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14. ABSTRACT This epidemiologic study utilizes both existing datasets and newly collected survey data to examine the prevalence and patterns of GWI symptoms, diagnosed medical conditions, reproductive health, birth outcomes, and other health issues among women who served during the Gulf War. The study will utilize data from multiple studies in order to establish a GWWC. In studies for which it is feasible to re-contact subjects, current data will be collected on women's symptoms and medical conditions and adverse reproductive outcomes (still births, ectopic pregnancies, birth defects), using postal survey questionnaires and telephone interviews. In this new data collection, the projected number of completed surveys is 450. Re-analyses of existing data will focus on health outcomes specifically affecting women. Female-to-male differences in GWI will be examined to determine whether GWI manifests differently in women. The number of women who will be included in the study is anticipated to be 955-1,420 women GW veterans and an additional 680-854 women veteran who were not deployed. The project will provide a comprehensive picture of the health of women GW veterans. This includes assessment of current health status, changes in health symptoms and conditions over time, and possible differences in health outcomes associated with specific experiences and exposures during the war. It will allow for an assessment of GWI symptom patterns that may be specific to women veterans and a determination of diagnosed medical conditions					
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1. INTRODUCTION

This epidemiologic study utilizes both existing datasets and newly collected survey data to examine the prevalence and patterns of GWI symptoms, diagnosed medical conditions, reproductive health, birth outcomes, and other health issues among women who served during the Gulf War. The study will utilize data from multiple studies in order to establish a Gulf War Women's Health Cohort. In new data collection, the projected number of completed surveys is 450.

2. KEYWORDS

Birth defects; Gulf War veterans; reproductive outcomes; women's health

3. ACCOMPLISHMENTS

What were the major goals of the project?

Prepare regulatory documents and research protocol for study; finalize consent form and human subjects protocol; coordinate with sites for IRB protocol submission; coordinate with sites for Augusta University IRB review; coordinate with sites for military 2nd level IRB review (ORP/HRPO).
Hire and train staff.
Assemble the GWWC from previous study data; develop and finalize data use agreements.
Develop survey questionnaire; conduct a pilot of survey questionnaire.
Implement quality assurance measures for data collection and data management.

What was accomplished under these goals?

Year one activities have carefully followed the Statement of Work. These activities have included preparation of a human subjects protocol and consent forms; submission of human subject's protocol and related documents at subsites; and submission of IRB protocol and related documents to ORP/HRPO.

IRB approval was expeditiously received from Augusta University in fall 2016, conditional upon the IRB's receipt of IRB approval notices from subsites (Baylor College of Medicine and VA Boston Healthcare System). The Boston School of Public Health IRB determined that the study was exempt from IRB review as Boston University would not be receiving any personally identifying information. Dr. Maxine Krengel submitted the human subject's protocol and related documents to the VA Boston Healthcare System IRB. The VA Boston Healthcare IRB required that letters be sent to Ft. Devon's Study participants informing them that longitudinal data from the study was being placed in a VA data repository and asking them for their consent to have their

study information placed in the repository. These letters have already gone out and VA Boston Healthcare IRB approval for the GWWC Study will likely be received in October. Dr. Lea Steele has been dealing with an ongoing family emergency and she has not yet received approval from the Baylor College of Medicine IRB.

A data use agreement is in place between CDC and Augusta University for the CDC Air Force dataset. The CDC did not consider the CDC Air Force study dataset to be human subjects as there are no personal identifiers. The data use agreement between VA CSP and Augusta University has essentially been completed and will likely be executed by the end of this month (August), allowing the VA ERIC program in Durham, NC to send CSP 585 Gulf War Survey and Biorepository survey data to the Boston University Data Coordinating Center via a secure server in early September.

A major accomplishment in year one was completion of carefully crafted and well-formatted survey questionnaires (CATI telephone and postal questionnaire versions). The postal questionnaire is included in the Appendices.

Boston University Data Coordinating Center Staff (Emily Sisson and others) and Vahe Heboyan and Steve Coughlin at Augusta University have begun the process of quality assurance of data management and data collection. This includes documenting data files, verifying n's of key variables included in existing datasets, and preparing CATI telephone forms for data collection.

Another major accomplishment in year one was presentations of information about the Gulf War Women's Health Cohort study as professional meetings and publication of journal articles and letters to the editor. These publications/presentation are included in the Appendices.

Another accomplishment in year one included media releases, newspaper articles, and radio talk show coverage of the Gulf War Women's Health Cohort Study, as detailed in the Appendices.

An unanticipated event that occurred during year one is that Penny Pierce of the Uniformed Services University Graduate School of Nursing notified Steve Coughlin that she had determined that the data from her survey of Air Force women no longer exist. This dataset, which cannot be retrieved, did not include any personally identifying information and was never a part of new data collection and longitudinal analyses for the Gulf War Women's Health Cohort Study.

The first annual study group meeting of the Gulf War Women's Health Cohort Study was held in Boston on August 16th. Dr. Kim Sullivan of the Boston University (BU) School of Public Health welcomed attendees who included Emily Sisson with the BU Data Coordinating Center, Joy Ajama with BU Department of Health Sciences, Zachary Barnes and Devra Cohen with NOVA University School of Osteopathic Medicine in Miami, Dr. Maxine Krengel with the VA Boston Healthcare System, and Drs. Vahe Heboyan and Steve Coughlin with Augusta University. Steve Coughlin led the group

through a discussion of the Statement of Work including items for which there has been a delay (IRB approval from two subsites: Baylor College of Medicine and VA Boston Healthcare System), items for which the group is well ahead of schedule (publications and presentations during the first year of the study), and items which are going according to schedule (data use agreements between CDC and Augusta University and between VA Cooperative Studies Program and Augusta University). Steve Coughlin led the group through a discussion of year two activities which include continuing to assemble the GWWC Study dataset, preparing for surveys of women Veterans in the Kansas Study and Ft. Devens Study, and continuing to prepare and submit collaborative journal articles. He noted that Dr. Benjamin Ansa was starting the doctoral program in Applied Health Sciences at Augusta University and that he would likely assist with data analysis and preparation of collaborative manuscripts as part of his doctoral studies. Steve Coughlin noted that he and Kim Sullivan had participated in a conference call with Dawn Provenzale's group in Durham, NC to discuss how the survey developed for the GWWC study can inform future follow-up surveys of women included in CSP 585 Gulf War Survey and Biorepository. The Durham group, which is funded by VA CSP, is very interested in receiving input from members of the GWWC study funded by DoD. Vahe Heboyan led a discussion of his efforts to examine variables in the CDC Air Force Study dataset, to validate n's reported by CDC authors more than 25 years ago in an article published in JAMA, and to work towards analyses to be completed in support of a journal article led by Maxine Krengel and Kim Sullivan (second hypothesis). Steve Coughlin mentioned that the CDC criteria for GWI should also look at severe GWI (multisymptom illness). Maxine Krengel provided the group with an update about the Ft. Devens Reunion Survey dataset. Drs. Krengel and Sullivan will share information with Vahe Heboyan and Steve Coughlin about how best to analyze variables that are part of the CDC and Kansas criteria for GWI. This information goes beyond information included in published articles. Kim Sullivan would like to validate the VA clinical practice guidelines for GWI using data from the GWWC. This can be the topic of a methodologic article to include other members of the study group (Emily Sisson, etc.). Emily Sisson gave an update about activities undertaken by the BU Data Coordinating Center in support of the GWWC Study. A discussion will be held during a monthly conference call about how best to assign unique study numbers for participants in the Kansas Study and Ft. Devens Study who will be re-surveyed. Emily Sisson mentioned that they use Teleform manual verification to review postal questionnaires for stray marks, ambiguous markings, etc. prior to scanning the surveys for data entry. Nancy Klimas at NOVA University gave closing remarks. She emphasized the great need to combine data from multiple studies because of limited numbers of women GW Veterans who have been studied.

What opportunities for training and professional development has the project provided?

Nothing to report

JAGWIRE NEWS Professor gets \$1.1 for Gulf War research
<http://jagwire.augusta.edu/archives/38185>

AU professor doing research on Gulf War health disparities. *The Augusta Chronicle*. October 24, 2016
<http://chronicle.augusta.com/news/education/2016-10-24/au-professor-doing-research-gulf-war-health-disparities?v=1477272671>

Augusta University professor gets \$1.1 for Gulf War research. *Augusta CEO*. October 24, 2016.
http://augustaceo.com/news/2016/10/augusta-university-professor-gets-11m-gulf-war-research/?utm_source=augustaceo&utm_medium=rss&utm_campaign=rss

SPH to share \$1.1 million for Gulf War women's research. *Boston University School of Public Health newsletter*. November 21, 2016
<http://www.bu.edu/sph/2016/11/21/sph-to-share-1-1m-for-gulf-war-womens-research/>

Deke Copenhaver "There It Is" radio program, WGAC AM 580, 95.1 FM May 24, 2017 (Steven Coughlin was interviewed about the Gulf War Women's Health Cohort Study and Gulf War health research)

What do you plan to do during the next reporting period to accomplish the goals?

Obtain all IRB approvals; hire and train additional staff at subsites; continue to assemble GWWC from previous study data; continue quality assurance measures; undertake postal survey and telephone interviews; code postal survey questionnaire/telephone interview responses; continue to prepare manuscripts and present finding at professional and scientific meetings.

4. IMPACT

What was the impact on the development of the principal discipline(s) of the project?

The Gulf War Women's Health Cohort Study will provide a comprehensive picture of the health of women GW veterans. This includes assessment of current health status, changes in health symptoms and conditions over time, and possible differences in health outcomes associated with specific experiences and exposures during the war. It will allow for an assessment of GWI symptom patterns that may be specific to women veterans and a determination of diagnosed medical conditions. The study will generate data that will improve our understanding of GWI in women veterans who served in the Gulf War, women GW veteran's health, and adverse reproductive outcomes.

What was the impact on other disciplines?

Nothing to report

What was the impact on technology transfer?

Nothing to report

What was the impact on society beyond science and technology?

Nothing to report

5. CHANGES/PROBLEMS

Changes in approach and reasons for change

Nothing to report

Actual or anticipated problems or delays and actions or plans to resolve them

There has been a delay in obtaining IRB approval from VA Boston Healthcare and Balor College of Medicine. We are working to resolve this problem. An unanticipated event that occurred during year one is that Penny Pierce of the Uniformed Services University Graduate School of Nursing notified Steve Coughlin that she had determined that the data from her survey of Air Force women no longer exist. This dataset did not include any personally identifying information and was never a part of new data collection or longitudinal analyses for the Gulf War Women's Health Cohort.

Changes that had a significant impact on expenditures

Nothing to report

Significant changes in use or care of human subjects, vertebrate animals, biohazards, and/or select agents

Significant changes in use or care of human subjects

Nothing to report

Significant changes in use or care of vertebrate animals.

Not applicable

Significant changes in use of biohazards and/or select agents

Not applicable

6. PRODUCTS

- **Publications, conference papers, and presentations**

Journal publications.

Coughlin SS. Physical Activity among Gulf War Veterans (Editorial). *Annals of Translational Medicine and Epidemiology* 2016;3
Coughlin SS, Krengel M, Sullivan K, Pierce P, Heboyan V, Wilson C. A Review of Epidemiologic Studies of the Health of Gulf War Women Veterans. *Journal of Environment and Health Science* 2017, in press
Coughlin SS. Need for Gulf War women's health research (Letter to the Editor). *Military Medicine* 2016;181:198.

Books or other non-periodical, one-time publications.

Nothing to report

Other publications, conference papers, and presentations.

Pierce P, Wilson C. Gulf War Women's Health Cohort Study, poster presentation, AMSUS Annual Continuing Education meeting, National Harbor, MD, November 29th-December 2nd, 2016

-

Nothing to report

- **Technologies or techniques**

Nothing to report

- **Inventions, patent applications, and/or licenses**

Nothing to report

- **Other Products**

Nothing to report

7. PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS

What individuals have worked on the project?

Steven Coughlin, PI, 2.4 person months, overseeing all aspects of the study
Vahe Heboyan, Co-I and study biostatistician, 2.4 person months, analysis of data and assisting with manuscripts
Maxine Krengel, Co-I, contributing to all aspects of the study, surveying GW women included in Ft. Devons Study, 1 Person Month.
Kimberly Sullivan, Co-I, contributing to all aspects of the study, 1 Person Month
Emily Sisson, overseeing Boston University Data Coordinating Center activities, 2 person months.
M. Brito, Boston University, Data Manager, 2 person months.
M. Raimundo, Boston University, Database Manager, 1 person month.
Lea Steele, Co-I, contributing to all aspects of the study, surveying GW women included in KansasStudy

Has there been a change in the active other support of the PD/PI(s) or senior/key personnel since the last reporting period?

Nothing to report

What other organizations were involved as partners?

Nothing to report

8. SPECIAL REPORTING REQUIREMENTS

COLLABORATIVE AWARDS

QUAD CHARTS

9. APPENDICES

Appendix A – Postal survey questionnaire, Gulf War Women's Health Cohort Study

Appendix B -- Coughlin SS, Krenzel M, Sullivan K, Pierce P, Heboyan V, Wilson C.
A Review of Epidemiologic Studies of the Health of Gulf War Women
Veterans. Journal of Environment and Health Science 2017, in press

Appendix C -- Coughlin SS. Need for Gulf War women's health research (Letter to the
Editor). Military Medicine 2016;181:198.

<http://militarymedicine.amsus.org/doi/10.7205/MILMED-D-15-00563>

Appendix D -- Coughlin SS. Physical Activity among Gulf War Veterans (Editorial).
Annals of Translational Medicine and Epidemiology 2016;3

<https://www.ncbi.nlm.nih.gov/pubmed/27860470>

Appendix E -- Coughlin SS. Reproducibility and Transparency of Epidemiologic
Research. American Journal of Epidemiology 2017;186:393–394

<https://doi.org/10.1093/aje/kwx065>

A Review of Epidemiologic Studies of the Health of Gulf War Women Veterans

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STRUCTURED SUMMARY

Introduction. In the 25 years since the 1990-1991 Gulf War (GW), studies have evaluated Gulf War Illness (GWI), sometimes referred to as medically unexplained multisymptom illness, and other medical and neurological conditions in women GW veterans.

Materials and Methods. In this article, we review epidemiologic studies of the health of women who served in the 1990-1991 GW based upon bibliographic searches in PubMed and CINAHL with relevant search terms through September 2015.

Results. A total of 56 articles were identified in the bibliographic searches. By screening abstracts or full-text articles, a total of 21 relevant studies were identified. Results from some studies, but not all, suggest that GWI is more common in women GW veterans than their male counterparts. Few studies of GW veterans focused on women's health. A small number of studies suggested excess rates of woman's health problems, e.g., breast cysts, abnormal Papanicolaou (Pap) smears, yeast infections, and bladder infections. Several studies have identified significantly elevated rates of birth defects and adverse reproductive outcomes among GW veterans. However, findings have varied with different study designs and sample sizes, with some studies showing elevated risks of stillbirths, miscarriages, and/or birth defects and others have not. In some studies, participants reported increased risks of ectopic pregnancies and spontaneous abortions.

Conclusion. Further research is needed to provide a comprehensive picture of the health of women GW veterans and to examine a broad range of women's health issues including adverse reproductive outcomes. Some deployment-related health problems only become apparent decades later and other conditions may worsen or improve over time. Assessments are needed of current health status, changes in health symptoms and conditions over time, and possible differences in health outcomes associated with specific experiences and exposures during the war. Future studies would be strengthened by assessing GWI symptom patterns that may be specific to women veterans, examine diagnosed medical conditions among women veterans, and evaluate changes in women's health over time, including changes potentially associated with menopause and age.

Key Words: Gulf War syndrome; Gulf War veterans; symptoms; epidemiology; women's health

Acknowledgements

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INTRODUCTION

Women comprised almost 7 percent of the nearly 700,000 military personnel who served in the 1991 Gulf War and represented the largest proportion of U.S. women serving in a war zone in U.S. military history to that point in time. In addition, expanded military roles for women increased their exposure to more intense levels of combat and to toxicant exposures (1). Woman GW veterans, therefore, may have health issues specific to their cohort that are more frequent than among other cohorts of women veterans or among non-veteran women. Several studies have examined rates of Gulf War Illness (GWI) and rates of psychiatric illnesses by gender in GW veterans. GWI illness is sometimes referred to medically unexplained multisymptom illness or chronic multisymptom illness (2, 3)

Results from some (2, 3) but not all (3) epidemiologic studies suggest that GWI is more common in women GW veterans than their male counterparts and additional studies have found no gender difference in the prevalence of GWI. A small number of studies suggested excess rates of woman's health problems, e.g., breast cysts, abnormal Papanicolaou (Pap) smears, yeast infections, and bladder infections (4-6). However, in the 25 years since the war, few studies have evaluated GWI and other medical and neurological conditions specifically in women GW veterans (5). In addition to the lack of studies specific to gender, the original research that was conducted was more than 10 years ago and, to our knowledge, follow-up studies have not been completed.

In this article, we review published epidemiologic studies on the health of women GW women and identify gaps in our current understanding of the health of women who were deployed to the GW or who served elsewhere during that era. We also summarize published studies of adverse reproductive outcomes such as ectopic pregnancies, spontaneous abortions, stillbirths, and birth defects. Finally, we offer several recommendations for further research on the health of women GW veterans.

METHODS

The present review is based upon bibliographic searches in PubMed and CINAHL and relevant search terms. Articles published in English from 1990 through September 2015 were identified using the following

medical subject heading (MeSH) search terms and Boolean algebra commands: ((Gulf War) and (veterans health) and ((women's health) or (women))). The searches were not limited to words appearing in the title of an article. Studies that focused on patients with chronic diseases other than obesity were excluded. Information obtained from bibliographic searches (title and topic of article, information in abstract, and key words) was used to determine whether to retain each article identified in this way. In addition, we reviewed the references of reports prepared by the Institute of Medicine and the Research Advisory Committee on Gulf War Illness Research and published review articles. A total of 56 article citations were identified in the bibliographic searches as detailed in Figure 1. After screening the abstracts or full texts of these articles, and examining the references of review articles and reports, 21 studies were identified for further review. This included one study that focused specifically on women GW veterans (5, 6); a study of women veterans from more than one era, in which results were reported separately by era (7); 10 studies of both male and female GW veterans in which at least some results were reported separately for women (2, 3, 8-10, 18-20); and 9 studies of adverse reproductive outcomes and birth defects (21-29). Several studies were also identified of mortality and cancer incidence among male and female GW veterans (30-36). The present review extends upon the work of earlier authors (4-6) by including studies published in the last several years and by offering suggestions for further epidemiologic research on the health of women Gulf War veterans.

RESULTS

Epidemiologic surveys that have examined the health of women GW veterans are summarized in Table 1. Several questions related to women's health have been asked in surveys of the Ft. Devens, Massachusetts cohort including difficulty conceiving, whether a child was born with a birth defect, stillbirths, uterine or ovary tumors, hysterectomy, menopause, amenorrhea, vaginal yeast infections, premenstrual symptoms, pain during intercourse, difficulty achieving orgasm, and breast disease (3). About 60% of the respondents met the Centers for Disease Control and Prevention (CDC) criteria for chronic multisymptom illness (CMI). In addition to

female gender, positive results were found for those with lower levels of education, self-reported use of a medical clinic in the Gulf, ingestion of anti-nerve gas pills, anthrax vaccination, tent heaters, and exposure to oil fire smoke, and chemical odors were related to CMI in logistic regression analyses.

The National Health Survey/Longitudinal Health Study of Gulf War Era Veterans (11, 12) is one of the largest studies of the health of male and female GW and GW era veterans. A sample of 30,000 veterans (50% deployed to the Persian Gulf, 20% women) were initially invited to participate in 1995 and again in 2005 and 2012. Branch of service (Army, Navy, Air Force, and Marine Corps) and unit component (active, reserve, National Guard) were represented in both groups. A stratified random sampling method was employed to ensure that women and those who served in the reserve or National Guard were adequately represented. Although this study has provided a wealth of information about the health of GW veterans and non-deployed GW era veterans, most published analyses have controlled for gender rather than reporting gender-specific results. A notable exception is an article by Kang et al. (19) on the role of sexual assault on the risk of PTSD among GW veterans. The adjusted odds ratio for PTSD associated with a report of sexual assault was 5.41 (95% confidence interval [CI] 3.19-9.17) in female veterans and 6.21 (95% CI 2.26-17.04) in male veterans (19). Neither the CDC criteria for CMI nor the Kansas criteria for GWI have been used in published analyses of data from this study (2). Results from the 2012 follow-up survey, which included questions about women's health, have not yet been reported.

Pierce (5) studied a stratified representative sample of GW and GW era military service women who served in the USAF. The control group consisted of GW era women veterans who were deployed elsewhere. The study included a stratified sample of women who were interviewed about two years following the war and again in a follow-up study conducted two years later (5). The sampling frame was stratified on component of the U.S. Air Force (USAF) (active, National Guard, or reserve), deployment (in the Persian Gulf theater or elsewhere), and parental status (parent or nonparent). Certain strata were over-sampled so that the obtained sample consisted of 50% active duty, 25% reserve, and 25% guard, and 33% deployed to the theater of operations vs. 66% who served elsewhere during the same period of time. Of the 638 who were sampled, 525

(82%) women were located and, of those, 509 (97%) participated. Subsequent data collection included self-administered postal surveys that had response rates of 92% (n=484) and 87% (n=456), respectively (5). Measures included items concerning general physical health and gender-specific health items. In addition to questions about general health status, survey items were included of 18 symptoms of gender-specific health problems and 17 medications for which medical treatment or health services were sought. Multiple statistical analyses were used to describe women's physical and emotional health at two time points following the war. Women deployed to the theater reported significantly more general health problems as well as gender-specific health problems than did women deployed elsewhere ($p<0.05$). A cluster of common health problems included: skin rash, cough, depression, unintentional weight loss, insomnia, and memory problems (6). Women serving in the theater also reported a significant increase in gender-specific problems (i.e., lumps or cysts in the breasts, abnormal Pap tests) compared to women deployed elsewhere. In a further follow-up survey of this cohort of USAF women two years later, a total sample of 2,400 women were sampled (1,200 GW and 1,200 deployed elsewhere during the GW era) and 1,164 completed the survey (6). About 45% of the initial sample responded. Women deployed to the theatre continued to report more health problems compared with women deployed elsewhere during the same period, after adjustment for age, education, smoking, and alcohol use ($p<0.001$). An association with GW deployment was observed for 29 of 48 symptoms (6).

In November 1994, the VA, DoD, and the Pennsylvania Department of Health requested that the CDC investigate a report of unexplained illnesses among members of an Air National Guard unit who were GW veterans. After an initial investigation of 59 GW veterans, which involved standardized interviews and physical examinations, a larger sample of GW veterans (n=3,927) were surveyed in 1995, who were members of the index unit and three comparison units in Pennsylvania and Florida (8, 9). After excluding 204 who were younger than 17 years during the GW, 1,163 (31.2%) were GW veterans and 2,560 (68.8%) had not been deployed (8). In addition to general health history, the respondents were asked about the frequency, duration, and severity of 35 symptoms and possible exposures during deployment. In all units, the prevalence of each of 13 chronic symptoms was significantly greater ($p<0.05$) among persons deployed to the GW than among those

not deployed. The prevalence of mild-to-moderate and severe cases of CMI was 39% and 6%, respectively, among GW veterans compared with 14% and 0.7% among 2,520 non-deployed veterans. Although no physical examination, laboratory, or serologic findings identified cases, veterans who met the case definition had significantly diminished functioning and well-being (8). About 14% of the participants in the CDC study are women.

Unwin et al. (4) conducted a cross-sectional mailed survey of a random sample of United Kingdom Armed Forces Personnel who were deployed to the GW, non-deployed controls and controls who were deployed to Bosnia. The GW cohort consisted of 4,000 deployed veterans plus an additional 250 women who were oversampled. The total sample size for the deployed cohort was 4,250 and the same number for the non-deployed cohort. The stratification variables were service (Royal Navy, Army, Royal Air Force), gender, age, service status (regular or reservist), rank (officer or other), and fitness (Army and Royal Air Force only). The questionnaire was completed by 645 women, 226 from the GW cohort, 227 from the Bosnia cohort, and 192 from the GW era cohort. The health of service women was compared with that of service men. The main outcome measures were physical symptoms and illnesses, functional capacity, and CMI defined using the CDC criteria. No gender differences were found for 32 of the 50 symptoms. Women were significantly more likely than men to report 6 symptoms (headaches, fatigue, constipation, stomach cramp, passing urine more often, and nausea). GW women had similar rates of ill health as their male counterparts (4). GW women veterans were about three times as likely to meet the CDC criteria for CMI than nondeployed GW era women veterans, and as compared to women who were deployed to Bosnia (4).

In a study conducted in Kansas in 1998, Steele (10) used telephone interviews of 1,548 veterans who served in the GW and 482 who served elsewhere during the GW era. All of the subjects lived in Kansas at the time of the study. In addition to general questions about military service, the respondents were asked about the severity of 37 symptoms in the past year and when the symptoms first occurred. They were also asked if they had ever been diagnosed or treated by a physician for any of 16 medical and psychiatric conditions, or for any medical condition in 5 general areas, and when each reported condition had developed. GWI, defined as having

chronic symptoms in 3 of 6 domains, occurred in 34% of GW veterans, 12% of non-deployed GW era veterans who reported receiving vaccines during the war, and 4% of non-deployed GW era veterans who did not receive vaccines (10). The prevalence of GWI was lowest among GW veterans who served on board ship (21%) and highest among those who were in Iraq and/or Kuwait (42%). Questions about women's health (e.g., questions to assess menopausal status) were included in the survey questionnaire. About 15.9% of the participants in the Kansas study are women. Additional analyses of data for women, and to compare female-to-male differences in risk of GWI and frequency of symptoms, are planned.

The Millennium Cohort Study (13, 14) is one of the largest, ongoing studies of US military personnel and veterans. The study was launched in 2001 to examine deployment, demographic, behavioral, and occupational characteristics related to military service and various health outcomes. The first panel of participants invited to participate in the study was randomly selected from US military personnel who were serving in October 2000. Persons who had been deployed to Bosnia, Southwest Asia, or Kosovo between 1998 and 2000, Reserve and National Guard members, and women were oversampled. The second panel of invited participants was randomly selected from military personnel with 1 to 2 years of service as of October 2003. Marines and women were oversampled in the second panel. In an analysis of data from panels one and two (n=73,078, 74.0% deployed to the Persian Gulf, 21.6-33.4% women), Smith et al. (14) examined 18 symptoms that have been reported to be higher among GW veterans (severe headache; diarrhea; rash or skin ulcer; sore throat; night sweats; chest pain; unusual muscle pains; shortness of breath; trouble sleeping; unusual fatigue; sudden unexplained hair loss; being sleepy all the time; forgetfulness; stomach pain; pain in the arms, legs, or joints; cough; feeling down, depressed, or hopeless; and feeling nervous, anxious, or on edge or worrying about different things). The CDC criteria were used to assess CMI. A higher prevalence of CMI was observed among GW veterans as compared with non-deployed veterans who had served during that same era. Women had a higher prevalence of CMI over time than men (14).

In a random sample of GW veterans from Iowa, Carney et al. (15) compared the combat experiences, occupational and other service-related exposures, and health care use of GW male and female veterans. The

sample (n=4,886 potential subjects, 9.2% women) was stratified by GW deployment and military status (active duty, National Guard/reserve), age, gender, race, officer status, and branch of service. Deployed women (n=129) were more often in the Army, single, without children, college educated, and reported fewer vaccinations than deployed men (n=3,695). Men and women had similar military experiences but men more often participated in combat. Women were less likely than men to report exposures to smoke, psychological stress, and lead. No significant gender differences were found in exposure to solvents/petrochemicals, infectious diseases, neurotoxins, heat stress, trauma, or radiation (15). Compared with male GW veterans, GW women veterans had more outpatient and inpatient health care use 5 years after deployment.

The National Survey of Women Veterans (7) is a nationally representative sample of 3,611 women veterans surveyed by telephone in 2009. Women who served during different eras (World War II, Korea, Vietnam, first GW, and Operations Enduring Freedom, Iraqi Freedom, New Dawn) are represented. Washington et al. (7) examined the healthcare delivery preferences and use (types of healthcare services and number of visits used, use of VA or non-VA healthcare services) of women veterans by military service era. GW era women veterans (n=780) often cited cost of care as an important consideration.

Vogt et al. (16, 17) studied 495 GW veterans from across the U.S. Women were oversampled at 25%. Participants (n=317, 26.2% women) deployed from active duty, reserve, and National Guard units and represented the Army, Navy, Air Force, Marines, and Coast Guard branches of the military. Several gender differences in exposure were observed along with gender-related differences in associations between deployment stressors and mental health outcomes. For example, as concerns about family/relationship disruptions increased, levels of anxiety increased for both women and men; however, the strength of the association was stronger for women than men. Using data from this same study, Smith et al. (18) found that 33.8% met CDC criteria for CMI. The prevalence of CMI was not reported for men and women separately.

Several epidemiologic studies have examined reproductive outcomes among GW veterans (21-29). Several studies have identified significantly elevated rates of birth defects and adverse reproductive outcomes among GW veterans. This includes findings reported in 2001 from VA's large national survey of U.S. Gulf

War veterans indicating that children born to women GW veterans had nearly three times the rate of “likely” birth defects as children of women veterans of the same period who did not serve in the Gulf War (21). In the National Health Survey (n=15,000 GW Veterans and n=15,000 non-deployed GW era Veterans; 20% women), Kang et al. (21) found that male GW Veterans, compared with their non-Gulf Veteran controls, reported a significantly higher rate of miscarriage (odds ratio [OR] = 1.62; 95% confidence interval [CI] = 1.32-1.99). Female GW veterans also reported more miscarriages than their respective controls, although their excess was not statistically significant (OR= 1.35; CI = 0.97-1.89). Both men and women deployed to the Gulf theater of operations reported significant excesses of birth defects among their live born infants. These excess rates also extended to the subset of "moderate to severe" birth defects [males: OR= 1.78 (CI = 1.19-2.66); females: OR = 2.80 (CI = 1.26-6.25)]. No statistically significant differences by deployment status were found among men or women for stillbirths, pre-term deliveries or infant mortality (21). Overall, however, findings have varied with different study designs and sample sizes, with some studies showing elevated risks of stillbirths, miscarriages, and/or birth defects (21, 23, 24). Increased risks of ectopic pregnancies and spontaneous abortions have been observed in some studies (22, 24).

DISCUSSION

The results of this review indicate that there is currently a paucity of epidemiologic studies that have evaluated GWI and other high interest health outcomes in women veteran subgroups, e.g., subgroups identified by deployment characteristics (e.g. location, exposures, branch of service). Studies often show differences, however, there are limitations in the research that need addressing, including limited numbers of women and variability in job and deployment times. There is a need for additional studies of women veterans who served in the 1990-1991 Gulf War and comparison groups of women who served in other locations during that same time period. This should include extended analyses of existing datasets and new data collection. Much more is known now about the complex configuration of symptoms reported at the time of the 1990-1991 Gulf War. Current, comprehensive data are needed on the health status of women who served during the 1990-1991 Gulf

War, and appropriate controls, in order to identify specific conditions that affect GW women veterans at excess rates. Among the questions of interest are: what is the prevalence of GWI among women GW veterans, defined by both the CDC and Kansas criteria (8, 10). What is the frequency and patterns of veteran-reported chronic symptoms and medical conditions diagnosed by healthcare providers? What is the prevalence of female-specific health symptoms and medical conditions? What is their general health and functional status and use of healthcare services including hospitalizations? Studies are needed to examine sex-differences in GWI including female-to-male differences in the frequency of symptoms that are associated with GWI and the overall-all prevalence of GWI among GW female and male veterans. In particular, longitudinal studies are needed to help separate out exposure outcomes from “normal” aging processes that occur over time. There is a need for longitudinal assessments of changes in GW era women veterans’ health over time, using baseline data collected in the original population studies from which current cohort samples are drawn. Studies are also needed to provide comprehensive data on veteran-reported pregnancy and birth outcomes among GW and GW era women veterans.

Few epidemiologic studies that have evaluated GWI and other high interest health outcomes in women veteran subgroups, by subgroups identified by age and menopausal status (e.g., pre-, peri-, and post-menopause subgroups). Theories about the pathobiology of GWI focus on neuro-immune mechanisms and those mechanisms may be altered by menopause. Menopause has effects on a number of organ systems including the cardiovascular, skeletal, central nervous, and genitourinary systems (37, 38). Studies have shown that following menopause, women can experience an increase in pro-inflammatory serum markers such as IL-1, IL-6, and TNF-alpha (38). Given that many women veterans who were deployed to the Gulf region may be in the midst of natural or surgically induced menopause, more research on this topic is important.

There remains a need to evaluate birth outcomes in appropriate subgroups, e.g., by time period of birth, by parental exposures and by other deployment characteristics (e.g., whether the women were later deployed to Operation Enduring Freedom or Operation Iraqi Freedom). There is a paucity of subgroup analyses assessing rates of birth defects and other reproductive outcomes by time period of birth and by parental exposures and

other deployment characteristics. Although data from a large GW birth defect registry suggests there may have been significant increases in rates of some birth defects in the early years after the war, but that those differences leveled off over time, GW birth defect studies have not compared rates in GW vs. nondeployed GW era veterans by birth year/time period, or by whether the parent veteran had GWI or experienced exposures that may be associated with birth outcomes. Further research is needed to address these important issues.

In summary, further research is needed to provide a comprehensive picture of the health of women GW veterans and to examine a broad range of women's health issues including adverse reproductive outcomes (spontaneous abortions, still births, ectopic pregnancies, pre-term births, and birth defects). This includes assessments of current health status, changes in health symptoms and conditions over time, and possible differences in health outcomes associated with specific experiences and exposures during the war. Future studies would be strengthened by assessing GWI symptom patterns that may be specific to women veterans, examine diagnosed medical conditions among women veterans, and evaluate changes in women's health over time, including changes potentially associated with menopause and age. Such data would improve our understanding of GWI in women veterans who served in the Gulf War, women GW veteran's health, and adverse reproductive outcomes, and lay the groundwork for future research aimed at a short-term or longer-term improvement in clinical treatment of women veterans with GWI, and the definition and diagnosis of GWI in women.

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Figure 1. Summary of search and exclusion process.

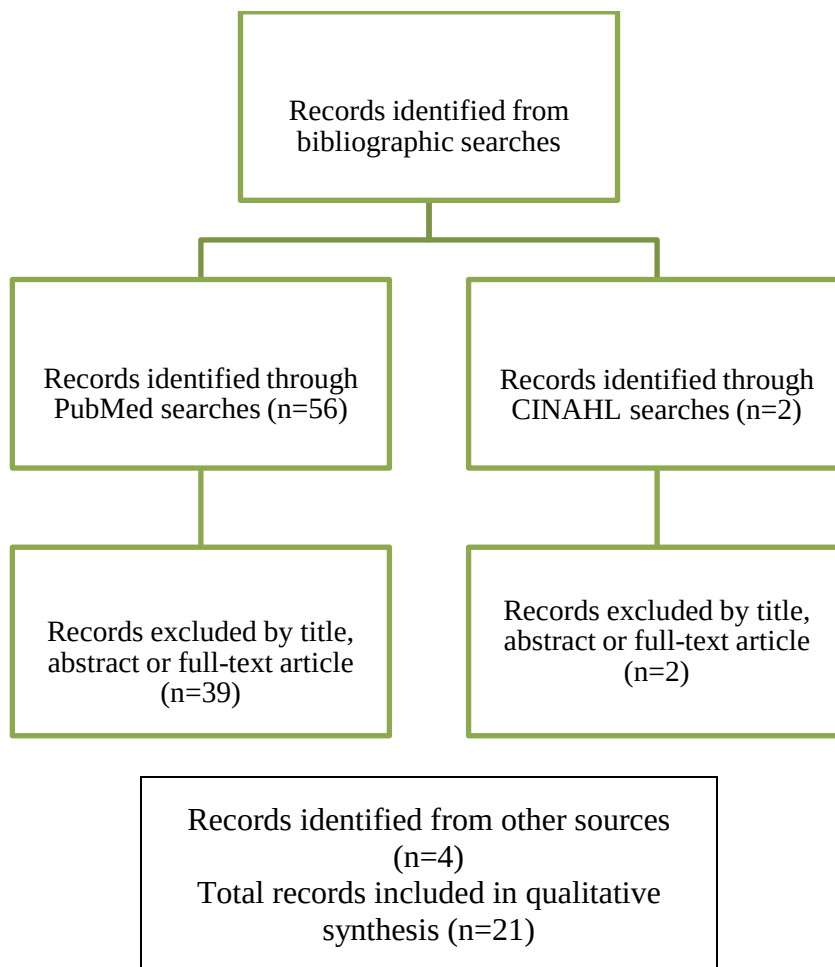


Table 1. Design characteristics of studies of U.S. veterans of the first Gulf War that provided information about the health of women veterans.

Study	Inception	Design	Administration	Population eligible to participate	Focus
Devens Cohort Study (Wolfe et al. 2002)	1991, 1995-1996, 1997, 2013 (ongoing)	Repeat cross-sectional surveys of established cohort	Initial re-adjustment survey, with follow-up surveys by mail or in-person	Deployed Army soldiers (84 units, n=2,300) returning from GW through Ft. Devens, MA	Physical and psychological health, symptoms, reproductive history, adverse birth outcomes, women's health, domestic and military exposures
Longitudinal Health Study (Kang et al. 2000, 2009)	1993-1995	Cross-sectional survey of established cohort with follow-up surveys conducted in 2005 and 2012	Mail survey, telephone interviews; web-based survey added in 2012	National sample of GW (n=15,000) and GW era (n=15,000) veterans	Health status, health care use, physical and psychological health conditions, symptoms, military exposures. Questions on reproductive health outcomes were included in the 1995 survey. Questions on women's health were included in the 2012 follow-up survey
USAF (Pierce 1997, 2005)	1993	Cross-sectional survey and follow-up surveys conducted 2 and 4 years later	Mail surveys	Sample of 525 USAF women (expanded to 2,400 women for the second follow-up survey) who served in USAF, stratified on	Physical and psychological health, symptoms, gender-specific health

				component (active, National Guard, or reserve), deployment (in the theater or deployed elsewhere), and parental status (parent or nonparent)	
Air Nat'l Guard (Fukuda et al. 1998; CDC 1995)	1994	Cross-sectional		GW veterans from a PA-based Air National Guard unit, two USAF reserve units (PA, FL) and an active duty USAF unit (FL) (n=3,927)	Physical health, symptoms, risk factors for illness
(Unwin et al. 2002)	Post-1997	Cross-sectional survey	Mail survey	Random sample of UK Armed Forces Personnel. 4,250 deployed to GW, 4,250 non-deployed, plus Bosnia cohort. Women (n=1,026) were oversampled	Physical and psychological symptoms, medical disorders, military exposures
Kansas (Steele 2000)	1998	Cross-sectional study	Telephone survey	KS veterans or reserve members (n=2,030) who served on active duty between 8/90 and 7/91	Physical and psychological health, symptoms, military exposures
Millennium Cohort Study (Gray et al. 2002; Smith et al. 2014)	2001	Repeated cross-sectional surveys	Mail survey, telephone survey	Random sample of US military personnel serving in October 2000 (panel one). Random sample of military personnel with 1 to 2 years of	Health status, health care use, medical and psychological health, symptoms, military exposures

				service as of October 2003 (panel two), and more recent panels. Marines and women were over sampled in panel two	
Iowa Gulf War Study (Carney et al. 2003)	1995-1996	Cross-sectional study	Telephone survey	Sample of 4,886 GW era veterans from Iowa (9.2% women) stratified on GW deployment and military status, age, gender, race, officer status, and branch of service	Health status, health care use, military preparedness and exposures
National Survey of Women Veterans (Washington et al. 2013)	2009	Cross-sectional survey of random sample of women veterans	Telephone survey	National sample of 3,611 women veterans	Healthcare delivery preferences, health care use, general health status, physical and psychological health conditions
Survey of GW veterans (Vogt et al. 2007, 2008; Smith et al. 2013)	Not stated	Cross sectional survey	Postal survey	National sample of 495 GW veterans (25% women) from all branches of service and unit components	Combat experiences, perceived threat, difficult living and working environment, concerns about family/relationship disruptions, sexual harassment, psychological health conditions,

					physical symptoms
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Table 2. Participant characteristics and findings of studies of U.S. veterans of the first Gulf War that provided information about the health of women veterans.

Study	Number of GW women who participated	Number of GW men who participated	Comparison group	Findings	Other Information
Devens Cohort Study (Wolfe et al. 2002)	Of 1,290 participants in the 1997 survey, 10.4% were women GW veterans	In 1997, 90.6% of 1,290 respondents were men	N/A	Female gender, lower levels of education, self-reported use of a medical clinic in the Gulf, ingestion of anti-nerve gas pills, anthrax vaccination, tent heaters, and exposure to oil fire smoke, and chemical odors were related to MSI in logistic regression analyses.	Additional analyses of data for women are planned.
National Health Study/ Longitudinal Health Study (Kang et al. 2000, 2005, 2009)	11,441 GW veterans, 19.7% women	9,476 non-deployed GW era veterans		Among GW veterans, the adjusted odds ratio for PTSD associated with a report of sexual assault was 5.41 (95% confidence interval [CI] 3.19-9.17) in female veterans and 6.21 (95% CI 2.26-17.04) in male veterans (19).	
USAF (Pierce 1997, 2005)	160 to 625	N/A	365 to 539 GW era women deployed elsewhere		Women deployed to the Gulf reported increased general health problems, skin rash, cough, depression, unintentional weight loss, insomnia, memory problems, breast lumps or cysts, and

					abnormal Pap tests than did women deployed elsewhere (p<0.05).
Air Nat'l Guard (Fukuda et al. 1998; CDC 1995)	Of 3,723 participants , 14% were female, 47% were deployed to the Persian Gulf. The number of deployed women was not reported	About 86% were male, 47% were deployed; the number of deployed men was not reported	Air Nat'l Guard not deployed to the Persian Gulf		Additional analyses of data for women are planned.
(Unwin et al. 2002)	226 GW women		192 non-deployed GW era women, and 227 deployed to Bosnia	Women were significantly more likely than men to report 6 symptoms (headaches, fatigue, constipation, stomach cramp, passing urine more often, and nausea). Women deployed to the Persian Gulf had similar rates of ill health as their male counterparts. GW women veterans were about three times as likely to meet the CDC criteria for CMI than GW era women veterans, and as compared to women who were deployed to Bosnia.	
Kansas (Steele 2000)	216	1,331	482 non-deployed GW era veterans residing in KS		Questions about women's health (e.g., questions to assess menopausal

					status) were included in the survey questionnaire.
Millennium Cohort Study (Smith et al. 2014)	n=73,078, 74.0% deployed to the Persian Gulf, 21.6-33.4% women	n=73,078, 74.0% deployed to the Persian Gulf, 66.6-78.4% men		A higher prevalence of CMI was observed among GW veterans as compared with non-deployed veterans who had served during that same era. Women had a higher prevalence of CMI over time than men	
Iowa Gulf War Study (Carney et al. 2003)	129 GW women	3,695 GW men	206 non-deployed GW era women	Men and women had similar military experiences but men more often participated in combat. Men were more likely than women to report exposures to smoke, psychological stress, and lead. No significant gender differences were found in exposure to solvents/ petrochemicals, infectious diseases, neurotoxins, heat stress, trauma, or radiation. Compared with male GW veterans, GW women veterans had more outpatient and inpatient health care use 5 years after deployment.	
National Survey of Women Veterans (Washington et al. 2013)	780 GW era women veterans, deployment status not reported	N/A	WW II, Korea era, Vietnam era, and OEF/OIF/OND era women	GW era women veterans (n=780) often cited cost of care as an important consideration.	

			veterans		
Survey of GW veterans (Vogt et al. 2007, 2008; Smith et al. 2013)	83 GW women	234 GW men		Several gender differences in exposure were observed along with gender-related differences in associations between deployment stressors and mental health outcomes. Among men and women combined, 33.8% met CDC criteria for CMI.	

Military Medicine

Need for Studies of the Health of Gulf War Women Veterans

--Manuscript Draft--

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Letter to the Editor

Women comprised almost 7 percent of the nearly 700,000 military personnel who served in the 1991 Gulf War (GW) and represented the largest proportion of U.S. women serving in a war zone in U.S. military history to that point in time. In addition, expanded roles for women increased their exposure to more intense levels of combat and to toxicant exposures (1). Women GW veterans, therefore, may have health issues specific to their cohort that are more frequent than among other cohorts of women veterans or among non-veteran women. Several studies have examined rates of Gulf War Illness (GWI) and health concerns specifically in GW women veterans (1-6).

Results from some but not all epidemiologic studies suggest that GWI is more common in women GW veterans and that they may have different biomarkers of illness than their male counterparts (3-4). However, in the 25 years since the war, few studies have evaluated GWI and other medical and neurological conditions in women GW veterans (5, 6). In addition to the lack of studies specific to gender, the original research that was conducted was more than 10 years

ago and follow-up studies have not been completed.

There is a need for additional studies of women veterans who served in the 1990-1991 Gulf War and comparison groups of women who served in other locations during that same time period. This should include extended analyses of existing datasets and new data collection. Current, comprehensive data are needed on the health status of women who served during the 1990-1991 Gulf War, and appropriate controls, in order to identify specific conditions that affect GW women veterans at excess rates. Among the questions of interest are: what is the prevalence of GWI among women GW veterans? What is the frequency and pattern of veteran-reported chronic symptoms and medical conditions diagnosed by healthcare providers? What is the

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4 prevalence of female-specific health symptoms and medical conditions? What is their general
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7 health and functional status and use of healthcare services including hospitalizations? Studies
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9 are needed to examine sex-differences in GWI including female-to-male differences in the
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11 frequency of symptoms that are associated with GWI and the overall-all prevalence of GWI
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13 among GW female and male veterans. There is a need for longitudinal assessments of changes
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15 in GW era women veterans' health over time, using baseline data collected in the original
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19 population studies from which current cohort samples are drawn.

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21 Studies should examine women veteran's health issues across the lifespan. This could
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24 include outcomes more relevant to the early years after the war such as reproductive difficulties
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26 and outcomes more relevant to the later years including menopausal symptoms. Theories about
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29 the pathobiology of GWI focus on neuro-immune mechanisms which may be altered by midlife
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31 menopausal changes. Menopause has effects on a number of organ systems including the
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33 cardiovascular, skeletal, central nervous, and genitourinary systems (7, 8). Studies have shown
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36 that following menopause, women can experience an increase in pro-inflammatory serum
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38 markers such as IL-1, IL-6, and TNF-alpha (8). Given that many women veterans who were
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41 deployed to the Gulf region may be in the midst of menopause or post-menopausal, more

research on this topic could be important in identifying unique pathobiological correlates of GWI in women veterans that could be used for gender targeted treatment strategies.

Further research is needed to provide a comprehensive picture of the health of women GW veterans and to examine adverse reproductive outcomes (spontaneous abortions, still births, ectopic pregnancies, pre-term births, and birth defects). This includes assessments of current health status, changes in health symptoms and conditions over time, and differences in health outcomes associated with specific experiences and exposures during the war. Future studies

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4 should assess GWI symptom patterns that may be specific to women veterans, examine
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7 diagnosed medical conditions among women veterans, and evaluate changes in women's health
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9 over time, including changes across the lifespan. Some chronic conditions (e.g., certain types of
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11 cancer and neurological diseases) have a latency period of years or decades. Such data would
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14 improve our understanding of GWI in women veterans who served in the Gulf War, women GW
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16 veteran's health, and adverse reproductive outcomes, and lay the groundwork for future research
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19 aimed at a short-term or longer-term improvement in clinical treatment of women veterans with
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21 GWI, and with determining the unique pathobiology of GWI in women veterans.
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Editorial

Physical Activity and Chronic Illnesses among Gulf War Veterans

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Editorial

The prevalence of physical inactivity and obesity is a serious threat to the health of Americans, including those who are military veterans, because of the increased risk of cancer of the breast, colon, and other sites; diabetes; cardiovascular diseases; arthritis; sleep apnea; premature mortality; and other adverse health consequences [1]. Along with maintenance of normal weight and consumption of healthy food, physical activity contributes to individual health and wellbeing [2,3]. Physical activity, nutrition, and energy balance are important determinants of weight loss and maintenance of healthy weight. However, many US adults do not meet the national guidelines for engaging in regular physical activity. Based on data from the 2013 Behavioral Risk Factor Surveillance System (BRFSS), only half of US adults (50.2%) met guidelines for physical activity and an additional 11.7% only partially met the guidelines (Woo et al., unpublished). Approximately 35% of U.S. adults are obese [4,5].

Public health recommendations emphasize a lifestyle approach to increasing physical activity that includes brisk walking, climbing stairs, doing house work and yard work, and engaging in recreational activities [1]. Among persons living with chronic illness, physical activity and maintaining a healthy body weight can reduce the risk of disease progression or recurrence and improve quality of life.

Encouraging physical activity among middle-aged and older persons is essential, as they may suffer from one or more chronic illnesses and are at risk of declining physical fitness or unintended weight gain. The 2008 Physical Activity Guidelines for Americans emphasize that all adults should avoid inactivity [6]. Some physical activity is better than none, and adults who participate in any amount of physical activity gain some health benefits. For substantial health benefits, adults should do at least 150 minutes a week of moderate-intensity or 75 minutes a week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate- and vigorous-intensity aerobic activity. Such activity should be performed in episodes of at least 10 minutes and, preferably, spread throughout the week [6].

Studies have found that less than half of US veterans meet recommendation for physical activity and that the prevalence of

inactivity is particularly high among veterans who obtain their health care from Department of Veterans Affairs (VA) facilities [7]. Following military discharge, the percentage of former military service men and women engaging in moderate-to-vigorous physical activity declines substantially [8]. Substantial weight gain has also been associated with the time of military discharge [9]. Although active duty military personnel are more fit and less likely to be overweight or obese than civilians, no such differences have been observed in comparisons of veteran and non-veteran populations [9]. In an analysis of data collected in 2003-2005, Coughlin et al. [10] found that the percentages of Gulf War and Gulf Era veterans who were overweight (BMI 25 to $\leq$ 29.9), were 46.8% and 48.7%, respectively. The percentages who were obese (BMI $\geq$ 30) were 29.6% and 28.3%, respectively [10]. The prevalence of obesity is 37.4% in veteran patients seen at Veterans Health Administration medical centers [11].

Gulf War veterans who suffer from Gulf War Illness often experience chronic pain, fatigue, fatigue upon exertion, impaired cognition, and other debilitating symptoms. As a result, they are less likely to engage in regular moderate to vigorous intensity physical activity and are at risk of chronic conditions such as overweight, obesity, cardiometabolic diseases, and certain types of cancer. The VA Cooperative Study 470 Study Group conducted a randomized controlled trial from 1999 to 2001 among 1,092 Gulf War veterans who reported at least 2 of 3 symptom types (fatigue, pain, and cognitive) for more than 6 months [12]. The participants were randomized to receive usual care, cognitive behavioral therapy (CBT) plus usual care, exercise plus usual care, or CBT plus exercise plus usual care. The exercise sessions were 60 minutes for 12 weeks and were specifically designed to improve physical activity level by incorporating the patient's symptoms into the treatment regimen. The percentage of veterans with improvement in physical function at 1 year was 11.5% for usual care, 11.7% for exercise alone, 18.4% for CBT plus exercise, and 18.5% for CB alone. The participants were relatively noncompliant with both therapies, attending on average only 50% of the sessions [12]. About 13% - 15% did not attend any sessions. For secondary outcomes, exercise alone or in combination with CBT significantly improved fatigue, distress, and cognitive symptoms but not pain [12]. Predictors of compliance during treatment included less pain, greater age, and body mass index [13]. The results of the trial suggest that CBT and/or exercise can provide modest relief for some of the symptoms of Gulf War Illness. Cook et al. [14] found that GWI patients (n=15) who suffered from chronic musculoskeletal pain rate exercise as more painful and effortful and were more sensitive to heat-pain stimuli than healthy Gulf War veteran controls (n=17).

Additional research is needed to identify optimal physical activity regimens for veterans who suffer from GWI which take into account differences in patient symptoms (e.g., musculoskeletal pain), response

to moderate or vigorous intensity physical activity, comorbid health conditions, age, gender, and other factors. Published studies do not clarify what types of physical activity are most appropriate for patients suffering from GWI according to intensity level, duration, or frequency. As veterans who served during the 1991 Gulf War advance in age, they are at increasing risk of chronic conditions that are prevalent among men and women in the general US population including heart disease, diabetes, and common forms of cancer (e.g., colorectal cancer and breast cancer). Gaining additional scientific information about effective treatments for GWI and patient self-management techniques, such as tailored physical activity regimens, is essential for limiting disability and premature mortality in this important veteran population.

Acknowledgments

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Commentary

Reproducing Epidemiologic Research and Ensuring Transparency

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Measures for ensuring that epidemiologic studies are reproducible include making data sets and software available to other researchers so they can verify published findings, conduct alternative analyses of the data, and check for statistical errors or programming errors. Recent developments related to the reproducibility and transparency of epidemiologic studies include the creation of a global platform for sharing data from clinical trials and the anticipated future extension of the global platform to non-clinical trial data. Government agencies and departments such as the US Department of Veterans Affairs Cooperative Studies Program have also enhanced their data repositories and data sharing resources. The Institute of Medicine and the International Committee of Medical Journal Editors released guidance on sharing clinical trial data. The US National Institutes of Health has updated their data-sharing policies. In this issue of the *Journal*, Shepherd et al. (*Am J Epidemiol.* 2017;000:000–000) outline a pragmatic approach for reproducible research with sensitive data for studies for which data cannot be shared because of legal or ethical restrictions. Their proposed quasi-reproducible approach facilitates the dissemination of statistical methods and codes to independent researchers. Both reproducibility and quasi-reproducibility can increase transparency for critical evaluation, further dissemination of study methods, and expedite the exchange of ideas among researchers.

clinical trials; confidentiality; de-identification; privacy; reproducible research

In 2006, Peng et al. (1) noted that, as is the case in other scientific fields, epidemiologic evidence is strengthened when important findings are replicated by multiple independent investigators using independent data, methods, and instruments; however, in many instances, epidemiologic studies may not be fully replicable because of the time and expense involved. They argued that an attainable minimum standard in epidemiology is reproducibility, meaning that independent investigators are able to analyze the original data and interpret it on their own (1). Measures for ensuring reproducibility include making data sets and software available to other researchers so that they can verify published findings, conduct alternative analyses of the data, evaluate the sensitivity of the findings to modeling choices, and check for statistical or programming errors (1). Ideally, de-identified data from epidemiologic studies should be shared with qualified researchers with data-use agreements in place that protect participants from re-identification. In the 11 years that have elapsed since the publication of the article by Peng et al. (1), there have been several important developments related to the reproducibility of epidemiologic studies. These developments include the creation of a global platform

for sharing data from clinical trials and the anticipated future extension of the global platform to non-clinical trial data (epidemiologic, public health, surveillance, and genomic data) (2). Government agencies and departments such as the US Department of Veterans Affairs Cooperative Studies Program have also enhanced their data repositories and data-sharing resources. Both the Institute of Medicine and the International Committee of Medical Journal Editors have released guidance on sharing clinical trial data (3, 4). Ongoing efforts by the Clinical Data Interchange Standards Consortium address key questions, such as how to best protect the privacy of trial participants, how much data to share, and in what format data should be stored and accessed (i.e., standards for data and metadata) (5). The US National Institutes of Health has updated data sharing policies for studies they fund (6–8).

Ioannidis et al. (9) argued that there is inadequate emphasis on recording of research decisions and on reproducibility of research and that correctable weaknesses in the design, conduct, and analysis of biomedical and public health research studies can lead to misleading results. Despite the growing movement to encourage reproducibility and transparency

practices in epidemiology and the broader scientific community, including a call to provide open access to original data from published studies, a recent review of a random sample of 441 articles published in biomedical journals from 2000 to 2014 found that only 1 study provided a full protocol and none had open access to all of the raw data (10). Potential solutions include rewarding reproducibility practices with funding and academic or other recognition and monitoring both the proportion of research studies undergoing rigorous independent reproducibility checks and the proportion that were able to be reproduced (9).

In this issue of the *Journal*, Shepherd et al. (11) outline a pragmatic approach for reproducible research with sensitive data for studies in which data cannot be shared because of legal or ethical restrictions. Their proposed approach, which they refer to as quasi-reproducible, includes posting analysis code used in the published study on a publicly available website along with simulated data and results obtained by applying that code to the simulated data. The empirical example provided by Shepherd et al. (11) illustrates that legal and ethical considerations may prevent the public disclosure of cohort data on conditions such as human immunodeficiency virus infection even when the data have been de-identified. However, it is still possible to increase the transparency of methods used in epidemiologic studies. Their proposed approach, while not a perfect way to resolve the potential conflicts between legal and ethical concerns and achieve the attainable minimum standard of ensuring reproducible epidemiologic studies, facilitates the dissemination of statistical methods and code to independent researchers. Researchers may wish to check for statistical or programming errors or to apply the analysis code from a published paper to different studies.

Epidemiologic research interacts with many disciplines, using methods and collaborating with researchers from other sciences including genomics, informatics, economics, and psychology. Careful attention to study design, conduct, analysis, documentation, and reproducibility is needed (9). Minor corrections and clarifications after publication should not be a reason to stigmatize other researchers (12). Both reproducibility and quasi-reproducibility can increase transparency for critical evaluation, further dissemination of study methods, and expedite the exchange of ideas among researchers.

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DRAFT

Gulf War Women's Health Cohort Study

Questionnaire

Subject ID:

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Today's Date:

		/			/				
M	M		D	D		Y	Y	Y	Y

Please think back to the time of the Gulf War — between August 1990 and July 1991.

1. Were you deployed anywhere outside the U.S. during that period?

- ☐ No → [Go to question 3]
☐ Yes
☐ Don't Know
☐ Prefer not to answer

1a. Were you deployed to the Persian Gulf area during that period?

- ☐ No → [Go to question 3]
☐ Yes
☐ Don't Know
☐ Prefer not to answer

YES → 1b. IF YES, which countries?

- ☐ Iraq ☐ Saudi Arabia
☐ Kuwait ☐ Bahrain
☐ Other: (specify) _____

1c. In what month and year did you first arrive in the Gulf area?

		Month /			Year
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1d. In what month and year did you last leave the Gulf area?

		Month /			Year
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2. A list of experiences you may have had while you were in the Persian Gulf region appears below.

Please indicate if you had the experience by checking Yes or No.

While you were in the Persian Gulf region...

2a. Did you ever see smoke from oil well fires?

- ☐ No → [Go to question 2b]
☐ Yes
☐ Don't Know
☐ Prefer not to answer

2a1. About how many days did you see oil fire smoke? [while in the Persian Gulf region] Was it...

- ☐ 1 to 6 days ☐ 7 to 30 days
☐ Longer than 30 days ☐ Don't Know
☐ Prefer not to answer



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2b. While you were in the Persian Gulf region, did you hear chemical alarms sounding?	☐ No → [Go to question 2c] ☐ Yes ☐ Don't Know ☐ Prefer not to answer
2b1. About how many days did you hear chemical alarms [while in the Persian Gulf region]? Was it:	☐ 1 to 6 days ☐ 7 to 30 days ☐ Longer than 30 days ☐ Don't Know ☐ Prefer not to answer
2c. [While you were in the Persian Gulf region] Did you ever have a SCUD missile explode within one mile of you?	☐ No → [Go to question 2d] ☐ Yes ☐ Don't Know ☐ Prefer not to answer
2c1. About how many days did a SCUD missile explode within 1 mile of you [while in the Persian Gulf region]? Was it:	☐ 1 to 6 days ☐ 7 to 30 days ☐ Longer than 30 days ☐ Don't Know ☐ Prefer not to answer
2d. [While you were in the Persian Gulf region] Were you directly involved in ground combat?	☐ No → [Go to question 2e] ☐ Yes ☐ Don't Know ☐ Prefer not to answer
2d1. About how many days were you directly involved in ground combat? [While in the Persian Gulf region]? Was it	☐ 1 to 6 days ☐ 7 to 30 days ☐ Longer than 30 days ☐ Don't Know ☐ Prefer not to answer
2e. [While you were in the Persian Gulf region] Were you directly involved in air combat?	☐ No → [Go to question 2f] ☐ Yes ☐ Don't Know ☐ Prefer not to answer
2e1. About how many days were you directly involved in air combat [while in the Persian Gulf region]?	☐ 1 to 6 days ☐ 7 to 30 days ☐ Longer than 30 days ☐ Don't Know ☐ Prefer not to answer
2f. [While you were in the Persian Gulf region] Did you see troops who had been badly injured or killed?	☐ No → [Go to question 2g] ☐ Yes ☐ Don't Know ☐ Prefer not to answer
2f1. About how many days did you see troops who were badly injured or killed [while in the Persian Gulf region]? Was it:	☐ 1 to 6 days ☐ 7 to 30 days ☐ Longer than 30 days ☐ Don't Know ☐ Prefer not to answer



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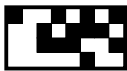
Gulf War Women's Health Cohort Study

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2g. [While you were in the Persian Gulf region] Did you come into direct contact with prisoners of war	☐ No → [Go to question 2h] ☐ Yes ☐ Don't Know ☐ Prefer not to answer
2g1. About how many days did you come into direct contact with prisoners of war? Was it:	☐ 1 to 6 days ☐ 7 to 30 days ☐ Longer than 30 days ☐ Don't Know ☐ Prefer not to answer
2h. [While you were in the Persian Gulf Region] Did you come into direct contact with destroyed enemy vehicles?	☐ No → [Go to question 2i] ☐ Yes ☐ Don't Know ☐ Prefer not to answer
2h1. About how many days did you come into direct contact with destroyed enemy vehicles? Was it:	☐ 1 to 6 days ☐ 7 to 30 days ☐ Longer than 30 days ☐ Don't Know ☐ Prefer not to answer
2i. While you were in the Persian Gulf region, did you use pesticide cream or liquid on your skin?	☐ No → [Go to question 2k1] ☐ Yes ☐ Don't Know ☐ Prefer not to answer
2i1. About how many days did you use pesticide cream or liquid on your skin [while in the Persian Gulf region]? Was it:	☐ 1 to 6 days ☐ 7 to 30 days ☐ Longer than 30 days ☐ Don't Know ☐ Prefer not to answer
2j. [While you were in the Persian Gulf region] Did you use pesticide powder on your skin?	☐ No → [Go to question 2k] ☐ Yes ☐ Don't Know ☐ Prefer not to answer
2j1. About how many days did you use pesticide powder on your skin [while in the Persian Gulf region]? Was it:	☐ 1 to 6 days ☐ 7 to 30 days ☐ Longer than 30 days ☐ Don't Know ☐ Prefer not to answer
2k. [While you were in the Persian Gulf region] Did you wear a uniform treated with pesticides?	☐ No → [Go to question 2l] ☐ Yes ☐ Don't Know ☐ Prefer not to answer
2k1. About how many days did you wear a uniform treated with pesticides [while in the Persian Gulf region]? Was it:	☐ 1 to 6 days ☐ 7 to 30 days ☐ Longer than 30 days ☐ Don't Know ☐ Prefer not to answer



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2l. [While you were in the Persian Gulf region] Did you wear a flea collar?	☐ No → [Go to question 2m] ☐ Yes ☐ Don't Know ☐ Prefer not to answer
2l1. About how many days did you wear a flea collar [while in the Persian Gulf region]? Was it:	☐ 1 to 6 days ☐ 7 to 30 days ☐ Longer than 30 days ☐ Don't Know ☐ Prefer not to answer
2m. [While you were in the Persian Gulf region] Did you see the area where you lived sprayed with pesticides	☐ No → [Go to question 2n] ☐ Yes ☐ Don't Know ☐ Prefer not to answer
2m1. About how many days did you see the area where you lived sprayed with pesticides [while in the Persian Gulf region]? Was it:	☐ 1 to 6 days ☐ 7 to 30 days ☐ Longer than 30 days ☐ Don't Know ☐ Prefer not to answer
2n. [While you were in the Persian Gulf region] Did you take pyridostigmine pills or PB? These were little white pills in a foil package, used to protect against nerve gas; also called NAPP pills	☐ No → [Go to question 2o] ☐ Yes ☐ Don't Know ☐ Prefer not to answer
2n1. About how many days did you take pyridostigmine pills? [while in the Persian Gulf region]? Was it:	☐ 1 to 6 days ☐ 7 to 30 days ☐ Longer than 30 days ☐ Don't Know ☐ Prefer not to answer
2o. [While you were in the Persian Gulf region] Did you sleep in a tent with a fuel-burning tent heater?	☐ No → [Go to question 3] ☐ Yes ☐ Don't Know ☐ Prefer not to answer
2o1. About how many days did you sleep in a tent with a fuel-burning tent heater [while in the Persian Gulf region]? Was it:	☐ 1 to 6 days ☐ 7 to 30 days ☐ Longer than 30 days ☐ Don't Know ☐ Prefer not to answer

3. Have you served in a more recent campaign such as Operation Enduring Freedom (OEF), Operation Iraqi Freedom (OIF), or Operation New Dawn (OND)?

☐ No

☐ Yes → ☐ OEF ☐ OIF ☐ OND ☐ Other (Please specify)

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4. How many times have you been deployed since September 2011?

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5. Are you still active duty, or in the National Guard or Reserves?

☐ No

☐ Yes → 5a. Select from the following

☐ Regular military ☐ National Guard

☐ Reserves ☐ Other (Please specify) _____

5b. Select from the following

☐ Army

☐ Air Force

☐ Marines

☐ Navy

☐ Coast Guard

6. What was the highest rank you achieved?

☐ Enlisted ☐ Non-commissioned Officer ☐ Officer ☐ Navy

7. What was your rank during 1991?

☐ Enlisted ☐ Non-commissioned Officer ☐ Officer ☐ Navy

Now we have some questions about your health.

8. Currently, would you say your health is...

☐ Excellent ☐ Good ☐ Fair ☐ Poor ☐ Don't Know ☐ Prefer not to answer

9. Now we want to focus on your health over the past 6 months. A list of common symptoms appears below. Please read each one and indicate if it has been a persistent or recurring problem for you in the past 6 months.

If you've had the problem, please rate it as mild, moderate, or severe.

	Would you rate it as	Problem in the past 6 months?
a. Headaches	☐ Mild ☐ Moderate ☐ Severe	☐ No ☐ Yes ☐ Don't know
b. Ringing in your ears	☐ Mild ☐ Moderate ☐ Severe	☐ No ☐ Yes ☐ Don't know
c. Hearing loss	☐ Mild ☐ Moderate ☐ Severe	☐ No ☐ Yes ☐ Don't know
d. Blurred or double vision	☐ Mild ☐ Moderate ☐ Severe	☐ No ☐ Yes ☐ Don't know
e. Eyes very sensitive to light	☐ Mild ☐ Moderate ☐ Severe	☐ No ☐ Yes ☐ Don't know
f. Feeling dizzy, lightheaded, or faint	☐ Mild ☐ Moderate ☐ Severe	☐ No ☐ Yes ☐ Don't know
g. Fatigue	☐ Mild ☐ Moderate ☐ Severe	☐ No ☐ Yes ☐ Don't know
h. Feeling unwell after exercise or exertion	☐ Mild ☐ Moderate ☐ Severe	☐ No ☐ Yes ☐ Don't know
i. Skin rashes	☐ Mild ☐ Moderate ☐ Severe	☐ No ☐ Yes ☐ Don't know
j. Other skin problems?	☐ Mild ☐ Moderate ☐ Severe	☐ No ☐ Yes ☐ Don't know
What type? _____		



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Gulf War Women's Health Cohort Study Questionnaire

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	Would you rate it as	Problem in the past 6 months?
k. Problems with your teeth or gums	1 ☐ Mild 2 ☐ Moderate 3 ☐ Severe	0 ☐ No 1 ☐ Yes 2 ☐ Don't know
l. Difficulty breathing or catching your breath	1 ☐ Mild 2 ☐ Moderate 3 ☐ Severe	0 ☐ No 1 ☐ Yes 2 ☐ Don't know
m. Persistent cough when you did not have a cold	1 ☐ Mild 2 ☐ Moderate 3 ☐ Severe	0 ☐ No 1 ☐ Yes 2 ☐ Don't know
n. Wheezing in your chest	1 ☐ Mild 2 ☐ Moderate 3 ☐ Severe	0 ☐ No 1 ☐ Yes 2 ☐ Don't know
o. Sore throat	1 ☐ Mild 2 ☐ Moderate 3 ☐ Severe	0 ☐ No 1 ☐ Yes 2 ☐ Don't know
p. Sore or swollen glands in your neck	1 ☐ Mild 2 ☐ Moderate 3 ☐ Severe	0 ☐ No 1 ☐ Yes 2 ☐ Don't know
q. Low tolerance for heat or cold	1 ☐ Mild 2 ☐ Moderate 3 ☐ Severe	0 ☐ No 1 ☐ Yes 2 ☐ Don't know
r. Night sweats	1 ☐ Mild 2 ☐ Moderate 3 ☐ Severe	0 ☐ No 1 ☐ Yes 2 ☐ Don't know
s. Abdominal pain or cramping	1 ☐ Mild 2 ☐ Moderate 3 ☐ Severe	0 ☐ No 1 ☐ Yes 2 ☐ Don't know
t. Nausea or upset stomach	1 ☐ Mild 2 ☐ Moderate 3 ☐ Severe	0 ☐ No 1 ☐ Yes 2 ☐ Don't know
u. Diarrhea	1 ☐ Mild 2 ☐ Moderate 3 ☐ Severe	0 ☐ No 1 ☐ Yes 2 ☐ Don't know
v. Pain in your muscles	1 ☐ Mild 2 ☐ Moderate 3 ☐ Severe	0 ☐ No 1 ☐ Yes 2 ☐ Don't know
w. Pain in your joints	1 ☐ Mild 2 ☐ Moderate 3 ☐ Severe	0 ☐ No 1 ☐ Yes 2 ☐ Don't know
x. Body pain, where you hurt all over	1 ☐ Mild 2 ☐ Moderate 3 ☐ Severe	0 ☐ No 1 ☐ Yes 2 ☐ Don't know
y. Numbness or tingling in your extremities	1 ☐ Mild 2 ☐ Moderate 3 ☐ Severe	0 ☐ No 1 ☐ Yes 2 ☐ Don't know
z. Tremors or shaking	1 ☐ Mild 2 ☐ Moderate 3 ☐ Severe	0 ☐ No 1 ☐ Yes 2 ☐ Don't know
aa. Difficulty concentrating	1 ☐ Mild 2 ☐ Moderate 3 ☐ Severe	0 ☐ No 1 ☐ Yes 2 ☐ Don't know
bb. Problems remembering recent information	1 ☐ Mild 2 ☐ Moderate 3 ☐ Severe	0 ☐ No 1 ☐ Yes 2 ☐ Don't know
cc. Trouble finding words when speaking	1 ☐ Mild 2 ☐ Moderate 3 ☐ Severe	0 ☐ No 1 ☐ Yes 2 ☐ Don't know
dd. Problems falling asleep or staying asleep	1 ☐ Mild 2 ☐ Moderate 3 ☐ Severe	0 ☐ No 1 ☐ Yes 2 ☐ Don't know
ee. Not feeling rested after you sleep	1 ☐ Mild 2 ☐ Moderate 3 ☐ Severe	0 ☐ No 1 ☐ Yes 2 ☐ Don't know
ff. Having physical or mental symptoms after breathing in certain smells or chemicals	1 ☐ Mild 2 ☐ Moderate 3 ☐ Severe	0 ☐ No 1 ☐ Yes 2 ☐ Don't know
gg. Feeling down or depressed	1 ☐ Mild 2 ☐ Moderate 3 ☐ Severe	0 ☐ No 1 ☐ Yes 2 ☐ Don't know
hh. Anxious	1 ☐ Mild 2 ☐ Moderate 3 ☐ Severe	0 ☐ No 1 ☐ Yes 2 ☐ Don't know
ii. Feeling irritable or having angry outbursts	1 ☐ Mild 2 ☐ Moderate 3 ☐ Severe	0 ☐ No 1 ☐ Yes 2 ☐ Don't know
jj. Feeling moody	1 ☐ Mild 2 ☐ Moderate 3 ☐ Severe	0 ☐ No 1 ☐ Yes 2 ☐ Don't know

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Subject ID:

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10. Have you ever been diagnosed or treated by a healthcare provider for any of the following conditions?
(Please mark after each condition).

		Year First Told	Do you still have it?								
a. Asthma	☐ No ☐ Yes	<table border="1"><tr><td></td><td></td><td></td><td></td></tr><tr><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr></table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
b. Allergies	☐ No ☐ Yes	<table border="1"><tr><td></td><td></td><td></td><td></td></tr><tr><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr></table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
c. High blood pressure	☐ No ☐ Yes	<table border="1"><tr><td></td><td></td><td></td><td></td></tr><tr><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr></table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
d. High cholesterol	☐ No ☐ Yes	<table border="1"><tr><td></td><td></td><td></td><td></td></tr><tr><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr></table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
e. Migraine headaches	☐ No ☐ Yes	<table border="1"><tr><td></td><td></td><td></td><td></td></tr><tr><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr></table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
f. Seizure disorder	☐ No ☐ Yes	<table border="1"><tr><td></td><td></td><td></td><td></td></tr><tr><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr></table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
g. Traumatic brain injury	☐ No ☐ Yes	<table border="1"><tr><td></td><td></td><td></td><td></td></tr><tr><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr></table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
h. Stroke	☐ No ☐ Yes	<table border="1"><tr><td></td><td></td><td></td><td></td></tr><tr><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr></table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
i. Multiple sclerosis	☐ No ☐ Yes	<table border="1"><tr><td></td><td></td><td></td><td></td></tr><tr><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr></table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
j. Parkinson's disease	☐ No ☐ Yes	<table border="1"><tr><td></td><td></td><td></td><td></td></tr><tr><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr></table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
k. Alzheimer's disease	☐ No ☐ Yes	<table border="1"><tr><td></td><td></td><td></td><td></td></tr><tr><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr></table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
l. ALS/Lou Gehrig's Disease	☐ No ☐ Yes	<table border="1"><tr><td></td><td></td><td></td><td></td></tr><tr><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr></table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
m. Arthritis	☐ No ☐ Yes	<table border="1"><tr><td></td><td></td><td></td><td></td></tr><tr><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr></table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
IF YES, what type? _____											
☐ Rheumatoid											
☐ Osteoarthritis											
☐ Other IF YES, what type? (Please Specify) _____											
n. Any skin condition	☐ No ☐ Yes	<table border="1"><tr><td></td><td></td><td></td><td></td></tr><tr><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr></table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
IF YES, what type? (Please Specify) _____											
o. Chronic fatigue syndrome	☐ No ☐ Yes	<table border="1"><tr><td></td><td></td><td></td><td></td></tr><tr><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr></table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								



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		Year First Told	Do you still have it?								
p. Fibromyalgia	☐ No ☐ Yes	<table border="1"> <tr> <td></td><td></td><td></td><td></td> </tr> <tr> <td>Y</td><td>Y</td><td>Y</td><td>Y</td> </tr> </table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
q. Gulf War syndrome	☐ No ☐ Yes	<table border="1"> <tr> <td></td><td></td><td></td><td></td> </tr> <tr> <td>Y</td><td>Y</td><td>Y</td><td>Y</td> </tr> </table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
r. Chronic bronchitis	☐ No ☐ Yes	<table border="1"> <tr> <td></td><td></td><td></td><td></td> </tr> <tr> <td>Y</td><td>Y</td><td>Y</td><td>Y</td> </tr> </table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
s. Lung disease	☐ No ☐ Yes	<table border="1"> <tr> <td></td><td></td><td></td><td></td> </tr> <tr> <td>Y</td><td>Y</td><td>Y</td><td>Y</td> </tr> </table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
t. Heart disease	☐ No ☐ Yes	<table border="1"> <tr> <td></td><td></td><td></td><td></td> </tr> <tr> <td>Y</td><td>Y</td><td>Y</td><td>Y</td> </tr> </table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
IF YES, what type? (Please Specify) _____											
u. Diabetes	☐ No ☐ Yes	<table border="1"> <tr> <td></td><td></td><td></td><td></td> </tr> <tr> <td>Y</td><td>Y</td><td>Y</td><td>Y</td> </tr> </table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
v. Thyroid problem	☐ No ☐ Yes	<table border="1"> <tr> <td></td><td></td><td></td><td></td> </tr> <tr> <td>Y</td><td>Y</td><td>Y</td><td>Y</td> </tr> </table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
IF YES, what type? (Please Specify) _____											
w. Lupus	☐ No ☐ Yes	<table border="1"> <tr> <td></td><td></td><td></td><td></td> </tr> <tr> <td>Y</td><td>Y</td><td>Y</td><td>Y</td> </tr> </table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
x. Ulcers	☐ No ☐ Yes	<table border="1"> <tr> <td></td><td></td><td></td><td></td> </tr> <tr> <td>Y</td><td>Y</td><td>Y</td><td>Y</td> </tr> </table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
y. Other stomach, digestive, or intestinal disorder?	☐ No ☐ Yes	<table border="1"> <tr> <td></td><td></td><td></td><td></td> </tr> <tr> <td>Y</td><td>Y</td><td>Y</td><td>Y</td> </tr> </table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
IF YES, what type? (Please Specify) _____											
z. Liver disease	☐ No ☐ Yes	<table border="1"> <tr> <td></td><td></td><td></td><td></td> </tr> <tr> <td>Y</td><td>Y</td><td>Y</td><td>Y</td> </tr> </table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
IF YES, what type? (Please Specify) _____											
aa. Kidney disease	☐ No ☐ Yes	<table border="1"> <tr> <td></td><td></td><td></td><td></td> </tr> <tr> <td>Y</td><td>Y</td><td>Y</td><td>Y</td> </tr> </table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
IF YES, what type? (Please Specify) _____											
bb. Skin cancer	☐ No ☐ Yes	<table border="1"> <tr> <td></td><td></td><td></td><td></td> </tr> <tr> <td>Y</td><td>Y</td><td>Y</td><td>Y</td> </tr> </table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
IF YES, what type? (Please Specify) _____											
cc. Any other cancer	☐ No ☐ Yes	<table border="1"> <tr> <td></td><td></td><td></td><td></td> </tr> <tr> <td>Y</td><td>Y</td><td>Y</td><td>Y</td> </tr> </table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
IF YES, what type? (Please Specify) _____											

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		Year First Told	Do you still have it?								
dd. Post traumatic stress disorder	☐ No ☐ Yes	<table border="1"><tr><td></td><td></td><td></td><td></td></tr><tr><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr></table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
IF YES, Have you been hospitalized for post traumatic stress disorder in the past 5 years?		☐ No ☐ Yes									
ee. Depression	☐ No ☐ Yes	<table border="1"><tr><td></td><td></td><td></td><td></td></tr><tr><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr></table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
IF YES, Have you been hospitalized for depression in the past 5 years?		☐ No ☐ Yes									
ff. Alcohol or drug dependence	☐ No ☐ Yes	<table border="1"><tr><td></td><td></td><td></td><td></td></tr><tr><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr></table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
IF YES, Have you been hospitalized for alcohol or drug dependence in the past 5 years?		☐ No ☐ Yes									
gg. Schizophrenia	☐ No ☐ Yes	<table border="1"><tr><td></td><td></td><td></td><td></td></tr><tr><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr></table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
hh. Bipolar disorder	☐ No ☐ Yes	<table border="1"><tr><td></td><td></td><td></td><td></td></tr><tr><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr></table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
ii. Any infectious disease lasting 6 months or longer	☐ No ☐ Yes	<table border="1"><tr><td></td><td></td><td></td><td></td></tr><tr><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr></table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
jj. Have you had any other condition diagnosed by a physician that has lasted 6 months or longer?	☐ No ☐ Yes	<table border="1"><tr><td></td><td></td><td></td><td></td></tr><tr><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr></table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
IF YES, what type? (Please Specify) _____											

11. Have you had any other medical or psychiatric conditions that we haven't asked about?

☐ No

☐ Yes → What condition? Do you still have it?

	Year First Told	Still have it?									
w. (Please specify) <table border="1"><tr><td></td></tr></table>		<table border="1"><tr><td></td><td></td><td></td><td></td></tr><tr><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr></table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
x. (Please specify) <table border="1"><tr><td></td></tr></table>		<table border="1"><tr><td></td><td></td><td></td><td></td></tr><tr><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr></table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								
y. (Please specify) <table border="1"><tr><td></td></tr></table>		<table border="1"><tr><td></td><td></td><td></td><td></td></tr><tr><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr></table>					Y	Y	Y	Y	☐ No ☐ Yes ☐ Don't know
Y	Y	Y	Y								

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Now we would like to ask you some questions pertaining to women's health.

12. Have you ever had an abnormal Pap smear?

☐ No

☐ Yes → 12a. What year did you first have an abnormal Pap smear?

☐ Don't Know

☐ Prefer not to answer

Y	Y	Y	Y

13. Have you ever taken birth control pills for any reason?

☐ No

☐ Yes → 13b. What types?

☐ Don't Know

☐ Prefer not to answer

1)	
2)	
3)	
4)	
5)	

14. Have you **ever** used injectables for contraception, such as Depo-Provera or Lunelle?

☐ No

☐ Yes

☐ Don't Know

☐ Prefer not to answer

15. Did you use birth control pills or injectables while in theatre in 1990-1991?

☐ No

☐ Yes → 15a. What types?

☐ Don't Know

☐ Prefer not to answer

16. Have you **ever** used female hormones such as estrogen and progesterone? Please include any forms of prescription female hormones, such as pills, creams, patches, and injectables, but do not include birth control methods or use for infertility

☐ No

☐ Yes

☐ Don't Know

☐ Prefer not to answer

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17. Have you ever had a hysterectomy, including a partial hysterectomy, that is, surgery to remove your uterus or womb?

☐ NO →

17a. Were you pregnant or nursing in the past year?

☐ No

☐ Yes

17b. Have you had menstrual periods in the past year?

☐ No

☐ Yes →

17c. **IF YES**, do you usually have difficult symptoms just Before or during your menstrual periods?
(Examples: headache, bloating, cramping, mood changes)

☐ YES → 17d. In what year?

☐ Don't Know

☐ Prefer not to answer

Y	Y	Y	Y

18. [If never had a hysterectomy, not pregnant in the past year, and no menstrual periods in the past year] Have you had menopausal symptoms such as hot flashes in the past year?

☐ No

☐ Yes

☐ Don't Know

☐ Prefer not to answer

19. Have you had frequent bladder infections?

☐ No

☐ Yes

☐ Don't Know

☐ Prefer not to answer

20. Have you had frequent yeast infections?

☐ No

☐ Yes

☐ Don't Know

☐ Prefer not to answer

21. Have you had breast lumps or cysts or other abnormalities on a mammogram?

☐ No

☐ Yes → 21b. What type? _____

☐ Don't Know

☐ Prefer not to answer

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22. Do you have any women's health problems I haven't mentioned?

☐ No

☐ Yes

22a. What type?

1)	
2)	
3)	
4)	
5)	

22b. In what year did you first experience this problem?/each problem?

Problem 1 22b.	<table border="1"><tr><td></td><td></td></tr><tr><td>M</td><td>M</td></tr></table>			M	M	/	<table border="1"><tr><td></td><td></td><td></td><td></td></tr><tr><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr></table>					Y	Y	Y	Y	Problem 4 22e.	<table border="1"><tr><td></td><td></td></tr><tr><td>M</td><td>M</td></tr></table>			M	M	/	<table border="1"><tr><td></td><td></td><td></td><td></td></tr><tr><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr></table>					Y	Y	Y	Y
M	M																														
Y	Y	Y	Y																												
M	M																														
Y	Y	Y	Y																												
Problem 2 22c.	<table border="1"><tr><td></td><td></td></tr><tr><td>M</td><td>M</td></tr></table>			M	M	/	<table border="1"><tr><td></td><td></td><td></td><td></td></tr><tr><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr></table>					Y	Y	Y	Y	Problem 5 22f.	<table border="1"><tr><td></td><td></td></tr><tr><td>M</td><td>M</td></tr></table>			M	M	/	<table border="1"><tr><td></td><td></td><td></td><td></td></tr><tr><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr></table>					Y	Y	Y	Y
M	M																														
Y	Y	Y	Y																												
M	M																														
Y	Y	Y	Y																												
Problem 3 22d.	<table border="1"><tr><td></td><td></td></tr><tr><td>M</td><td>M</td></tr></table>			M	M	/	<table border="1"><tr><td></td><td></td><td></td><td></td></tr><tr><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr></table>					Y	Y	Y	Y																
M	M																														
Y	Y	Y	Y																												

☐ Don't Know

☐ Prefer not to answer

The following questions are about activities you might do during a typical day.

23 Does your health now limit you in moderate activities, such as moving a table, pushing a vacuum cleaner, bowling or playing golf?

☐ Not at all

☐ Limited a little

☐ limited a lot

☐ Don't Know

☐ Prefer not to answer

24. Does your health now limit you in climbing several flights of stairs?

☐ Not at all

☐ Limited a little

☐ limited a lot

☐ Don't Know

☐ Prefer not to answer

25. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

a. Accomplished less than you would like?	b. Were limited in the kind of work or other activities?
☐ No	☐ No
☐ A little of the time	☐ A little of the time
☐ Some of the time	☐ Some of the time
☐ Most of the time	☐ Most of the time
☐ All of the time	☐ All of the time
☐ Don't Know	☐ Don't Know
☐ Prefer not to answer	☐ Prefer not to answer

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26. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problem (such as feeling depressed or anxious)?

a. Accomplished less than you would like?	b. Did NOT do work or other activities as carefully as usual?
☐ No	☐ No
☐ A little of the time	☐ A little of the time
☐ Some of the time	☐ Some of the time
☐ Most of the time	☐ Most of the time
☐ All of the time	☐ All of the time
☐ Don't Know	☐ Don't Know
☐ Prefer not to answer	☐ Prefer not to answer

27. During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and house work)?

- ☐ Not at all
☐ A little bit
☐ Moderately
☐ Quite a bit
☐ Extremely
☐ Don't Know
☐ Prefer not to answer

28. At any time since 1991, do you remember feeling extremely fatigued almost every day, for one month or longer?

☐ NO → [Go to question 29]

☐ YES → 28a. In what year did you first notice the fatigue?

Y	Y	Y	Y

28b. Are you still fatigued much of the time?

- ☐ No
☐ Yes

28c. Do you have a medical explanation for the fatigue?

☐ No

☐ Yes → 28e. What is it? _____

☐ Don't Know

☐ Prefer not to answer

29. Thinking back, were you a regular smoker during 1990 and 1991?

- ☐ No
☐ Yes
☐ Don't Know
☐ Prefer not to answer

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30. In your entire life, which of the following have you consumed? (Circle all that apply)

- ☐ Cigarettes
☐ Cigars or little cigars
☐ e-cigarettes
☐ Smokeless tobacco such as chewing tobacco or snuff)
☐ Other (Specify _____)
☐ None of the above (Go to question 33)
☐ Don't Know
☐ Prefer not to answer

31. Do you now smoke cigarettes

- ☐ Every day ☐ Most days
☐ Some days ☐ Not at all
☐ Don't Know ☐ Prefer not to answer

32. On days that you smoke, how many cigarettes do you smoke on average?

- ☐ 1-5 cigarettes ☐ 6-10 cigarettes
☐ 11-15 cigarettes ☐ 16-20 cigarettes
☐ 21-30 cigarettes (1 – 1.5 packs) ☐ 31-40 cigarettes (1.5 – 2 packs)
☐ 41+ cigarettes (2+ packs) ☐ Don't Know
☐ Prefer not to answer

33. In the past 3 months, how many days have you missed work or other regular activities because of health problems?

(Please Specify)

--	--	--

 (Your best estimate is fine)

- ☐ Don't Know
☐ Prefer not to answer

34. In the past 12 months, how many clinic or doctor visits have you made because you had a health problem?

(Please Specify)

--	--	--

 (Your best estimate is fine)

- ☐ Don't Know
☐ Prefer not to answer

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35. In the past 12 months, how many time have you been hospitalized overnight or longer?

(Please Specify)

--	--	--

 (Your best estimate is fine)

- ☐ Don't Know
☐ Prefer not to answer

36. Are you covered by any type of healthcare plan or insurance that pays most of your medical bills?

- ☐ No
☐ Yes → 19a. What type of plan? ☐ Military medical care or insurance
☐ Veterans health care services
☐ Private medical insurance (like Blue Cross, etc.)
☐ Medicare
☐ Medicaid
☐ Other 36b. (Please Specify) _____)
☐ Don't Know
☐ Prefer not to answer

Now we have some questions about your family's health.

37. Do you have any children?

- ☐ No [Go to question 39]
☐ Yes → 37a. How many?

--	--

 (number)

37b. How old are your children and are they boys or girls?

	a) Age	b) Sex		a) Age	b) Sex				
c. Child 1	<table border="1"><tr><td></td><td></td></tr></table>			☐ Male ☐ Female	g. Child 5	<table border="1"><tr><td></td><td></td></tr></table>			☐ Male ☐ Female
d. Child 2	<table border="1"><tr><td></td><td></td></tr></table>			☐ Male ☐ Female	h. Child 6	<table border="1"><tr><td></td><td></td></tr></table>			☐ Male ☐ Female
e. Child 3	<table border="1"><tr><td></td><td></td></tr></table>			☐ Male ☐ Female	i. Child 7	<table border="1"><tr><td></td><td></td></tr></table>			☐ Male ☐ Female
f. Child 4	<table border="1"><tr><td></td><td></td></tr></table>			☐ Male ☐ Female	j. Child 8	<table border="1"><tr><td></td><td></td></tr></table>			☐ Male ☐ Female

37k. Is this/Are all of these... your biological child/children?

- ☐ No → 37l. How old are the ones who are not your biological Children? _____
☐ Yes

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38. Please indicate in the below table if any of your children has had any of the following conditions. **IF YES**, please indicate how old that child is.

CONDITION		How old is the child with problem?											
		(a) Child 1	(b) Child 2	(e) Child 3	(d) Child 4								
a. Heart problems gg. What type? _____	☐ No ☐ Yes	<table border="1"><tr><td></td><td></td></tr></table>			<table border="1"><tr><td></td><td></td></tr></table>			<table border="1"><tr><td></td><td></td></tr></table>			<table border="1"><tr><td></td><td></td></tr></table>		
b. Any type of birth defect? bb. What type? _____	☐ No ☐ Yes	<table border="1"><tr><td></td><td></td></tr></table>			<table border="1"><tr><td></td><td></td></tr></table>			<table border="1"><tr><td></td><td></td></tr></table>			<table border="1"><tr><td></td><td></td></tr></table>		
c. Pre-term birth?	☐ No ☐ Yes	<table border="1"><tr><td></td><td></td></tr></table>			<table border="1"><tr><td></td><td></td></tr></table>			<table border="1"><tr><td></td><td></td></tr></table>			<table border="1"><tr><td></td><td></td></tr></table>		
d. Any type of disability? dd. What type? _____	☐ No ☐ Yes	<table border="1"><tr><td></td><td></td></tr></table>			<table border="1"><tr><td></td><td></td></tr></table>			<table border="1"><tr><td></td><td></td></tr></table>			<table border="1"><tr><td></td><td></td></tr></table>		
e. Hyperactivity or Attention Deficit Disorder	☐ No ☐ Yes	<table border="1"><tr><td></td><td></td></tr></table>			<table border="1"><tr><td></td><td></td></tr></table>			<table border="1"><tr><td></td><td></td></tr></table>			<table border="1"><tr><td></td><td></td></tr></table>		
f. Frequent behavior problems	☐ No ☐ Yes	<table border="1"><tr><td></td><td></td></tr></table>			<table border="1"><tr><td></td><td></td></tr></table>			<table border="1"><tr><td></td><td></td></tr></table>			<table border="1"><tr><td></td><td></td></tr></table>		
g. Any other problems I haven't mentioned? gg. Type 1) _____ Type 2) _____ Type 3) _____ Type 4) _____	☐ No ☐ Yes	<table border="1"><tr><td></td><td></td></tr></table>			<table border="1"><tr><td></td><td></td></tr></table>			<table border="1"><tr><td></td><td></td></tr></table>			<table border="1"><tr><td></td><td></td></tr></table>		

39. Have you ever had difficulty conceiving a child? By that we mean tried for one year or longer for you to become pregnant.

- ☐ No
- ☐ Yes → 39a. Was this before or after 1991?
- ☐ Before
- ☐ After
- ☐ Both before and after
- ☐ Don't Know
- ☐ Prefer not to answer

40. Have you had any pregnancies that ended in miscarriage or stillbirth?

- ☐ No
- ☐ Yes → 40a. How many times before 1991?

--	--

 times
- 40b. How many times since 1991?

--	--

 times
- ☐ Don't Know
- ☐ Prefer not to answer



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41. Since 1991, have you lost any children due to an illness or health condition?

☐ No

☐ Yes → 41a. How many?

--	--

 times

41b. What condition/conditions? _____

☐ Don't Know

☐ Prefer not to answer

Now we have some questions about your work and family life.

42. What is your marital status?

☐ Married or live-in significant other

☐ Separated

☐ Divorced

☐ Widowed

☐ Single and never married?

☐ Other (Please Specify) _____

☐ Don't Know

☐ Refused

43. Are you currently employed?

☐ Employed full time

☐ Employed part time

☐ Taking care of home and family

☐ Not working for pay but actively seeking employment

☐ Attending school full time

☐ Unemployed for health reasons or medically retired

☐ Retired

☐ Don't Know

☐ Prefer not to answer

We have a few last questions that are needed for statistical purposes.

44. What is your year of birth?

Y	Y	Y	Y

45. Are you of Spanish or Hispanic origin?

☐ No

☐ Yes

☐ Don't Know

☐ Prefer not to answer

46. What is your race?

☐ White/Caucasian

☐ Black/African American

☐ Asian/Pacific Islander

☐ American Indian/Native American

☐ Mixed race

☐ Other 46b. (Please Specify) _____

☐ Don't Know

☐ Prefer not to answer



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47. What is the highest year of school you have completed?

- | | |
|--|---|
| ☐ 1 Did not finish high school | ☐ 2 High school graduate or G.E.D. |
| ☐ 3 Some college or vocational school | ☐ 4 Two-year college degree (associate degree) |
| ☐ 5 Four-year college degree | ☐ 6 Master's degree or higher |
| ☐ 7 Other (Please Specify) _____ | ☐ 8 Don't Know |
| ☐ 9 Prefer not to answer | |

48. What category best describes your combined household income before taxes in the past year?

- | | |
|---|---|
| ☐ 1 Less than \$20,000 | ☐ 2 From 20 up to \$35,000 |
| ☐ 3 From 35 up to \$50,000, | ☐ 4 From 50 up to \$75,000 |
| ☐ 5 From \$75,000 up to \$100,000, | ☐ 6 \$100,000 or more |
| ☐ 7 Don't Know | ☐ 8 Prefer not to answer |

That's all our questions. We appreciate your help.