



2021 Workplace and Gender Relations Survey of Military Members - Active Component

Statistical Methodology Report

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OPA's Statistical Methods Team, under the guidance of Mr. David McGrath, Branch Chief, and Ms. Wendy Barboza, Statistical Methods Team Lead, was responsible for all statistical aspects of this survey, including population formation, sampling, weighting, nonresponse bias (NRB) analysis, and statistical hypothesis testing. Mr. John Chantis designed the sample, implemented the weighting methodology, and wrote this report. Ms. Susan Reinhold developed the population, selected the sample, and provided other data processing support. Data Recognition Corporation (DRC) collected and edited the data.

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2021 WORKPLACE AND GENDER RELATIONS SURVEY OF MILITARY MEMBERS - ACTIVE COMPONENT

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 on sensitive topics which impact the health and well-being of military populations.

This report describes the statistical methodologies for the *2021 Workplace and Gender Relations Survey of Military Members - Active Component (2021 WGRA)*. The survey fielded from December 9, 2021 to March 3, 2022. Historically, surveys of the Active and Reserve components were conducted in opposite years. The DoD did not conduct the Active component survey in 2020 due to the COVID-19 pandemic, so the survey was administered to both the Active and Reserve components in 2021. Although the survey fielded as one survey, the Active and Reserve components were sampled and weighted separately. Section 1 defines statistical terminology in this report. Section 2 discusses the sample design and selection of the sample. Section 3 describes the design of experiments. Section 4 describes the weighting and variance estimation. Section 5 discusses the statistical tests used for the *2021 WGRA*. Section 6 describes the calculation of contact, cooperation, and response rates for the full sample and population subgroups. Section 7 discusses the results of the experiments. Section 8 discusses nonresponse bias. Survey estimates for all questions are found in the report entitled *2021 Workplace and Gender Relations Survey of Military Members: Overview Report* (OPA, 2022a). Information about administration of the survey and detailed documentation of the survey dataset is found in the *2021 Workplace and Gender Relations Survey of Military Members: Administration, Datasets, and Codebook* (OPA, 2022b).

Section 1: Definitions

OPA defines below survey and statistical terminology used in this report. After the survey, all sampled members are classified as either record ineligible (defined in Table 3), known eligible, or unknown eligible. Complete sampled members are a subset of known eligible sampled members.

- *Cases of known eligibility:* Sampled members who through their interaction with the survey website or communications with OPA (or contract team) identify that they are in the target population (i.e., eligible) or not in the target population (i.e., ineligible).
- *Cases of unknown eligibility:* Sampled members who do not reply to the survey or inform OPA of their eligibility status (e.g., phone call) so OPA cannot confirm if they are eligible or ineligible.

- *Complete eligible respondent*: Sampled members who respond to the survey and meet all criteria to be considered a complete respondent.
- *Ineligibility rate*: This percentage is calculated by dividing the ineligible sampled members by the sample members with known eligible status. This rate is represented as ‘e’ in Section 5 in formulas such as $e(NC + O)$.¹
- *Response rate*: This percentage is calculated by dividing the complete sampled members by the summation of known eligible sampled members and the estimated number of eligible sampled members among people with unknown eligibility status.

Section 2: Sample Design and Selection

Target Population

The 2021 WGRA was designed to represent individuals meeting the following criteria:

- Active duty members of the:
 - Army
 - Navy
 - Marine Corps
 - Air Force
 - Coast Guard
- Paygrades E1–O6

National Guard and Reserve members serving on active duty (i.e., activated) were excluded from the target population and only valid Personnel status (i.e., not a prisoner, deserter, etc.) were included in the target population.

Sampling Frame

OPA created the sampling frame using the *February 2021 Active Duty Master File (ADMF)*. There were 1,375,844 individuals included in the target population. Auxiliary frame data were obtained from the following files:

- *February 2021 Active Duty Family Database File* (identifies number of children)
- *February 2021 Basic Allowance for Housing (BAH) Population File* (identifies member’s off base/on base status)

¹ The AAPOR Standard Definition uses the term ‘e’ to represent the eligibility rate. OPA’s calculations use the ineligibility rate, OPA’s formulas are mathematically equivalent to the AAPOR definition.

- *August 2021 Defense Enrollment Eligibility Reporting System (DEERS) Medical Point-in-Time Extract (PITE) File* (contains mailing address and used to identify record ineligible)
- *November 2020 Contingency Tracking System (CTS) Deployment File* (contains deployment history)
- *July 2021 Unit Identification Code (UIC) Address File* (contains unit address)
- *February 2021 Reserve Components Common Personnel Data System (RCCPDS) Master File* (assists in the identification of dual-service families)
- *September 9, 2021 Defense Enrollment Eligibility Reporting System (DEERS) Database Extract (DBE)* (includes member's email address)

Sample Design

The sample for the 2021 WGRA survey used a single-stage stratified design. Table 1 shows the stratification variables and their associated levels.

Table 1.
Variables for Stratification

Variable	Variable Name	Variable Levels
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 initially partitioned the population frame into 96 strata that were determined by a full cross-classification of the stratification variables.² To ensure enough survey respondents within every stratum, OPA sets a goal of a minimum stratum size of 200 sample members and

² In this example, a full cross-classification produces 100 strata. The initial number of strata is fewer because some subgroups did not exist in the population (e.g., the Air Force does not have Warrant Officers).

collapses strata that do not meet this objective. OPA collapsed variable levels in reverse order as shown in Table 1 (e.g., if there were fewer than 200 members in the stratum, OPA may collapse “Race categories Non-Minority and Minority” to form a new stratification level “All Race”). CSERVICE, CSEX were always preserved during strata formation. The final number of strata was 87.

OPA selected individuals with equal probability and without replacement within each stratum. However, because the allocation was not proportional to the size of the strata, selection probabilities varied between strata and individuals in different strata were not selected with equal probability. To achieve adequate sample sizes for all domains (reporting levels) with specified precision requirements, OPA used a non-proportional allocation.

Sample Allocation

OPA based the total sample size on precision requirements for 104 estimation domains (Appendix A). Given estimated variable survey costs and anticipated eligibility and response rates, an optimization algorithm determined the minimum-cost allocation that simultaneously satisfied the domain precision requirements. The *2016 WGRA*, *2018 WGRA*, and *2019 SOFA* were used to estimate the eligibility and response rates.

OPA determined the allocation by means of the OPA Sample Planning Tool (SPT), Version 2.1 (Dever et al., 2003). This application is based on the method originally developed by J. R. Chromy (1987) and described in Mason et al. (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. Eligibility, prevalence, and response rates affect the variance equations, thus affecting both the allocation of sample to strata and the final sample size.

For the *2021 WGRA* domains, the initial goal was to achieve estimates of percentages with associated precisions of less than a 5% Margin of Error (MOE). The precision requirement for each domain was based on an estimated prevalence rate of 50%³ with a 95% confidence interval half-width no greater than $\pm 5.0\%$. OPA attempts to ensure the survey produces sufficient complete respondents so overall estimates have a 95% confidence interval half-width no greater than $\pm 5\%$. OPA manipulated constraints for the estimation domains in Appendix A to produce an allocation that achieved satisfactory precision, while targeting a target sample size of 50% males and 75% females. The final *2021 WGRA* total sample size was 746,987; Table 2 provides the sample size by stratification variable and experiment variables.

³ OPA uses a prevalence rate of 50% (0.5) because this maximizes the variance of a proportion, thus ensuring that precision goals will be met for any estimated proportion from the survey.

Table 2.
Sample Size by Stratification and Experiment Variables

Variable	Total	Army	Navy	Marine Corps	Air Force	Coast Guard
Sample	746,987	265,387	191,147	115,081	135,090	40,282
Gender						
Male, Unknown	558,803	207,330	136,216	98,776	82,423	34,058
Female	188,184	58,057	54,931	16,305	52,667	6,224
Paygrade Group						
E1–E4	419,665	157,624	103,466	83,155	62,905	12,515
E5–E9	237,477	75,753	68,915	22,941	50,713	19,155
W1–W5	7,718	4,694	572	779	0	1,673
O1–O3	54,036	18,925	12,589	5,383	13,060	4,079
O4–O6	28,091	8,391	5,605	2,823	8,412	2,860
Race						
Non-Minority	413,166	140,744	98,714	68,454	75,942	29,312
Minority	333,821	124,643	92,433	46,627	59,148	10,970
Postcard Experiment						
Treatment 1	141,341	53,077	38,229	23,017	27,018	0
Treatment 2	141,341	53,078	38,229	23,016	27,018	0
Treatment 3	141,341	53,078	38,229	23,016	27,018	0
Treatment 4	141,341	53,077	38,230	23,016	27,018	0
Treatment 5	141,341	53,077	38,230	23,016	27,018	0
Paper Experiment						
Paper Survey	353,352	132,693	95,574	57,540	67,545	0
No Paper Survey	353,353	132,694	95,573	57,541	67,545	0

Note: Postcard experiment totals do not equal total sample because Coast Guard were excluded from the experiment.

After selecting the sample, OPA performed an additional check to verify sampled members were still in the target population and identified 49,999 (6.7% unweighted) sampled members as record ineligible (defined in Table 3). This process reduces costs because sampled members who have subsequently left the DoD are not contacted.

Section 3: Design of Experiment

For the 2021 WGRA, OPA mailed five versions of reminder postcards to DoD personnel (i.e., personnel not in the Coast Guard) in order to test the effect of different messaging on response rates. All reminder postcards used the same graphics and design; only the message text varied across the five versions. OPA conducted this experiment to determine the effect of the different messages on both survey response rates and survey estimates.

Postcards contained the following messages:

- Treatment 1: “Don’t Miss Your Chance. Thousands have already responded. Now it is your turn. Respond Today!”

- Treatment 2: “In Your Opinion, has sexual harassment in the military become more or less of a problem?”
- Treatment 3: “Did You Know? Your participation helps us take care of military members and their families. We must. Our people deserve it, our strength depends on it.”
- Treatment 4: “What Do You Think? ‘Assault is assault. Harassment is harassment. And I think there should be more moral courage at the end of the day addressing that.’—Junior Officer”
- Treatment 5: “What do you think? ‘From my perspective, I see my Service trying very hard to create changes within the culture.’—Junior Officer”

There was an additional experiment where 50 percent of DoD personnel (not in the Coast Guard) received a paper survey form in addition to email invitations to the survey. The other 50 percent of the DoD sample received only email invitations to the survey. This experiment was independent of the postcard experiment. OPA assesses the effectiveness of both experiments on response rates by service, gender, and paygrade in Section 7.

Section 4: Weighting

OPA created analytical weights for the *2021 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 26 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 dispositions; 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 a sampled member refused the survey because it was too long, the disposition would be “Active Refusal” (SAMP_DC=8) in the absence of any other information. However, if a family member of this same individual also reported the sampled member had left the military, the disposition of “Ineligible by self- or proxy-report” (SAMP_DC=2) would override the later disposition and be the final disposition code for this member.

Case disposition counts for all sample members for the 2021 WGRA are shown in Table 3. There were 77,466 eligible, complete respondents (SAMP_DC=4). Table 4 presents the number of eligible, complete respondents by stratification and experiment variables.

Table 3.
Case Dispositions for Weighting

Case Disposition (SAMP_DC)	Information Source	Conditions	Sample Size
1. Record ineligible	Personnel record	OPA performed an additional check to verify if a sampled member was still eligible, which identified: 1) members who were still in the August 2021 PITE and 2) members who were still on active duty in the February 2021 ADMF.	49,999 (6.7%) ⁴
2. Ineligible by self- or proxy-report	Survey Control System (SCS)	The sampled member or a proxy reported the member was ineligible due to reasons such as “No longer employed by DoD,” “Incarcerated,” or “Deceased.”	461 (0.1%)
3. Ineligible by survey self-report	Survey eligibility questions	The sampled member was ineligible because they answered “no” to Question 1 of the survey: “Were you on active duty on December 6, 2021?”	859 (0.1%)
4. Eligible, complete response	Item response rate	Respondent needed to answer at least one of the critical questions related to unwanted sexual contact and at least one of the critical questions related to sexual harassment or gender discrimination.	77,466 (10.4%)
5. Eligible, incomplete response	Item response rate	Respondent answered some questions on the survey, but did not answer at least one of each of the critical questions.	5,250 (0.7%)
8. Eligible, active refusal	SCS	Respondent refused due to reasons such as “too long,” “too intrusive,” or “not interested.”	440 (0.1%)
9. Eligible, blank return	SCS	Respondent submitted blank questionnaire with no reason given.	540 (0.1%)
10. Postal Non-Deliverable (PND)	SCS	Last postal communication was returned as undeliverable.	167,352 (22.4%)
11. Nonrespondent	Remainder	Remaining sampled members who did not respond to survey.	444,620 (59.5%)
Total			746,987 (100%)

⁴ The percentage of record ineligible cases was higher than normal due to a delay in survey fielding.

Table 4.
Complete Eligible Respondents by Stratification and Experiment Variables

Variable	Total	Army	Navy	Marine Corps	Air Force	Coast Guard
Sample	77,466	23,567	16,131	6,541	23,342	7,885
Gender						
Male, Unknown	52,250	16,943	10,897	5,048	13,245	6,117
Female	25,216	6,624	5,234	1,493	10,097	1,768
Paygrade Group						
E1–E4	21,788	6,788	4,006	2,639	6,994	1,361
E5–E9	33,229	9,306	7,652	2,179	10,141	3,951
W1–W5	1,896	1,000	150	183	0	563
O1–O3	10,441	3,453	2,185	740	3,053	1,010
O4–O6	10,112	3,020	2,138	800	3,154	1,000
Race						
Non-Minority	46,776	13,472	8,997	4,119	14,353	5,835
Minority	30,690	10,095	7,134	2,422	8,989	2,050
Postcard Experiment						
Treatment 1	13,930	4,714	3,290	1,327	4,599	0
Treatment 2	14,012	4,742	3,171	1,361	4,738	0
Treatment 3	13,897	4,719	3,254	1,346	4,578	0
Treatment 4	13,844	4,705	3,151	1,225	4,763	0
Treatment 5	13,898	4,687	3,265	1,282	4,664	0
Paper Experiment						
Paper Survey	35,389	12,038	8,199	3,307	11,845	0
No Paper Survey	34,192	11,529	7,932	3,234	11,497	0

Note: Postcard experiment totals do not equal total sample because Coast Guard were excluded from the experiment.

Nonresponse Adjustments and Final Weights

After case dispositions were resolved, OPA adjusted the sampling weights for nonresponse. First, the sampling weights for cases of known eligibility (SAMP_DC=2, 3, 4, 5, 8, or 9) were increased to account for cases of unknown eligibility (SAMP_DC=10 or 11). Next, the known eligibility-adjusted weights for eligible respondents with complete questionnaires (SAMP_DC=4) were increased to account for known eligible sample members who returned an incomplete questionnaire, refused the survey, or returned a blank questionnaire (SAMP_DC=5, 8, 9). OPA sets the weights for all record ineligible (SAMP_DC=1) to 0.

The weighting adjustment factors for known eligibility and completion were computed as the inverse of model-predicted probabilities. OPA used extreme gradient boosted (XGBoost⁵) decision tree models to predict the probability of known eligibility and completion (Chen, 2016). The reciprocals of the predicted values from these models, referred to as adjustment factors, were

⁵ XGBoost is an R package function and stands for Extreme Gradient Boosting, which is a machine-learning algorithm OPA uses to predict eligibility and survey completion status.

multiplied by the respondents' weight after the prior weighting step. The known eligibility model used the sampling weight and the completion model used the known eligibility-adjusted weight. Table 5 provides a list of the predictor variables entered into the known eligibility and completion XGBoost models.

Table 5.
Predictor Variables Used for the Known Eligibility and Completion Models

Variable	Variable Name	Variable Levels
Military Accession Program	ACC_SRC_CD	1=Induction 2=Voluntary enlistment in a Regular Component 3=Vol enlist - Rsv Comp for Reg DEP - 10 USC 12103/10 USC 4=Voluntary enlistment - Rsv Comp, Sec 511, ref(b), Excl DEP 5=Voluntary enlistment in a Regular component under the National Call to Service (NCS) program A=U.S. Military Academy B=U.S. Naval Academy C=U.S. Air Force Academy D=U.S. Coast Guard Academy E=U.S. Merchant Marine Academy F=Air National Guard Academy of Military Sciences G=ROTC/NROTC scholarship program H=ROTC/NROTC non-scholarship program J=OCS, AOCS, OTS, or PLC K=Aviation Cadet program L=National Guard state OCS M=Direct appointment authority, Commissioned Off, professional N=Direct appointment authority, Commissioned Off, all other P=Aviation training program other than OCS, AOCS, OTS, or PLC Q=Limited Duty Officer Program R=Direct appointment authority, warrant officer S=Direct appointment authority, commissioned warrant officer T=Warrant Officer Aviation Training Program V=ROTC Scholarship Program 10 USC 2107 (a) W=Not Applicable X=Other Z=Unknown
Armed Forces Qualification Test Percentile Score	AFQT_SCR_QY	. =Not Applicable 0=Unknown 1-99
Person's Age Quantity	AGE	17-76
Assigned Unit Navy Ashore/Afloat	ASSGN_UIC_NV_AS HR_AFLT_CD	2=Sea Duty-CONUS Ship 4=Non-rotated Sea Duty-Ships Homeported Overseas 9=Unknown
BAH File Match Flag	BAHFLAG	N = No match Y = Match
Number of Active Duty Members at Base	BASESIZE	1 - 48236 Unk/Reserve/No Base = 94659
Age Grouping 2	CAGE2	1 = <= 24 years old 2 = All Others

Variable	Variable Name	Variable Levels
Education Level Grouping	CEDUC	0=Unknown 1=No College 2=Some College 3=4-year Degree 4=Grad/Prof Degree
Number of Children	CHILDCNT	0-13
Marital Status Grouping	CMARITAL_STAT	0 = Unknown 1 = Married 2 = Not Married
Pay Grade Group 5	CPAYGRP5	1 = E1 - E4, E0 2 = E5 - E9 3 = W1 - W5, W0, O1 - O3, O0 4 = O4 - O6
Minority or Non-Minority Code	CRACECAT	1 = Non-minority / Unknown 2 = Minority
Duty Location by World Regions – Group 1	CREGION1	1=US & US territories, Other, Unknown 2=Europe 3=Asia & Pacific Islands
Numeric Service	CSERVICE	1 = Army 2 = Navy 3 = Marine Corps 4 = Air Force 5 = Coast Guard
Sex	CSEX	1=Male, Unknown 2=Female
Years of Service Grouping	CYOS	0 = Unknown 1 = <= 2 years 2 = 3 to 5 3 = 6 to 9 4 = 10+ . = NA; active duty only
Duty Service Occupation	DTY_DOD_OCC_CD	100000-290500
Dual Status Flag	DUAL_FLAG	DUAL = Dual spouse OTHR = Not a dual spouse " " = NA; active duty only
Family Status	FAMSTAT	0=Unknown 1=Single with child(ren) 2=Single without child(ren) 3=Married with child(ren) 4=Married without child(ren)
Education Level Code	EDUC	11=Non-high school graduate 12=Attending high school, junior or less 13=Attending high school, senior 14=Secondary school credential near completion 21=Test-based equivalency diploma 22=Occupational program certificate 23=Correspondence school diploma 24=High school certificate of attendance 25=Home study diploma 26=Adult education diploma 27=ARNG Challenge Program GED Certificate

Variable	Variable Name	Variable Levels
		28=Other Non-Traditional High School Credential 31=High school diploma 32=Completed High School-- No Diploma 41=Completed one semester of college, no high school diploma 44=Associate degree 45=Professional nursing diploma 51=Baccalaureate degree 61=Master's degree 62=Post master's degree 63=First professional degree 64=Doctorate degree 65=Post doctorate degree 99=Unknown
OffBase Status	OFFBASE	1 = On Base (no BAH) 2 = Off Base (receiving BAH) 0 = Unknown
Percent Males in Member's Duty UIC	P_DUICMALE	0 - 100
Percent Males in Members Primary DOD Occupation	P_OCCMALE	0 - 100
Pay Plan Grade Identifier	PAYGRADE	E0 = Enlisted, Grade Unknown E1 – E9 W0 = Warrant Officer, Grade Unknown W1 – W5 O0 = Officer, Grade Unknown O1 – O6
Race/Ethnic Category	RACE_ETH	A=Am Id/Al Native B=Asian C=Black D=White E=Hispanic F=Hawaiian/PI M=Multi Race Z=Unknown
Occupation was Closed to Women	WASCLOSED	0=Was not closed 1=Was closed

OPA used a common statistical practice called weight trimming. This reduces the variance of estimates and prevents any survey respondent from exerting too much influence on an estimate, but introduces some bias. OPA applied weight trimming during the known eligibility status adjustment by constraining the factor to a maximum of 66.7, which equates to a minimum predicted known eligibility status adjustment of 1.5% (i.e., $1 / 0.015 = 66.7$). For example, if a survey respondent has a model-predicted known eligibility propensity of 0.01, OPA replaced the known eligibility status adjustment of 100 (i.e., $1/0.01$) with 66.7. The trimming methodology preserves the sum-product of the sampling weights and the untrimmed known eligibility status adjustments. This is accomplished by multiplying the trimmed and untrimmed

known eligibility status adjustments by a trimming adjustment factor (TAF), which is calculated as:

$$\text{TAF} = \frac{\sum_{i=1}^n w_{s,i} f_{p,i}}{\sum_{i=1}^n w_{s,i} f_{t,i}}$$

The abbreviations within this formula are:

$w_{s,i}$ = sampling weight for record i

$f_{p,i}$ = pre-trimmed known eligibility status adjustment for record i

$f_{t,i}$ = trimmed known eligibility status adjustment for record i

$i = 1, 2, \dots, n$

n = sample size

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 mitigate potential nonresponse bias and coverage error in 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 they add up to the known totals—called control totals—for the different levels within each raking dimension. Processing 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 (within a specified tolerance). Control totals were computed using information from the sampling frame. Table 6 shows the raking variables and their associated levels.

Table 6.
Variables Used for Raking

Variable	Variable Name	Variable Levels
Service by Race	SERV RACE	1=Army Non-minority 2=Army Minority 3=Navy Non-minority 4=Navy Minority 5=Marine Corps Non-minority 6= Marine Corps Minority 7=Air Force Non-minority 8=Air Force Minority 9=Coast Guard Non-minority 10=Coast Guard Minority
Gender by Age	SEX AGE	1=Male ≤ 24 years old 2=Female ≤ 24 years old 3=Male All Others 4=Female All Others
Gender by Race	SEX RACE	1=Male Non-minority 2=Female Non-minority 3=Male Minority 4=Female Minority
Gender by Service by Paygrade	SEXSERV PAY	1=Male Army E1-E4 2=Female Navy E1-E4 3=Male Marine Corps E1-E4 4=Female Air Force E1-E4 5=Male Coast Guard E1-E4 6=Female Army E1-E4 7=Male Navy E1-E4 8=Female Marine Corps E1-E4 9=Male Air Force E1-E4 10=Female Coast Guard E1-E4 11=Male Army E5-E9 12=Female Navy E5-E9 13-20 same pattern as above 21=Male Army W1-W5, O1-O3 22=Female Navy W1-W5, O1-O3 23-30 same pattern as above 31=Male Army O4-O6 32=Female Navy O4-O6 33-40 same pattern as above

Table 7 summarizes the distributions of the sampling, known eligibility, completion, and final weights, and the corresponding adjustment factors for the 77,466 complete, eligible respondents (SAMP_DC=4).

Table 7.
Distribution of Weights and Adjustments for Complete, Eligible Respondents

Statistic	Sampling Weight	Known Eligibility Status Adjustment Factor	Known Eligibility Weight	Completion Status Adjustment Factor	Completion Weight	Raking Adjustment Factor	Final Weight
MIN	1.0	1.3	1.5	1.0	1.6	0.9	1.5
MAX	4.3	66.7	120.1	1.4	135.7	1.2	149.6
MEAN	2.2	7.7	14.5	1.1	15.9	1.1	17.4
STD	1.0	8.3	12.8	0.0	14.5	0.0	16.4
CV	0.46	1.08	0.89	0.04	0.91	0.05	0.94

The mean sampling weights for the entire sample was 1.8 (data not shown) while the mean for the complete, eligible respondents was 2.2. The known eligibility status adjustment made the largest adjustment (mean of 7.7) to the weights and coefficient of variation (CV) of the weights (increased from 0.46 to 0.89). The completion and raking adjustments (mean of 1.1 and 1.1, respectively) had a modest effect on increasing the mean weight. The final weights had the largest difference between the minimum and maximum values (weights ranged from 1.5 to 149.6).

Under simplifying assumptions, Kish (1965) approximates the relative increase in variance due to weight variation as 1 plus the coefficient of variation of the weights squared ($1 + [CV]^2$). Because the CV of the weights is 0.94, the increase in variance due to weighting is less than 3 (1.88). Given the weighting adjustments 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 8 shows the sum of the weights by eligibility category at different stages of weighting. These categories, assigned based on the case disposition, are eligible respondent (SAMP_DC=4), ineligible (SAMP_DC=2,3), nonrespondent (SAMP_DC=5,8,9,10,11), and record ineligible (SAMP_DC=1).

Table 8.
Sum of Weights by Eligibility Status

Eligibility Category (ELIGFLGW)	Sum of Sampling Weights	Sum of Known Eligibility Weights	Sum of Completion Weights	Sum of Final Weights
1. Eligible respondent	168,347	1,121,995	1,228,291	1,348,065
2. Ineligible	2,779	24,996	24,996	27,819
3. Nonrespondent	1,118,135	106,694	0	0
4. Record ineligible	86,622	86,622	86,622	0
Total	1,375,884	1,340,307	1,339,909	1,375,884

Treatment of Missing Data

Some survey organizations handle missing data through imputation techniques that replace missing survey data with estimated responses; however, OPA left all survey responses as missing unless a corresponding administrative variable exists (e.g., gender).

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 2021 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. The 2021 WGRA variance estimation strata corresponded closely to the design strata; however, it was necessary to collapse some sampling strata with similar strata when a stratum contained fewer than 50 complete eligible responses with non-zero final weights. There were 84 variance strata defined for the 2021 WGRA.

Section 5: Multiple Comparisons

To support the 2021 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 2021 WGRA, OPA used a p-value of 0.01 for within-year comparisons and 0.01 for across-year comparisons. OPA chose this cut-off after empirically testing a statistical method called False Discovery Rate correction (FDR) developed by Benjamini et al. (1995) in several prior OPA population-based surveys.

When comparing groups, a hypothesis whether there are no statistically significant differences (null hypothesis) versus there are statistically significant 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. Anytime 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 usually means there is a 1% chance of finding a difference as large as the observed result if the null hypothesis were true, but OPA uses this threshold to approximately control the family-wise error rate at 0.05 per prior FDR research.

Section 6: 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), which estimates the proportion of eligible respondents among cases of unknown eligibility (SAMP_DC=10,11).

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

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

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

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

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

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

The abbreviations within these formulas are:

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=5,8,9)⁶

⁶ OPA considers these all cases of known eligibility.

NC=Non-contact (SAMP_DC=10)⁶

e=Ineligibility rate (SAMP_DC=2,3/SAMP_DC=2-9)

O=Other (SAMP_DC=11)⁷

e(O)=Estimated ineligible nonrespondents

e(NC)=Estimated ineligible PND

N_C=Adjusted contacted sample

N_E=Adjusted eligible sample

N_R=Complete eligibles⁸

Table 9 shows the corresponding sample disposition codes associated with the response categories. Based on the above formulas, only an estimated proportion of SAMP_DC=10,11 records are in the eligible and contacted samples.

Table 9.
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 Eligible	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 both weighted and unweighted to be applied to Table 10:

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

⁷ These are all nonrespondents that OPA considers cases of unknown eligibility.

⁸ Complete eligibles is an OPA term that applies to self-administered surveys, which relates to the terms complete and partial interviews used by AAPOR.

Estimated Ineligible Postal Non-Deliverable/Not Contacted Rate

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

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

Estimated Ineligible Nonresponse

The estimated ineligible nonresponse (EINR) is defined as:

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

Adjusted Contact Rate

The adjusted contacted 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 (ACOR) is defined as:

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

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 contact rate and the cooperation rate. Table 10 shows both unweighted and weighted contact, cooperation, and response rates for the 2021 WGRA. The final weighted response rate for the survey was 13.3%.

Table 10.
Contact, Cooperation, and Response Rates

Type of Rate	Computation	Unweighted (Percent)	Weighted (Percent)
Contact	Adjusted contacted sample/Adjusted eligible sample	76.0	79.5
Cooperation	Complete Eligibles/Adjusted contacted sample	14.9	16.7
Response	Complete Eligibles/Adjusted eligible sample	11.3	13.3

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

Table 11 shows weighted contact, cooperation, and response rates for the sample by the stratification variables.

Table 11.
Weighted Rates for Sample by Stratification Variables and Experiment Variables

Variable	Contact Rate (Percent)	Cooperation Rate (Percent)	Response Rate (Percent)
Sample	80	17	13
Service			
Army	78	16	12
Navy	76	15	11
Marine Corps	70	11	8
Air Force	89	22	19
Coast Guard	100	21	21
Gender			
Male	79	16	13
Female	82	19	16
Pay Group			
E1-E4	66	9	6
E5-E9	88	17	15
W1-W5	94	26	25
O1-O3	89	22	20
O4-O6	97	40	39
Race			
Non-Minority	81	18	15
Minority	77	15	11
Postcard Experiment			
Treatment 1	79	16	13
Treatment 2	79	17	13
Treatment 3	79	16	13
Treatment 4	79	16	13
Treatment 5	79	17	13
Paper Experiment			
Paper Survey	79	17	13
No Paper Survey	79	16	13

Note. Weighted response rates are the official reported rates. Unweighted rates can be influenced by the sample design. This table was rounded for clarity.

Section 7: Results of Experiment

The postcard experiment for 2021 WGRA was first analyzed for its impact on response rates. The experiment compared response rates from the five postcard treatment groups. Response rates for these groups ranged from 12.8% to 12.9%. When controlling for DoD service, gender, and paygrade grouping, the postcard treatment was found to not have a statistically significant effect on response rates, χ^2 (df=4, n= 658,722) = 0.61, p = 0.6541. Table 12 shows that response rates are very similar across DoD services, genders, and paygrade groupings.

Table 12.
Response Rates by Postcard Experiment Treatment Group

Variable	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5
Total	12.8%	12.9%	12.8%	12.8%	12.8%
Service					
Army	11.7%	11.9%	11.8%	11.8%	11.8%
Navy	11.5%	11.0%	11.2%	10.9%	11.2%
Marine Corps	7.6%	7.7%	7.7%	7.1%	7.2%
Air Force	18.6%	19.1%	18.4%	19.2%	18.9%
Gender					
Male	12.3%	12.4%	12.2%	12.3%	12.4%
Female	15.2%	15.5%	15.2%	15.3%	15.1%
Paygrade Grouping					
E1–E4	5.7%	5.7%	5.8%	5.6%	5.7%
E5–E9	14.7%	14.5%	14.3%	14.4%	14.3%
W1–W5	22.0%	26.0%	21.7%	22.0%	24.6%
O1–O3	19.1%	19.7%	18.9%	19.0%	19.4%
O4–O6	36.9%	38.0%	38.2%	39.4%	38.4%

The second analysis was to determine whether respondents in different treatment groups reported experiencing different rates of sexual harassment or gender discrimination. Table 13 shows the estimates for men and women experiencing these key metrics, comparing respondents in the five postcard treatment groups. The table shows that no key sexual harassment or gender discrimination estimates were significantly different between postcard treatments. This does not provide support for the hypothesis that the message on a reminder postcard may influence response from harassment/discrimination victims at higher rates.

Table 13.
Key Estimates by Gender by Survey Communication Experiment

Gender	Variable	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	χ^2	p Value
Male	Sexual Harassment	6.2%	6.5%	6.3%	6.7%	7.2%	4.81	0.307
	Gender Discrimination	1.8%	1.7%	1.7%	1.6%	1.6%	0.79	0.939
Female	Sexual Harassment	27.1%	28.1%	29.1%	29.6%	28.1%	4.83	0.305
	Gender Discrimination	18.0%	17.2%	18.7%	19.0%	17.3%	4.95	0.292

Note. Variable names are SEXHAR and SDISC.

The second experiment for 2021 WGRA, where 50 percent of the DoD sample received a paper survey form in addition to email invitations to the survey, was first analyzed for its impact on response rates. The experiment compared response rates from the two paper treatment groups. Response rates for these groups ranged from 12.6% to 13.1%. At the DoD level, the paper treatment was found to have a statistically significant effect on response rates, χ^2 (df=1, n=658,725) = 37.56, $p < 0.0001$, although this difference is not practically significant. Table 14 shows that response rates are fairly constant across DoD services, genders, and paygrade groupings; however, similar to prior versions of this experiment the use of paper surveys on active duty military populations increases response rates the most for officers, the group that already possesses disproportionately high response rates. This effect is undesirable because the goal of any response inducing action is to increase response rates among low responding groups.

Table 14.
Response Rates by Paper Experiment Treatment Group

Variable	No Paper	Paper
Total	12.6	13.1
Service		
Army	11.5	12.1
Navy	11.0	11.4
Marine Corps	7.4	7.5
Air Force	18.6	19.1
Gender		
Male	12.1	12.5
Female	14.8	15.7
Paygrade Grouping		
E1–E4	5.7	5.7
E5–E9	14.2	14.7
W1–W5	22.1	24.5
O1–O3	18.5	19.9
O4–O6	37.1	39.2

The second analysis was to determine whether respondents in different treatment groups reported experiencing different rates of sexual harassment or sexual discrimination. Table 15 shows the estimates for men and women experiencing these key metrics, comparing respondents in the two paper treatment groups. The table shows that no key sexual harassment or gender discrimination estimates were significantly different between paper treatments. This does not provide support for the hypothesis that the survey mode may influence response from harassment/discrimination victims at higher rates. While not statistically significant, these results are consistent with previous versions of this experiment where the rates for the paper survey treatment are consistently higher than the no paper survey treatment.

Table 15.
Key Estimates by Gender by Survey Mode Experiment

Gender	Variable	Paper	No Paper	χ^2	p Value
Male	Sexual Harassment	6.8%	6.3%	2.10	0.147
	Gender Discrimination	1.7%	1.7%	0.01	0.928
Female	Sexual Harassment	28.8%	28.0%	0.95	0.330
	Gender Discrimination	18.4%	17.7%	1.13	0.287

Note. Variable names are SEXHAR and SDISC.

Section 8: Nonresponse Bias

Survey nonresponse has the potential to introduce bias in the estimates of key outcomes. To the extent that nonrespondents and respondents differ on observed characteristics, OPA can use weights to adjust the sample so the weighted respondents match the full population on the most critical characteristics. This eliminates the portion of nonresponse bias (NRB) associated with those observed variables if these variables are strongly associated with the behaviors being estimated. When all NRB can be eliminated in this manner, the missingness is called *ignorable* or *missing at random* (Little et al., 2002). The more observable demographic variables that are incorporated into the weights, the more plausible it is to assume that the weights eliminate any NRB.

NRB occurs when survey respondents are systematically different from nonrespondents. The bias in a respondent mean is a function of the response rate and the relationship (covariance) between response propensity and the estimated statistic. The formula is written as:

$$\text{Bias } (\bar{y}_r) = \frac{\sigma_{yp}}{\bar{p}} = \left(\frac{\rho_{yp}}{\bar{p}} \right) \sigma_y \sigma_p$$

The abbreviations within this formula are:

\bar{y}_r = estimated response mean

σ_{yp} = covariance between y and response propensity

\bar{p} = mean propensity over the sample

ρ_{yp} = correlation between y and p

σ_y = standard deviation of y

σ_p = standard deviation of p

NRB can occur with high or low survey response rates. In the past decade, the decrease in overall survey response rates for DoD surveys, as well as civilian studies, has resulted in a greater focus on potential NRB. Studies of NRB can be accomplished either by 1) conducting a follow-up survey of nonrespondents or 2) by using the survey responses and characteristics of the respondents to assess NRB. Two survey outcomes are critical in assessing NRB: response rates and the expected difference between respondents and nonrespondents on survey estimates.

It is common that survey quality is judged by response rates; they are the most visible measure of survey quality. However, response rates do not necessarily provide an accurate measure of survey bias. Low response rates are only indicative of the possibility of survey bias. A number of research studies have found little relationship between the level of nonresponse and bias (e.g., Keeter et al., 2000). Where bias is found, adjusting survey weights for nonresponse and raking using variables that are correlated with the response characteristics can significantly reduce that bias.

Using the second approach discussed above, OPA conducted an extensive NRB study on the *2016 WGRA*. When the essential survey conditions (i.e., survey mode, contacts, response rates [including subgroups]) remain mostly constant, the level and direction of NRB should remain similar. Therefore, OPA conducted an abbreviated NRB study on the *2021 WGRA* in an attempt to confirm that the levels and direction of NRB were the same as *2018 WGRA* by comparing the sample composition with the survey respondents. This same analysis of the level and direction of NRB was conducted for the *2018 WGRA*. If these comparisons are the same across survey iterations, OPA asserts that the NRB is similar and the *2021 WGRA* requires no further assessments. That result is confirmed in the following section.

Comparing Survey Respondents With Survey Nonrespondents

The *2021 WGRA* NRB analysis compared the sample composition with the survey respondent composition and assessed whether the patterns matched the *2021 WGRA* results. The *2021 WGRA* sample composition demographically differs from the active duty service member population distribution due to intentional sampling strategies that allow OPA to make precise estimates for small subgroups and to sample constraints from simultaneously sampled surveys. The respondent composition differs from the sample distribution in predictable ways due to subgroups (e.g., junior enlisted members) responding at different rates. This analysis assesses whether survey respondents possess similar observable characteristics (e.g., gender, Service, and paygrade grouping) to survey nonrespondents.

OPA draws optimized samples to reduce survey burden on members as well as produce high levels of precision for important domain estimates by using known information about the military population and their response propensity. It is important to note that OPA samples are often not proportional to their respective population. Depending on specific subgroups, OPA will oversample or undersample a specific group (e.g., E1–E4 Army Females) to obtain enough expected responses to make statistically accurate estimates. Therefore, the sample composition is out of alignment with the population, and this is intentional. OPA is able to use its military personnel data to weight the respondents in order to make survey estimates representative of the entire active duty population. The demographics considered in this analysis include gender,

Service, and paygrade grouping, which were directly controlled for in the raking stage and thus exactly match the known population values.

Table 16 shows the population, sample, and response breakdown by gender. OPA intentionally oversampled females in order to achieve reliable precision on estimates for outcomes conditional on reporting a sexual assault (i.e., retaliation) and other measures that were only asked of a very small subset of members. For example, females make up 17 percent of the active duty population but 25 percent of the 2021 WGRA sample (Table 16: columns b and d). The final weighting procedure (i.e., raking) pulls the respondents back into alignment with the gender composition in the active duty population to ensure final weighted estimates do not over-represent females (Table 16: columns b and h).

OPA performed a base-weighted Chi-square test of independence to examine the relationship between survey response and gender. Survey respondents are defined as complete eligible (n=77,466) or self/proxy report ineligible (n=1,320). OPA defines survey nonrespondents as SAMP_DC levels 5-11 (n=618,202; see Table 3). Record ineligible (n=49,999) are not included in the analysis. The relationship between gender and survey response was significant, χ^2 (df=1, n= 696,988) = 974.6,⁹ p < 0.0001. The results indicate that different genders responded at significantly different rates. Males moved from 75 of the sample to 68 percent of the respondents while females moved from 25 to 32 percent, showing that females responded to the 2021 WGRA at significantly higher rates. Table 17 shows the response patterns in 2018 were similar, where males moved from 77 to 73 percent and females moved from 23 to 27 percent. Therefore, 2021 estimates should have similar levels and direction of NRB as 2018 survey estimates.

Table 16.
2021 WGRA Population, Sample Design, and Response Composition for Gender

Gender	Population		Sample		Respondents		Weighted Estimates (Final Weights)	
	Frequency (a)	Percent (b)	Frequency (c)	Percent (d)	Frequency (e)	Percent (f)	Frequency (g)	Percent (h)
Male	1,138,767	83	558,803	75	53,242	68	1,138,767	83
Female	237,117	17	188,184	25	25,544	32	237,117	17
Total	1,375,884	100	746,987	100	78,786	100	1,375,884	100

⁹ The weighted Chi-square was generated using the PROC SURVEYFREQ with a weight statement within SAS 9.4 and SAS/STAT 13.1. The Rao-Scott correction to the Chi-square test was used since the data comes from a complex sample survey.

Table 17.
2018 WGRA Population, Sample Design, and Response Composition for Gender

Gender	Population		Sample		Respondents		Weighted Estimates (Final Weights)	
	Frequency (a)	Percent (b)	Frequency (c)	Percent (d)	Frequency (e)	Percent (f)	Frequency (g)	Percent (h)
Male	1,111,364	84	569,823	77	84,453	73	1,111,364	84
Female	215,830	16	165,822	23	31,431	27	215,830	16
Total	1,327,194	100	735,645	100	115,884	100	1,327,194	100

Table 18 shows the breakdown of the population, sample, and respondent distributions by Service. There are differences between the unweighted sample size and unweighted respondent percentages, such as with Marine Corps (went from 15 to 9 percent; Table 18: columns d and f) and Air Force (18 to 30 percent). Similar results are found in 2018 WGRA where Marine Corps moved from 13 to 7 percent, and Air Force moved from 23 to 37 percent (Table 19). The final weighting procedure aligns respondent proportions back with the active duty population for the Services (Table 18: columns b and h).

OPA performed base weighted Chi-square test of independence on respondents and nonrespondents by Service. The relationship between Service and survey response was significant, χ^2 (df=4, n= 696,988) = 8518.0, $p < 0.0001$. The results indicate that different Services respond at different rates and unweighted estimates are prone to nonresponse bias if not adjusted. Response patterns (e.g., Army and Marine Corps respond at lower rates) are the same across the 2018 and 2021 surveys, and therefore OPA concludes that NRB levels and direction will also be similar.

Table 18.
2021 WGRA Population, Sample Design, and Response Composition for Service

Service	Population		Sample		Respondents		Weighted Estimates (Final Weights)	
	Frequency (a)	Percent (b)	Frequency (c)	Percent (d)	Frequency (e)	Percent (f)	Frequency (g)	Percent (h)
Army	480,370	35	265,387	36	24,014	30	480,370	35
Navy	342,870	25	191,147	26	16,434	21	342,870	25
Marine Corps	181,412	13	115,081	15	6,776	9	181,412	13
Air Force	330,950	24	135,090	18	23,573	30	330,950	24
Coast Guard	40,282	3	40,282	5	7,989	10	40,282	3
Total	1,375,884	100	746,987	100	78,786	100	1,375,884	100

Table 19.
2018 WGRA Population, Sample Design, and Response Composition for Service

Service	Population		Sample		Respondents		Weighted Estimates (Final Weights)	
	Frequency (a)	Percent (b)	Frequency (c)	Percent (d)	Frequency (e)	Percent (f)	Frequency (g)	Percent (h)
Army	462,160	35	240,814	33	28,387	25	462,160	35
Navy	321,062	24	188,210	26	22,563	19	321,062	24
Marine Corps	184,154	14	97,076	13	8,270	7	184,154	14
Air Force	318,614	24	168,341	23	42,889	37	318,614	24
Coast Guard	41,204	3	41,204	6	13,775	12	41,204	3
Total	1,327,194	100	735,645	100	115,884	100	1,327,194	100

Table 20 shows the breakdown of the population, sample, and respondent percentage distributions by paygrade grouping. Based on historically different response rates and the need to make estimates for each paygrade, OPA oversampled the junior enlisted members and undersampled the other paygrades (Table 20: columns b and d). For instance, senior enlisted members make up 40 percent of the active duty population but only 32 percent of the 2021 WGRA sample. On the other hand, junior enlisted are oversampled in proportion to their population (43 to 56 percent). The logic for this approach is seen clearly in the differences between respondent percentages. The senior enlisted members account for 43 percent of the respondents, despite making up only 32 percent of the sample, while the junior enlisted members made up over half the sample (56 percent), yet represented only 28 percent of the respondents. Table 21 shows similar results in 2018 where junior enlisted members moved from 54 to 29 percent, and senior enlisted members moved from 34 to 46 percent. These differences are adjusted based on known characteristics in post-survey weighting procedures, which aligned the respondent proportions equal to the active duty population for paygrade (Table 20: columns b and h).

OPA performed base weighted Chi-square test of independence for paygrade grouping. The relationship between paygrade grouping and survey response was significant, χ^2 (df=4, n=696,988) = 28,961.9, $p < 0.0001$. The results indicate that different paygrade groupings respond at different rates and unweighted estimates are prone to nonresponse bias if not adjusted. Response patterns (e.g., junior enlisted respond at the lowest rates) are the same across the 2018 and 2021 surveys, and therefore OPA concludes that NRB levels and direction will also be similar.

Table 20.
2021 WGRA Population, Sample Design, and Response Composition for Paygrade

Paygrade Grouping	Population		Sample		Respondents		Final Weighted Estimates	
	Frequency (a)	Percent (b)	Frequency (c)	Percent (d)	Frequency (e)	Percent (f)	Frequency (g)	Percent (h)
E1-E4	586,054	43	419,665	56	22,230	28	586,054	43
E5-E9	548,316	40	237,477	32	33,787	43	548,316	40
W1-W5	20,320	1	7,718	1	1,933	2	19,540	1
O1-O3	134,939	10	54,036	7	10,530	13	135,719	10
O4-O6	86,255	6	28,091	4	10,306	13	86,255	6
Total	1,375,884	100	746,987	100	78,786	100	1,375,884	100

Table 21.
2018 WGRA Population, Sample Design, and Response Composition for Paygrade

Paygrade Grouping	Population		Sample		Respondents		Final Weighted Estimates	
	Frequency (a)	Percent (b)	Frequency (c)	Percent (d)	Frequency (e)	Percent (f)	Frequency (g)	Percent (h)
E1-E4	572,231	43	397,301	54	33,842	29	572,231	43
E5-E9	520,557	39	249,754	34	53,523	46	520,557	39
W1-W5	20,124	2	7,255	1	2,400	2	20,124	2
O1-O3	130,014	10	53,754	7	14,585	13	130,014	10
O4-O6	84,268	6	27,581	4	11,534	10	84,268	6
Total	1,327,194	100	735,645	100	115,884	100	1,327,194	100

Summary

The purpose of this NRB analysis was to determine whether there were differences between respondents and nonrespondents for three observable characteristics (gender, Service, and paygrade grouping). Similar to the 2018 WGRA, OPA found that the distribution of survey respondents was substantively and statistically significantly different from survey nonrespondents for gender, Service, and paygrade grouping.

Differences between respondents and nonrespondents on observable characteristics may suggest NRB. However, survey weighting effectively adjusts for these observable characteristics. Survey weighting also reduces any biases associated with unobservable characteristics (e.g., sexual assault rate) that are correlated with the observable characteristics.

Comparing survey respondents with the survey sample cannot definitively detect NRB. For example, if the respondents and nonrespondents look similar on observable characteristics,

there is no evidence of NRB. However, if the respondents and nonrespondents look different on observable characteristics, OPA reduces this source of NRB during survey weighting. Therefore, neither of these two outcomes has the capability of detecting NRB. The relationship between observable and unobservable characteristics is unknown, and therefore the most desirable outcome would be where respondents and nonrespondents match on observable characteristics, something OPA does not find in either the *2018 WGRA* or *2021 WGRA*.

In this analysis, OPA observes that response patterns for the *2021 WGRA* are very similar to patterns from the *2018 WGRA* and concludes that the level and direction of NRB should essentially be the same in both surveys. In the NRB studies conducted in *2018 WGRA* and *2016 WGRA*, OPA found little evidence of NRB and OPA draws that same conclusion here.

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Appendix A. Estimation Domains

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Estimation Domains

Domain	Domain Levels	Population Size	Percent Sampled	Expected Sample Size
1	Total DoD	1,335,602	52.9	706,705
2	Army	480,370	55.2	265,387
3	Navy	342,870	55.7	191,147
4	Marine Corps	181,412	63.4	115,081
5	Air Force	330,950	40.8	135,090
6	DoD*Enlisted	1,102,700	56.7	625,472
7	DoD*E1-E4	573,539	71.0	407,150
8	DoD*E5-E9	529,161	41.3	218,322
9	DoD*Officers	232,902	34.9	81,233
10	DoD*O1-O3/ W1-W5	149,507	37.5	56,002
11	DoD*O4-O6	83,395	30.3	25,231
12	DoD*Non-Hispanic White	764,193	50.2	383,855
13	DoD*Total Minority	571,409	56.5	322,850
14	DoD*Female	230,893	78.8	181,960
15	DoD*Female*Enlisted	186,717	83.7	156,259
16	DoD*Female*E1-E4	103,685	94.9	98,411
17	DoD*Female*E5-E9	83,032	69.7	57,848
18	DoD*Female*Officers	44,176	58.2	25,701
19	DoD*Female*O1-O3/ W1-W5	30,164	60.5	18,245
20	DoD*Female*O4-O6	14,012	53.2	7,456
21	DoD*Female*Age17-24	95,128	90.2	85,808
22	DoD*Female*Age25+	135,765	70.8	96,152
23	DoD*Female*Non-Hispanic White	102,286	74.2	75,919
24	DoD*Female*Total Minority	128,607	82.5	106,041
25	Female*Army	74,444	78.0	58,057
26	Female*Army*Enlisted	57,558	84.9	48,878
27	Female*Army*E1-E4	33,329	98.1	32,682
28	Female*Army*E5-E9	24,229	66.8	16,196
29	Female*Army*Officers	16,886	54.4	9,179
30	Female*Army*O1-O3/ W1-W5	11,821	58.2	6,879
31	Female*Army*O4-O6	5,065	45.4	2,300
32	Female*Navy	70,012	78.5	54,931
33	Female*Navy*Enlisted	58,925	83.3	49,096
34	Female*Navy*E1-E4	30,967	99.4	30,778
35	Female*Navy*E5-E9	27,958	65.5	18,318
36	Female*Navy*Officers	11,087	52.6	5,835
37	Female*Navy*O1-O3/ W1-W5	7,791	53.7	4,185
38	Female*Navy*O4-O6	3,296	50.1	1,650
39	Female*Marine Corps	16,305	100.0	16,305
40	Female*Marine Corps*Enlisted	14,415	100.0	14,415
41	Female*Marine Corps*E1-E4	9,877	100.0	9,877
42	Female*Marine Corps*E5-E9	4,538	100.0	4,538

Domain	Domain Levels	Population Size	Percent Sampled	Expected Sample Size
43	Female*Marine Corps*Officers	1,890	100.0	1,890
44	Female*Marine Corps*O1-O3/ W1-W5	1,494	100.0	1,494
45	Female*Marine Corps*O4-O6	396	100.0	396
46	Female*Air Force	70,132	75.1	52,667
47	Female*Air Force*Enlisted	55,819	78.6	43,870
48	Female*Air Force*E1-E4	29,512	85.0	25,074
49	Female*Air Force*E5-E9	26,307	71.4	18,796
50	Female*Air Force*Officers	14,313	61.5	8,797
51	Female*Air Force*O1-O3/ W1-W5	9,058	62.8	5,687
52	Female*Air Force*O4-O6	5,255	59.2	3,110
53	DoD*Male	1,104,709	47.5	524,745
54	DoD*Male*Enlisted	915,983	51.2	469,213
55	DoD*Male*E1-E4	469,854	65.7	308,739
56	DoD*Male*E5-E9	446,129	36.0	160,474
57	DoD*Male*Officers	188,726	29.4	55,532
58	DoD*Male*O1-O3/ W1-W5	119,343	31.6	37,757
59	DoD*Male*O4-O6	69,383	25.6	17,775
60	DoD*Male*Age17-24	428,920	61.5	263,971
61	DoD*Male*Age25+	675,789	38.6	260,774
62	DoD*Male*Non-Hispanic White	661,907	46.5	307,936
63	DoD*Male*Total Minority	442,802	49.0	216,809
64	Male*Army	405,926	51.1	207,330
65	Male*Army*Enlisted	330,611	55.8	184,499
66	Male*Army*E1-E4	174,770	71.5	124,942
67	Male*Army*E5-E9	155,841	38.2	59,557
68	Male*Army*Officers	75,315	30.3	22,831
69	Male*Army*O1-O3/ W1-W5	51,222	32.7	16,740
70	Male*Army*O4-O6	24,093	25.3	6,091
71	Male*Navy	272,858	49.9	136,216
72	Male*Navy*Enlisted	228,737	53.9	123,285
73	Male*Navy*E1-E4	98,303	73.9	72,688
74	Male*Navy*E5-E9	130,434	38.8	50,597
75	Male*Navy*Officers	44,121	29.3	12,931
76	Male*Navy*O1-O3/ W1-W5	27,373	32.8	8,976
77	Male*Navy*O4-O6	16,748	23.6	3,955
78	Male*Marine Corps	165,107	59.8	98,776
79	Male*Marine Corps*Enlisted	145,359	63.1	91,681
80	Male*Marine Corps*E1-E4	98,346	74.5	73,278
81	Male*Marine Corps*E5-E9	47,013	39.1	18,403
82	Male*Marine Corps*Officers	19,748	35.9	7,095
83	Male*Marine Corps*O1-O3/ W1-W5	13,568	34.4	4,668
84	Male*Marine Corps*O4-O6	6,180	39.3	2,427
85	Male*Air Force	260,818	31.6	82,423
86	Male*Air Force*Enlisted	211,276	33.0	69,748

Domain	Domain Levels	Population Size	Percent Sampled	Expected Sample Size
87	Male*Air Force*E1-E4	98,435	38.4	37,831
88	Male*Air Force*E5-E9	112,841	28.3	31,917
89	Male*Air Force*Officers	49,542	25.6	12,675
90	Male*Air Force*O1-O3/ W1-W5	27,180	27.1	7,373
91	Male*Air Force*O4-O6	22,362	23.7	5,302
92	Coast Guard	40,282	100.0	40,282
93	Coast Guard*Enlisted	31,670	100.0	31,670
94	Coast Guard*E1-E4	12,515	100.0	12,515
95	Coast Guard*E5-E9	19,155	100.0	19,155
96	Coast Guard*Officers	8,612	100.0	8,612
97	Coast Guard*W1-W5/O1-O3	5,752	100.0	5,752
98	Coast Guard*O4-O6	2,860	100.0	2,860
99	Coast Guard*Females	6,224	100.0	6,224
100	Coast Guard*Females*Enlisted	4,375	100.0	4,375
101	Coast Guard*Females*Officers	1,849	100.0	1,849
102	Coast Guard*Males	34,058	100.0	34,058
103	Coast Guard*Males*Enlisted	27,295	100.0	27,295
104	Coast Guard*Males*Officers	6,763	100.0	6,763

Note. Percent Sampled may not equal Expected Sample Size divided by Population Size. This is because Expected Sample Size is a non-integer value and it is rounded in the table. Expected Sample Size is based on the expected sample drawn from all strata associated with each domain. Only after the sample is selected can true (whole number) sample sizes be determined for domains.

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