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# Mental health comorbidity patterns and impact on quality of life among veterans serving during the first Gulf War

Valerie L. Forman-Hoffman[1], Caroline P. Carney[2,3,4], Tomoko R. Sampson[5], Paul M. Peloso[6], Robert F. Woolson[7], Donald W. Black[8] & Bradley N. Doebbeling[3,4,9]
[1]*Department of Internal Medicine, Roy J. and Lucille A. Carver College of Medicine, The University of Iowa, 200 Hawkins Drive, SE 611-GH Iowa City, IA52242 (E-Mail: valerie-hoffman@uiowa.edu);* [2]*Department of Psychiatry, Indiana University School of Medicine, Indianapolis, IN;* [3]*Department of Internal Medicine, Indiana University School of Medicine, Indianapolis, IN;* [4]*Regenstrief Institute for Health Care, Indiana University School of Medicine, Indianapolis, IN;* [5]*Roy J. and Lucile A. Carver College of Medicine, The University of Iowa, Iowa City, IA;* [6]*Amgen, Inc., Thousand Oaks, CA;* [7]*Department of Biometry and Epidemiology, Medical University of South Carolina, Charleston, SC;* [8]*Department of Psychiatry, Roy J. and Lucille A. Carver College of Medicine, The University of Iowa, Iowa City, IA;* [9]*Health Services Research and Development, Roudebush VAMC, Indianapolis, IN*

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**Abstract**

*Purpose*: To examine the patterns of coexisting (comorbid) mental disorders and whether comorbidity influences quality of life ratings in a sample of U.S. veterans. *Patients and Methods*: The Iowa Gulf War Study Case Validation study evaluated 602 military personnel, two-thirds of whom had symptoms of depression, cognitive dysfunction, or chronic widespread pain, who were activated or on active duty sometime during the first Gulf War (GW). Mental health disorders were defined using the SCID-IV, and the Health Utilities Index Mark 3 (HUI3) was used to measure health-related quality of life (HRQoL). Comorbidity was defined as having two or more mental disorders that spanned across at least two separate categories (e.g., depressive disorders and anxiety disorders). *Results*: Over 35% of veterans with a current mental disorder had at least one other comorbid mental disorder. Those with mental disorder comorbidity had lower HUI scores than veterans with only one or less mental disorders (mean $0.41 \pm 0.30$ vs. $0.72 \pm 0.25$, $p < 0.0001$). *Conclusion*: The co-occurrence of mental disorders that span at least two mental disorder categories is associated with impaired HRQoL in this veteran population. Early identification of mental health comorbidity may lead to interventions to enhance HRQoL among military personnel.

**Key words:** Comorbidity, Gulf War, Health outcomes, Health Utilities Index, Quality of life

## Introduction

Epidemiological studies have consistently shown increased symptomatology among veterans deployed to the first Gulf War (GW) [1, 2]. These symptoms are numerous and include chronic widespread pain, fatigue, cognitive impairment, depression, and anxiety. Health-related quality of life (HRQoL) is the perceived value an individual assigns to his or her health status in terms of its impact on daily living. Physical, mental, and social factors influence HRQoL differently, according to how much an individual values each individual component of health. Health-related quality of life of veterans deployed to the first Gulf War may be compromised for a variety of reasons.

Gulf War I veterans reported lower HRQoL as assessed by SF-36 scores than non-deployed veterans at five years post-conflict [1, 3]. Furthermore, reports of pre-existing medical and psychiatric conditions, as well as other factors such as smoking and perceived military preparedness, were related to physical and mental health component summary scores. Several other subsequent studies of Gulf War veterans have had similar findings [2, 4, 5]. Additionally, patients seen in the VA medical system have lower SF-36 scores than patients who do not use the VA health care system [6], suggesting that this population may have compromised HRQoL.

Mental health comorbidity patterns were studied earlier in the National Comorbidity Survey (NCS) [7]. In the NCS sample, most individuals (79%) with a mental disorder reported two or more lifetime mental disorders. The major burden of mental disorders, in terms of health care utilization, was concentrated in the approximately one-sixth of the population who had two or more lifetime comorbid mental disorders. Men had higher rates of comorbid substance use and antisocial personality disorders, while women had higher rates of comorbid affective and anxiety disorders.

A number of factors influence overall health-related quality of life. There are several competing conceptual models used to explain the definition of HRQoL. For example, the HRQoL model created by Rogerson [8] includes symptom characteristics, individual perceptions of health, and overall satisfaction and well-being, Wilson and Cleary [9] incorporate biological and physiological variables, symptom status, functional status, and general health perceptions into their conceptual framework. Studies have shown moderate to high correlations of HRQoL scores to factors varying from self-rated health disability to age, gender, income, type of chronic condition, and health service utilization [10].

Mental health is also an important component of HRQoL because individuals with a psychiatric disorder typically have lower HRQoL ratings than individuals without [11]. Pyne et al. [12] found that patients with major depressive disorder had similar quality of life ratings as patients with physical illnesses. Spitzer and Kroenke [13], however, found that psychiatric disorders, particularly mood disorders, account for more impairment across all of the major HRQoL domains than common medical disorders. Furthermore, the HRQoL of patients with comorbid mental disorders are particularly low [14]. Mental illness also has been shown to affect HRQoL in persons with coexisting physical illnesses. For example, one study found a higher rate of comorbid psychiatric illnesses and psychosocial burden among patients with musculoskeletal disorders compared to control patients [15]. Similarly, Mancuso and colleagues [16] determined that asthma patients with concurrent depression had lower HRQoL than those without depressive symptoms. Comorbid substance dependence and psychiatric comorbidity [17] and comorbid schizophrenia and medical disorders [18] have been correlated with low health status ratings as well.

Comorbid mental health conditions are common and associated with poor health outcomes [7, 19] in the U.S. population. Given the impaired HRQoL and mental disorder prevalence among some military veteran populations, Gulf War I veterans represent an unique population to study the relationship between HRQoL and mental disorder comorbidity. In a previous study by Barrett et al. [20], military veterans with PTSD reported lower HRQoL ratings than military veterans without PTSD. Ismail et al. [4] also found a relationship between psychiatric distress and disability among Gulf War I veterans from the U.K., although the association was weak. The additional impairment imposed by coexisting mental disorders that span two or more mental disorder categories has not been determined. Previous studies that have sampled the Gulf War I veteran population also have relied upon screening instruments to define the mental health outcomes of interest. The purpose of this study is to examine the patterns of mental health comorbidity in a veteran population using a standardized, structured diagnostic interview process, as well as the influence of mental health comorbidity on health-related quality of life.

## Patients and methods

Data used for this analysis were obtained from the Case Validation Study phase of the Iowa Gulf War Study. The Iowa Gulf War Study involved a broad-based health assessment of military

personnel to estimate the magnitude of health problems encountered by military personnel deployed to first Gulf War. Wave I of this study was conducted with a stratified, random sample of military personnel either deployed to, or eligible but not deployed to the first Persian Gulf War, who listed Iowa as the home of record. The participants who were not deployed to the first Persian Gulf War were deployed elsewhere during the same time period. Veterans deployed to the Persian Gulf War outnumbered the veterans deployed elsewhere by a ratio of approximately 3–1. Of 4886 military personnel sampled, 3695 veterans participated in a telephone survey that asked a variety of questions related to health concerns, medical conditions, mental health issues, and health care utilization. The methods and results from this wave (Wave I) of data collection have been reported elsewhere [1, 21].

Based on the results of Wave I, a second wave of data collection was designed. In this wave of interviews conducted between 1999 and 2002, subjects were sampled for a series of case-control studies nested with the population-based survey at Wave I in order to study the reliability of self-reported symptoms [1]. Subjects were recruited for Wave II (Case Validation Study) if they had one or more of the most prevalent *a priori* defined conditions of interest, Symptoms of Cognitive Dysfunction (CD), Depression (Dep), or Chronic Widespread Pain (CWP). A control group consisting of subjects who did not have any of the three conditions of interest was also drawn. Approximately two cases were selected for every control. Subjects were invited to The University of Iowa General Clinical Research Center for a full day in-person assessment, which included a number of standardized interviews, self-report assessments, and examinations to assess medical and mental health problems. The final sample included a total of 602 military personnel activated or on active duty at sometime between August 1990 and August 1991, the period of time the U.S. was involved in the first Gulf War (GW).

In addition to collecting demographic and military information, participants were questioned about the presence of multiple medical symptoms related to combat exposure, depressive and anxious symptomatology using the Anxiety Sensitivity Index (ASI), posttraumatic stress disorder using the Mini-Mississippi Index, social support, somatization symptoms and symptom amplification using the Barsky Amplification Scale, hypochondriasis using the Whiteley Index, personality traits, pain, and health-related quality of life using the Medical Outcomes Study Short Form-36 (SF-36) and the Health Utilities Index-Mark 3 (HUI3).

The SCID-IV was administered to all study subjects by a trained rater. Interviewers received training in the use and administration of the SCID-IV by a psychiatrist, which included readings about psychopathology and direct supervision. The results of the SCID-IV and all other relevant data were used to assign current and lifetime diagnoses for each psychiatric disorder assessed, using a ''best estimate'' procedure described by Leckman et al. [22] . The inter-rater reliability of SCID-IV results was compared on three separate occasions using audiotapes from randomly selected cases. On these occasions, the Kappa coefficient was consistently in excess of 0.8. Furthermore, assessments based on the trained interviewers use of the SCID and blinded assessments of the psychiatrists based on all available data were nearly always identical.

For this analysis, we used the Health Utilities Index-Mark 3 (HUI3) to measure health related quality of life (HRQoL). The HUI was created as a measure of HRQoL to monitor health status within and among populations, based on functional capacity rather than performance [23]. The HUI3 is a 15-item instrument that yields a multiple-attribute composite utility score as well as eight single-attribute utility scores, each ranging from 0 (death) to 1 (perfect health). The eight single-attribute utility HUI3 scores include vision, hearing, speech, ambulation, dexterity, emotion, cognition, and pain. The mulitiple-attribute composite score provides a measure of self-perceived health and can be used in the calculation of disability-adjusted life years (DALYs). The HUI3 [24] improved upon the HUI2 by having the capability to distinguish between 972,000 unique health states using eight structurally independent vectors that calculate utility scores. These utility scores represent preference scores measured under conditions of uncertainty [23]. The HUI score is calculated by using a multiplicative model of interactions between attributes derived from multi-attribute utility theory [25]. The measure has high

test-retest reliability (ICC = 0.77) [26]. In contrast to measures of physiological processes, the HUI3 has been used to examine how patients perceive their health status in various clinical studies, including five population-based studies in Canada [23]. A Canadian cross-cultural comparison study by Kopec et al. [27] determined that an HUI score of less than 0.83 represented dysfunctional health status, while an HUI score of greater than 0.946 represented good health.

Mental health comorbidity consisted of the endorsement of at least two current mental disorders from two or more separate mental disorder categories based on current diagnoses from the SCID-IV and independent psychiatrist review, blinded to case and deployment status. The mental disorder categories included depressive disorders [Major Depressive Disorder, Dysthymic Disorder, and Depressive Disorder-Not Otherwise Specified (NOS)], anxiety disorders [Panic Disorder, Agoraphobia, Social Phobia, Specific Phobia, Generalized Anxiety Disorder, Obsessive Compulsive Disorder, Posttraumatic Stress Disorder (PTSD), and Anxiety Disorder- NOS], substance use disorders (Abuse or Dependence of Alcohol, Sedatives/Hypnotics/Anxiolytics, Cannabis, Stimulants, Opioids, Cocaine, Hallucinogens/PCP, Poly Drugs, or Other Drugs), somatization disorders (Somatization Disorder, Pain Disorder, Undifferentiated Somatoform Disorder, and Hypochondriasis), eating disorders (Body Dysmorphic Disorder, Anorexia Nervosa, Bulimia Nervosa, and Binge Eating Disorder), psychotic disorders (Schizophrenia, Schizophreniform Disorder, Schizoaffective Disorder, Delusional Disorder, Brief Psychotic Disorder, and Psychotic Disorder-NOS), adjustment disorders (Adjustment Disorder), and "other" mental disorders (any other mental disorder not listed previously). In addition to the presence of mental health comorbidity, patterns of co-occurring mental health disorder categories were examined to determine the most prevalent comorbidity profiles for each study participant.

Analyses were completed using SAS Version 8 (SAS Institute, Cary, NC). Means and standard deviations were examined for each continuous variable of interest. The distribution of the categorical variables was studied, as well. *T*-tests or one-way ANOVAs were used to determine differences between each level of independent variable of interest with respect to HUI3 and the eight single-attribute utility scores. Patterns of comorbidity were examined using simple frequency tables.

Bivariate linear regression was used to assess the relationships between individual variables of interest, including mental health comorbidity and demographics, and HRQoL, as measured by the HUI3. Beta coefficients and 95% confidence limits were calculated and significant independent variables were identified at the $\alpha = 0.05$ level of significance. For the multivariate linear regression models, any variables significant at the $p < 0.15$ level of significance in the bivariate models were entered into this multivariate model. Using a backwards stepwise linear regression technique, non-significant variables were removed one-by-one until only variables related to the outcome at the $p < 0.05$ level of significance were retained in the model. Once this model was constructed, the final model forced deployment status, *a priori* medical syndromes, age, and gender into the model to control for the sampling covariates.

## Results

Table 1 contains the demographic and military-related characteristics of the 602 interviewed veterans in the case validation study. Most veterans were deployed to the Gulf War I theater, since these participants were over-sampled. The majority of the sample were male, White, married, had some college education or graduated from college, were currently unemployed, were enlisted, served in the Army, and served in the National Guard/Reserve during the first Gulf War. The mean age of the interviewed veterans was 39.1 years (sd = 8.9). The mean number of days spent in the Gulf theater, among those deployed to the first Gulf War, was 110.5 days (sd = 92.2).

One-hundred ninety-three (32%) of the 602 surveyed veterans had a current mental disorder. The most frequent current mental disorder category was anxiety disorders (22.4%), followed by depressive disorders (14.2%) and substance use disorders (5.9%, Table 2). More than 35% (n = 69) of the 193 with current mental disorders had a second current mental disorder from

**Table 1.** Demographic and military-related characteristics of participants in the Iowa Gulf War case validation study (n = 602)

| Characteristic | n (%) |
|---|---|
| *Gender* | |
| Female | 73 (8.0) |
| Male | 529 (92.0) |
| *Race** | |
| Black/Other | 18 (3.0) |
| White | 584 (97.0) |
| *Marital status** | |
| Single/never married | 54 (9.1) |
| Divorced/separated/widowed | 111 (18.7) |
| Marrried | 430 (72.3) |
| *Education** | |
| Some college/college graduate | 386 (35.0) |
| ≤ High school graduate | 208 (65.0) |
| *Employment* | |
| Currently employed | 156 (26.0) |
| Unemployed | 443 (74.0) |
| *Rank*† | |
| Officer | 33 (5.5) |
| Enlisted | 539 (94.5) |
| *Branch of service* | |
| Air Force | 35 (5.8) |
| Navy/Coast Guard | 55 (9.1) |
| Marines | 82 (13.6) |
| Army | 430 (71.4) |
| *Military Status*‡ | |
| U.S. Guard/reserve | 412 (68.9) |
| Active duty | 187 (31.1) |
| *Deployment*† | |
| Gulf War Theater | 437 (72.6) |
| Other location | 165 (27.4) |
| *Case status* | |
| Cases (CWP, CD, and/or DEP) | 374 (62.1) |
| Controls (no symptoms of CWP, CD, DEP) | 228 (37.9) |
| | *Mean (s.d.)* |
| Days in Gulf Theater** | 110.5 (92.2) |
| Age | 39.1 (8.9) |

† At time of Persian Gulf War

‡ At time of Persian Gulf War; others were National Guard or Reserve status.

* Reported at the time of the original telephone survey in 1995–1996.

** is 0 if not in Gulf War Theater.

another diagnostic category. Among the 69 participants with mental disorder comorbidity, the most common patterns were co-occurring depressive and anxiety disorders (47%), followed by co-occurring substance use, depressive, and anxiety disorders (14%) and all other combinations (39%). Nearly all (91.4%) of the 69 participants with mental disorders that spanned two or more mental health disorder categories had an anxiety disorder, while many (82.6%) also had a current depressive disorder. Nearly one third (31.9%) of the 69 veterans with two or more current mental disorder categories were diagnosed with coexisting current mental disorders that spanned *three* or more categories. All of these veterans who reported three or more categories of mental disorders had at least one current anxiety disorder.

Those with mental health comorbidity had lower HUI scores than veterans with one or no current mental disorders (mean $0.41 \pm 0.30$ vs. $0.72 \pm 0.25$, $p < 0.0001$). Furthermore, comorbid mental health disorders had an additive effect on lower HUI scores. For example, the 69 veterans with co-occurring mental disorders had significantly lower HUI scores than the additional 124 veterans who had a single category of current mental disorder (mean $0.41 \pm 0.30$ vs. $0.57 \pm 0.28$, $p < 0.0001$). Veterans with a single category of mental disorder had significantly lower HUI scores than those with no current mental disorder (mean $0.57 \pm 0.28$ vs. $0.77 \pm 0.21$).

The single-attribute utility HUI3 scores are presented in Table 3. Participants with mental disorder comorbidity had significantly lower scores on the speech, dexterity, cognition, and pain attributes than those without mental disorder comorbidity. Hearing and ambulation also were nearly significantly impaired ($p < 0.10$) among the participants with mental disorder comorbidity, as well. Furthermore, the mean single-attribute HUI3 utility scores among all study participants were lower than those found in a referent Canadian population who had neither stroke nor arthritis in the 1990 Ontario Health Survey [28].

Bivariate analyses identified a number of examined variables significantly associated with current HUI3 score (Table 4). Lower HRQoL, as assessed by the HUI3, was significantly associated with being older than 32 years old at the time of the interview, having CWP or CD, having high hypochondriacal symptoms, having anxious symptoms on the ASI, having a high somatosensory rating, having a higher body mass index (BMI), or having more PTSD symptoms. Veterans who served in the Air Force or the Marines rated their health as significantly higher than Army veterans. The presence of comorbid mental health conditions strongly ($p < 0.00001$) correlated with

**Table 2.** The concentration of current mental disorders among participants in the Iowa Gulf War case validation study (n = 602)

| Current mental disorder category | Number of participants | 2+ Coexisting mental disorder categories, n (% of total with disorder)* | 3+ Coexisting mental disorder categories, n (% of total with disorder)* |
|---|---|---|---|
| Anxiety disorders | 134 | 63 (47.0%) | 22 (16.4%) |
| Depressive disorders | 85 | 57 (67.1%) | 21 (24.7%) |
| Substance use disorders | 35 | 19 (54.3%) | 12 (34.3%) |
| Somatization disorders | 14 | 9 (64.3%) | 5 (35.7%) |
| Eating disorders | 12 | 10 (83.3%) | 7 (58.3%) |
| Adjustment disorders | 3 | 1 (33.3%) | 0 (0%) |
| Psychotic disorders | 3 | 3 (100%) | 1 (33.3%) |
| Other mental disorders | 2 | 2 (100%) | 2 (100%) |
| All mental disorders | 193 | 69 (35.8%)** | 22 (11.4%)** |

* Not mutually exclusive categories.
** Not a sum of all previous categories due to overlapping mental disorders.

HUI3 HRQoL ratings. The beta coefficient for mental health comorbidity, −0.31, can be interpreted as "Those with mental health comorbidity had a mean HUI score 0.31 points lower than the mean HUI score among those without mental health comorbidity".

In the multivariate analyses, mental health comorbidity remained an important correlate ($p = 0.01$) of lower HRQoL, even after controlling for physical syndromes (CWP, CD), deployment status, age, gender, branch of service, hypochondriacal symptoms, BMI, and PTSD symptoms. Controlling for the presence of one mental disorder category did not change the significant findings, as individuals with mental health comorbidity still had significantly lower scores on the HUI than those with only one mental disorder category or no current mental disorders.

## Discussion

In our sample of veterans on active duty during the first Gulf War, over 35% with a current mental disorder had at least one other comorbid mental disorder in a separate diagnostic category. The crude rates of mental disorders, however, should not be interpreted as estimates of prevalence among all veterans since our study over-sampled veterans with symptoms of cognitive dysfunction, depression, and/or chronic widespread pain. The most prevalent patterns of comorbidity among sampled veterans resemble those found in the general U.S. population [7, 19]. Anxiety and depressive disorders were highly prevalent among the subset of veterans with two or more coexisting current mental disorder categories. This military population, therefore, has combinations of mental disorders similar to the general U.S. population.

Veterans who were deployed to the Gulf did not have significantly different HUI3 scores than those deployed elsewhere in this study. This finding contrasts that found by Proctor et al. [5], who found lower HRQoL scores among Gulf War deployed veterans as compared to veterans deployed to Germany. Among the Gulf-deployed veterans in Proctor's study, however, lower SF-36 scores on the Physical Component Subscale (PCS) were related to lower educational attainment, psychological symptomatology, and a higher number of self-reported medical conditions. These findings resemble our current findings with respect to the relationship between HRQoL and psychological morbidity.

Veterans with two or more co-occurring psychiatric disorders had significant impairments in speech, dexterity, emotion, cognition, and pain, and moderately significant impairments in hearing and ambulation as compared to veterans without coexisting disorders. The only single-attribute HUI3 utility score that did not differ based on mental disorder comorbidity status was vision. This finding confirms that mental health comorbidity affects several of the components that comprise health-related quality of life. The strongest relationships were found between mental health comorbidity and emotion, cognition, and pain, as expected.

**Table 3.** Single-attribute utility HUI3 scores by mental disorder comorbidity status among participants in the Iowa Gulf War case validation study (n = 602)

| Attribute | Mean (s.d.) all participants (n = 602) | Population norms in 1990 Ontario Health Survey* (Mean in reference population, n = 53,838) | Mean (95% CL) have mental disorder comorbidity (n = 69) | Mean (95% CL) do not have mental disorder comorbidity (n = 520) | $p$ value† |
|---|---|---|---|---|---|
| Vision | 0.963 (0.07) | 0.977 | 0.967 (0.954–0.980) | 0.963 (0.957–0.969) | 0.56 |
| Hearing | 0.929 (0.20) | 0.993 | 0.876 (0.815–0.936) | 0.935 (0.918–0.951) | 0.06 |
| Speech | 0.961 (0.11) | 0.998 | 0.905 (0.870–0.939) | 0.967 (0.959–0.976) | 0.001 |
| Ambulation | 0.971 (0.08) | 0.994 | 0.955 (0.937–0.973) | 0.973 (0.967–0.980) | 0.07 |
| Dexterity | 0.980 (0.06) | 0.998 | 0.956 (0.935–0.978) | 0.983 (0.978–0.988) | 0.02 |
| Emotion | 0.901 (0.16) | 0.984 | 0.714 (0.651–0.777) | 0.923 (0.915–0.937) | < 0.001 |
| Cognition | 0.872 (0.19) | 0.964 | 0.697 (0.641–0.754) | 0.894 (0.879–0.909) | < 0.001 |
| Pain | 0.833 (0.17) | 0.971 | 0.714 (0.662–0.765) | 0.849 (0.835–0.862) | < 0.001 |
| Overall | 0.688 (0.27) | 0.925 | 0.407 (0.330–0.483) | 0.721 (0.700–0.743) | < 0.001 |

* Grootendorst et al. [28].
† Mental disorder comorbidity vs. No current mental disorder comorbidity.

Consistent with previous comorbidity studies, military veterans with comorbid mental disorders had decreased quality of life ratings. The decrease was an average of 0.31 points lower on the HUI among those with comorbid mental disorders, a difference most likely to be clinically meaningful given the nature of the 0–1.00 scale of the HUI and the fact that in the Kopec et al. [27] study, less than 0.12 points separated good health from dysfunctional health status (0.946 vs. 0.83, respectively). This strong relationship persisted even after controlling for other important correlates of HRQoL. In addition to having co-occurring mental disorders including at least two diagnostic categories, the variables with significant associations with HRQoL, symptoms of Cognitive Dysfunction and Chronic Widespread Pain, body mass index, hypochondriacal symptoms, and symptoms of PTSD support previous models of HRQoL [8, 9] that indicate that symptom status and general health perceptions contribute to overall health-related quality of life. Veterans with concurrent mental disorders across different diagnostic categories also had significantly lower HRQoL scores than those with a single current mental disorder category, indicating an additive effect of each additional category of mental disorder. This study is unique in that it examines comorbidity across mental disorder categories (e.g., depressive and anxiety disorders), rather than comorbidity due to the co-occurrence of two or more disorders that may be etiologically related (e.g., social phobia and specific phobia). Our findings suggest that a substantial portion of veterans who have a mental disorder may also have another co-occurring mental disorder from a separate diagnostic category and that those with two or more current mental disorders in varying categories experience more impairment.

The mean HUI3 scores determined in this population were much lower than population-based norms found in previous studies (e.g., [23, 27, 28]). The mean of 0.69 found among this veteran population is indicative of dysfunctional health status, as determined by a Canadian population-based study [27]. Even the veterans with no current mental disorders had a mean HUI (0.77) much lower than what Kopec et al., determined as representative of good health (HUI3 score of ≥0.95). These low HUI3 scores cannot be

**Table 4.** Relationship of covariates with Health Utilities Index Mark 3 (HUI3) among participants in the Iowa Gulf War case validation study (n = 602)

| | | Unadjusted | | | Adjusted** | |
|---|---|---|---|---|---|---|
| | | HUI Mean (s.d.) | Beta coefficient (95%CL) | *p* value | Beta coefficient (95%CL) | *p* value |
| Mental health comorbidity | | | −0.31 (−0.38,−0.25) | < 0.0001 | −0.07 (−0.13, −0.01) | 0.01 |
| | Yes | 0.41 (0.30) | | | | |
| | No | 0.72 (0.25) | | | | |
| Deployment† | | | −0.03 (−0.08, 0.02) | 0.29 | 0.03 (−0.01, 0.07) | 0.13 |
| | Gulf War Theater | 0.68 (0.28) | | | | |
| | Other location | 0.71 (0.25) | | | | |
| Age | | | −0.05 (−0.10, 0.00) | 0.02 | −0.03 (−0.06, 0.00) | 0.11 |
| | 32 + years | 0.65 (0.28) | | | | |
| | < 32 years | 0.71 (0.26) | | | | |
| Gender | | | 0.04 (−0.03, 0.11) | 0.25 | 0.02 (−0.02, 0.06) | 0.38 |
| | Female | 0.72 (0.25) | | | | |
| | Male | 0.69 (0.27) | | | | |
| Race* | | | 0.10 (−0.04, 0.24) | 0.16 | | |
| | Black/other | 0.78 (0.25) | | | | |
| | White | 0.69 (0.27) | | | | |
| Marital status* | | | | | | |
| | Divorced/separated/widowed | 0.65 (0.28) | −0.05 (−0.11, 0.01) | 0.08 | | |
| | Single/never married | 0.72 (0.23) | 0.03 (−0.05, 0.11) | 0.43 | | |
| | Married | 0.69 (0.27) | – | | | |
| Education* | | | | 0.60 | | |
| | Some college/college graduate | 0.69 (0.28) | 0.01 (−0.04, 0.06) | | | |
| | ≤ High school graduate | 0.68 (0.25) | | | | |
| Employment | | | 0.03 (−0.02, 0.08) | 0.22 | | |
| | Currently employed | 0.71 (0.24) | | | | |
| | Unemployed | 0.68 (0.28) | | | | |
| Rank† | | | −0.02 (−0.12, 0.08) | 0.76 | | |
| | Officer | 0.67 (0.29) | | | | |
| | Enlisted | 0.69 (0.27) | | | | |
| *Branch of service*† | | | | | | |
| | Air force | 0.78 (0.20) | 0.10 (0.01, 0.11) | 0.04 | 0.03 (−0.04, 0.10) | 0.33 |
| | Marines | 0.76 (0.20) | 0.08 (0.02, 0.14) | 0.01 | 0.05 (0.02, 0.08) | 0.02 |
| | Navy/coast guard | 0.71 (0.22) | 0.02 (−0.06, 0.10) | 0.62 | −0.03 (−0.09, 0.03) | 0.30 |
| | Army | 0.66 (0.29) | – | – | – | – |
| Military status‡ | | | | | | |
| | Guard/reserve | 0.68 (0.28) | −0.04 (−0.9, 0.01) | 0.09 | | |
| | Active duty | 0.72 (0.25) | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Days in Gulf Theater** | | | −0.01 (−0.06, 0.04) | 0.78 | | |
| | 165+ days | 0.68 (0.27) | | | | |
| | < 165 days | 0.69 (0.27) | | | | |
| *Medical condition* | | | | | | |
| Symptoms-chronic widespread pain (CWP) | | | −0.31 (−0.35, −0.27) | < 0.0001 | −0.17 (−0.21, −0.13) | < 0.0001 |
| | Yes | 0.47 (0.29) | | | | |
| | No | 0.78 (0.20) | −0.32 (−0.36, −0.28) | < 0.0001 | | |
| Symptoms-cognitive dysfunction (CD) | | | | < 0.0001 | −0.19 (−0.23, −0.15) | < 0.0001 |
| | Yes | 0.50 (0.28) | | | | |
| | No | 0.82 (0.17) | | | | |
| Whitely Index (Hypochondriasis) | | | −0.41 (−0.49, −0.33) | < 0.0001 | −0.13 (−0.20, −0.06) | 0.0001 |
| | High (39+) | 0.31 (0.30) | | | | |
| | Low (< 39) | 0.72 (0.24) | | | | |
| Anxiety Symptoms Index (ASI) | | | −0.15 (−0.20, −0.10) | < 0.0001 | | |
| | 38+ | 0.58 (0.29) | | | | |
| | < 38 | 0.73 (0.25) | | | | |
| Barsky scale (Somatosensory symptoms amplification) | | | −0.19 (−0.23, −0.15) | < 0.0001 | | |
| | 2.7+ | 0.55 (0.31) | | | | |
| | < 2.7 | 0.74 (0.23) | | | | |
| Body Mass Index (BMI) | | | −0.10 (−0.15, −0.05) | < 0.0001 | −0.04 (−0.07, −0.01) | 0.04 |
| | 30+ | 0.63 (0.30) | | | | |
| | < 30 | 0.73 (0.23) | | | | |
| Mini-Mississippi Index (Posttraumatic stress symptoms) | | | −0.29 (−0.33, −0.25) | < 0.0001 | −0.11 (−0.15, −0.07) | < 0.0001 |
| | 29+ | 0.47 (0.29) | | | | |
| | < 29 | 0.77 (0.21) | | | | |

† At time of Persian Gulf War.

‡ At time of Persian Gulf War; others were National Guard or Reserve status.

* Reported at the time of the original telephone survey in 1995–1996.

** Is 0 if not in Gulf War Theater.

*** All variables significant at the $p < 0.20$ level of significance in the unadjusted analyses were entered into the model and selected to remain in the final model at the $p < 0.05$ level of significance using a backwards stepwise procedure. The final model included age, gender, exposure to the Persian Gulf War status, and all variables selected to remain in the final model using the backwards stepwise procedure described above.

generalized to the entire military population, however, because our Case Validation Study participants were over-sampled based on symptoms of chronic widespread pain, cognitive dysfunction, and depression. Given the high proportion of these individuals in our sample, we would imagine that our mean HRQoL scores would be lower than those found in the general population.

Our study suggests that efforts to improve diagnosis and treatment of coexisting mental health conditions may lead to enhanced HRQoL in this population. Previous research has demonstrated the importance of measuring HRQoL when assessing the impact of chronic diseases, to guide policy decisions, and to manage patients most effectively [29]. Awareness of mental disorder comorbidity and HRQoL in military veterans, therefore, may help physicians to detect these and related conditions early and provide appropriate treatment. Routinely administering standardized HRQoL instruments in ambulatory care settings can facilitate provider awareness of patients' HRQoL-related problems, improve communication, and influence treatment [30]. For example, Linzer et al. found that screening for and treating mental disorders greatly improves HRQoL in the PRIME-MD study [14]. Based on the results of this study, improving HRQoL by focusing on the recognition and treatment of common mental disorders and on the presence of more than one distinct mental disorder category are important goals in health care delivery. Studies examining how to best modify interventions designed to detect and treat common mental disorders are needed to confirm suspected improvements in HRQoL that will occur as a result.

The prevalence rates reported in this study are not generalizable to the entire military population because of our sampling methods. The participants of this study were selected from our original population-based survey on the basis of having symptoms of cognitive impairment, major depressive disorder, and/or chronic widespread pain. Although some participants sampled had none of these conditions at baseline, participants from each of these three condition groups were over-sampled for the case validation study, most likely inflating the prevalence rates of current mental disorders, thus lowering the HUI3 summary scores. Finally, since only veterans originally from Iowa were included, these findings may not generalize to other military populations.

This study has a number of strengths. First, we were able to examine the relationship between the presence of two or more current mental disorders across two or more diagnostic categories and HRQoL in an unique study population. We used instruments of established reliability and validity, including the SCID-IV and the HRQoL instrument, the HUI3 [26]. Using the HUI3 rather than the more commonly-used SF-36 to assess HRQoL has many advantages. Besides being shorter and easier to complete [31], the HUI3 yields a single summary score that can be used in cost studies to determine the economic burden and/or to calculate health-adjusted life expectancy. Because the HUI3 is a utility measure, it enabled us to calculate a standardized value needed to measure the societal burden of mental disorder comorbidity. In addition, all assessed variables were evaluated after blinding the raters to deployment and diagnostic status. Psychiatric diagnoses were made using the well-validated "best-estimate" method [22], in which all sources of data are taken into account; a senior diagnostician made all of the diagnoses. We also used current diagnoses and current HRQoL ratings to eliminate any temporal differences between the occurrences of conditions. No additional memory probes were needed to assess the occurrence of any of the mental disorders studied.

Quality of life is an important determinant of overall health. For example, even though women live longer than men, on average, women experience greater morbidity during their lives; therefore, adjusting for quality of life decreases the advantage women have over men with respect to the number of years lived [32]. Sherbourne et al., in a study of diabetic and hypertensive patients, recommended that coexisting anxiety disorders be treated aggressively because of their adverse effect on HRQoL among these patients [33]. The low HUI3 scores reported by our sample are indicative of the high cost of mental disorder comorbidity to society. Focus on the prevention, identification, and management of mental disorder comorbidity, therefore, may lead to substantial improvements in how military veterans perceive their overall quality of life.

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*Address for correspondence*: Valerie Forman Hoffman, Roy J and Lucille A. Carver College of Medicine, The University of Iowa, 200 Hawkins Drive, SE611-GH, Iowa City, IA, 52242, USA
Phone: +1-319-384-8050; Fax: +1-319-356-7165
E-mail: valerie-hoffman@uiowa.edu