



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

Statistical Methodology Report

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To address unwanted gender-related issues in the military, each of the Services and DoD has implemented and expanded sexual assault and sexual harrasment programs to spearhead prevention efforts and to provide reporting options and survivor care procedures. Continuing evaluation of these programs through cross-component surveys is important for reducing instances of sexual assault and sexual harrasment of military members. This report contains the statistical methodology for active duty component members in the 2021 Workplace and Gender Relations Survey of Military Members.

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Statistical Methodology Report

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Individuals who contributed to the development and administration include Dr. Aubrey Hilbert and Dr. Sarah Newman (DoD SAPRO), Mr. Cyrus Salazar, Director of the Office for Diversity Equity and Inclusion (ODEI) and Candice Cook (ODEI), Dr. Samantha Daniel, Dr. Jonathan Schreiner, Kristin Williams, Leonid Levin, and Michael DiNicolantonio (OPA).

The lead survey design analyst was Dr. Rachel Breslin. The lead operations analyst was Kimberly Hylton, with additional operations support from Alycia White, Mark Petusky, and Surya Sampath and consultation by Margaret Coffey (FMG).

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. Alex McMillan of Fors Marsh Group 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.

Table of Contents

	<u>Page</u>
Introduction.....	1
Section 1: Definitions	1
Section 2: Sample Design and Selection	2
Target Population.....	2
Sampling Frame	2
Sample Design	3
Sample Allocation.....	4
Section 3: Design of Experiment	5
Section 4: Weighting.....	6
Case Dispositions.....	6
Nonresponse Adjustments and Final Weights	8
Treatment of Missing Data	15
Variance Estimation.....	15
Section 5: Multiple Comparisons.....	15
Section 6: Contact, Cooperation, and Response Rates	16
Ineligibility Rate	17
Estimated Ineligible Postal Non-Deliverable/Not Contacted Rate.....	18
Estimated Ineligible Nonresponse	18
Adjusted Contact Rate	18
Adjusted Cooperation Rate	18
Adjusted Response Rate	18
Section 7: Results of Experiment.....	19
Section 8: Nonresponse Bias	21
Comparing Survey Respondents With Survey Nonrespondents	22
Summary.....	26
References.....	29

Appendices

A. Estimation Domains.....	31
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List of Tables

1. Variables for Stratification.....	3
2. Sample Size by Stratification and Experiment Variables	5
3. Case Dispositions for Weighting	7
4. Complete Eligible Respondents by Stratification and Experiment Variables	8

Table of Contents (Continued)

	<u>Page</u>
5. Predictor Variables Used for the Known Eligibility and Completion Models	9
6. Variables Used for Raking.....	13
7. Distribution of Weights and Adjustments for Complete, Eligible Respondents	14
8. Sum of Weights by Eligibility Status.....	15
9. Disposition Codes for Response Rates	17
10. Contact, Cooperation, and Response Rates	18
11. Weighted Rates for Sample by Stratification and Experiment Variables.....	19
12. Response Rates by Postcard Experiment Treatment Group	20
13. Key Estimates by Gender by Survey Communication Experiment.....	21
14. 2021 WGRR Population, Sample Design, and Response Composition for Gender.....	23
15. 2019 WGRR Population, Sample Design, and Response Composition for Gender.....	24
16. 2021 WGRR Population, Sample Design, and Response Composition for Component.....	25
17. 2019 WGRR Population, Sample Design, and Response Composition for Component.....	25
18. 2021 WGRR Population, Sample Design, and Response Composition for Paygrade.....	26
19. 2019 WGRR Population, Sample Design, and Response Composition for Paygrade.....	26

2021 WORKPLACE AND GENDER RELATIONS SURVEY OF MILITARY MEMBERS - RESERVE 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 - Reserve Component (2021 WGRR)*. 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 WGRR*. Section 6 describes the calculation of contact, cooperation, and response rates for the full sample and population subgroups. Section 7 provides the results of the experiment. 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 WGRR was designed to represent individuals meeting the following criteria:

- Members of the Selected Reserve who are in Reserve Unit, Active Guard/Reserve (AGR/FTS/AR; Title 10 and Title 32), or Individual Mobilization Augmentee (IMA) programs within the:
 - Army National Guard (ARNG)
 - U.S. Army Reserve (USAR)
 - U.S. Navy Reserve (USNR)
 - U.S. Marine Corps Reserve (USMCR)
 - Air National Guard (ANG)
 - U.S. Air Force Reserve (USAFR)
 - Coast Guard Reserve
- Paygrades E1–O6

Sampling Frame

OPA created the sampling frame using the *March 2021 Reserve Components Common Personnel Data System (RCCPDS) Master File*. There were 799,356 individuals included in the target population. Auxiliary frame data were obtained from the following files:

- *March 2021 Reserve Duty Family Database File* (identifies number of children)

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.

- *February 2021 DoD Appropriated Fund Civilian Personnel Master File* (identifies Military Technicians)
- *December 2020 Contingency Tracking System (CTS) Deployment File* (contains deployment history)
- *July 2021 Unit Identification Code (UIC) Address File* (contains unit address)
- *July 2021 Reserve Address File* (contains the mailing address for Reserve members)
- *September 13, 2021 Defense Enrollment Eligibility Reporting System (DEERS) Database Extract (DBE)* (includes member's email address)

Sample Design

The sample for the 2021 WGRR 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
Reserve Component	RORG_CD	1=Army National Guard 2=Army Reserve 3=Navy Reserve 4=Marine Corps Reserve 5=Air National Guard 6=Air Force Reserve 7=Coast Guard Reserve
Gender	CSEX	1=Male/Unknown 2=Female
Paygrade Grouping	CPAYGRP5	1=E1-E4 2=E5-E9 3=W1-W5/O1-O3 4=O4-O6
Reserve Program	RPROGCIV	1=TPU 2=AGR/TAR 3=MilTech 4=IMA

OPA initially partitioned the population frame into 167 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 300 sample members and

² In this example, a full cross-classification produces 224 strata. The initial number of strata is fewer because some subgroups did not exist in the population (e.g., the Coast Guard only has one Reserve Program).

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 300 members in the stratum, OPA may collapse “MilTech and IMA” to form a new stratification level “MilTech/IMA”). RORG_CD and CSEX were always preserved during strata formation. The final number of strata was 121.

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 98 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 *2020 SOFS-R*, *2019 WGRR*, and *2017 WGRR* 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 WGRR* 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. After setting precision requirements on all estimation domains, OPA inflated the sample to meet the target sample size of 245,000 by manipulating the Total DoD estimation domain. The final *2021 WGRR* total sample size was 247,839; Table 2 provides the sample size by stratification 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 National Guard	Army Reserve	Navy Reserve	Marine Corps Reserve	Air National Guard	Air Force Reserve	Coast Guard Reserve
Sample	247,839	76,269	55,725	26,182	25,162	26,445	31,848	6,208
Gender								
Male/Unknown	146,192	43,483	29,878	12,034	23,601	14,104	17,946	5,146
Female	101,647	32,786	25,847	14,148	1561	12,341	13,902	1,062
Paygrade Grouping								
E1-E4	117,919	45,788	28,563	6,362	16,694	8,777	10,620	1,115
E5-E9	80,703	16,365	15,046	14,177	4,220	12,231	14,583	4,081
W1-W5/O1-O3	28,770	11,753	7,748	2,107	1676	2,674	2,279	533
O4-O6	20,447	2,363	4,368	3,536	2572	2,763	4,366	479
Reserve Program								
TPU	201,052	65,485	47,508	21,323	21,314	17,903	21,311	6,208
AGR	18,238	4,557	3,062	4,788	1288	3,363	1180	0
MilTech	17,287	6,227	2,839	0	0	5,179	3,042	0
IMA	11,262	0	2316	71	2560	0	6,315	0
Postcard Experiment								
Treatment 1	48,326	15,254	11,145	5,236	5,033	5,289	6,369	0
Treatment 2	48,326	15,254	11,145	5,236	5,032	5,289	6,370	0
Treatment 3	48,326	15,253	11,145	5,237	5,032	5,289	6,370	0
Treatment 4	48,327	15,254	11,145	5,237	5,032	5,289	6,370	0
Treatment 5	48,326	15,254	11,145	5,236	5,033	5,289	6,369	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 10,597 (4.3% 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 WGRR, 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”

OPA assesses the effectiveness of this experiment on response rates by service, gender, and paygrade in Section 7.

Section 4: Weighting

OPA created analytical weights for the *2021 WGRR* 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 22 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 the *2021 WGRR* sample members are shown in Table 3. There were 29,750 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 members who no longer appeared on the July 2021 RCCPDS.	10,597 (4.3%) 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.”	202 (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 a member of the National Guard or a Reserve component on December 6, 2021?”	754 (0.3%)
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.	29,750 (12.0%)
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.	1,645 (0.7%)
8. Eligible, active refusal	SCS	Respondent refused due to reasons such as “too long,” “too intrusive,” or “not interested.”	181 (0.1%)
9. Eligible, blank return	SCS	Respondent submitted blank questionnaire with no reason given.	248 (0.1%)
10. Postal Non-Deliverable (PND)	SCS	Last postal communication was returned as undeliverable.	23,804 (9.6%)
11. Nonrespondent	Remainder	Remaining sampled members who did not respond to survey.	180,658 (72.9%)
Total			247,839 (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 National Guard	Army Reserve	Navy Reserve	Marine Corps Reserve	Air National Guard	Air Force Reserve	Coast Guard Reserve
Sample	29,750	8,209	5,905	4,105	1,434	5,000	4,456	641
Gender								
Male/Unknown	16,340	4,572	3,052	1,957	1,279	2,559	2,425	496
Female	13,410	3,637	2,853	2,148	155	2,441	2,031	145
Paygrade Grouping								
E1-E4	7,088	2,974	1,345	437	538	906	809	79
E5-E9	11,800	2,303	2,173	1,922	287	2,609	2,128	378
W1-W5/O1-O3	5,131	2,136	1,220	547	175	579	382	92
O4-O6	5,731	796	1,167	1,199	434	906	1,137	92
Reserve Program								
TPU	19,896	5,792	3,996	3,427	934	2,690	2,416	641
AGR	3,893	1,235	716	657	134	899	252	0
MilTech	3,771	1,182	627	0	0	1,411	551	0
IMA	2,190	0	566	21	366	0	1,237	0
Postcard Experiment								
Treatment 1	5,787	1,648	1,122	818	289	1,009	901	0
Treatment 2	5,817	1,648	1,200	846	274	949	900	0
Treatment3	5,880	1,658	1,237	801	288	1,033	863	0
Treatment 4	5,804	1,633	1,164	810	319	1,010	868	0
Treatment 5	5,821	1,622	1,182	830	264	999	924	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 ineligibles (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 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

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.

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
AFQT Category	AFQT_CAT_CD	1=Category I 2=Category II 3A=Category III A 3B=Category III B 4A=Category IV A 4B=Category IV B 4C=Category IV C 5=Category V WW=Not Applicable ZZ=Unknown
Armed Forces Qualification Test Percentile Score	AFQT_SCR_QY	.=Not Applicable 0=Unknown 1-99
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
Person's Age Quantity	AGE	17-72

Variable	Variable Name	Variable Levels
Enlisted Years of Service Grouping	CEYOS	1=Enlisted 3 - 5 years 2=Enlisted 6 - 9 years 3=All others, Unknown
Number of Children	CHILDCNT	0-13
Sex	CSEX	1=Male/Unknown 2=Female
Duty Service Occupation	DTY_DOD_OCC_CD	100000-290500
Education level	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 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
Ethnic Affinity	ETHNIC	AA=Asian Indian AB=Chinese AC=Filipino AD=Guamanian AF=Japanese AG=Korean AI=Vietnamese AJ=Other Asian descent AK=Mexican AL=Puerto Rican AM=Cuban AN=Latin American with Hispanic descent AO=Other Hispanic descent AP=Aleut AQ=Eskimo AR=US or Canadian Indian tribes AS=Melanesian AT=Micronesian AU=Polynesian AV=Other Pacific island descent BG=Other

Variable	Variable Name	Variable Levels
		BH=None ZZ=N/A or Unknown
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)
Marital Status	MARITAL	A=Annulled D=Divorced I=Interlocutory L=Legally separated M=Married N=Never married W=Widowed Z=Unknown
Pay Plan Grade	PAYGRADE	E0 = Enlisted, Grade Unknown E1 - E9 W0 = Warrant Officer, Grade Unknown W1 - W5 O0 = Officer, Grade Unknown O1 - O6
Military Longevity Pay Service Base Calendar Date	PEBD_DT2	1976-2021
Prior Regular Component Service Indicator	PRIOR_ASVC_INDC_CD	N=No W=NA Y=Yes Z=Unknown
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
Numeric Organizational	RORG_CD	1=Army National Guard 2=Army Reserve 3=Navy Reserve 4=Marine Corps Reserve 5=Air National Guard 6=Air Force Reserve 7=Coast Guard Reserve
Reserve Category Programs	RPROGCIV	1=TPU/Unknown 2=AGR/TAR 3=Military Technicians 4=IMA
Reserve Subcategory	RSV_SCAT	A=Drilling Unit Member B=Individual Mobilization Augmentees (IMA) F=On Initial Active Duty For Training (IADT) G=Active Guard Reserve P=Person awaiting IADT

Variable	Variable Name	Variable Levels
		Q=Awaiting Second Part of IADT T=Simultaneous Membership Program (SMP) V=FT members performing AD on FTNGD for >180, but exempt from X=SEL RES - Other Training Programs
US Citizen Citizenship Origin	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 W=NA Z=Unknown
Occupation was Closed to Women	WASCLOSED	0=Was not closed 1=Was closed

OPA typically uses 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 applies 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. For the 2021 WGRR, the largest eligibility status adjustment did not exceed this threshold so weight trimming was not necessary.

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
Gender by Paygrade	GENPAY	1=Male E1–E4 2=Male E5–E9 3=Male W1–W5 4=Male O1–O3 5=Male O4–O6 6=Female E1–E4 7=Female E5–E9 8=Female W1–W5 9=Female O1–O3 10=Female O4–O6
Gender by Program	GENPROG	1=Male TPU/Unknown 2=Male AGR/TAR 3=Male Military Technicians 4=Male IMA 5=Female TPU/Unknown 6=Female AGR/TAR 7=Female Military Technicians 8=Female IMA
Gender by Race	GENRACE	1=Male Non-minority 2=Male Minority 3=Female Non-minority 4=Female Minority
Gender by Service by Paygrade	GENORGPAY	1=Male ARNG Enlisted 2=Male ARNG Officer 3=Male USAR Enlisted 4=Male USAR Officer 5=Male USNR Enlisted 6=Male USNR Officer 7=Male USMCR Enlisted 8=Male USMCR Officer 9=Male ANG Enlisted 10=Male ANG Officer 11=Male USAFR Enlisted 12=Male USAFR Officer 13=Female ARNG Enlisted 14=Female ARNG Officer 15=Female USAR Enlisted 16=Female USAR Officer 17=Female USNR Enlisted 18=Female USNR Officer 19=Female USMCR Enlisted 20=Female USMCR Officer 21=Female ANG Enlisted 22=Female ANG Officer 23=Female USAFR Enlisted 24=Female USAFR Officer

Table 7 summarizes the distributions of the sampling, known eligibility, completion, and final weights, and the corresponding adjustment factors for the 29,750 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	1.1	1.2	1.0	1.3	0.8	1.4
MAX	11.6	63.2	287.5	1.2	304.8	1.3	331.1
MEAN	3.4	6.9	22.4	1.1	24.1	1.1	25.9
STD	2.6	5.9	25.6	0.0	27.7	0.1	30.2
CV	0.77	0.86	1.14	0.02	1.15	0.07	1.17

The mean sampling weights for the entire sample was 3.2 (data not shown) while the mean for the complete, eligible respondents was 3.4. The known eligibility status adjustment made the largest adjustment (mean of 6.9) to the weights and coefficient of variation (CV) of the weights (increased from 0.77 to 1.14). 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 1.4 to 331.1).

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 1.17, the increase in variance due to weighting is less than 3 (2.36). 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	101,899	666,967	717,249	771,321
2. Ineligible	3,404	25,677	25,677	28,035
3. Nonrespondent	663,336	50,443	0	0
4. Record ineligible	30,717	30,717	30,717	0
Total	799,356	773,804	773,644	799,356

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 WGRR 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 WGRR 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 30 complete eligible responses with non-zero final weights. There were 106 variance strata defined for the 2021 WGRR.

Section 5: Multiple Comparisons

To support the 2021 WGRR 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 WGRR, 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 WGRR. The final weighted response rate for the survey was 13.7%.

Table 10.
Contact, Cooperation, and Response Rates

Type of Rate	Computation	Unweighted (Percent)	Weighted (Percent)
Contact	Adjusted contacted sample/Adjusted eligible sample	90.0	90.5
Cooperation	Complete Eligibles/Adjusted contacted sample	14.4	15.1
Response	Complete Eligibles/Adjusted eligible sample	12.9	13.7

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 and experiment variables.

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

Variable	Contact Rate (Percent)	Cooperation Rate (Percent)	Response Rate (Percent)
Sample	91	15	14
Reserve Component			
Army National Guard	89	13	12
Army Reserve	90	14	12
Navy Reserve	88	21	18
Marine Corps Reserve	89	7	6
Air National Guard	95	21	20
Air Force Reserve	93	17	15
Coast Guard Reserve	97	11	11
Gender			
Male/Unknown	91	15	14
Female	90	15	14
Paygrade Grouping			
E1 - E4	87	8	7
E5 - E9	93	17	16
W1 - W5, O1 - O3	93	21	19
O4 - O6	97	32	31
Reserve Program			
TPU/Unknown	90	12	11
AGR/TAR	91	26	24
Military Technicians	95	25	23
IMA	94	23	22
Postcard Experiment			
Treatment 1	91	15	14
Treatment 2	90	15	14
Treatment 3	91	15	14
Treatment 4	90	15	14
Treatment 5	90	15	14

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

Section 7: Results of Experiment

The postcard experiment for 2021 WGRR 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 13.2% to 13.5%. When controlling for Reserve

component, gender, and paygrade grouping, the postcard treatment was found to not have a statistically significant effect on response rates, χ^2 (df=4, n= 231,205) = 0.66, p = 0.6206. Table 12 shows that response rates are very consistent across Reserve components, gender, and paygrade groupings.

Table 12.
Response Rates by Postcard Experiment Treatment Group

Variable	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5
Total	13.2%	13.3%	13.5%	13.2%	13.2%
Reserve Component					
Army National Guard	11.6%	11.7%	11.8%	11.5%	11.4%
Army Reserve	11.4%	11.8%	12.5%	12.0%	11.9%
Navy Reserve	18.2%	18.2%	16.8%	17.6%	17.8%
Marine Corps Reserve	5.8%	5.6%	5.8%	6.7%	5.1%
Air National Guard	19.5%	19.0%	20.7%	19.6%	19.5%
Air Force Reserve	15.3%	15.4%	14.5%	14.4%	15.5%
Gender					
Male/Unknown	13.2%	13.3%	13.6%	13.1%	13.1%
Female	13.2%	13.3%	13.4%	13.6%	13.6%
Paygrade Grouping					
E1-E4	6.4%	6.5%	6.6%	6.4%	6.3%
E5-E9	15.5%	15.6%	16.0%	15.9%	15.6%
W1-W5	29.2%	27.1%	27.0%	25.9%	25.4%
O1-O3	16.3%	17.2%	17.8%	15.8%	17.0%
O4-O6	31.1%	30.1%	30.2%	29.7%	30.5%

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	3.6%	3.6%	3.7%	3.5%	2.7%	3.11	0.540
	Gender Discrimination	1.0%	1.2%	0.8%	0.8%	0.6%	3.46	0.485
Female	Sexual Harassment	15.5%	18.2%	15.3%	16.7%	17.3%	4.94	0.294
	Gender Discrimination	12.2%	12.1%	10.9%	11.5%	10.2%	3.82	0.431

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 *2015 WGRR*. 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 WGRR* in an attempt to confirm that the levels and direction of NRB were the same as *2019 WGRR* by comparing the sample composition with the survey respondents. This same analysis of the level and direction of NRB was conducted for the *2019 WGRR*. If these comparisons are the same across survey iterations, OPA asserts that the NRB is similar and the *2021 WGRR* requires no further assessments. That result is confirmed in the following section.

Comparing Survey Respondents With Survey Nonrespondents

The *2021 WGRR* NRB analysis compared the sample composition with the survey respondent composition and assessed whether the patterns matched the *2019 WGRR* results. The *2021 WGRR* sample composition demographically differs from the Reserve component 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, Reserve component, 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 Reserve) 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 Reserve population. The demographics considered in this analysis include gender,

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

Table 14 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 21% of the Reserve population but 41% of the 2021 WGRR sample (Table 14: columns b and d). The final weighting procedure (i.e., raking) pulls the respondents back into alignment with the gender composition in the Reserve population to ensure final weighted estimates represent both genders correctly (Table 14: 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=29,750) or self/proxy report ineligible (n=956). OPA defines survey nonrespondents as SAMP_DC levels 5-11 (n=206,536; see Table 3). Record ineligibles (n=10,597) are not included in the analysis. The relationship between gender and survey response was not significant, χ^2 (df=1, n= 237,242) = 0.7⁹, p = 0.415. The results indicate that different genders did not respond at significantly different rates. While the unweighted sample and unweighted respondents percentages for males moved from 59 to 55 percent and females moved from 41 to 45 percent, the weighted response rates were similar between genders. Table 15 shows the response patterns in 2019 were similar, where males moved from 62 to 58 percent and females moved from 38 to 42 percent. Therefore, 2021 estimates should have similar levels and direction of NRB as 2019 survey estimates.

Table 14.
2021 WGRR 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/Unknown	629,333	79	146,192	59	16,921	55	629,333	79
Female	170,023	21	101,647	41	13,785	45	170,023	21
Total	799,356	100	247,839	100	30,706	100	799,356	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 15.
2019 WGRR 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/Unknown	631,734	80	167,106	62	20,127	58	631,734	80
Female	161,482	20	102,369	38	14,777	42	161,482	20
Total	793,216	100	269,475	100	34,904	100	793,216	100

Table 16 shows the breakdown of the population, sample, and respondent distributions by Reserve component. There are differences between the unweighted sample and unweighted respondent percentages, such as Army National Guard (went from 32 to 28 percent; Table 16: columns d and f) and Air National Guard (11 to 17 percent). Table 17 shows similar results in 2019 where Army National Guard moved from 43 to 32 percent and Air National Guard moved from 13 to 21 percent). The final weighting procedure aligns respondent proportions back with the Reserve population for the components (Table 16: columns b and h).

OPA performed a base weighted Chi-square test of independence on respondents and nonrespondents by component. The relationship between component and survey response was significant, χ^2 (df=6, n= 237,242) = 2198.1, $p < 0.0001$. The results indicate that different components respond at different rates and unweighted estimates are prone to nonresponse bias if not adjusted. Response patterns (e.g., Air National Guard respond at higher rates) are the same across the 2019 and 2021 surveys, and therefore OPA concludes that NRB levels and direction are likely also similar.

Table 16.
2021 WGRR Population, Sample Design, and Response Composition for Component

Reserve Component	Population		Sample		Respondents		Weighted Estimates (Final Weights)	
	Frequency (a)	Percent (b)	Frequency (c)	Percent (d)	Frequency (e)	Percent (f)	Frequency (g)	Percent (h)
Army National Guard	335,477	42	76,269	32	8,456	28	335,477	42
Army Reserve	187,028	24	55,725	23	6,151	20	187,028	24
Navy Reserve	58,198	7	26,182	11	4,249	14	58,198	7
Marine Corps Reserve	35,662	4	25,162	10	1,519	5	35,662	4
Air National Guard	107,063	13	26,445	11	5,098	17	107,063	13
Air Force Reserve	69,720	9	31,848	13	4,577	15	69,720	9
Coast Guard Reserve	6,208	1	6,208	3	656	2	6,208	1
Total	799,356	100	247,839	100	30,706	100	799,356	100

Table 17.
2019 WGRR Population, Sample Design, and Response Composition for Component

Reserve Component	Population		Sample		Respondents		Weighted Estimates (Final Weights)	
	Frequency (a)	Percent (b)	Frequency (c)	Percent (d)	Frequency (e)	Percent (f)	Frequency (g)	Percent (h)
Army National Guard	330,976	42	114,579	43	10,997	32	330,976	42
Army Reserve	190,213	24	63,746	24	8,231	24	190,213	24
Navy Reserve	58,715	7	17,995	7	2,811	8	58,715	7
Marine Corps Reserve	38,185	5	13,160	5	1,032	3	38,185	5
Air National Guard	106,391	13	34,602	13	7,483	21	106,391	13
Air Force Reserve	68,736	9	25,393	9	4,350	12	68,736	9
Total	793,216	100	269,475	100	34,904	100	793,216	100

Table 18 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 senior enlisted members (Table 18: columns b and d). For instance, senior enlisted members make up 41 percent of the Reserve population but only 33 percent of the 2021 WGRR sample. On the other hand, junior enlisted are oversampled in proportion to their population (42 to 48 percent). The logic for this approach is seen clearly in the differences between respondent percentages. The senior enlisted members account for 40 percent of the respondents, despite making up only 33 percent of the sample, while the junior enlisted members made up nearly half the sample (48 percent), yet represented only 24 percent of the respondents. Table 19 shows similar results in 2019 where junior enlisted members moved from 50 to 22 percent, and senior enlisted members moved from 34 to 47 percent. These differences are adjusted based on known characteristics in post-survey weighting procedures, which aligned the

respondent proportions equal to the Reserve population for paygrade (Table 18: 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=237,242) = 7085.9, $p < 0.0001$. 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 2019 and 2021 surveys, and therefore OPA concludes that NRB levels and direction will also be similar.

Table 18.
2021 WGRR 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	334,192	42	117,919	48	7,359	24	334,192	42
E5-E9	330,168	41	80,703	33	12,212	40	330,168	41
W1-W5	12,948	2	4,147	2	1,095	4	12,948	2
O1-O3	58,819	7	24,623	10	4,151	14	58,819	7
O4-O6	63,229	8	20,447	8	5,889	19	63,229	8
Total	799,356	100	247,839	100	30,706	100	799,356	100

Table 19.
2019 WGRR 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	333,602	42	134,810	50	7,539	22	333,602	42
E5-E9	329,762	42	92,295	34	16,245	47	329,762	42
W1-W5/O1-O3	70,367	9	24,412	9	5,165	15	70,367	9
O4-O6	59,485	7	17,958	7	5,955	17	59,485	7
Total	793,216	100	269,475	100	34,904	100	793,216	100

Summary

The purpose of this NRB analysis was to determine whether there were differences between respondents and nonrespondents for three observable characteristics (gender, Reserve component, and paygrade grouping). Similar to the 2019 WGRR, OPA found that the

distribution of survey respondents was statistically significantly different from survey nonrespondents for Reserve component and paygrade grouping and that while gender was not found to be significant in 2021, response patterns by gender were similar to 2019.

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 *2019 WGRR* or *2021 WGRR*.

In this analysis, OPA observes that response patterns for the *2021 WGRR* are very similar to patterns from the *2019 WGRR* and concludes that the level and direction of NRB should essentially be the same in both surveys. In the NRB studies conducted in *2019 WGRR* and *2017 WGRR*, 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	793,148	30.5	241,631
2	National Guard	442,540	23.2	102,714
3	Army National Guard	335,477	22.7	76,269
4	Air National Guard	107,063	24.7	26,445
5	Reserve	350,608	39.6	138,917
6	Army Reserve	187,028	29.8	55,725
7	Navy Reserve	58,198	45.0	26,182
8	Marine Corps Reserve	35,662	70.6	25,162
9	Air Force Reserve	69,720	45.7	31,848
10	Enlisted	659,164	29.3	193,426
11	E1-E4	333,077	35.1	116,804
12	E5-E9	326,087	23.5	76,622
13	Officers	133,984	36.0	48,205
14	W1-O3	71,234	39.6	28,237
15	O4-O6	62,750	31.8	19,968
16	TPU/Unknown	635,484	30.7	194,838
17	AGR/FTS/AR	78,400	23.2	18,228
18	Military Technician	66,425	26.0	17,297
19	IMA	12,839	87.8	11,269
20	Non-Hispanic White	495,377	28.4	140,802
21	Total Minority	297,771	33.9	100,829
22	Females	168,961	59.5	100,585
23	Females*Enlisted	141,803	55.2	78,344
24	Females*E1-E4	77,881	60.1	46,825
25	Females*E5-E9	63,922	49.3	31,519
26	Females*Officers	27,158	81.9	22,241
27	Females*O1-O3	13,666	84.9	11,603
28	Females*O4-O6	11,944	78.5	9,371
29	Females*TPU/Unknown	135,358	59.8	80,935
30	Females*AGR/FTS/AR	17,565	47.9	8,411
31	Females*Military Technician	12,637	62.3	7,874
32	Females*IMA	3,401	99.0	3,366
33	Females*Non-Hispanic White	85,965	59.7	51,316
34	Females*Total Minority	82,996	59.4	49,269
35	Females*National Guard	86,789	52.0	45,127
36	Females*Army National Guard	63,438	51.7	32,786
37	Females*Army National Guard*Enlisted	56,550	46.7	26,384
38	Females*Army National Guard*Officers	6,888	92.9	6,402
39	Females*Air National Guard	23,351	52.8	12,341
40	Females*Air National Guard*Enlisted	20,141	45.4	9,148
41	Females*Air National Guard*Officers	3,210	99.5	3,193
42	Females*Reserve	82,172	67.5	55,458

Domain	Domain Levels	Population Size	Percent Sampled	Expected Sample Size
43	Females*Army Reserve	46,802	55.2	25,847
44	Females*Army Reserve*Enlisted	36,898	53.3	19,683
45	Females*Army Reserve*Officers	9,904	62.2	6,164
46	Females*Navy Reserve	14,347	98.6	14,148
47	Females*Navy Reserve*Enlisted	11,492	100.0	11,492
48	Females*Navy Reserve* Officers	2,855	93.0	2,656
49	Females*Marine Corps Reserve	1,561	100.0	1,561
50	Females*Air Force Reserve	19,462	71.4	13,902
51	Females*Air Force Reserve*Enlisted	15,536	67.3	10,451
52	Females*Air Force Reserve*Officers	3,926	87.9	3,451
53	Males	624,187	22.6	141,046
54	Males*Enlisted	517,361	22.2	115,082
55	Males*E1-E4	255,196	27.4	69,979
56	Males*E5-E9	262,165	17.2	45,103
57	Males*Officers	106,826	24.3	25,964
58	Males*O1-O3	44,731	28.2	12,603
59	Males*O4-O6	50,806	20.9	10,597
60	Males*TPU/Unknown	500,126	22.8	113,903
61	Males*AGR/FTS/AR	60,835	16.1	9,817
62	Males*Military Technician	53,788	17.5	9,423
63	Males*IMA	9,438	83.7	7,903
64	Males*Non-Hispanic White	409,412	21.9	89,486
65	Males*Total Minority	214,775	24.0	51,560
66	Males*National Guard	355,751	16.2	57,587
67	Males*Army National Guard	272,039	16.0	43,483
68	Males*Army National Guard*Enlisted	233,546	15.3	35,769
69	Males*Army National Guard*Officers	38,493	20.0	7,714
70	Males*Air National Guard	83,712	16.8	14,104
71	Males*Air National Guard*Enlisted	70,936	16.7	11,860
72	Males*Air National Guard*Officers	12,776	17.6	2,244
73	Males*Reserve	268,436	31.1	83,459
74	Males*Army Reserve	140,226	21.3	29,878
75	Males*Army Reserve*Enlisted	110,954	21.6	23,926
76	Males*Army Reserve*Officers	29,272	20.3	5,952
77	Males*Navy Reserve	43,851	27.4	12,034
78	Males*Navy Reserve*Enlisted	32,417	27.9	9,047
79	Males*Navy Reserve* Officers	11,434	26.1	2,987
80	Males*Marine Corps Reserve	34,101	69.2	23,601
81	Males*Marine Corps Reserve*Enlisted	29,972	65.8	19,728
82	Males*Marine Corps Reserve*Officers	4,129	93.8	3,873
83	Males*Air Force Reserve	50,258	35.7	17,946
84	Males*Air Force Reserve*Enlisted	39,536	37.3	14,752
85	Males*Air Force Reserve*Officers	10,722	29.8	3,194
86	Coast Guard Reserve	6,208	100.0	6,208

Domain	Domain Levels	Population Size	Percent Sampled	Expected Sample Size
87	Coast Guard Reserve*Enlisted	5,196	100.0	5,196
88	Coast Guard Reserve*E1-E4	1,115	100.0	1,115
89	Coast Guard Reserve*E5-E9	4,081	100.0	4,081
90	Coast Guard Reserve*Officers	1,012	100.0	1,012
91	Coast Guard Reserve*W1-O3	533	100.0	533
92	Coast Guard Reserve*O4-O6	479	100.0	479
93	Coast Guard Reserve*Female	1,062	100.0	1,062
94	Coast Guard Reserve*Female*Enlisted	808	100.0	808
95	Coast Guard Reserve*Female*Officers	254	100.0	254
96	Coast Guard Reserve*Male	5,146	100.0	5,146
97	Coast Guard Reserve*Male*Enlisted	4,388	100.0	4,388
98	Coast Guard Reserve*Male*Officers	758	100.0	758

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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