



2018 Workplace and Gender Relations Survey of Active Duty Members

Statistical Methodology Report

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2018 WORKPLACE AND GENDER RELATIONS SURVEY OF ACTIVE DUTY MEMBERS: STATISTICAL METHODOLOGY REPORT

Introduction

The Office of People Analytics (OPA) conducts both web-based and paper-and-pen surveys to support the personnel information needs of the Under Secretary of Defense for Personnel and Readiness (USD[P&R]). These surveys assess the attitudes and opinions of the entire Department of Defense (DoD) community on a wide range of personnel issues. Health and Resilience (H&R) Surveys are in-depth studies of topics which impact the health and well-being of military populations.

This report describes the statistical methodologies for the *2018 Workplace and Gender Relations Survey of Active Duty Members (2018 WGRA)*. The first section describes the sample design and selection of the sample. The second section describes weighting and variance estimation. The third section describes the statistical tests used for the *2018 WGRA*. The fourth section describes the calculation of cooperation, completion, and response rates for the full sample and population subgroups. The fifth section provides an overview of the nonresponse bias analysis that will be done at a later date. Estimates for all survey questions are found in the *2018 Workplace and Gender Relations Survey of Active Duty Members: Results and Trends* (OPA, 2019a).

Sample Design and Selection

Target Population

The *2018 WGRA* was designed to represent individuals meeting the following criteria:

- Active duty members of the Army, Navy, Marine Corps, Air Force and Coast Guard excluding Public Health and NOAA members
- Paygrades E1 to O6
- Reside on the April 2018 *Active Duty Master File (ADMF)*
- Valid Personnel status (Not a prisoner, deserter, or unknown)

National Guard and Reserve members in active duty programs were excluded. Data were collected between August 24 and November 5, 2018.

Sampling Frame

The sampling frame consisted of 1,327,194 active duty members (1,285,990 DoD and 41,204 Coast Guard) determined from using the April 2018 *ADMF*. Auxiliary frame data were obtained from the following files:

- April 2018 *Active Duty Family Database (ADFD)*
- April 2018 *Basic Allowance for Housing (BAH) File*
- March 2018 *Contingency Tracking System (CTS) Deployment File*
- April 2018 *Defense Enrollment Eligibility Reporting System (DEERS) Medical Point-in-Time Extract (PITE)*
- April 2018 *Unit Identification Code (UIC) Address File*
- June 2018 *Database Extract (DBE) File*
- April 2018 *Reserve Components Common Personnel Data System (RCCPDS) Master File (Dual Spouse Variable)*

After selecting the sample, OPA performed additional checks to verify the member was still eligible. To save costs, OPA excluded ineligible sample members from mailings and notifications. Individuals were included on the frame based on membership in both the April 2018 *ADMF* and the May 2018 *PITE*; sample members no longer in the May 2018 *DEERS Medical PITE* were recorded as record ineligible. There were 9,800 (1.3%) members determined to be record ineligible from this process (SAMP_DC=1 in Table 3 below). OPA identified 999 (0.1%) additional members as ineligible through either the survey instrument or member contact (SAMP_DC=2 or 3 in Table 3).

Sample Design

The sample for the 2018 *WGRA* survey used a single-stage stratified design. Design parameters from the DoD Sexual Assault and Prevention Office (SAPRO) specified an agreed upon 23 installations that OPA would consider when designing the sample to ensure that there were a sufficient number of respondents to make accurate estimates by base and gender.

OPA implemented the stratification in two steps. First, the selected installations were considered based on their size and expected number of respondents, and OPA determined that placing women from these 23 bases into a single stratum was the most effective method to meet the estimation goals. Next, OPA stratified the remaining members into 85 strata that were initially determined by a full cross-classification of the four stratification variables (see Table 1 below). When initial strata contained fewer than 200 members in the stratum, OPA collapsed variables together in reverse order as shown in Table 1 (e.g., first collapse Race by combining minority with non-minority, so a stratum may look like Coast Guard/Female/O4-O6).

Table 1 shows these four variables and associated variable levels.

Table 1.
Variables for Stratification and Key Reporting Domains

| Stratification Variable | Variable Name | Categories |
|-------------------------|---------------|------------------|
| Service | CSERVICE | 1. Army |
| | | 2. Navy |
| | | 3. Marine Corps |
| | | 4. Air Force |
| | | 5. Coast Guard |
| Gender | CSEX | 1. Male, Unknown |
| | | 2. Female |
| Paygrade Group | CPAYGRP9 | 1. E1–E4 |
| | | 2. E5–E9 |
| | | 3. W1–W5 |
| | | 4. O1–O3 |
| | | 5. O4–O6 |
| Race | CRACECAT | 1. Non-Minority |
| | | 2. Minority |

OPA selected individuals with equal probability and without replacement within each stratum. However, because allocation was not proportional to the size of the strata, selection probabilities varied among strata, and individuals were not selected with equal probability overall. To achieve adequate sample sizes for all domains (reporting categories), OPA used a nonproportional allocation.

Sample Allocation

OPA allocated the sample to achieve the goal of reliable precision on estimates for outcomes associated with reporting a sexual assault (e.g., retaliation) and other measures that were only asked of a very small subset of members, especially for males. Given estimated variable survey costs and anticipated eligibility and response rates, OPA used an optimization algorithm to determine the minimum-cost allocation that simultaneously satisfied the domain precision requirements. Response rates from previous surveys were used to estimate eligibility and response rates for all strata. The *2016 Status of Forces Survey of Active Duty Members (SOFS-A)*, the *2017 SOFS-A*, and the *2016 WGRA* were used to estimate these rates.

OPA determined the sample allocation by means of the OPA Sample Planning Tool (SPT), Version 2.1 (Dever & Mason, 2003). This application is based on the method originally developed by J. R. Chromy (1987) and described in Mason, Wheelless, George, Dever, Riemer, and Elig (1995). The SPT defines domain variance equations in terms of unknown stratum sample sizes and user-specified precision constraints. A cost function is defined in terms of the unknown stratum sample sizes and the per-unit cost of data collection, editing, and processing. The variance equations are solved simultaneously, subject to the constraints imposed, for the sample size that minimizes the cost function. Estimated eligibility and response rates affect the allocation by inflating the final sample size to compensate for projected survey nonresponse.

Prevalence rates (e.g., sexual harassment rate) refer to a percentage that is used in determining the estimated variance used for the calculation of the sample size. OPA always uses a projected prevalence of 50 percent since it is the most conservative and yields the largest estimated sample size.

There were 122 reporting domains defined for the *2018 WGRA* and the initial goal was to achieve below 5 percent precision on estimates. The survey design cannot control for 16 of the domains because the domains are conditional upon survey responses. The precision requirement for each domain is typically based on an estimated prevalence rate of 50 percent with a 95 percent confidence interval half-width no greater than ± 5 percent. However, given the rarity of events covered by many of the *2018 WGRA* questions, OPA ensured that a much tighter precision would be met for questions seen by all respondents, while making it likely that confidence interval half-widths of ± 5 could be met for questions that are relevant to only a small portion of respondents. Therefore, OPA tightened the precision constraints accordingly. The overall sample for DoD was approximately 75 percent of all women and 50 percent of all men. All Coast Guard members were selected for the survey.

The *2018 WGRA* total sample size was 735,645 (694,441 DoD and 41,204 Coast Guard); Table 2 provides the sample sizes by stratification variables.

Table 2.
Sample Size by Stratification Variables

| Stratification Variable | Total | Army | Navy | USMC | Air Force | Coast Guard |
|--------------------------|---------|---------|---------|--------|-----------|-------------|
| Sample | 735,645 | 240,814 | 188,210 | 97,076 | 168,341 | 41,204 |
| Gender | | | | | | |
| Male, Unknown | 569,823 | 184,308 | 136,594 | 83,873 | 129,795 | 35,253 |
| Female | 165,822 | 56,506 | 51,616 | 13,203 | 38,546 | 5,951 |
| Paygrade Grouping | | | | | | |
| E1–E4 | 397,301 | 138,332 | 95,313 | 73,650 | 75,835 | 14,171 |
| E5–E9 | 249,754 | 74,277 | 71,852 | 18,498 | 66,269 | 18,858 |
| W1–W5 | 7,255 | 4,240 | 839 | 522 | 0 | 1,654 |
| O1–O3 | 53,754 | 17,304 | 14,069 | 3,101 | 15,478 | 3,802 |
| O4–O6 | 27,581 | 6,661 | 6,137 | 1,305 | 10,759 | 2,719 |
| Race | | | | | | |
| Non-Minority | 435,168 | 131,530 | 106,488 | 61,759 | 105,206 | 30,185 |
| Minority | 300,477 | 109,284 | 81,722 | 35,317 | 63,135 | 11,019 |

Weighting

Using methods similar to the 2016 WGRA, OPA created analytical weights for the *2018 WGRA* to account for unequal probabilities of selection and varying response rates among

population subgroups. Sampling weights were computed as the inverse of the selection probabilities. The sampling weights were then adjusted for nonresponse using models that considered over 50 possible correlates of nonresponse. The adjusted weights were raked to match population totals and to reduce bias unaccounted for by the previous weighting steps. More details about the weighting process can be found later in this document.

Case Dispositions

As the first step in the weighting process, case dispositions were assigned based on eligibility for the survey and on completion of the questionnaire. Execution of the weighting process and computation of response rates both depended on this classification.

Final case dispositions for weighting were determined using information from personnel records, field operations (as recorded in the Survey Control System [SCS]), and returned questionnaires. No single source of information is entirely complete and correct for determining the case disposition; inconsistencies among sources were resolved according to the order of precedence shown in Table 3. This order of execution is critical to resolving case dispositions. For example, suppose an individual in the sample refused the survey with the reason that it was too long. In the absence of any other information, the disposition would be “Active refusal,” a type of eligible nonrespondent. However, if OPA received a phone call that this same member had left the military; the final disposition would be “Ineligible by self- or proxy-report.”

Case disposition counts for the *2018 WGRA* are shown in Table 3. Table 4 presents the number of complete eligible respondents (SAMP_DC=4) by stratification variables: Service, gender, paygrade grouping, and race.

Table 3.
Case Dispositions for Weighting

| Case Disposition (SAMP_DC) | Information Source | Conditions | Sample Size |
|--|------------------------------|--|-----------------|
| 1. Record ineligible | Personnel record | OPA determined whether sampled members had a record in the <i>DEERS PITE</i> prior to fielding the survey. No record in DEERS indicated the member either separated from the military, passed away, etc. | 9,800 (1.3%) |
| 2. Ineligible by self- or proxy-report | Survey Control System (SCS) | The sampled member or a proxy reported that member was ineligible due to such reasons as "Retired," "Ill," "Incarcerated," "No longer employed by DoD," or "Deceased." | 211 (0.03%) |
| 3. Ineligible by survey self-report | Survey eligibility questions | The sampled member was determined to be ineligible based on their response to Q1 of the survey questionnaire "Were you on active duty on [OPEN DATE]?" | 788 (0.1%) |
| 4. Eligible, complete response | Item response rate | Respondents needed to answer at least three of the six critical questions related to sexual assault. | 115,884 (15.8%) |
| 5. Eligible, incomplete response | Item response rate | Survey is not blank but none of the critical sexual assault questions were answered. | 5,735 (0.8%) |
| 8. Active refusal | SCS | Survey is returned blank due to such reasons as "Refused-too long," "Refused-inappropriate/intrusive," "Refused-other," "Unreachable at this address," "Refused by current resident," "Refused additional e-mails," or "Concerned about security/confidentiality." | 560 (0.1%) |
| 9. Blank return | SCS | Blank questionnaire returned with no reason given. | 962 (0.1%) |
| 10. PND | SCS | Postal non-deliverable or original address is non-locatable. | 169,487 (23.0%) |
| 11. Nonrespondent | Remainder | Remaining sampled members that did not respond to survey. | 432,218 (58.8%) |
| Total | | | 735,645 |

Table 4.
Complete Eligible Respondents by Stratification Variables

| Stratification Variable | Total | Army | Navy | USMC | Air Force | Coast Guard |
|--------------------------|---------|--------|--------|-------|-----------|-------------|
| Sample | 115,884 | 28,387 | 22,563 | 8,270 | 42,889 | 13,775 |
| Gender | | | | | | |
| Male | 84,453 | 19,739 | 15,687 | 6,315 | 31,561 | 11,151 |
| Female | 31,431 | 8,648 | 6,876 | 1,955 | 11,328 | 2,624 |
| Paygrade Grouping | | | | | | |
| E1–E4 | 33,842 | 8,639 | 4,575 | 3,783 | 13,803 | 3,042 |
| E5–E9 | 53,523 | 12,330 | 11,399 | 3,090 | 19,629 | 7,075 |
| W1–W5 | 2,400 | 1,021 | 297 | 191 | 0 | 891 |
| O1–O3 | 14,585 | 3,861 | 3,519 | 733 | 5,025 | 1,447 |
| O4–O6 | 11,534 | 2,536 | 2,773 | 473 | 4,432 | 1,320 |
| Race | | | | | | |
| Non-Minority | 73,395 | 16,215 | 13,350 | 5,152 | 28,198 | 10,480 |
| Minority | 42,489 | 12,172 | 9,213 | 3,118 | 14,691 | 3,295 |

Nonresponse Adjustments and Final Weights

After case dispositions were resolved, the sampling weights were adjusted for nonresponse. First, the sampling weights for cases of known eligibility (SAMP_DC=2, 3, 4, or 5) were adjusted to account for cases of unknown eligibility (SAMP_DC=8, 9, 10, or 11). Next, the eligibility-adjusted weights for eligible respondents with completed questionnaires (SAMP_DC=4) were adjusted to account for eligible sample members who returned an incomplete questionnaire (SAMP_DC=5). All weights for the record ineligibles (SAMP_DC=1) were set to 0 and this weight was transferred to the other cases during raking.

The weighting adjustment factors for eligibility and completion were computed as the inverse of model-predicted probabilities. OPA used extreme gradient boosted (XGBoost) decision trees to model the six outcomes in Table 5, separately for females and males.

Table 5.
Key Outcome Variables

| Variable | Variable Name | Question Type |
|--------------------------------|---------------|----------------------------|
| Hostile Work Environment | HWE | Military Equal Opportunity |
| Gender Discrimination | SDISC | Military Equal Opportunity |
| Sexual Quid Pro Quo | QPQ | Military Equal Opportunity |
| Attempted Sexual Assault | SA_ATT | Sexual Assault |
| Non-Penetrative Sexual Assault | SA_TOUCH | Sexual Assault |
| Penetrative Sexual Assault | SA_PEN | Sexual Assault |

The 2018 *WGRA* nonresponse adjustment involved two steps, each of which produced a set of models. The first step used data from the eligible, complete respondents to develop stage one models for the key outcome variables. Predicted values of the six outcomes from Table 5 were computed for both respondents and nonrespondents. Two second stage models (eligibility and completion) were fit separately by gender to predict the probability of response, using the results from the stage one models along with a limited number of other predictors: Service, paygrade, race. In addition survey form type (paper vs. web) was used for the second stage completion model. The reciprocals of the predicted values from the second model were used as nonresponse adjustments and applied to the respondents. The XGBoost models were weighted; first by the sampling weight, and second by the eligibility-adjusted weight resulting from multiplying the sampling weight by the eligibility status adjustment. Then, the models were adjusted by multiplying the eligibility status weight by the completion status adjustment. Table 6 provides a list of the auxiliary variables included in the first-stage XGBoost models. A subset of these variables is used in the second stage for modeling the response and completion variables.

Table 6.
Variables Used to Model Key Outcome Variables

| Variable | Variable Name | Categories |
|---|---------------|---|
| Military Accession Program | ACC_SRC_CD2 | ACC_SRC_CD was recoded. Any accession code that had less than 50 respondents were put into the category '0' |
| Mailing Address Match Flag | ADDMATCH | 0=Address is different; 1=Address is the same |
| Armed Forces Qualification Test score | AFQT_CAT_CD2 | AFQT_CAT_CD was recoded; Groups with less than 100 respondents were combined into '4Z'; |
| Member Age | AGE | 17–76 |
| Basic Allowance for Housing Indicator | BAHREC | N=Not receiving BAH, Y=receiving BAH, Z=Unknown, .=Missing |
| Number of People that are Female/Male at Base | BASEMALE_PCT | BASEMALE and BASESIZE were used to create percentage that were male |
| Base name of Member | BASENAME_CD | BASENAME was recoded; Any base with less than 50 complete eligible responses were combined into an "**** All Small Bases" group |
| Number of People at Base | BASESIZE_CD | BASESIZE was recoded into subgroups |
| Email address purchase flag | BUYEMAIL | 0=Do not buy email address, 1=Buy email address |
| Total Number of Children | CHILDCNT | 0–13 |
| Duty Location in the World Regions | CREGION1 | 1='US & US territories, Other, Unknown', 2='Europe', 3='Asia & Pacific Islands' |
| Service of Member | CSERVICE | 1=Army, 2= Navy, 3= Marine Corps, 4= Air Force, 5= Coast Guard |
| Gender of Member | CSEX | 1=Male, 2= Female |
| Current deployment status | CUR_DEPLOY | 1=Yes; 0=No |
| Number of Deployments | DCOUNT | 0–33 |
| Deployment flag in the last 12 months | DEPLOY12 | 1=Yes; 0= No |
| Deployment flag in the last 24 months | DEPLOY24 | 1=Yes; 0= No |
| Dual Spouse Flag | DUAL_FLAG | Dual="Dual Spouse"; OTHR="Not a dual spouse" |
| Duty UIC Match Flag; Address is the Same | DUICMATCH | 0=Duty UIC is different; 1=Duty UIC is the same |
| Education level | EDUC_CD | EDUC was recoded; Less than 100 respondents were put into similar education levels |
| E-mail at Time of Sampling | EMAIL | 1=Have an e-mail ; 0= no email |
| Email address flag | EMAILSTAT_CD | EMAILSTAT was recoded: '1=No email or all attempted email addresses invalid, 2=At least one attempted email address not invalid |
| Ethnic affinity code | ETH_CD | ETH was recoded; Less than 100 respondents were put into other ethnicity group (OTH) |

Table 6. (continued)

| Variable | Variable Name | Categories |
|---|-----------------|--|
| Family Status | FAMSTAT | 0= Unknown marital status and/or child status, 1= Single with child(ren), 2= Single without child(ren), 3= Married with child(ren), 4=Married without child(ren) |
| Home Address Flag | FLG_H | N=No home address; Y=Home address |
| Retired or Separated from Service Flag | LEFTSERV | 0=No; 1=Yes |
| Marital Status Code | MRTL_STA_CD | MRTL_STA was recoded; Less than 100 respondents were put into 'O' |
| Number of members in member's duty UIC | N_DUIC | 1–6,560 |
| Number of males in member's duty UIC | N_DUICMALE | 0–5,215 |
| Number of people within members' specific occupation code | N_OCC | 4–80,284 |
| Number of males in member's primary occupation | N_OCCMALE | 0–80,096 |
| On or Off Base Status | OFFBASE | 0=Unknown, 1=On Base (No BAH), 2=Off Base (receiving BAH) |
| Percent of males in member's duty UIC | P_DUICMALE | 0–100% |
| Percent male within members' specific occupation | P_OCCMALE | 0–100% |
| Paygrade of Member (20 level) | PAYGRADE | E1–E9, W1–W5, O1–O6 |
| Occupation Grouping | PDODOCC_CD | PDODOCC was recoded; There were 298 levels and this was formed by taking the first 2 characters |
| Race/Ethnic Category | RACE_ETH | A=AIAN, B=Asian, C=Black, D=White, E=Hispanic, F=NHPI, M=Multi Race, Z=Unknown |
| Strength Accounting Codes | STR_ACCT_CD2 | STR_ACCT_CD was recoded; the A20's were put with the A24 |
| Active Federal Military Service Base Calendar Date | TAFMS_DT2 | TAFMS_DT2 was recoded: Took the year and month |
| Years of service | TAFMS_YR_QY | 0–49; 99's were coded to missing |
| US Citizen Citizenship Origin Code | US_CITZ_ORIG_CD | A='Born within the US, GU, PR or VI', B='US citizen, parent became a citizen by naturalization', C='Born outside US, GU, PR or VI to at least one citizen parent', D='US citizen by naturalization', Y='Not a US citizen', Z='Origin not determined' |
| US Citizenship Status Code | US_CITZ_STAT_CD | A=US national, C=US citizen, N=Non US citizen or national, Z=Unknown |

To further explain the 2018 *WGRA* nonresponse adjustments, recall from Table 3 that SAMP_DC (case disposition) 2, 3, 4, and 5 denote cases with known eligibility, whereas SAMP_DC 8, 9, 10, and 11 correspond to cases for which eligibility is unknown. The eligibility adjustment increased the weights of case dispositions 2, 3, 4, and 5 to represent dispositions 8, 9, 10, and 11. The second adjustment increased the weights of complete eligible cases (SAMP_DC=4) to compensate for incomplete eligible cases (SAMP_DC=5).

To increase response to the 2018 *WGRA*, nonrespondents to the web version of the survey were sent a paper form of the questionnaire. The paper version included the key survey items, but it omitted many secondary items on the web questionnaire, presenting the recipient with approximately 70 questions instead of the approximately 216 on the web version. The primary set of weights was based on responses from the full data set including both the web and paper versions. To support analysis of items only on the web version, a second set of weights was produced, following the same steps as the full data set excluding the paper questionnaire. For this weighting, all paper questionnaire respondents were treated as nonrespondents, including in the fitting of the XGBoost models. This second set of weights is intended solely for analysis of web-only items. The primary set of weights provides the basis for estimating the key outcomes from the survey items collected on both the web and paper versions of the questionnaire.

Finally, the nonresponse-adjusted weights were modified through a process called raking. The purpose of raking is to use known information about the survey population to increase the precision of survey estimates. This information consists of totals for different levels of variables (such as demographic characteristics). For example, the variable CSEX has two levels: male and female. During the raking process, sampled individuals are first categorized into the cells of a table defined by two or more variables—called raking dimensions. The goal of raking is to adjust the weights so that they add up to the known totals—called control totals—for the different levels within each raking dimension. Preceding one dimension at a time, raking computes a proportional adjustment to the weights associated with each level of the raking dimension. After all dimensions are adjusted, the process is repeated until the totals for all levels of the raking dimensions are equal to the corresponding control totals (at least within a specified tolerance).

Control totals were computed from information from the sampling frame. There were four raking dimensions, defined in Table 7:

Table 7.
Variables Used for Raking

| Variable | Variable Name | Categories | |
|--|---------------|-----------------------------|------------------------------|
| DoD x paygroup (CDOD x CPAYGRP7) | DODPAY7 | 1. DoD*E1–E3 | 8. CG*E1–E3 |
| | | 2. DoD*E4 | 9. CG*E4 |
| | | 3. DoD*E5–E6 | 10. CG*E5–E6 |
| | | 4. DoD*E7–E9 | 11. CG*E7–E9 |
| | | 5. DoD*W1–W5 | 12. CG*W1–W5 |
| | | 6. DoD*O1–O3 | 13. CG*O1–O3 |
| | | 7. DoD*O4–O6 | 14. CG*O4–O6 |
| DoD x race (CDOD x CRACECAT) | DODRACE | 1. DoD*Non-minority | 3. CG*Non-minority |
| | | 2. DoD*Minority | 4. CG*Minority |
| DoD x Gender x Pay (CDOD x GENDER x CPAYGRP5) | DODGENPAY | 1. DOD*Male*E1–E4 | 11. CG*Male*E1–E4 |
| | | 2. DOD*Male*E5–E9 | 12. CG*Male*E5–E9 |
| | | 3. DOD*Male*W1–W5 | 13. CG*Male*W1–W5 |
| | | 4. DOD*Male*O1–O3 | 14. CG*Male*O1–O3 |
| | | 5. DOD*Male*O4–O6 | 15. CG*Male*O4–O6 |
| | | 6. DOD*Female*E1–E4 | 16. CG*Female*E1–E4 |
| | | 7. DOD*Female*E5–E9 | 17. CG*Female*E5–E9 |
| | | 8. DOD*Female*W1–W5 | 18. CG*Female*W1–W5 |
| | | 9. DOD*Female*O1–O3 | 19. CG*Female*O1–O3 |
| | | 10. DOD*Female*O4–O6 | 20. CG*Female*O4–O6 |
| DoD x Gender x Service x Officer (CDOD x CSEX x CSERVICE X CPAYGRP6) | DODGENSVCOFF | 1. DOD*Army*Male*Enlisted | 11. DOD*Navy*Female*Enlisted |
| | | 2. DOD*Army*Male*Officer | 12. DOD*Navy*Female*Officer |
| | | 3. DOD*Navy*Male*Enlisted | 13. DOD*USMC*Female*Enlisted |
| | | 4. DOD*Navy*Male*Officer | 14. DOD*USMC*Female*Officer |
| | | 5. DOD*USMC*Male*Enlisted | 15. DOD*AF*Female*Enlisted |
| | | 6. DOD*USMC*Male*Officer | 16. DOD*AF*Female*Officer |
| | | 7. DOD*AF*Male*Enlisted | 17. CG*Male*Enlisted |
| | | 8. DOD*AF*Male*Officer | 18. CG*Male*Officer |
| | | 9. DOD*Army*Female*Enlisted | 19. CG*Female*Enlisted |
| | | 10. DOD*Army*Female*Officer | 20. CG*Female*Officer |

Table 8 summarizes the distributions of the sampling weights, intermediate weights, final weights, and corresponding adjustment factors by eligibility status for the primary weights. As described earlier in the report, eligible respondents are those individuals who were not only eligible to participate in the survey but also completed at least three of the critical sexual assault

questions. Record ineligible individuals are those who were not eligible to participate in the survey according to administrative records; no weights were computed for these cases.

The mean sampling weight is 2.0 for the complete eligibles. The nonresponse adjustment for eligibility status that follows next makes the biggest single adjustment to the weights, in terms of increasing both the mean and the coefficient of variation (C.V.) of the weights. The two remaining adjustments for nonresponse among the eligible population and the final raking have a modest effect on increasing the mean weight. The corresponding factors shown in the last two columns of Table 8 have small C.V.'s; in other words, the factors in each column differ from each other by relatively small amounts.

Table 8.
Distribution of Weights and Adjustment Factors for Complete Eligibles

| Statistic | Sampling Weight | Eligibility Status Adjusted Weight | Complete Eligible Response Adjusted Weight | Final Weight | Eligibility Status Factor | Complete Eligible Response Factor | Raking Factor |
|-----------|-----------------|------------------------------------|--|--------------|---------------------------|-----------------------------------|---------------|
| N | 115,884 | 115,884 | 115,884 | 115,884 | 115,884 | 115,884 | 115,884 |
| MIN | 1.0 | 1.3 | 1.3 | 1.2 | 1.2 | 1.0 | 0.9 |
| MAX | 6.2 | 249.5 | 262.9 | 275.9 | 43.8 | 1.2 | 1.5 |
| MEAN | 2.0 | 9.9 | 10.5 | 11.1 | 5.4 | 1.1 | 1.0 |
| STD | 0.9 | 10.2 | 10.9 | 12.5 | 6.0 | 0.02 | 0.09 |
| C.V. | 0.46 | 1.03 | 1.04 | 1.12 | 1.12 | 0.02 | 0.09 |

Under simplifying assumptions, Kish (Kish, 1965) approximates the relative increase in variance due to weight variation as 1 plus the C.V. squared ($1+(C.V.)^2$). Because the C.V. of the weights is 1.12, the increase in variance due to weighting is 2.27. Given the task of the weighting adjustments is to compensate for differential nonresponse and its possible impact on the bias of key outcome variables, the increase in variance due to weighting appears reasonable.

Table 9 shows the sum of the weights at different stages of weighting. The weights adjusted for known eligibility status distribute the sampling weights for nonrespondents with unknown eligibility status among the remaining dispositions. The eligible response adjusted weights then compensate for eligible respondents providing incomplete surveys. By design, the final raking adjustments redistribute record ineligible and other dispositions excluded from the final weights to match the total number in the original frame.

Table 9.
Sum of Weights by Eligibility Status

| Eligibility Category | Sum of Sampling Weights | Sum of Eligibility Status Adjusted Weights | Sum of Complete Eligible Response Adjusted Weights | Sum of Final Weights |
|---------------------------------|-------------------------|--|--|----------------------|
| 1. Eligible weighted | 228,711 | 1,142,342 | 1,212,408 | 1,283,244 |
| 2. Ineligible weighted | 2,078 | 41,093 | 41,093 | 43,950 |
| 3. Non-response unweighted | 1,079,581 | 66,842 | 0 | 0 |
| 4. Record ineligible unweighted | 16,824 | 16,824 | 16,824 | 0 |
| Total | 1,327,194 | 1,267,101 | 1,270,325 | 1,327,194 |

Variance Estimation

Sampling error is the uncertainty associated with an estimate that is based on data gathered from a sample of the population rather than the full population. Note that sample-based estimates will vary depending on the particular sample selected from the population. Measures of the magnitude of sampling error, such as the variance and the standard error (the square root of the variance), reflect the variation in the estimates over all possible samples that could have been selected from the population using the same sampling methodology. Analysis of the 2018 WGRA data required a variance estimation procedure that accounted for the weighting procedures. The final step of the weighting process was to define strata for variance estimation by Taylor series linearization. For each strata/variance strata, OPA ensured that there were at least 25 complete eligible responses with non-zero final weights. The variance strata closely mirrored the original strata and collapsing only occurred in four strata.

Multiple Comparisons

To support the WGRA reports and briefings, OPA conducts a large number of statistical tests to identify significant differences across demographic groups or compare estimates with prior years. This is known in statistical hypothesis testing as the multiple comparisons problem. Numerous techniques have been developed to reduce the false positives associated with conducting multiple statistical tests. It should be noted that there is no universally accepted approach for dealing with the problem of multiple comparisons. To protect against erroneous statistically significant results during the 2018 WGRA, OPA used a p-value of 0.01 for its statistical tests. OPA chose this cut-off after empirically testing a statistical method called False Discovery Rate correction (FDR) developed by Benjamini and Hochberg (1995). FDR is defined as the expected percentage of erroneous rejections among all rejections. The idea is to control the false discovery rate which is the proportion of "discoveries" (significant results) that are actually false positives. Based on the FDR thresholds from several prior gender relations surveys, OPA determined that a p-value of 0.01 was a reasonable threshold. More details on performing multiple statistical tests follows.

When statistically comparing groups, a statistical hypothesis whether there are no differences (null hypothesis) versus there are differences (alternative hypothesis) is tested. OPA

mainly uses independent two sample t-tests and the conclusions are usually based on the p-value associated with the test-statistic. If the p-value is less than the critical value then the null hypothesis is rejected. Any time a null hypothesis is rejected (a conclusion that estimates are significantly different), it is possible this conclusion is incorrect. In reality, the null hypothesis may have been true, and the significant result may have been due to chance. A p-value of 0.01 means there is a one percent chance of finding a difference as large as the observed result if the null hypothesis were true.

Contact, Cooperation, and Response Rates

Contact, cooperation, and response rates were calculated in accordance with the recommendations of the American Association for Public Opinion Research (AAPOR, 2016 Standard Definitions), which estimates the proportion of eligible respondents among cases of unknown eligibility (SAMP_DC=10 and 11).

The *contact rate* uses the concepts of AAPOR standard formula CON2 and is defined as

$$CON2 = \frac{(I + P) + R + O - e(O)}{(I + P) + R + O + NC - e(NC + O)} = \frac{\text{adjusted contacted sample}}{\text{adjusted eligible sample}} = \frac{N_C}{N_E}.$$

The *cooperation rate* uses the concepts of AAPOR standard formula COOP2 and is defined as

$$COOP2 = \frac{(I + P)}{(I + P) + R + O - e(O)} = \frac{\text{complete eligibles}}{\text{adjusted contacted sample}} = \frac{N_R}{N_C}.$$

The *response rate* uses the concepts of AAPOR standard formula RR4 and is defined as

$$RR4 = \frac{(I + P)}{(I + P) + R + O + NC - e(NC + O)} = \frac{\text{complete eligibles}}{\text{adjusted eligiblesample}} = \frac{N_R}{N_E}.$$

Where:

I = Fully complete responses according to RR4 are greater than 80% complete (SAMP_DC=4)

P = Partially complete responses according to RR4 are between 50–80% complete (SAMP_DC=4)

R = Refusal and break-off according to RR4 are less than < 50% complete (SAMP_DC=5, 8, and 9)¹

NC = Non-contact (SAMP_DC=10)

¹ OPA considers these all cases of known eligibility.

$O = \text{Other (SAMP_DC=11)}^2$

$e(O)$ = Estimated ineligible nonrespondents

$e(\text{NC})$ = Estimated ineligible PND

N_C = Adjusted contacted sample

N_E = Adjusted eligible sample

N_R = Complete eligibles³

Table 10 shows the corresponding sample disposition codes associated with the response categories.

Table 10.
Disposition Codes for Response Rates

| Response Category | SAMP_DC Values |
|------------------------|--------------------|
| Eligible Sample | 4, 5, 8, 9, 10, 11 |
| Contacted Sample | 4, 5, 8, 9, 11 |
| Complete Eligibles | 4 |
| Not Returned | 11 |
| Eligibility Determined | 2, 3, 4, 5, 8, 9 |
| Self-report Ineligible | 2, 3 |

Ineligibility Rate

The ineligibility rate (IR) is defined as the following and needs to be calculated for both weighted and unweighted to be applied to Table 10:

$$\text{IR} = \text{Self Report Ineligible} / \text{Eligibility Determined}.$$

Estimated Ineligible Postal Non-Deliverable/Not Contacted Rate

The estimated ineligible postal non-deliverable or not contacted (IPNDR) is defined as:

$$\text{IPNDR} = (\text{Eligible Sample} - \text{Contacted Sample}) * \text{IR}.$$

² These are all nonrespondents which OPA considers cases of unknown eligibility.

³ Complete eligibles is an OPA term that applies to self-administered surveys in comparison to the terms complete and partial interviews used by AAPOR.

Estimated Ineligible Nonresponse

The estimated ineligible nonresponse (EINR) is defined as:

$$\text{EINR} = (\text{Not Returned}) * \text{IR}.$$

Adjusted Contact Rate

The adjusted contact rate (ACR) is defined as:

$$\text{ACR} = (\text{Contacted Sample} - \text{EINR}) / (\text{Eligible Sample} - \text{IPNDR} - \text{EINR}).$$

Adjusted Cooperation Rate

The adjusted cooperation rate (ACR) is defined as:

$$\text{ACR} = (\text{Complete Eligible}) / (\text{Contacted Sample} - \text{EINR}).$$

Adjusted Response Rate

The adjusted response rate (ARR) is defined as:

$$\text{ARR} = (\text{Complete Eligible}) / (\text{Eligible Sample} - \text{IPNDR} - \text{EINR}).$$

The final response rate is the product of the location rate and the completion rate. Table 11 shows both weighted and unweighted location, completion, and response rates for the 2018 *WGRA*.

Finally, Table 12 shows weighted contact, completion, and response rates for the full sample by the stratification variables. The final weighted response rate for the survey was 17.6 percent.

Table 11.
Contacted, Cooperation, and Response Rates

| Type of Rate | Computation | Unweighted | Weighted |
|--------------|--|------------|----------|
| Contacted | Adjusted contacted sample/Adjusted eligible sample | 76.6% | 79.1% |
| Cooperation | Usable responses/Adjusted contacted sample | 21.0% | 22.3% |
| Response | Usable responses/Adjusted eligible sample | 16.1% | 17.6% |

Note: Weighted response rates are the official reported rates. Unweighted response rates can be influenced by the sample design.

Table 12.
Rates for Full Sample and Stratification Categories

| Domain Variable | Domain | Contact Rate | Completion Rate | Response Rate |
|-----------------|--------------|--------------|-----------------|---------------|
| Sample | All | 79% | 22% | 18% |
| Service | Army | 77% | 19% | 14% |
| | Navy | 76% | 19% | 15% |
| | Marine Corps | 70% | 16% | 11% |
| | Air Force | 87% | 31% | 27% |
| | Coast Guard | 100% | 34% | 34% |
| Gender | Male | 79% | 21% | 17% |
| | Female | 81% | 26% | 21% |
| Paygrade | E1–E4 | 65% | 13% | 9% |
| | E5–E9 | 88% | 24% | 21% |
| | W1–W5 | 94% | 31% | 29% |
| | O1–O3 | 89% | 29% | 26% |
| | O4–O6 | 96% | 43% | 41% |
| Race | Non-minority | 81% | 24% | 19% |
| | Minority | 77% | 20% | 15% |

Note: Reported rates are weighted. Unweighted rates can be influenced by the sample design.

Nonresponse Bias Analysis

OPA is conducting a nonresponse bias analysis (NRB) on the *2018 WGRA* and those results will be available in a separate report. OPA assessed NRB on the *2016 WGRA* and found little evidence of NRB across the three studies conducted (OPA, 2017).

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Appendix A.

Estimation Domains

**DATA
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SOLUTIONS
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Estimation Domains

| Domain Number | Domain Label | Population Size | Percent Sampled | Sample Size |
|---------------|--|-----------------|-----------------|-------------|
| 1 | Total DoD | 1,285,990 | 54.0 | 694,441 |
| 2 | Army | 462,160 | 52.1 | 240,814 |
| 3 | Navy | 321,062 | 58.6 | 188,210 |
| 4 | Marine Corps | 184,154 | 52.7 | 97,076 |
| 5 | Air Force | 318,614 | 52.8 | 168,341 |
| 6 | DoD*Enlisted | 1,059,759 | 57.9 | 614,026 |
| 7 | DoD*E1-E4 | 558,060 | 68.7 | 383,130 |
| 8 | DoD*E1-E3 | 311,453 | 68.9 | 214,504 |
| 9 | DoD*E4 | 246,607 | 68.4 | 168,626 |
| 10 | DoD*E5-E9 | 501,699 | 46.0 | 230,896 |
| 11 | DoD*Officer | 226,231 | 35.5 | 80,415 |
| 12 | DoD*W1-W5/O1-O3 | 144,682 | 38.4 | 55,553 |
| 13 | DoD*O4-O6 | 81,549 | 30.5 | 24,862 |
| 14 | DoD*Deployed Past 12 Months | 203,627 | 51.6 | 105,130 |
| 15 | DoD*Not Deployed Past 12 Months | 1,082,363 | 54.4 | 589,311 |
| 16 | DoD*Non-Hispanic White | 758,911 | 53.4 | 404,965 |
| 17 | DoD*Total Minority | 527,079 | 54.9 | 289,476 |
| 18 | DoD*Female | 209,879 | 76.2 | 159,871 |
| 19 | DoD*Female*Enlisted | 169,835 | 79.5 | 135,062 |
| 20 | DoD*Female*E1-E4 | 95,307 | 88.3 | 84,171 |
| 21 | DoD*Female*E5-E9 | 74,528 | 68.3 | 50,891 |
| 22 | DoD*Female*Officers | 40,044 | 62.0 | 24,809 |
| 23 | DoD*Female*W1-W5/O1-O3 | 27,294 | 65.0 | 17,730 |
| 24 | DoD*Female*O4-O6 | 12,750 | 55.5 | 7,079 |
| 25 | DoD*Female*Deployed Past 12 Months | 25,880 | 74.7 | 19,320 |
| 26 | DoD*Female*Not Deployed Past 12 Months | 183,999 | 76.4 | 140,551 |
| 27 | Female*Army | 68,496 | 82.5 | 56,506 |
| 28 | Female*Army*Enlisted | 52,856 | 86.8 | 45,878 |
| 29 | Female*Army*Officers | 15,640 | 68.0 | 10,628 |
| 30 | Female*Navy | 62,011 | 83.2 | 51,616 |
| 31 | Female*Navy*Enlisted | 52,018 | 87.2 | 45,374 |
| 32 | Female*Navy*Officers | 9,993 | 62.5 | 6,242 |
| 33 | Female*Marine Corps | 15,651 | 84.4 | 13,203 |
| 34 | Female*Marine Corps*Enlisted | 14,043 | 86.6 | 12,159 |
| 35 | Female*Marine Corps*Officers | 1,608 | 64.9 | 1,044 |
| 36 | Female*Air Force | 63,721 | 60.5 | 38,546 |
| 37 | Female*Air Force*Enlisted | 50,918 | 62.2 | 31,651 |
| 38 | Female*Air Force*Officers | 12,803 | 53.9 | 6,895 |
| 39 | DoD*Male | 1,076,111 | 49.7 | 534,570 |
| 40 | DoD*Male*Enlisted | 889,924 | 53.8 | 478,964 |
| 41 | DoD*Male*E1-E4 | 462,753 | 64.6 | 298,959 |
| 42 | DoD*Male*E5-E9 | 427,171 | 42.1 | 180,005 |

| Domain Number | Domain Label | Population Size | Percent Sampled | Sample Size |
|---------------|--------------------------------------|-----------------|-----------------|-------------|
| 43 | DoD*Male*Officers | 186,187 | 29.9 | 55,606 |
| 44 | DoD*Male*W1-W5/O1-O3 | 117,388 | 32.2 | 37,823 |
| 45 | DoD*Male*O4-O6 | 68,799 | 25.8 | 17,783 |
| 46 | DoD*Male*Deployed Past 12 Months | 177,747 | 48.3 | 85,810 |
| 47 | DoD*Male*Not Deployed Past 12 Months | 898,364 | 50.0 | 448,760 |
| 48 | Male*Army | 393,664 | 46.8 | 184,308 |
| 49 | Male*Army*Enlisted | 319,022 | 52.3 | 166,731 |
| 50 | Male*Army*Officer | 74,642 | 23.5 | 17,577 |
| 51 | Male*Navy | 259,051 | 52.7 | 136,594 |
| 52 | Male*Navy*Enlisted | 215,287 | 56.6 | 121,791 |
| 53 | Male*Navy*Officer | 43,764 | 33.8 | 14,803 |
| 54 | Male*Marine Corps | 168,503 | 49.8 | 83,873 |
| 55 | Male*Marine Corps*Enlisted | 148,832 | 53.7 | 79,989 |
| 56 | Male*Marine Corps*Officer | 19,671 | 19.7 | 3,884 |
| 57 | Male*Air Force | 254,893 | 50.9 | 129,795 |
| 58 | Male*Air Force*Enlisted | 206,783 | 53.4 | 110,453 |
| 59 | Male*Air Force*Officer | 48,110 | 40.2 | 19,342 |
| 60 | Coast Guard | 41,204 | 100.0 | 41,204 |
| 61 | Coast Guard*Enlisted | 33,029 | 100.0 | 33,029 |
| 62 | Coast Guard*E1-E4 | 14,171 | 100.0 | 14,171 |
| 63 | Coast Guard*E5-E9 | 18,858 | 100.0 | 18,858 |
| 64 | Coast Guard*Officers | 8,175 | 100.0 | 8,175 |
| 65 | Coast Guard*W1-W5/O1-O3 | 5,456 | 100.0 | 5,456 |
| 66 | Coast Guard*O4-O6 | 2,719 | 100.0 | 2,719 |
| 67 | Coast Guard*Females | 5,951 | 100.0 | 5,951 |
| 68 | Coast Guard*Females*Enlisted | 4,359 | 100.0 | 4,359 |
| 69 | Coast Guard*Females*Officers | 1,592 | 100.0 | 1,592 |
| 70 | Coast Guard*Males | 35,253 | 100.0 | 35,253 |
| 71 | Coast Guard*Males*Enlisted | 28,670 | 100.0 | 28,670 |
| 72 | Coast Guard*Males*Officers | 6,583 | 100.0 | 6,583 |
| 73 | DoD*Males*Ft Hood | 29,787 | 49.7 | 14,818 |
| 74 | DoD*Males*Ft Bragg | 39,782 | 46.9 | 18,644 |
| 75 | DoD*Males*Ft Bliss | 21,955 | 49.5 | 10,876 |
| 76 | DoD*Males*Ft Campbell | 24,455 | 49.5 | 12,101 |
| 77 | DoD*Males*Ft Leonard Wood | 8,315 | 51.6 | 4,292 |
| 78 | DoD*Males*Naval Station Norfolk | 36,412 | 54.0 | 19,677 |
| 79 | DoD*Males*Naval Base San Diego | 24,553 | 53.8 | 13,215 |
| 80 | DoD*Males*Naval Station Great Lakes | 10,657 | 66.0 | 7,033 |
| 81 | DoD*Males*Naval Base Coronado | 5,197 | 50.6 | 2,632 |
| 82 | DoD*Males*Naval Base Kitsap | 11,157 | 55.7 | 6,219 |
| 83 | DoD*Males*Camp Lujune | 35,107 | 53.4 | 18,755 |
| 84 | DoD*Males*Camp Pendleton | 36,244 | 52.7 | 19,104 |
| 85 | DoD*Males*29 Palms | 10,196 | 55.3 | 5,636 |
| 86 | DoD*Males*Miramar | 6,474 | 49.4 | 3,199 |

| Domain Number | Domain Label | Population Size | Percent Sampled | Sample Size |
|---------------|---|-----------------|-----------------|-------------|
| 87 | DoD*Males*Parris Island | 3,997 | 56.2 | 2,248 |
| 88 | DoD*Males*Eglin AFB | 7,018 | 48.0 | 3,367 |
| 89 | DoD*Males*Keesler AFB | 3,265 | 53.6 | 1,751 |
| 90 | DoD*Males*Nellis AFB | 8,027 | 50.3 | 4,036 |
| 91 | DoD*Males*Kadena AB | 5,418 | 51.8 | 2,809 |
| 92 | DoD*Males*Hill AFB | 3,314 | 51.5 | 1,706 |
| 93 | DoD*Males*Joint Base San Antonio | 24,577 | 50.7 | 12,455 |
| 94 | DoD*Males*Joint Base Lewis-McChard | 25,184 | 48.3 | 12,155 |
| 95 | DoD*Males*Joint Base Pearl Harbor-Hickman | 13,040 | 50.5 | 6,584 |
| 96 | DoD*Males*Joint Base Langley-Eustis | 9,403 | 49.1 | 4,617 |
| 97 | DoD*Males*Joint Base Elmendorf-Richardson | 8,307 | 50.9 | 4,228 |
| 98 | DoD*Females*Ft Hood | 5,997 | 100.0 | 5,997 |
| 99 | DoD*Females*Ft Bragg | 5,561 | 100.0 | 5,561 |
| 100 | DoD*Females*Ft Bliss | 3,677 | 100.0 | 3,677 |
| 101 | DoD*Females*Ft Campbell | 3,134 | 100.0 | 3,134 |
| 102 | DoD*Females*Ft Leonard Wood | 1,533 | 100.0 | 1,533 |
| 103 | DoD*Females*Naval Station Norfolk | 10,166 | 100.0 | 10,166 |
| 104 | DoD*Females*Naval Base San Diego | 6,130 | 100.0 | 6,130 |
| 105 | DoD*Females*Naval Station Great Lakes | 2,766 | 100.0 | 2,766 |
| 106 | DoD*Females*Naval Base Coronado | 657 | 100.0 | 657 |
| 107 | DoD*Females*Naval Base Kitsap | 1,861 | 100.0 | 1,861 |
| 108 | DoD*Females*Camp Lujune | 3,180 | 100.0 | 3,180 |
| 109 | DoD*Females*Camp Pendleton | 3,664 | 100.0 | 3,664 |
| 110 | DoD*Females*29 Palms | 671 | 100.0 | 671 |
| 111 | DoD*Females*Miramar | 993 | 100.0 | 993 |
| 112 | DoD*Females*Parris Island | 1,224 | 100.0 | 1,224 |
| 113 | DoD*Females*Eglin AFB | 1,413 | 100.0 | 1,413 |
| 114 | DoD*Females*Keesler AFB | 1,213 | 100.0 | 1,213 |
| 115 | DoD*Females*Nellis AFB | 1,930 | 100.0 | 1,930 |
| 116 | DoD*Females*Kadena AB | 1,088 | 100.0 | 1,088 |
| 117 | DoD*Females*Hill AFB | 601 | 100.0 | 601 |
| 118 | DoD*Females*Joint Base San Antonio | 10,116 | 100.0 | 10,116 |
| 119 | DoD*Females*Joint Base Lewis-McChard | 4,397 | 100.0 | 4,397 |
| 120 | DoD*Females*Joint Base Pearl Harbor-Hickman | 2,600 | 100.0 | 2,600 |
| 121 | DoD*Females*Joint Base Langley-Eustis | 2,625 | 100.0 | 2,625 |
| 122 | DoD*Females*Joint Base Elmendorf-Richardson | 1,539 | 100.0 | 1,539 |

| | | | | | | |
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INSTRUCTIONS FOR COMPLETING SF 298

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