more than 33 percent higher if she pursued a field artillery career. Ammunition and intelligence are two other CMFs with among the highest point estimates for women's sexual assault and sexual harassment adjusted risk. Among those CMFs with strong evidence of having lower-than-expected sexual harassment risk are fields that concern medical care (e.g., medical, nurse) and veterinary care (e.g., food safety/veterinary). Military police and chaplains are also associated with lower-than-expected sexual harassment risk for Army women.

In contrast to the high-risk careers for Army women, none of the CMFs for which there is good evidence of elevated sexual harassment risk for Army men are combat specializations (see Figure 4.7). Indeed, some of the largest combat career fields are among the CMFs with the lowest point estimates of adjusted sexual harassment risk among Army men, including aviation, special forces, and infantry. Similarly, the medical CMF, which was associated with low sexual harassment risk for Army women, is among those for which there is credible evidence of elevated sexual harassment risk for Army men.

Cluster Characteristics Associated with Adjusted Sexual Harassment Risk Across Stratification Approaches

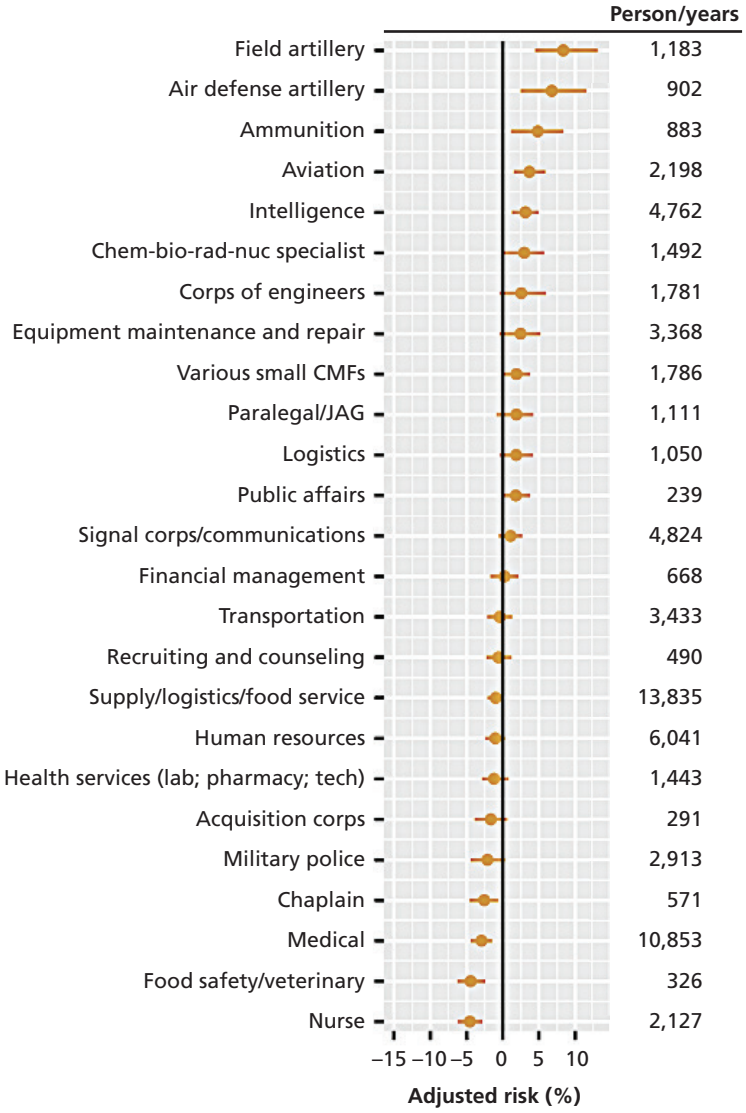
Similar to our findings regarding sexual assault risk, we also consider cluster characteristics that might assist with understanding what contributes to variation across clusters in sexual harassment risk. We again focus on cluster characteristics for which there are available data and that our Army sponsors believed might be important for distinguishing risk, and we focus on adjusted sexual harassment risk.

Cluster Characteristics That Account for Adjusted Sexual Harassment Risk Across Stratification Approaches for Women

Table 4.1 addresses how well each cluster characteristic explains variation in Army women's adjusted sexual harassment risk across each stratification approach. Whereas the general pattern of associations between cluster characteristics and adjusted sexual harassment is quite similar to that for adjusted sexual assault, there are some differences that might be important. For adjusted sexual harassment risk among Army women, deployment OPTEMPO appears to account for more variation in risk than the other cluster characteristics across all stratification approaches. For both adjusted sexual assault and adjusted sexual harassment among Army women, a higher deployment OPTEMPO in a cluster is associated with higher risk, but the relationship appears considerably stronger for sexual harassment than for sexual assault. Similarly, the proportion of combat arms soldiers has nearly the same pattern of associations for adjusted sexual assault and adjusted sexual harassment among Army women, but the association appears to be considerably stronger for sexual harassment.

Across all stratification approaches except soldier CMF, a more supportive unit climate is associated with lower adjusted sexual harassment risk among Army women, just as it is

Figure 4.6
Adjusted Sexual Harassment Risk by Soldier CMF for Women, 2018

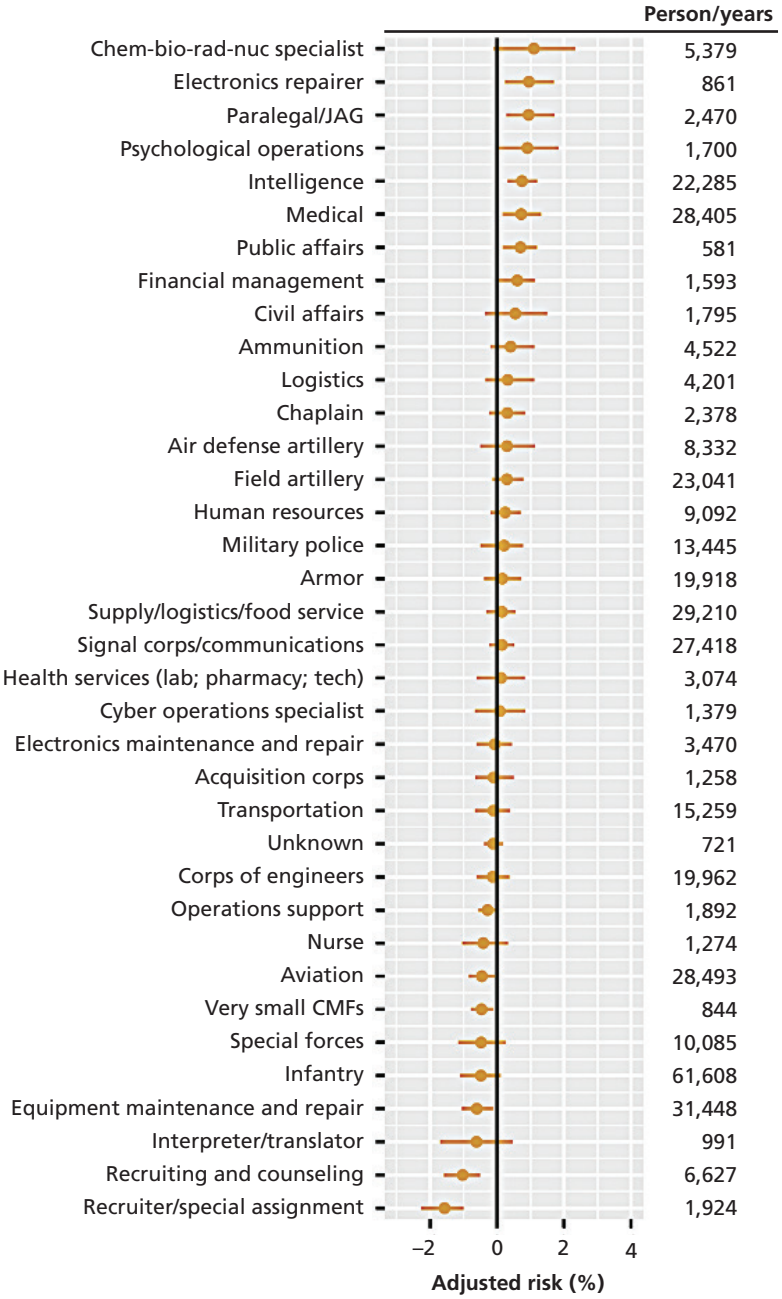


NOTES: *Adjusted risk* is the risk of sexual harassment greater (or less than) expected for members of the cluster based on their demographic and service history characteristics. Appendix D describes how the labels used in this table correspond with CMF codes and career descriptions.

also associated with lower adjusted risk of sexual assault. Notably, the positive relationship observed between unit climate and adjusted sexual harassment risk within the soldier CMF stratification approach—and also that between supervisor climate and adjusted sexual harassment risk—is inconsistent with the findings from other stratification approaches. It is unclear why CMFs associated with elevated sexual harassment risk also are more likely to have more-supportive unit climates.

As with adjusted sexual assault, the proportion of civilians working on base is consistently associated with lower adjusted sexual harassment risk among Army women. However, whereas for sexual assault the proportion of soldiers living on base is consistently associated

Figure 4.7
Adjusted Sexual Harassment Risk by Soldier CMF for Men, 2018



NOTES: *Adjusted risk* is the risk of sexual harassment greater (or less than) expected for members of the cluster based on their demographic and service history characteristics. Appendix D describes how the labels used in this table correspond to CMF codes and career descriptions.

Table 4.1
Proportion of Variance in Adjusted Sexual Harassment Risk Associated with Cluster Characteristics Across Five Stratification Approaches, Women

Characteristic	Soldier CMF	Installation	Command Echelon 3	Command Echelon 2	Command Echelon 1
Proportion of cluster living on base	0.01 (<0.01, 0.04)	(–) 0.03 (0.01, 0.07)	(–) 0.02 (<0.01, 0.04)	0.01 (<0.01, 0.03)	(+) 0.04 (0.01, 0.09)
Proportion of individuals in combat arms specialization	(+) 0.22 (0.05, 0.42)	(+) 0.23 (0.12, 0.34)	(+) 0.17 (0.11, 0.25)	(+) 0.19 (0.11, 0.29)	(+) 0.23 (0.11, 0.35)
Deployment OPTEMPO	(+) 0.37 (0.20, 0.53)	(+) 0.42 (0.27, 0.54)	(+) 0.18 (0.08, 0.27)	(+) 0.29 (0.15, 0.4)	(+) 0.37 (0.18, 0.52)
Good unit climate*	(+) 0.05 (0.01, 0.10)	(–) 0.35 (0.18, 0.50)	(–) 0.42 (0.21, 0.63)	(–) 0.42 (0.20, 0.63)	(–) 0.53 (0.42, 0.64)
Good supervisor climate**	(–) 0.06 (0.01, 0.12)	(–) 0.13 (0.04, 0.21)	(–) 0.21 (0.10, 0.34)	(–) 0.32 (0.17, 0.47)	(– 0.51 (0.19, 0.86)
Proportion of civilians	(–) 0.10 (0.01, 0.20)	(–) 0.05 (0.01, 0.10)	(–) 0.03 (0.01, 0.07)	(–) 0.07 (0.02, 0.12)	(–) 0.14 (0.05, 0.24)
Separations	0.06 (<0.01, 0.13)	(+) 0.08 (0.03, 0.14)	(+) 0.02 (0.01, 0.04)	(+) 0.05 (0.02, 0.09)	(+) 0.03 (<0.01, 0.07)
Administrative discharges	0.02 (<0.01, 0.06)	0.06 (<0.01, 0.14)	(–) 0.04 (<0.01, 0.09)	0.02 (<0.01, 0.05)	0.01 (<0.01, 0.04)
Recent transitions***	0.02 (<0.01, 0.04)	(–) 0.20 (0.07, 0.34)	(–) 0.08 (0.01, 0.16)	(–) 0.08 (0.01, 0.17)	0.06 (<0.01, 0.15)

NOTES: Parentheses under each estimate contain 80 percent CIs. The direction of the association is indicated in parentheses before the estimate: (–) means the 80 percent CI for the slope of the relationship between the cluster characteristic and cluster sexual assault risk is negative and does not include zero, (+) indicates that the slope is positive and the CI does not include 0, and no symbol in parentheses before the estimate indicates a less consistent association between the characteristics and cluster risk (the 80 percent CI for the slope of the relationship includes 0).
* *Good unit climate* is the average of responses among women to questions regarding the behaviors of military members. Higher values indicate more-positive workplace behaviors, including more support for victims of sexual assault.
** *Good supervisor climate* is the average of responses among women to questions regarding how actively supervisors address unprofessional behaviors, sexual harassment, and other negative behaviors. Higher values indicate better responses.
*** *Recent transitions* is the percentage of a cluster's members that are new in an average month.

with increased adjusted risk among Army women, it had mixed and uncertain associations with risk for sexual harassment. Finally, recent transitions in the unit, or the proportion of a unit's members who joined in the past month explains little of the difference in cluster risk among Army women across all stratification approaches for both adjusted sexual assault and adjusted sexual harassment.

Cluster Characteristics That Account for Adjusted Sexual Harassment Risk Across Stratification Approaches for Men

Table 4.2 addresses how well each cluster characteristic explains variation in Army men's adjusted sexual harassment risk across each stratification approach. Among Army men, unit climate, supervisor climate, and recent transitions appear to account for more variation in adjusted sexual harassment risk than all or most of the other cluster characteristics that we considered, other than for CMF. As was the case for women, a more supportive unit climate in a cluster is associated with lower adjusted sexual harassment risk among Army men across the stratification approaches. Similarly, deployment OPTEMPO explains a good deal of variation in men's adjusted sexual harassment risk, just as it does for women.

For all but the soldier CMF stratification, recent transitions appear to account for a relatively large amount of variation in soldier risk, such that a higher proportion of the members that are new to the unit in a given month, the lower the risk of adjusted sexual harassment for men will be. Although this same association was found among several stratifications for Army women, recent transitions appear to explain more of the variability in adjusted sexual harassment risk across men's stratification approaches than women's.

By contrast, the proportion of a cluster living on base appears to account for little variation in adjusted sexual harassment risk among Army men. Moreover, in contrast to the results observed for Army women (see Table 4.2), proportion of combat arms tends to account for little variation in adjusted sexual harassment risk among Army men.

Stability of Installation Sexual Harassment Risk over Time

Table 4.3 describes the correlation of total and adjusted sexual harassment risk estimates over time (from 2016 to 2018). As was true for sexual assault risk estimates, cluster risk for sexual harassment is quite stable over the two year period that we have examined. This is especially true for total sexual harassment risk, for which all stratifications exhibit correlations of at least 0.77 for women and 0.65 for men. Correlations for adjusted sexual harassment risk are lower but still suggest a good deal of stability in adjusted risk over time for Army men and women. Indeed, correlations over time for sexual harassment are comparable with those that we observed for sexual assault for men and women.

For the installations stratification approach, we can also compare the 2018 estimates of total and adjusted sexual harassment risk with 2014 estimates produced from the RMWS (see Morral et al., 2018). Again, the correlation of total risk estimates for installations in both waves of estimates was relatively high for total risk (0.83 for women and 0.79 for men), although

Table 4.2
Proportion of Variance in Adjusted Sexual Harassment Risk That Is Associated with Cluster Characteristics Across Five Stratification Approaches, Men

Characteristic	Soldier CMF	Installation	Command Echelon 3	Command Echelon 2	Command Echelon 1
Proportion of cluster living on base	0.02 (<0.01, 0.04)	0.01 (<0.01, 0.02)	0.01 (<0.01, 0.02)	0.01 (<0.01, 0.03)	(+) 0.08 (0.01, 0.18)
Proportion of individuals in combat arms specialization	0.19 (0.01, 0.53)	0.04 (<0.01, 0.12)	0.06 (<0.01, 0.16)	0.03 (<0.01, 0.08)	0.03 (<0.01, 0.09)
Deployment OPTEMPO	0.13 (0.01, 0.34)	(+) 0.07 (0.01, 0.14)	(+) 0.10 (0.02, 0.19)	(+) 0.21 (0.06, 0.36)	(+) 0.37 (0.13, 0.62)
Good unit climate*	(–) 0.05 (0.01, 0.10)	(–) 0.35 (0.18, 0.50)	(–) 0.42 (0.21, 0.63)	(–) 0.42 (0.20, 0.63)	(–) 0.15 (0.04, 0.27)
Good supervisor climate**	(+) 0.02 (<0.01, 0.04)	(–) 0.02 (<0.01, 0.06)	(–) 0.09 (0.01, 0.17)	(–) 0.14 (0.03, 0.25)	(–) 0.51 (0.19, 0.86)
Proportion of civilians	0.06 (<0.01, 0.15)	0.01 (<0.01, 0.03)	0.01 (<0.01, 0.04)	(–) 0.07 (0.01, 0.15)	(–) 0.16 (0.03, 0.31)
Separations	0.04 (<0.01, 0.10)	(+) 0.03 (<0.01, 0.07)	(+) 0.03 (<0.01, 0.06)	(+) 0.06 (0.02, 0.10)	(+) 0.27 (0.11, 0.44)
Administrative discharges	0.02 (<0.01, 0.06)	(–) 0.10 (0.02, 0.20)	(–) 0.08 (0.02, 0.16)	(–) 0.12 (0.02, 0.24)	(–) 0.13 (0.02, 0.28)
Recent transitions***	0.02 (<0.01, 0.06)	(–) 0.29 (0.10, 0.51)	(–) 0.30 (0.10, 0.51)	(–) 0.33 (0.10, 0.59)	(–) 0.57 (0.2, 0.97)

NOTES: Parentheses under each estimate contain 80 percent CIs. The direction of the association is indicated in parentheses before the estimate: (–) means the 80 percent CI for the slope of the relationship between the cluster characteristic and cluster sexual assault risk is negative and does not include zero, (+) indicates that the slope is positive and the CI does not include 0, and no symbol in parentheses before the estimate indicates a less consistent association between the characteristics and cluster risk (the 80 percent CI for the slope of the relationship includes 0).
* *Good unit climate* is the average of responses among men to questions regarding the behaviors of military members. Higher values indicate more-positive workplace behaviors, including more support for victims of sexual assault.
** *Good supervisor climate* is the average of responses among men to questions regarding how actively supervisors address unprofessional behaviors, sexual harassment, and other negative behaviors. Higher values indicate better responses.
*** *Recent transitions* is the percentage of a cluster's members that are new in an average month.

Table 4.3
Correlations Between 2016 and 2018 Estimates of Total and Adjusted Sexual Harassment Risk by Stratification Approach and Sex

	Total Risk		Adjusted Risk	
Stratification approach	**Women**	**Men**	**Women**	**Men**
Installation	0.77	0.65	0.36	0.36
Soldier CMF	0.84	0.74	0.51	0.42
Echelon 1 commands	0.85	0.80	0.45	0.36
Echelon 2 commands	0.83	0.79	0.44	0.31
Echelon 3 commands	0.95	0.91	0.76	0.29

adjusted risk is more attenuated across this four-year span of time (0.54 for women and 0.47 for men).[2]

Figures 4.8 and 4.9 illustrate the correlation between the 2016 and 2018 adjusted sexual harassment risk estimates for women and men, respectively. Appendix B includes figures with 2014, 2016, and 2018 estimates plotted.

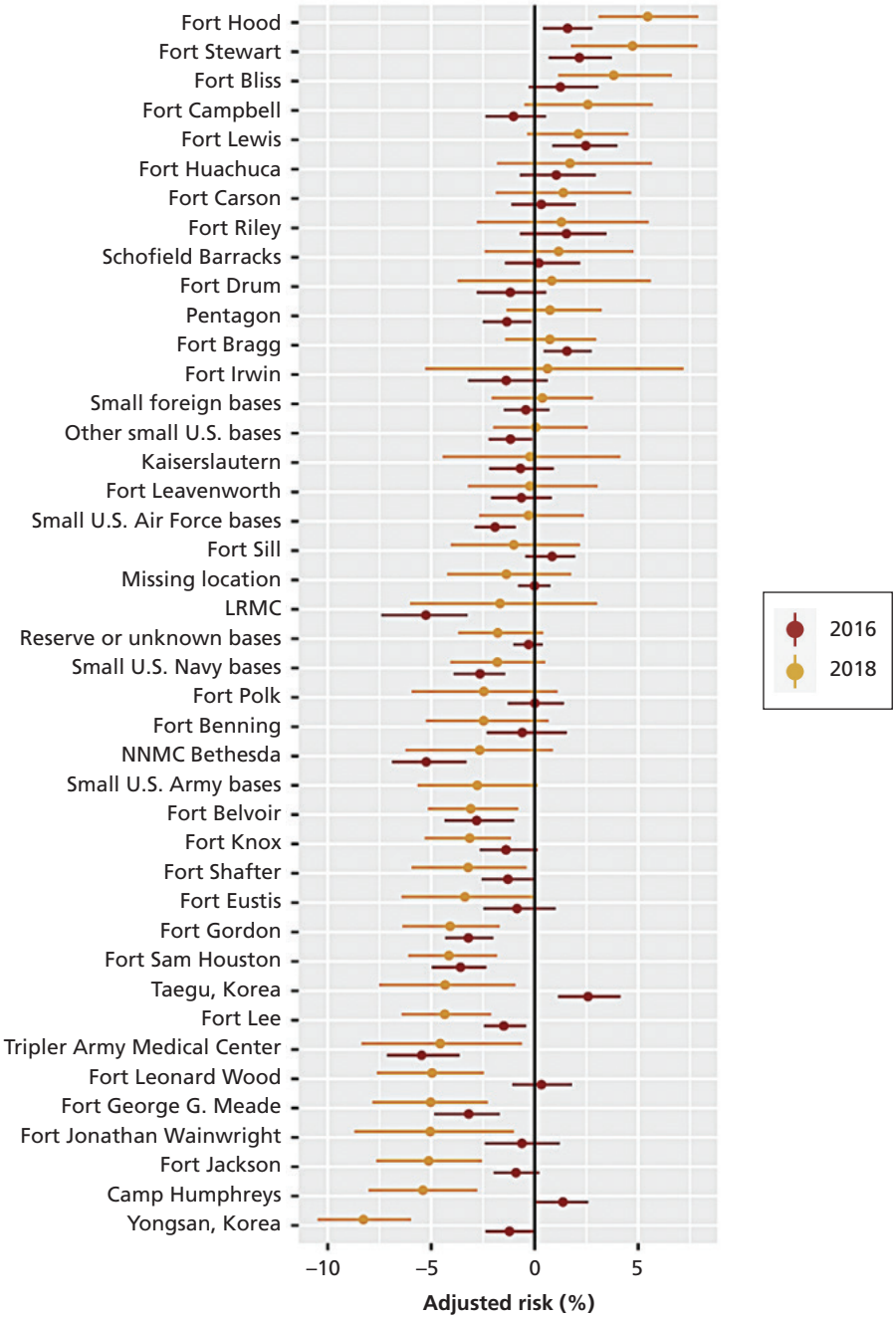
Summary

In this chapter, we considered how sexual harassment risk varies across location, command, and CMF for Army women and men. Total sexual assault risk and total sexual harassment risk are highly correlated across these stratification approaches. Because total sexual assault risk was described in Chapter Three, we focused our discussion in this chapter on adjusted sexual harassment risk, or the component of soldiers' sexual harassment risk that is above (if positive) or below (if negative) the risk that would be expected given personnel characteristics (for details on total risk estimates, see Appendix C, which is not publicly available). Among Army women, Fort Hood, Fort Stewart, and Fort Bliss were among the installations with the highest adjusted sexual harassment risk. Three bases in South Korea, by contrast, were among the lowest-risk installations for women. In addition, the 1st CD and several Infantry Divisions were associated with relatively high adjusted sexual harassment risk among echelon 3 commands for Army women. Although multiple Infantry Divisions were associated with higher risk, the 2nd Infantry Division was among the lowest-risk commands. Among CMFs, combat arms CMFs were among the highest adjusted risk CMFs for Army women.

Among Army men, in part because of higher rates of sexual harassment, we found greater risk differentiation among groups for adjusted sexual harassment risk than what we had observed for sexual assault risk (see Chapter Three). Several German bases were associated with the highest point estimates for adjusted sexual harassment risk among Army men, and although Fort Stewart was among the highest-risk commands for Army women, it was associated with one of the lowest adjusted sexual harassment risk point estimates for Army men. The

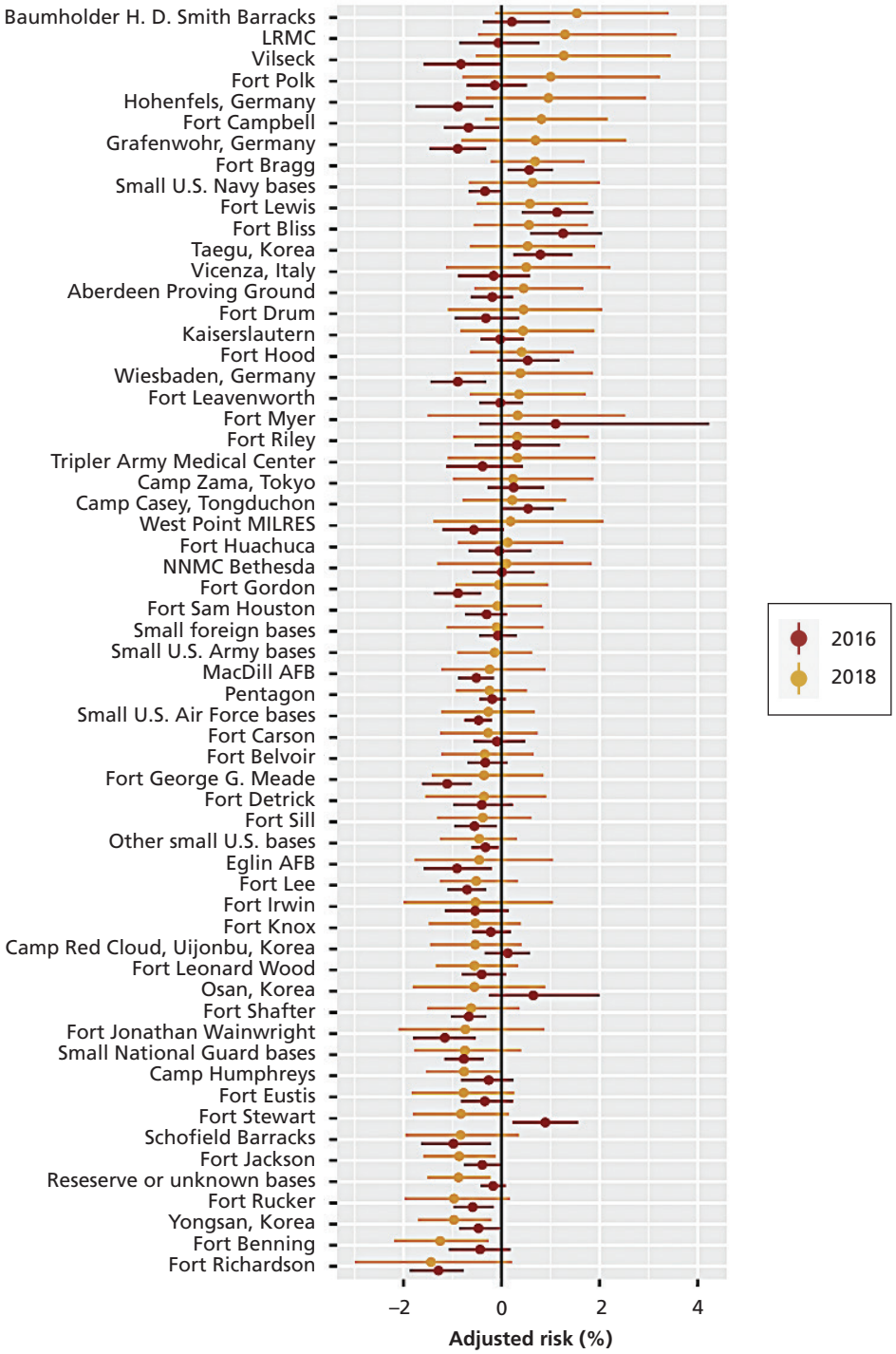
[2] Because of variations in terms of which installations we could construct risk estimates for in each of the three years that we are studying, the number of installations that can be matched to produce these correlations differs for the 2018 to 2016 comparison (n = 41 for women and n = 59 for men), compared with the 2018 to 2014 comparison (n = 30 for women, n = 38 for men).

Figure 4.8
Installation-Adjusted Sexual Harassment Risk Estimates for 2016 and 2018, Women



NOTES: This figure displays all installations for which estimates were available in 2018 and 2016. 80 percent CIs are displayed.

Figure 4.9
Installation-Adjusted Sexual Harassment Risk Estimates for 2016 and 2018, Men



NOTE: This figure displays all installations for which estimates were available in 2018 and 2016. 80 percent CIs are displayed.

Defense Language Institute was associated with the highest adjusted sexual harassment risk for Army men, and several Infantry Divisions were among the lowest-risk commands for men. In contrast to Army women, combat arms CMFs were associated with lower adjusted sexual harassment risk for men.

Addressing the characteristics associated with variability in adjusted sexual harassment risk, high rates of recent transitions and administrative discharges tended to be associated with lower risk for Army women and men. High rates of separations from the Army tended to be associated with higher adjusted sexual harassment risk for both women and men.

CHAPTER FIVE

Discussion and Recommendations

Using survey data on all Army soldiers in FY 2014, 2016, and 2018, along with detailed personnel and administrative records, we examined the distribution of sexual assault risk using several approaches to stratifying soldiers into different clusters. We estimated soldiers' risk of sexual assault and harassment using two measures: Total risk is an estimate of the prevalence of sexual assault or harassment within a group of soldiers, and adjusted risk describes how much higher or lower total risk is than would be expected for a group given the characteristics of personnel assigned to it.

We then examined the characteristics of clusters of soldiers that might help to explain why some face considerably higher or lower adjusted risk than others. In this chapter, we discuss the results of our analyses and their implications for preventing sexual assault and sexual harassment. We conclude with recommendations for steps that the Army should consider to better understand and address sexual assault and sexual harassment in the service.

Variation in Sexual Assault and Sexual Harassment Risk Across the Army Suggests Where to Target Prevention Efforts

We identified considerable variation in both total and adjusted sexual assault risk across each of the stratification approaches we used to sort Army women into separate groups in FY 2018. Across stratification approaches, we identified groups of women soldiers whose total sexual assault risk differed by a factor of nearly six, ranging from just 1.8 percent total risk among women serving at the Pentagon or in the Human Resources Command to 10.6 percent among women serving in field artillery CMFs. Women's adjusted risk ranged from a low of –1.2 percent for women serving at Fort Gordon and those serving in Intelligence and Security Command to 2.2 percent in the 1st CD. This suggests that a woman with average risk in the Army (5.8 percent) might be expected to have a risk of 8.0 percent in the 1st CD. This is substantially greater than would be expected for the same woman were she based at Fort Gordon, where her risk would be expected to be just 4.6 percent.

Army women's total risk of sexual harassment ranged from a high of nearly half of all women in Field Artillery CMFs experiencing sexual harassment during FY 2018 (44.5 percent), to a low of 10.2 percent among women with food safety/veterinary and acquisition corps CMFs. Women's adjusted risk of sexual harassment ranged from a high of 8.4 percent among women in field artillery CMFs to a low of –9.9 percent at Medical Command headquarters. This suggests that an Army woman with an average sexual harassment risk of 24.4 percent might be expected to have a risk of 32.8 percent in a field artillery CMF. By contrast, this

same woman would be expected to have a risk of 14.5 percent if she were working in Medical Command HQ.

Although many groups of Army women showed considerable variation in total or adjusted sexual assault risk estimates, this was less true for men's risk estimates. This weaker differentiation of risk for Army men was partially because of the relatively low numbers of men who were identified as experiencing a sexual assault during the year. Nevertheless, total sexual assault risk for men ranged from a low of 0.3 percent among men with operations support CMFs to 0.9 percent among men assigned to Baumholder H. D. Smith Barracks. Adjusted risk ranged from –0.1 percent among Army men working in the office of the G-1 and several other groups of men to a high of 0.2 percent for men at Baumholder H. D. Smith Barracks and Landstuhl Regional Medical Center. This implies that a man with average sexual assault risk in the Army (0.6 percent) could be expected to have a risk of 0.8 percent at Baumholder or Landstuhl. The same man would be expected to have a risk of 0.5 percent in the office of the G-1 or in several other clusters of soldiers with similarly low adjusted risk.

Although relatively few men in the Army appeared to have experienced sexual assault in FY 2018, considerably more had experiences that could be classified as sexual harassment. Therefore, we had a greater ability to differentiate sexual harassment risk among men than sexual assault risk, particularly adjusted sexual harassment risk. Total sexual harassment risk for Army men ranged from a low of 2.8 percent for men in operational support CMFs to a high of 8.8 percent for men in the 82nd Airborne Division. Adjusted sexual harassment risk for men ranged from –1.6 percent for men with recruiter and special assignment CMFs to 1.8 percent for men in the Defense Language Institute Command. Thus, a man with average sexual harassment risk in the Army (6.5 percent) would be expected to have a risk of 8.3 percent at the Defense Language Institute, and this same man would be expected to have a risk of 4.9 percent if he had a recruiter or special duty assignment CMF.

These results demonstrate that the Army can produce much-finer-grain analyses of sexual assault risk than have previously been available; these can create new opportunities to target prevention and response services where they could have the greatest effects. Specifically, where total risk of sexual assault is high and there are large numbers of personnel, such as at III Corps or Fort Hood for women, any reduction in risk achieved through new or tailored prevention programs would have a disproportionate effect on Army sexual assault rates. For instance, five bases (Forts Hood, Bliss, Riley, Campbell [Kentucky and Tennessee], and Carson [Colorado]) had roughly 17,000 women assigned to them during each month of FY 2018. We estimate that approximately 1,370 of these women were assaulted during that year, which is 34 percent of the total number of women in the active component Army estimated to have been assaulted that year. A targeted prevention program that reduced total risk to women at these five bases to the average risk to women in the Army (i.e., 5.8 percent) would reduce the number of sexual assaults across the Army by about 390 and would reduce the Army's servicewide risk to women by about 10 percent. Overall, the strategy of using total risk to target efforts could be part of an Army-wide effort to address risk where it appears to be high relative to the average risk across the Army. Thus, this might be considered separately from efforts addressing cluster-specific characteristics associated with risk.

Recommendation 1: To optimize reductions in Army sexual assault rates, new or supplementary prevention programs that cannot be provided to the entire Army should be targeted to those bases, commands, and CMFs that have large numbers of soldiers and high total sexual assault risk.

Sexual Harassment Risk Can Serve as an Early Warning Indicator of Sexual Assault Risk

Total sexual assault risk and total sexual harassment risk were highly correlated across each stratification approach for men and women; correlations ranged from 0.85 to 0.97. This means that there is very little information in our sexual assault risk estimates that is not also available through our sexual harassment risk estimates: Groups of soldiers with high total risk for sexual assault can be expected to have high total risk for sexual harassment, and groups with low risk of sexual assault will also have low risk of sexual harassment.

Because sexual harassment risk and sexual assault risk are closely related, these risks could be determined by a similar or identical sets of risk factors. It might be, for instance, that sexual harassment and sexual assault are two levels on the same continuum of risk. This is consistent with findings from earlier research on sexual assault in the military, which found that nearly two-thirds of women who were sexually assaulted indicated that the perpetrator had previously sexually harassed them (Morral, Gore, and Schell, 2015a; Schell et al., 2021).

Although both sexual assault and sexual harassment might reflect the same risk factors or phases along the same risk continuum, there are different reasons why the Army might benefit from more closely monitoring sexual harassment risk as an early warning indicator of sexual assault risk. First, sexual harassment is much more common than sexual assault in the Army. In 2014, more than 50 percent of men and more than 80 percent of women in the Army described sexual harassment of women as "common" or "very common" (Morral, Gore, and Schell, 2015b; Schell et al., 2021). In addition, unlike sexual assault, sexual harassment often occurs in public or in larger groups of soldiers, so many are likely more aware of it when it is happening. Together, these observations indicate that many more soldiers might be able to provide information on sexual harassment risk than sexual assault risk within a group. This means that measuring sexual harassment risk is likely easier, cheaper, and potentially faster than measuring sexual assault risk, and it could provide nearly all of the information about sexual assault risk that is needed to develop tailored intervention programs. Finally, sexual harassment risk is already routinely measured as part of the Defense Equal Opportunity Climate Survey (DEOCS), which is administered by law to every unit shortly after a change of command and then periodically thereafter. The same survey does not assess sexual assault risk in a comprehensive way.

Thus, the Army could capture much of the information it needs to identify high-risk units or other groups of soldiers using measures of sexual harassment that are already deployed across the service and administered regularly. Such a project would require some development effort to ensure that DEOCS or other survey results are adequately representative of the groups of soldiers for which they are used to assess sexual harassment—and by extension sexual assault—risk.

Recommendation 2: The Army could use routinely collected survey data from DEOCS or other surveys to more-rapidly identify units, commands, bases, CMFs, or other groups of soldiers with high or rising risk of sexual assault and sexual harassment. The Army should consider investing some resources in developing current surveys to serve this purpose.

Characteristics of Groups Associated with High or Low Adjusted Risk Can Inform the Design of Prevention Efforts

Many groups of soldiers have high total sexual assault risk and sexual harassment risk because the characteristics of the personnel assigned to them are associated with higher risk across the Army. For instance, higher-risk personnel are younger, unmarried, and junior-ranking. There is little the Army can do to change these demographic risk factors, so prevention must focus on reducing or eliminating assaults. Other groups of soldiers have higher total risk for reasons that are likely related to the group to which they were assigned rather than something about themselves. These groups with high adjusted risk might have characteristics that the Army has direct control over. Therefore, one of the objectives of this project was to examine if we could identify characteristics that distinguish high or low adjusted risk groups of soldiers.

Our analysis of group characteristics associated with adjusted risk identified several that were associated with sexual assault and sexual harassment risk to women and with sexual harassment risk for men.[1] One such group characteristic concerns climate scores: Across most stratification approaches and for men and women, groups of soldiers with better supervisor and unit climate scores have lower adjusted risk scores, and groups that have worse climate scores have higher adjusted risk scores. Indeed, across echelon 1 commands, 26 percent to 31 percent of the variance in adjusted sexual assault risk to women across major commands may be accounted for by differences in unit or supervisor climate (see Figure 3.13). Men's unit climate scores explain comparable amounts of variance in adjusted sexual harassment risk across installations and across command echelons 1, 2 and 3. These findings replicate and reinforce findings on unit climate that we have previously identified in forthcoming analyses of active component men and women in the U.S. Navy and the U.S. Marine Corps.

We cannot conclude from these associations that a poor unit or supervisory climate causes increases in risk to soldiers. This could be true, but it is also possible that high sexual assault risk in a group causes soldiers to rate their unit and supervisory climates poorly. Indeed, both could be true. Nevertheless, climate is presumed to be under the control of the Army and its commanders, so it presents a reasonable target for interventions designed to reduce sexual assault of soldiers.

Recommendation 3: The Army should consider developing climate-improvement interventions for commands, bases, and CMFs with high adjusted sexual assault risk or high adjusted sexual harassment risk and poor climate scores. These interventions could be designed to improve features of the climate that assessed in the WGRA scales that we used to examine unit and supervisory climates. For instance, the supervisory climate scale inquired whether respondents' immediate supervisor encouraged unit members to challenge sexual harassment and gender discrimination when they witness it, and whether they actively encourage their subordinates who might have experienced or witnessed behavior likely to produce harmful outcomes to report those situations. The scale measuring unit climate asked respondents whether their unit deals effectively with adversity and conflict, whether members are likely to support victims of sexual assault, and whether members respect others with diverse backgrounds.

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[1] Because of low resolution of men's sexual assault risk, we had a limited ability to identify group characteristics associated with men's adjusted risk. Instead, we refer here to the findings from our analysis of group characteristics associated with men's adjusted sexual harassment risk. Because this risk is relatively strongly correlated with adjusted sexual assault risk, findings from the sexual harassment risk analyses are likely to reveal group characteristics that would also be associated with men's adjusted sexual assault risk if we had adequate statistical power to detect them.

Other group characteristics associated with adjusted sexual harassment risk for both men and women include deployment OPTEMPO and separations rates. Higher deployment OPTEMPO, defined here as the average number of months during the past year that members of a group of soldiers were deployed, was associated with greater adjusted risk. Similarly, higher separation rates, or the proportion of a group of soldiers who separated from the military within 18 months, were also associated with increased adjusted risk for men and women. Our finding that recent deployments are associated with elevated risk is consistent with findings from other research (e.g., LeardMann et al., 2013). The fact that groups of soldiers with higher separation rates have higher adjusted risk could be related to the association mentioned earlier between climate and adjusted risk. In other words, it might be that when soldiers are exposed to climates that they rate negatively, such as where they believe negative behaviors are tolerated, they are less inclined to continue their military careers than soldiers exposed to climates that they rate more positively.

Additional group characteristics were associated with women's adjusted risk scores but were not clearly associated with men's. Most conspicuously, groups with large proportions of soldiers in combat arms occupations were associated with higher adjusted sexual assault risk for women. This result was consistent with our findings that installations and commands with higher proportions of combat arms occupations exhibit higher adjusted risk. For example, some of women's highest adjusted risk occupations (such as field artillery, air defense artillery, ammunition, aviation, and engineers) are combat arms occupations and related commands (for example, among echelon 3 commands: 1st CD, 1st Armored Division, HQ III Corps, 3rd Infantry Division, 4th Infantry Division, and 7th Infantry Division) involved large proportions of combat arms soldiers. In contrast, the lowest adjusted risk CMFs and commands for women often involved combat service support roles, such as nurse, food safety/veterinary, medical, and chaplain CMFs. In addition, HQ offices, training centers, and medical commands were likely to have lower proportions of combat arms soldiers.

The association between combat arms and adjusted risk was not true for men. Indeed, air defense artillery, special forces, and aviation were among the lowest adjusted risk CMFs for men, and one of the echelon 3 commands associated with highest risk for women (3rd Infantry Division) is associated with the lowest adjusted risk for men.

It would be valuable to better understand the association between combat arms and adjusted risk to women. To some extent, it could be that in these CMFs and commands a larger proportion of soldiers are men, which can increase women's risk of sexual assault and sexual harassment, as discussed in Chapter One. However there are exceptions to the general association of combat arms to women's risk that could provide valuable lessons on creating combat arms environments that minimize risk to women. In particular, whereas multiple infantry divisions are associated with elevated adjusted risk of sexual assault or sexual harassment for women, the 2nd Infantry Division is associated with especially low adjusted risk of sexual harassment for Army women, possibly indicating a protective effect associated with that command. Therefore, despite the structural and personnel similarities between the 2nd Infantry Division and other infantry divisions, something appears to be causing Army women in the 2nd Infantry Division to experience lower-than-average sexual harassment risk. Understanding what that difference is could help the Army to promulgate the factors producing these benefits to other commands.

Recommendation 4: The Army should investigate the differences in soldier's experiences in similar groups with different risk profiles—such as the 2nd Infantry Division and the 4th

Infantry Division—to understand what differences in work life, social life, culture, or climate might be contributing to differences in women's risk exposure. Then, test whether candidate risk factors generalize in explaining differences in risk elsewhere in the Army.

A final characteristic associated with women's adjusted risk, but not clearly men's, is the presence of civilians in the workplace. As the proportion of civilians increases, adjusted risk of sexual assault and sexual harassment decreases for Army women. This finding might be functionally equivalent to our findings concerning combat arms because commands and CMFs involving high proportions of soldiers with combat arms occupations could also involve bases where there are relatively fewer civilians. However, it is also possible that the presence of civilians changes the work environment in ways that benefit women in the active component Army. It could be—although we have no evidence to support this conjecture—that a larger civilian presence reduces sexual harassment and sexual assault risk because civilians can sue their employer if required to work in a hostile workplace environment. With this threat, employers might be especially scrupulous about preventing sexual harassment and encouraging reporting of sexual harassment so that it can be remedied quickly, an effect from which soldiers in the workplace could also benefit. Alternatively, it could be that the presence of civilians signals something about the work or workplace environment that itself is associated with reduced risk. For instance, civilians might be more common in office buildings, which could be environments that are less conducive to sexual harassment and sexual assault than other environments where soldiers work.

Notably, we focused on a set of cluster characteristics of interest to the U.S. Army and for which there were readily available data. Therefore, these analyses should not be assumed to address all possible cluster characteristics that might be associated with risk. Rather there are additional characteristics that might be considered in future analyses. For example, analyses that consider the association between risk and alcohol consumption—such as by considering local liquor laws or the number of liquor stores near installations—could prove informative.

Stability of Risk over Time Also Creates Opportunities for Prevention

Sexual assault risk and sexual harassment risk were remarkably consistent over the two- and four-year time periods we examined. Bases with high total sexual assault risk in 2014 continue to have high sexual assault risk in 2018, with correlations of 0.79 and 0.87 for men and women, respectively. Similarly, adjusted sexual assault risk has a relatively strong correlation among bases in 2014 and 2018 for women (0.41), although the correlation is less strong for men (0.27). Over the two-year span from 2016 to 2018, correlations in total and adjusted sexual assault risk were comparable for women and generally higher for men. This stability in risk estimates over time has several important implications for the Army.

Despite the relatively high correlation over time, there were some bases that appeared to have noteworthy changes in their risk estimates over time. For instance, Landstuhl Regional Medical Center showed a large increase in women's adjusted sexual assault risk between 2016 and 2018, and Fort Hood showed a smaller but potentially meaningful increase in 2018 after consistently lower adjusted risk estimates in 2014 and 2016. Other bases, such as Fort Jonathan Wainwright (Alaska), appear to have lower risk in 2018 compared with their earlier sexual assault risk estimates. Whether these apparent shifts in adjusted risk are real, or instead because of uncertainties in our estimation, is unclear. Nevertheless, the possibility that some-

thing changed at these locations that affected risk might be compelling enough to conduct case studies to explore possible reasons why risk might have changed.

Recommendation 5: The Army could conduct case studies of bases where adjusted sexual assault risk to women appears to have changed substantially between 2016 and 2018 and identify candidate causes of these changes. Then, test the generalizability of these causes for explaining sexual assault risk among other groups of soldiers across the Army.

The fact that risk today at a base or command is likely similar to its risk two years ago presents an opportunity to provide commanders with actionable information on risks faced by their commands that they might be unaware of, yet for which they will be held accountable. Commanders will appreciate leading indicators for any behavioral problems emerging within their commands, but leading indicators for sexual assault and sexual harassment have been challenging to identify. Reports like this one, which use WGRA survey data, come years after the data are first collected. In addition, DEOCS survey results are difficult to interpret. They are not normed for the population in each unit, and they are often not collected on a representative sample of unit members, meaning the results could be biased or misleading.

In the absence of good leading indicators, it would nevertheless be useful for commanders to know if their units have a history of especially elevated risk of sexual assault or sexual harassment. Knowing this information might encourage commanders to be more vigilant in their training and prevention efforts, and to be faster to respond to problems as they emerge.

Recommendation 6: Decisionmakers should share historical sexual assault risk and sexual harassment risk information with unit commanders. Doing so can forewarn commanders of known problems that are likely to persist within their units. This information can sensitize them to the possible need for special prevention measures and prepare them to address problems quickly.

Conclusions

Our objectives with this project were to provide new insights into where there might be groups of Army men and women facing unexpectedly high or low risk of sexual assault and sexual harassment and to identify the group characteristics associated with risk. We focused our investigation on a set of group characteristics that might be within the control of the Army, with the hope of identifying candidate causes of variation in sexual assault risk that the Army could address as part of its sexual assault prevention activities.

Our results identified many groups of soldiers where total sexual assault risk and total sexual harassment risk is higher or lower than the average risk to Army men and women. This information could be helpful for identifying where resources should be allocated. In addition, we found that risk is stable across organizational units over time. This suggests that providing information on unit sexual assault risk and sexual harassment risk could be particularly useful for commanders of units with a history of high rates of risk.

We also identified many clusters of soldiers where adjusted sexual assault risk and sexual harassment risk were considerably higher or lower than would be expected given the characteristics of the personnel within those groups. This information could help the Army to better understand risk and focus ongoing prevention research and programming on candidate risk factors.

Finally, our exploration of the group characteristics associated with higher and lower risk showed that where the unit and leadership climate is better, soldiers face lower sexual assault risk and lower sexual harassment risk. This evidence can be used to design interventions to improve workplace climate, especially for those clusters of soldiers where risk is higher than expected and climate ratings are poor.

APPENDIX A

Technical Modeling Details

Based on previous work using the 2016 WGRA sexual assault survey data, we explored a wide range of candidate predictors of sexual assault risk and different transformations of each to identify a best-fitting model (candidate variables are listed in Table A.1, along with annotation indicating whether the variable was retained or dropped in the final model). This was used to inform our Stage 1 GBM model specifications. To explore which form of transformation or summary measure of monthly cluster characteristics best predicted sexual assault, we began by including pseudo-observations equal to the global mean by service (as well as sex for variables that are known to differ across gender; e.g., for sexual harassment) to shrink characteristics of small clusters slightly toward the global mean. For each person, we then calculated the average of these monthly values, the average of the cubes, and the average of the cube roots, across 12 months. Although inclusion of the average of the monthly values might have been the most straightforward approach, "extreme" months might affect sexual assault risk. We explored this possibility using cube and cube root transformations with the intent to include only one version (transformation) of each variable because these would be highly correlated and result in an overly complex model. Model fit in this exploratory stage was assessed with ten-fold cross validation.

To implement the GBM model in stage 1, we use Friedman's Gradient Boost algorithm (Friedman, 2001; 2002) in the R package "gbm" (Ridgeway, 2005). We used a logit link function, allowing for four-way interactions among predictors. We determine the subset of individual and cluster-level predictors that yield the best model fit via a ten-fold CV. We began by identifying the version of each cluster characteristic that was most useful in predicting sexual assault. To do so, we determined (1) whether one or ten pseudo-observations yield more-predictive influence, and (2) which form of transformation (linear, cube, or cube root) yields more-predictive influence.

We then used a stepwise approach to select variables, looking for broad patterns across variables that are derived from survey respondents and those that are derived based on the full population using administrative data. Relative influence tables indicated that variables derived from the full population should include only one pseudo-observation, and variables derived from respondents should include ten pseudo-observations. The square-root transformation for sexual harassment measures was selected as being more predictive than other transformations, but for all other variables, we selected a simple linear transformation.

To account for uncertainty in the predicted probabilities, we generated ten predictions for each individual using a Bayesian bootstrap (Rubin, 1981). The Bayesian bootstrap is a technique used to simulate the posterior distribution of a parameter; in this case, the probabilities of sexual assault. To generate multiple predictions per individual, we repeated the following

Table A.1
Variables Considered for Predicting Sexual Assault Risk

Individual Characteristics	Cluster Characteristics***
• Gender (female, male)	• Number of active-duty service members in cluster (postal code–level retained)
• Age	• Percent of members within cluster who are male (UIC-level, postal code–level retained)
• Race indicators (seven binary variables; kept AI, Black, White dropped four, Unknown, PI, Other, Asian)	• Average age within cluster (UIC-level retained)
• Ethnic affinity code (11 categories; Hispanic, AI, Other Asian, PR, Filipino, Mexican, Latin American, other, none, unknown) • Hispanic status (yes/no, dropped)	• Percent of leaders within cluster who are male (dropped)
• Marital status code (three categories; divorced, married, never married)	• Number of male respondents in cluster (dropped)
• Total number of dependents	• Number of female respondents in cluster (UIC-level retained)
• Education level code (six categories: non–high school graduate, alternative high school equivalent, high school diploma, associate's degree or equivalent, bachelor's degree, graduate degree)	• Average sexual harassment measure for females in cluster (all levels retained)
• AFQT score (percentile)	• Average sexual harassment measure for males in cluster (MCC- and postal code–level retained)
• Service branch (four categories; Air Force, Army, Marine Corps, Navy)	• Percent of female respondents in cluster indicating sexual harassment (dropped)
• Pay grade (18 categories; E01–09, O01–06, W01, W03, W05)	• Percent of male respondents in cluster indicating sexual harassment (dropped)
• Strength accounting code (six categories; A11, A12, A22, A24, A25, Other)	• Average retention intent (postal code– and UIC-level retained)
• Days of active-duty service, past year (dropped)	• Actual retention in cluster based on December 2017 separation status (dropped)
• Cumulative lifetime months of active federal military service	• Proportion of senior enlisted in cluster who are female**** (dropped)
• Projected end date for current term of employment	• Proportion of senior officers in cluster who are female**** (UIC-level retained)
• Separated from the military by December 2019 (yes/no)	• Proportion of cluster in middle management leadership (E07 through O04, postal code–level retained)
• Months deployed between September 2017 and September 2018	• Average workplace hostility scale score in cluster (UIC- and postal code–level retained)
• Months deployed between September 2001 and September 2018	• Sexual assault prevention and response (SAPR) climate in cluster (all levels retained)[+]
• DoD occupational group (20 categories, dropped from reduced model)**	• Percent of cluster that identifies as sexual minority[++] (dropped)
• Percent male within members' specific occupation** (dropped from reduced model)	• Percent of cluster that prefers not to answer sexual orientation question (all levels retained)
• Number of people within members' specific occupation** (dropped from reduced model)	• 2016 cluster-specific risk of sexual assault for males (MCC- and postal code–level retained)

Table A.1—Continued

Individual Characteristics	Cluster Characteristics***
• Email address validity flag (dropped)	• 2016 cluster-specific risk of sexual assault for females (MCC- and postal code–level retained)
• Number of changes in UIC/postal code/MCC within year	• Proportion of total personnel on base that are civilians (retained)
• Proportion of time spent on base	• Percent of cluster that has experienced sexual assault in military previously (UIC and postal code level retained)
	• Rate of recent transitions++++ (dropped)
	• Percent of cluster that is on base (dropped)
	• Percent of cluster with flags for APO, FPO, DPO, SHIP (dropped)

NOTES: AI = American Indian or Alaska Native; PI = Pacific Islander; PR = Puerto Rican. *Kept* means that the indicator was kept for these analyses; *dropped* means that it was not included in these analyses.
* For these administrative variables, categories that comprise less than 0.5 percent of the population are combined into an "other" category when used as a predictor in the model. The number of categories after this recode is included in parenthesis.
** Derived from 302 DoD occupational categories.
*** Each variable type was computed for three types of clusters: duty UIC, duty installation or postal code, and duty MCC. Each variable was computed for each month in the year period (approximately FY 2016) and an individual service member's value was the average of their monthly values over the year.
**** *Senior enlisted* are defined as having one or more of the following: E7+, ten-plus years of service, or among the enlisted members of the unit in the top 10th percentile for age. *Senior officers* are defined as having one or more of 04+, officers with ten-plus years of military service or officers in the top 10th percentile for officer age in the unit.
+ *SAPR climate* is the average of responses to questions regarding the behaviors of military members. It includes responses to the following questions (text shortened for brevity): "In the past 12 months, how well have military members of the following paygrades . . . " (1) made it clear that sexual assault has no place in the military, (2) promoted a climate based on mutual respect and trust, (3) led by example by refraining from sexist comments and behaviors, (4) recognized and immediately responded to incidents of sexual harassment, (5) created an environment where victims would feel comfortable reporting sexual harassment or sexual assault, (6) encouraged bystander intervention to assist others in situations at risk for sexual assault or harmful behaviors, (7) publicized sexual assault report resources, and (8) encouraged victims to report sexual assault. Participants responded using a five-point scale (1 = very poorly, 5 = very well). Responses were requested for the following ranks: (1) E1–E3, (2) E4, (3) E5, (4) E6, (5) E7–E9, (6) O1–O3, (7) O4–O6, (8) O7 and above for each of the eight questions (OPA, 2017d).
++ *Sexual minority* is defined as gay/lesbian, bisexual, or transgender (male to female or female to male).
+++ The *attrition index* is the number who separated by December 2017 divided by the number who had end dates prior to December 2017. This is not a proportion, and it can be greater than 1.
++++ The *rate of recent transitions* is the percent of member's UIC that consists of new members, where *new* is defined as present in the current month but not present in previous month.

ten times: simulate a vector of weights from a Dirichlet distribution with parameter vector (1, 1, . . . , 1), and fit a GBM model using these weights. When fitting these GBM models, we used the number of trees previously determined to be optimal through cross-validation.

For the second-stage model, we estimated the parameters using the Stan package within the R programming language, which is a probabilistic programming language for implementing full Bayesian models using Hamiltonian Monte Carlo methods (Stan Development Team, undated). We specified priors that were moderately informative, and all prior distributions were assumed to be independent. The response propensity spline terms have prior distributions

of N (0,0.52), the random effects have Normal prior distributions with unknown variances,[1] and the unknown random effect variances have half-Normal prior distributions with variance 0.12. These priors were set using information from similar models that were fit to 2014 RMWS data. For example, the prior on the variance of random effects used in these models is slightly larger than to the posterior variance of the analogous parameters in our analysis of 2014 RMWS data. For each of the ten sets of predictions from the stage 1 model (one for each Bayesian bootstrap sample), we obtained 2,000 posterior samples of all model parameters. Specifically, 500 posterior samples were obtained from each of four Markov Chains, each with 1,000 burn-in iterations. This provides a total of 2,000 posterior samples in each bootstrap sample, and 20,000 total samples describing the posterior distribution of risk. Standard convergence diagnostics were conducted and did not indicate any issues with model convergence or poor mixing.

Computing Effects Sizes for Cluster Characteristics Across Different Stratification Approaches

To understand which characteristics of clusters are associated with the risk to soldiers within the cluster, we have computed an effect-size metric that relates each cluster characteristic (such as the OPTEMPO or the percent of soldiers who recently transitioned into the cluster) to each approach to stratifying, or clustering, soldiers (e.g., by installation, command, occupation). These effect sizes are expressed as the proportion of total variance in risk across an approach to clustering that is associated with a specific characteristic of those clusters. This standardizes the effect size so that all effect sizes fall between zero and one, regardless of how much variation in risk exists across a given approach to clustering soldiers. These effect sizes are presented in Tables 3.1 and 3.2 for sexual assault risk, and Tables 4.1 and 4.2 for sexual harassment risk.

The effect-size statistic is computed as the variance in individual-level adjusted sexual assault risk associated with a given cluster characteristic divided by the total variance in individual-level adjusted sexual assault risk across the clusters themselves. This statistic was computed separately within each MCMC across the full population to derive the Bayesian posterior distribution of the effect size. Because these calculations are done on the adjusted risk distributions, they control for the full variety of individual-level characteristics (see Table A.1), but they do not control for either the other approaches to clustering nor for the other cluster characteristics for the same approach to clustering. For example, our effect size documenting installation OPTEMPO's association with installation-level sexual assault risk does not control for other characteristics of these installations, such as the number of civilians who worked there or the evaluation of the command climate by soldiers at the installation.

It is worth noting that these statistics are highly uncertain whenever an approach to clustering (e.g., CMF) is only weakly associated with individual-level sexual assault risk. It is difficult to precisely estimate the proportion of variance in risk across CMFs that is associated with differences in the OPTEMPO of CMFs if there is little variation in risk across CMFs.

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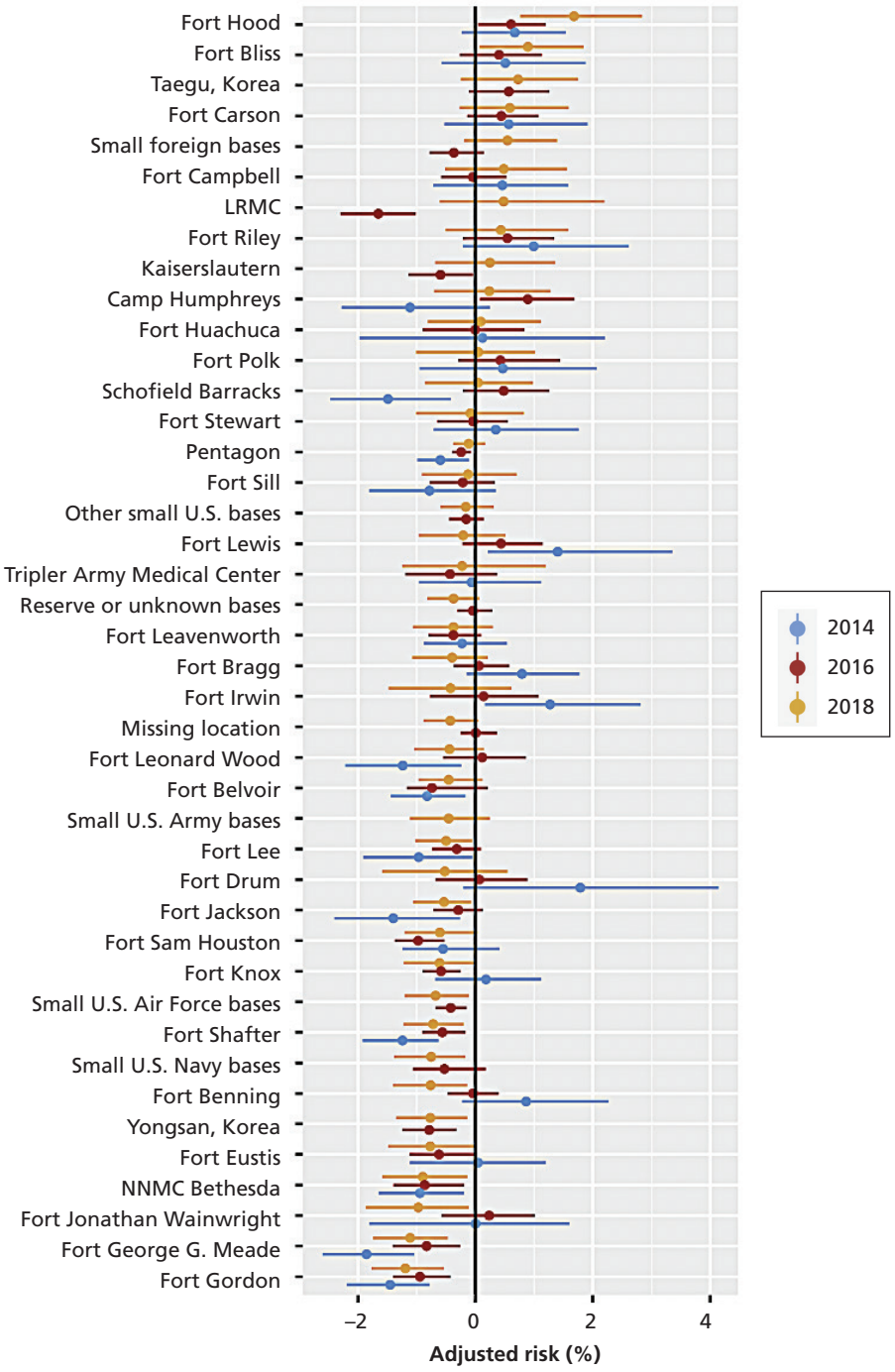
[1] The random effects for the clusters of administrative and operational command structures shared a single random-effect variance, while unit type and homeport or base had distinct random effect variances.

APPENDIX B

Adjusted Installation Sexual Assault Risk from 2014 to 2018

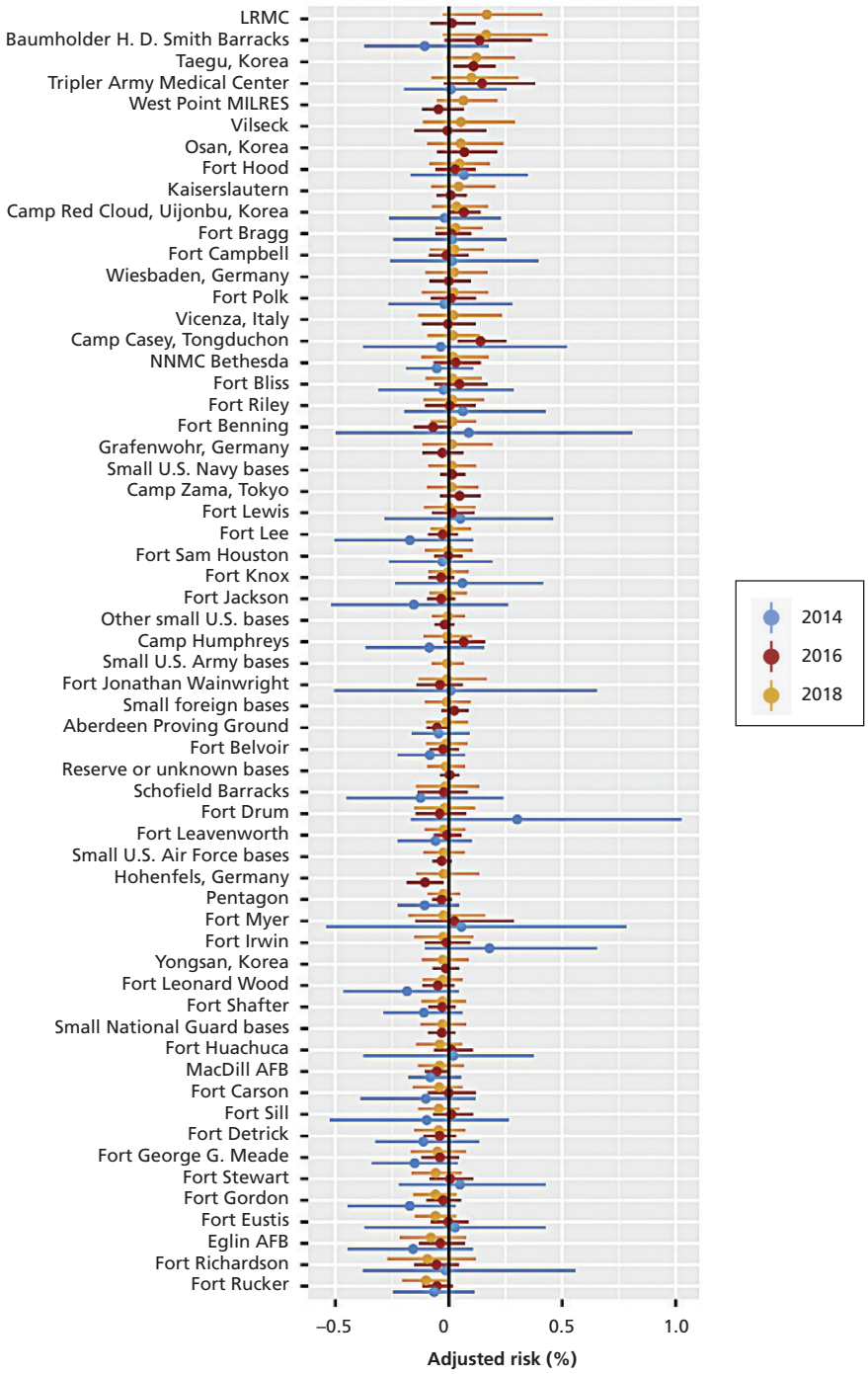
Figures B.1 through B..4 illustrate changes in adjusted risk estimates across the four-year period from 2014 to 2018. These figures supplement Figures 3.13 and 3.14 (for adjusted sexual assault risk) and Figures 4.8 and 4.9 (for adjusted sexual harassment risk) by adding a third set of estimates from 2014.

Figure B.1
Adjusted Installation Sexual Assault Risk Estimates for 2014, 2016, and 2018, Army Women



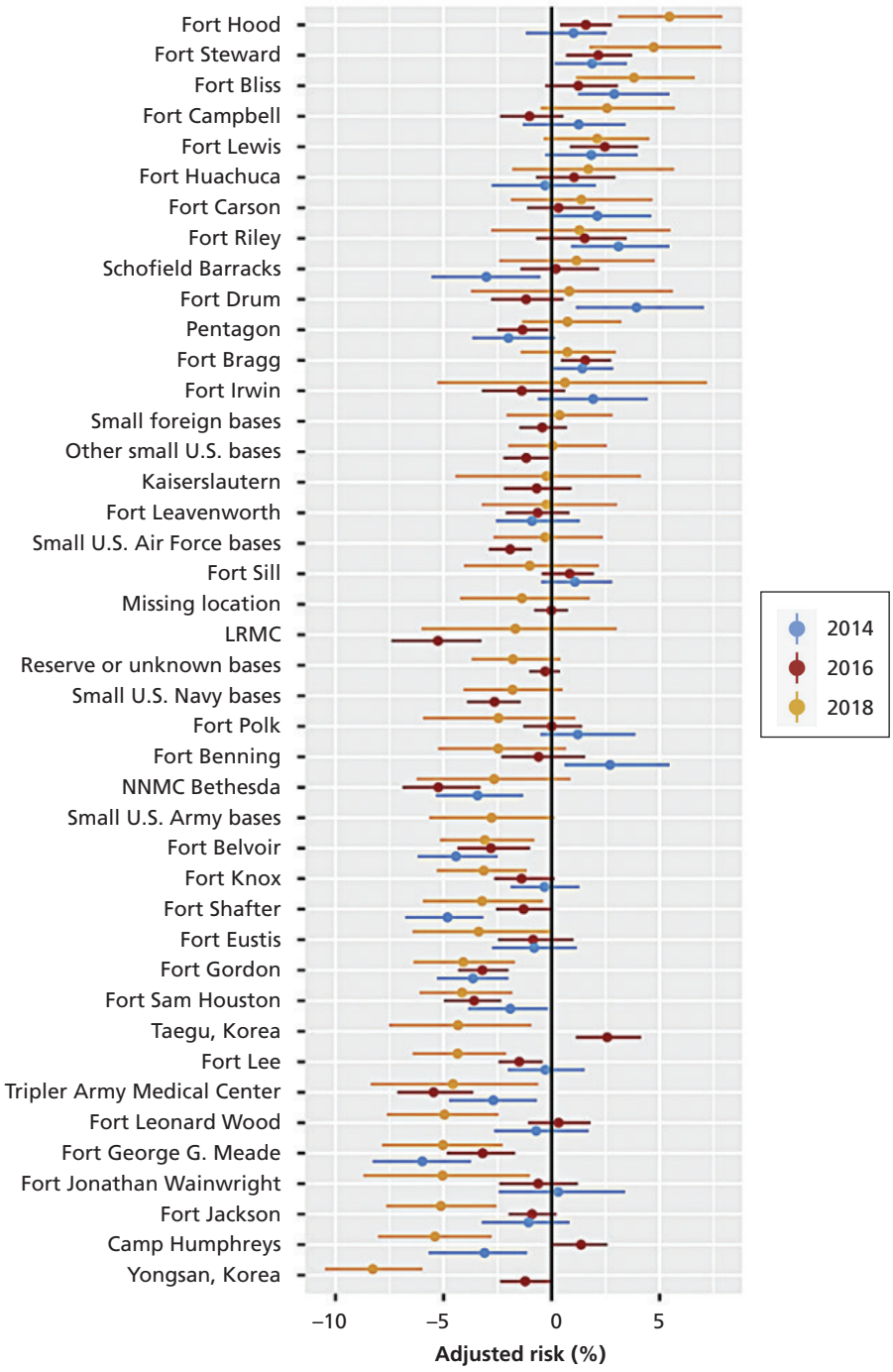
NOTES: This figure displays all installations for which estimates were available in at least two of the three biennial estimates. For 2018 (gold) and 2016 (red) estimates, 80 percent CIs are displayed. For 2014 (blue) estimates, previously published 95 percent CIs are displayed.

Figure B.2
Adjusted Installation Sexual Assault Risk Estimates for 2014, 2016, and 2018, Army Men



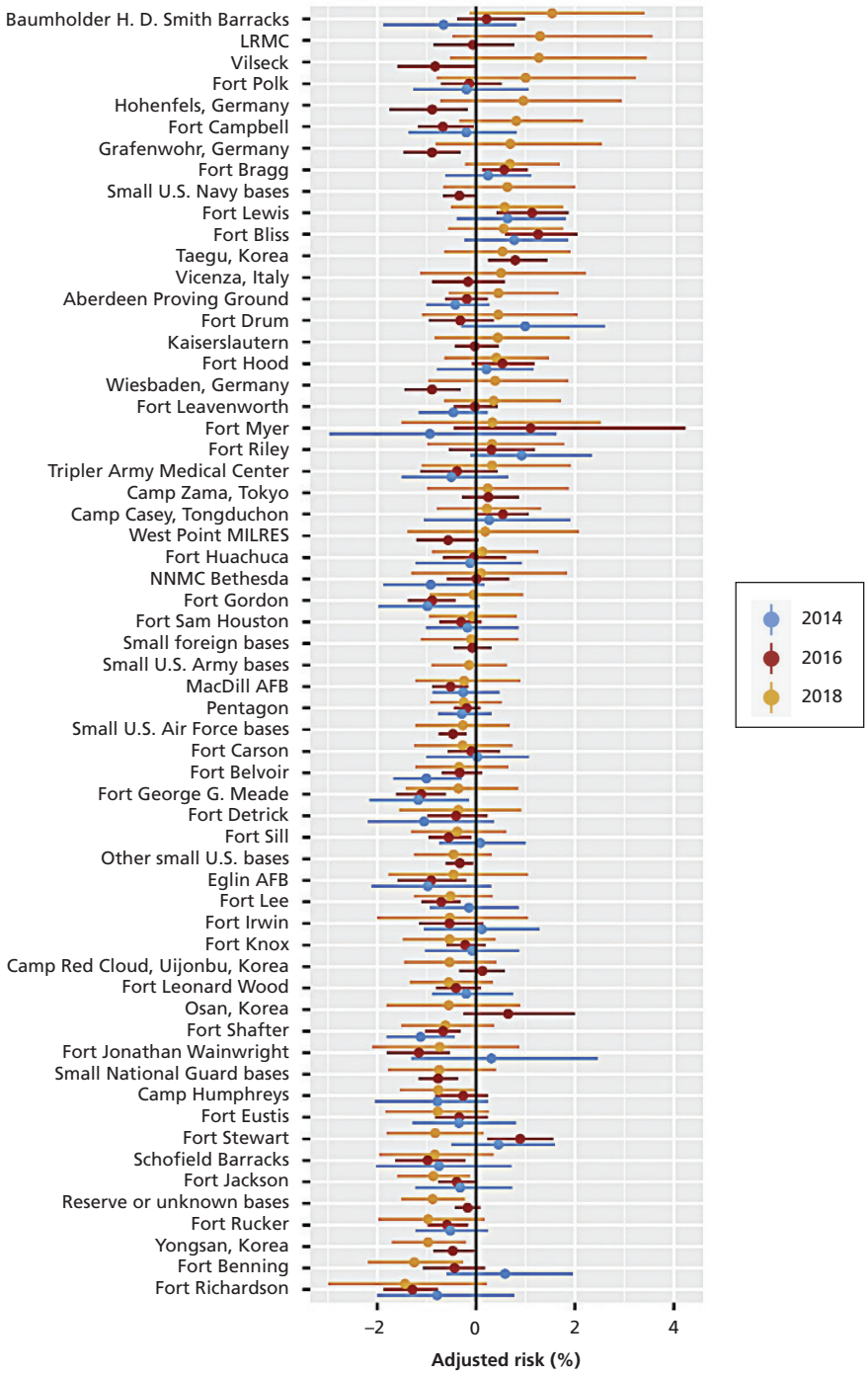
NOTES: This figure displays all installations for which estimates were available in at least two of the three biennial estimates. For 2018 (gold) and 2016 (red) estimates, 80 percent CIs are displayed. For 2014 (blue) estimates, previously published 95 percent CIs are displayed.

Figure B.3
Adjusted Installation Sexual Harassment Risk Estimates for 2014, 2016, and 2018, Army Women



NOTES: This figure displays all installations for which estimates were available in at least two of the three biennial estimates. For 2018 (gold) and 2016 (red) estimates, 80 percent credible intervals are displayed. For 2014 (blue) estimates, previously published 95 percent credible intervals are displayed.

Figure B.4
Adjusted Installation Sexual Harassment Risk Estimates for 2014, 2016, and 2018, Army Men



NOTES: This figure displays all installations for which estimates were available in at least two of the three biennial estimates. For 2018 (gold) and 2016 (red) estimates, 80 percent CIs are displayed. For 2014 (blue) estimates, previously published 95 percent CIs are displayed.

APPENDIX C

All Risk Estimates for All Clusters

This is a separate appendix that is not publicly available.

APPENDIX D

Classification of Career Management Fields

Several CMFs were too small to calculate risk estimates for them individually. Instead, we aggregated smaller CMFs and produced estimates for these aggregated categories. Table D.1 displays the original CMF number and name, the number of person-years associated with each, and the label used in this report to describe the risk estimate for that CMF combined with others under the same label. Person-years listed in this table are from 2016. We used the same aggregations in 2016 so that CMF cluster estimates would be comparable across the two years.

Table D.1
CMF Numbers, Names, and Associated Person-Years

CMF (two-digit military occupational specialty)	CMF Description	Person-Years	Aggregated Code
(Blank)	Unknown	3,043	Unknown
00	Recruiter/special duty assignment	560	Recruiter/special duty assignment
01	Special forces/civil affairs/ psychological operations	183	Recruiter/special duty assignment
02	Musician	94	Recruiter/special duty assignment
05	Unknown	1	Unknown
09	Interpreter/translator	688	Interpreter/translator
11	Infantry	65,627	Infantry
12	Corps of engineers	19,787	Corps of engineers
13	Field artillery	23,748	Field artillery
14	Air defense artillery	8,753	Air defense artillery
15	Aviation	31,456	Aviation
17	Cyber operations specialist	948	Cyber operations specialist
18	Special forces	9,772	Special forces
19	Armor	18,334	Armor
24	Telecommunication systems engineering	203	Operations support
25	Signal corps/communications	33,626	Signal corps/communications
27	Paralegal/JAG	3,488	Paralegal/JAG
29	Electronics repairer	841	Electronics repairer
30	Information operations officer	198	Operations support
31	Military police	16,331	Military police
34	Strategic intelligence officer	182	Operations support
35	Intelligence	27,413	Intelligence
36	Financial management	2,390	Financial management
37	Psychological operations	1,656	Psychological operations
38	Civil affairs	1,892	Civil affairs
40	Space operations (pilots, flight engineers)	182	Operations support
42	Human resources	15,802	Human resources
46	Public affairs	897	Public affairs
47	Professor	89	Operations support
48	Foreign area officer	613	Foreign area officer

Table D.1—Continued

CMF (two-digit military occupational specialty)	CMF Description	Person-Years	Aggregated Code
49	Operations research	341	Operations support
50	Force development	177	Operations support
51	Acquisition corps	1,701	Acquisition corps
52	Systems development/contract officer	186	Operations support
53	Information systems	353	Operations support
56	Chaplain	2,963	Chaplain
57	Simulations operations	204	Operations support
59	Strategist	282	Operations support
60	Medical	1,707	Medical
61	Medical	2,191	Medical
62	Medical	534	Medical
63	Medical	1,115	Medical
64	Food safety/veterinary	600	Food safety/veterinary
65	Medical	1,443	Medical
66	Nurse	3,774	Nurse
67	Health services (laboratory, pharmacy, technician)	4,822	Health services (laboratory, pharmacy, technician)
68	Medical	32,511	Medical
70	Health care administration	6	Medical
72	Nuclear medicine, entomology, audiology	10	Medical
73	Social work, clinical psychology	42	Medical
74	Chemical, biological, radiological, and nuclear specialist	6,710	Chemical, biological, radiological, and nuclear specialist
79	Recruiting and counseling	4,448	Recruiting and counseling
88	Transportation	17,906	Transportation
89	Ammunition	6,263	Ammunition
90	Logistics	5,262	Logistics
91	Equipment maintenance/repairer	32,941	Equipment maintenance/repairer
92	Supply and logistics/food service	41,584	Supply and logistics/food service
94	Electronics maintenance/repairer	3,915	Electronics maintenance/repairer

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Extending previous RAND analyses, researchers found variation in total sexual assault risk—estimated prevalence of sexual assault—across groups of soldiers. For example, Army women at Fort Hood, Fort Bliss, and several other bases face total sexual assault risk that is higher than the risk faced by the average woman in the Army.

Sexual harassment is more common than sexual assault, but the results also showed that risk of sexual harassment is highly associated with risk of sexual assault. Thus, bases with high sexual assault risk also have high sexual harassment risk.

One question is whether groups with higher risk estimates simply have soldiers assigned to them who are at higher risk because of their individual characteristics (e.g., younger, unmarried), or whether personnel in those groups would experience lower risk if stationed elsewhere. To evaluate this, researchers calculated adjusted risk: This measures how much higher or lower than expected the risk of sexual assault is for a group of soldiers. Army women at Fort Hood had an adjusted sexual assault risk of 1.7 percent during 2018, indicating that their risk was 1.7 percent higher than expected based on the characteristics of women assigned there.

Several characteristics were associated with different levels of adjusted risk for Army women's sexual assault and sexual harassment and for men's sexual harassment, including positive unit or supervisor climate (associated with lower risk) and deployment operational tempo (associated with higher risk). Army women in environments with higher proportions of combat arms have higher adjusted risk.

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