# War-related mental health disorders among Iraqis 10 years after the 1991 Gulf War: A comparative study of soldiers and civilians living under sustained socio-environmental stress

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## Abstract

**Background:** Prior studies of mental health consequences of the Gulf War (GW) have been confined to Allied forces, limiting the ability to control for important geographically and culturally-related factors. We conducted an epidemiological mental health study among Iraqi soldiers and civilians who are still residing in Iraq. This group has been exposed to sustained socio-environmental stress.

**Methods:** A cross-sectional sample of 742 Iraqi GW veterans and 413 civilians responded to a validated mental health survey. The response rate was 96.3%. Mental health disorders, including post traumatic stress disorder (PTSD), were classified using both self-reports and validated scales. War-related exposure was calculated using the sum score of items assessing trauma exposure.

**Results**: Iraqi soldiers reported significantly more depression (Odds Ratio [OR] 4.9; 95% confidence interval [CI] 2.2-11.1) and anxiety (OR 3.9; 95% CI, 1.2-13.3) compared to civilians, adjusting for age, education, and smoking. Soldiers closest to Kuwait during the GW reported significantly more depression compared to soldiers deployed further away from the war epicenter (OR 104.6; 95% CI, 28.0-390.8) and anxiety (OR 4.1; 95% CI, 1.5-11.1). The highest self-reported trauma exposure occurred in the southwest of Iraq.

**Conclusion:** Iraqi soldiers that took part in the GW are at increased risk suffering from many of the same mental health disorders plaguing Allied soldiers. Soldiers closest to Kuwait were more at risk, suggesting a direct link to war-specific environmental exposures, although self-reported trauma exposure

was higher in the southwest of Iraq. The study offers additional insights into the mental health consequences of living under sustained socio-environmental stress, originating from the Iraqi war. The study points out socio-environmental factors worthy of further explorations.

## Introduction

Between August 1, 1990 to June 1, 1991, soldiers and support personnel from nearly fifty countries were engaged in the Gulf War (GW) Operation Desert Shield/Desert Storm. Following the war when veterans were returning to their native countries, there was an apparent increase in the number of soldiers reporting an array of mental and somatic symptoms [1-18]. Similar symptoms have been reported by soldiers deployed to other recent conflicts, including the 2003 invasion of Iraq, albeit more limited in the numbers affected [9-24]. Epidemiological studies have provided substantial evidence of an increased prevalence of PTSD, and other mental health disorders among GW veterans compared to non-deployed soldiers, or soldiers deployed to other conflicts [1, 11, 25-27]. Specifically, depressive disorders and PTSD have been reported to be more common among GW veterans as compared to veterans from the Afghanistan conflict [28].

Prior studies of mental health effects from the GW have almost exclusively involved Allied forces. There are a number of important confounders in such studies including the fact that deployed soldiers were not accustomed to the GW's regions geographical, ethnic, cultural and microbial characteristics, neither desert climate.

The purposes of this study were two-fold. We wanted to determine whether:

1) Mental health disorders differ between Iraqi soldiers deployed during the 1991 Gulf War as compared to Iraqi civilians, and

2) Soldiers deployed closer to the war epicenter (presumed to have the highest trauma exposure history) exhibited more mental health disorders as compared to soldiers deployed further away.

The study provides new insights as to possible mental health effects from living under sustained socio-environmental stress, originating from the 1991 Gulf War and subsequent hardships, including oppression, unemployment, and lack of food.

## Participants and Setting

A sample of men (women were not allowed to enter the Iraqi military forces at this time) who were soldiers and civilians between 18-45 years of age in the Iraqi provinces of Basrah and Messan at the time of the 1991 GW and living within 300 Kilometers from Kuwait were eligible for study enrollment. Three surgical residents from Basrah University were trained to select and interview individuals who accompanied patients attending three outpatient clinics in the Basrah and Messan Provinces in Iraq. Thus, we interviewed persons that did not themselves seek out the health care centers. The three clinics were run by the Iraqi Ministry of Health and available to all Iraqis. All residents followed a standard algorithm to identify and interview participants. Potential participants were asked about their interest in participating in a health study of the GW. Participation was voluntary

and respondents were able to withdraw from the study at any time. Once verbal consent was obtained, the medical residents proceeded to ask each question and read their respective response choices in Arabic and recorded the participants' responses in the survey questionnaire. All interviews were done in a physician's office to ensure confidentiality.

A total of 1266 prospective participants that accompanied patients to the health centers were approached. Sixty-six (5.5%) refused to participate for the following reasons: no time (n=16), the patient they accompanied were critically ill or a child in need of constant attention (n=22), fear of reprisal from the regime (n=28).

## Questionnaire content

A structured interviewer-administered questionnaire, which was based on the survey developed and used in several studies of large numbers of U.S. GW Veterans, was used [29, 30]. This questionnaire was initially designed and validated at the University of Iowa and the Iowa Department of Health and the Center for Disease Control. This original questionnaire was translated into Arabic and back-translated into English to ensure the validity of the phrasing of the questions. It has been validated among Iraqi refugees living in Michigan, US [31-33]. In the current study, we excluded a total of 24 questions from the original English version since 12 questions were not applicable, and an additional 12 questions were deemed culturally too sensitive, and not of relevance to the current study.

The questionnaire contained questions concerning socioeconomics, smoking history, age, height, and weight.

Residential or stationed distance from Kuwait was queried from the participants. Distance from Kuwait was classified into three zones: $zone_1$ consisted of soldiers in Kuwait; $zone_2$, participants 100-199 kilometers from Kuwait; and $zone_3$, participants between 200-300 kilometers from Kuwait. Out of a total of 1200 respondents, 45 respondents were removed from the analysis due to the fact that they had resided between 300 to 860 kilometers from Kuwait. The final group thus consisted of 1155 participants. All participants reported the city or village in which they resided during the Gulf War. Based on this information we assigned a zone to the person based on distance from Kuwait.

War-related trauma exposure was assessed by asking whether participants had been exposed (yes or no) to one or more of the following (warning alarms for chemical exposures (received a weighted score of times 9; seen dead bodies and/or persons seriously disfigured, 10; personal exposures judged to be harmful or extremely stressful, 6; under fire from small fire arms, 10; had a scud missile explode in the air or on the ground within a perimeter of a 1 mile, 8; had artillery, rockets, mortars, or anything else, apart from scud missiles, explode within 1 mile, 8; suffered a war-related injury requiring medical attention during the war,10; witnessed anyone dying, 10). These weighted item scores formed a scale. The aggregate, weighted score was used as a self-reported trauma exposure measure.

## Self-reported mental health

The participants were asked to respond to whether they during the last year had had any of a number of specific psychiatric conditions diagnosed by a physician, including PTSD, depression, anxiety disorder, or other psychiatric

disorders, such as Schizophrenia. If they responded affirmative to any of the psychiatric conditions, they were asked whether the conditions had debuted before, during or after the 1991 GW.

## Check-list-based diagnosis

PTSD was formally assessed by the PTSD Checklist-Military Version (PCL-M) [34]. Respondents were asked about symptoms experienced in the month before the interview. Responses were provided on a Likert-type scale, typically ranging from 1 (symptom not experienced) to 5 (extremely bothered). The severity score for each item is summed and a total PTSD severity score, ranging from a low of 17 to a high of 85 was calculated. A previously established cutoff score of 50 or higher was used to categorize PTSD [34]. The questionnaire also contained scales for assessing depression, panic and anxiety symptoms (PRIME-MD, 35). The Medical Outcomes Study Short Form-36 (SF-36) was used to assess functional status and health-related quality of life [36].
The study was approved by the Human Investigative Committees at Basrah University and Wayne State University as a collaborative research investigation. The study received formal approval from Wayne State University following the removal of former President of Iraq, Saddam Hussein.

## Statistical Analyses

The proportions of soldiers and civilians (no civilians in $zone_1$, which denotes Kuwait) in each zone were calculated. Means and standard deviations for continuous variables are reported. Chi-square tests were used to determine differences between groups. Yates's correction for chi-square tests was used as indicated by the data. We calculated unadjusted odds ratios (ORs) and 95% confidence intervals (CIs) to determine the univariate associations between military status and self-reported as well as instrument-based and algorithm-based mental health diagnosis. We also calculated adjusted ORs for these associations controlling for age, smoking, and education based on unconditional logistic regression modeling. Age and education were included as continuous variables. We examined associations between distance from Kuwait and mental health. Specifically, we compared $zone_1$ to $zone_3$ and $zone_2$ to $zone_3$ where $zone_3$ served as the reference group. We related our distance-based zone-exposure classification scheme to self-reported aggregate war-trauma exposure scores. All reported p-values are 2-tailed and p-values <.05 were considered statistically significant. All analyses were performed using SAS (version 9.1.2, SAS Institute, Cary, NC).

## Results

Of the total study group of 1155, 64% (n=742) were deployed soldiers. Among the soldiers, 22.6% had been deployed to $zone_1$, the Kuwait war zone, 34.1% to $zone_2$, and 43.4% to $zone_3$, the reference zone. Among the 413 civilians, 35.6% had resided in $zone_2$ and 64.4% in $zone_3$ during the GW.
Table 1 depicts demographics for soldiers and civilians. Soldiers were significantly older, had fewer years of formal schooling, and worse self-reported health as compared to civilians (p<.01). There were no significant differences in smoking history between soldiers and civilians.

**Table 1. Demographics and self-reported mental status comparing soldiers to civilians.**

| Characteristic | All Participants (n= 1155) N (%) | Group | | |
|---|---|---|---|---|
| | | Soldiers (n=742) N (%) | Civilians (n=413) N (%) | *P** |
| Age, mean (SD), years | 31.0(7.5) | 32.1(8.0) | 28.7(5.6) | <.001 |
| Body Mass Index / mean (SD) | 20.8(2.6) | 20.9(2.7) | 20.7(2.4) | n.s. |
| Education Status | | | | <.001 |
|    8th Grade or Less | 285(25.3) | 212(29.2) | 73(18.3) | |
|    > 8th Grade but < HS | 368(32.7) | 218(30.1) | 150(37.5) | |
|    Completed HS | 252(22.4) | 161(22.2) | 91(22.8) | |
|    Less than College | 48(4.3) | 28(3.9) | 20(5.0) | |
|    Completed Bachelors or more | 172(15.3) | 106(14.6) | 66(16.5) | |
| Smoking Status | | | | n.s. |
|    Never smoked | 549(48.3) | 344(47.3) | 205(50.1) | |
|    Former smoker | 177(15.6) | 115(15.8) | 62(15.2) | |
|    Current smoker | 410(36.1) | 268(36.9) | 142(34.7) | |
| Self-Rated Health Status at Time of Survey | | | | <.01 |
|    Excellent | 48(4.2) | 32(4.3) | 16(3.9) | |
|    Very good | 231(20.1) | 131(17.7) | 100(24.5) | |
|    Good | 723(63.0) | 465(62.8) | 258(63.2) | |
|    Fair | 125(10.9) | 98(13.2) | 27(6.6) | |
|    Poor | 21(1.8) | 14(1.9) | 7(1.7) | |
| Depression | 69 (6.1) | 60(8.4) | 09(2.20) | <.001[†] |
| Anxiety | 30 (2.7) | 26(3.8) | 04(1.00) | <.01 [†] |

\* Data are presented in percentages unless otherwise indicated. Percentages are based on non-missing data.
*P** represents the p-value for overall $\chi^2$ tests.
[†] Odds ratios (95% Confidence Intervals), Depression = 4.9 (2.2-11.18) and Anxiety = 3.9 (1.26-13.3) where civilians serve as the reference group.
n.s. = statistically non-significant.

Soldiers reported significantly more often having received a diagnosis of depression during the last year (OR 4.9; 95% confidence interval, CI, 2.2-11.1) and anxiety (OR 3.9; 95% CI, 1.2-13.3) as compared to civilians

### Self-reported mental health
Table 2 depicts odds ratios for reporting currently suffering from depression or during the last year, after adjusting for age, smoking status, and years of education. Participants that were stationed closest to Kuwait had an increased odds ratio reporting suffering from depression as compared to those that had resided in further away located zones. These findings held true for all participants as well as when the analysis was restricted to soldiers only. Anxiety differed only when the war epicenter zone was compared to those that resided 200-300 kilometers from Kuwait.

## Mental health assessment using validated scales

We also employed validated scales, not self-reports, for the diagnosis of PTSD, depression, and panic disorders. There were no significant differences between soldiers and civilians in the prevalence of these disorders (Table 3). However, the numbers of depression symptoms were significantly higher among soldiers as compared to civilians.

## War trauma exposure by zone

War trauma exposure scores of soldiers only across different war zones; $Zone_1$ Mean = 38.7/of max 71 (S.E. 4.6), $Zone_2$, Mean = 49.7 (S.E. 4.6), and $Zone_3$ Mean = 13.7 (9.7) ($F_2$ = 15, 2, p<.01). Tukey post-hoc tests revealed a significant difference between $Zone_2$ and any of the other two zones.

## Mental health across war zones for soldiers only

Restricting the analysis to solders only, we found significant differences across zones for depression, dysthymia, and panic disorders. The number of sub-syndromal scores on the PTSD scale also differed significantly across zones, with the highest number among soldiers having been deployed in the war epicenter. However, no one of the participants reached the necessary cut-off points for the PTSD diagnosis.

## Discussion

To the best of our knowledge, this is the first epidemiological study of mental health among Iraqi soldiers that were actively involved in the 1991 Gulf War. We found a dose-response relationship between geographical closeness to Kuwait and mental health disorders. Self-reported war-related trauma exposure also varies across zones, and reported to be the highest in the south-western part of Iraq, objectively the center for the Allied forces activities following the liberation of Kuwait.

There have been a substantial number of studies during the last fifteen years concerning the health among veterans of the 1991 Gulf War [1-13]. More recent ones cover, as is the case for the current study, the entire first decade following the completion of the war [27]. Compared to other recent conflicts, for example the 2003 Iraq war and the war in Afghanistan, the GW appears to have resulted in a higher prevalence of medical symptoms and with longer duration [23]. Despite much research, there is no consensus as to the underlying reason behind the elevated

| All Participants | | | | | | | Odds Ratios (95% Confidence Intervals) | |
|---|---|---|---|---|---|---|---|---|
| Self-Reported Mental Disorders | All Zones (n=1155) N (%) | Zone1 (n=168) N (%) | Zone2 (n=400) N (%) | Zone3 (n=587) N (%) | p* | p$^{Trend}$ | (Zone 1 vs 2)$^{†}$ | (Zone 1 vs 3) |
| Depression | 69(6.1) | 46(31.9) | 18(4.6) | 5(0.9) | <.0001 | <.0001 | 7.6 (2.77-21.79)[4] | 135.6 (43.8-419.8)[4] |
| Anxiety | 30(2.7) | 13(10.9) | 7(1.8) | 10(1.7) | <.0001 | <.0001 | 0.9 (0.39- 2.9)[1] | 5.7 (2.2-14.4)[2] |
| Gulf War Soldiers Only | All Zones (n=742) | Zone1 (n=168) | Zone2 (n=253) | Zone3 (n=321) | | | | |
| Depression | 60(8.4) | 46(31.9) | 11(4.4) | 3(0.9) | <.0001 | <.0001 | 6.6 (1.7-24.9)[2] | 104.6 (28.0-390.8)[3] |
| Anxiety | 26(3.8) | 13(10.9) | 5(2.0) | 8(2.5) | <.0001 | <.0001 | 0.7 (0.20- 2.55)[1] | 4.1(1.5- 11.1)[2] |

**Table 2. Self-reported medical history by zone and Odds Ratios (95% Confidence Intervals) for zones 1 vs. 2 and zones 1 vs. 3.**
Percentages are based on non-missing data.
Zone 1 = In Kuwait; Zone 2 = 100-199 kilometers from Kuwait; and Zone3 = 200-300 kilometers from Kuwait.
*Represents the p-value for overall $\chi^2$ test.
$P^{Trend}$ represents the p-value for the Cochran-Armitage trend test.
$^{†}$OR represents the magnitude of association between self-reported depression and zone where zone 2 is the reference zone after controlling for age, smoking, and education.
$^{‡}$OR represents the magnitude of association between self-reported anxiety and zone where zone 3 is the reference zone after controlling for age, smoking, and education.
[1] No significant difference; [2] $p<0.01$; 3 $p<0.001$; [4] $p<0.0001$

prevalence of psychological symptoms in GW veterans as compared to soldiers not deployed to the Gulf in 1991. The mechanism causing PTSD following trauma-exposure is also far from understood. For example, only a minority of trauma-exposed develop PTSD as compared to depression and anxiety which are more common. However, apart from risk factors such as prior trauma history, female gender, and low intelligence, peri-traumatic psycho-physiological arousal and sustained sympathetic arousal have been reported to be reliable predictors of the future development of PTSD [37-38]. Studies of deployed soldiers have reported that depression is a risk factor for the later development of PTSD [40]. Sustained stress exposure increases the risk to develop depression as well as anxiety [40] PTSD symptoms, in contrast, might not emerge until after removal from a chronic stressor conditions which might partly explain why PTSD symptoms tend too increase with time [40-42]. Prior studies of Allied soldiers have been done when they have already returned to their home country. The Iraqis taken part in the current study is still living under highly stressful conditions, possible not allowing for the expression of PTSD symptoms. Further support for this idea is the fact that Iraqi refugees, including soldiers, surveyed by us in Michigan, using the same validated instrument exhibit a high rate of PTSD [43].
Studies to date have mostly dealt with members of the Allied forces. Epidemiological studies typically compare soldiers that have been deployed to the Gulf in 1991 as

| Mental Disorder | All Participants (n= 1155) N (%) | Group | | |
|---|---|---|---|---|
| | | Soldiers (n=742) N (%) | Civilians (n=413) N (%) | *P* |
| PSTD* (%) | 0.0 | 0.0 | 0.0 | - |
| Number of PTSD symptoms. Mean (SD) | 19.1(4.2) | 19.1(4.6) | 19.0(3.3) | n.s. |
| Depression** No depression Minor depression Major depression | 792 (68.6) 326 (28.2) 37 (3.2) | 494 (66.6) 225 (30.3) 23 (3.1) | 298 (72.2) 101 (24.5) 14 (3.4) | n.s. |
| Number of Depression symptoms. Mean (SD) | 1.1(1.5) | 1.2(1.5) | 1.0(1.4) | <.05 |
| Dysthymia | 15(1.3) | 11(1.5) | 4(1.0) | n.s. |
| Panic Disorder | 60(5.2) | 45(6.1) | 15(3.6) | 0.074 |

**Table 3. Mental disorders diagnosed using a validated instrument comparing soldiers with civilians**

PTSD, post-traumatic stress disorder; SD, standard deviation; N/A, non-applicable
* PTSD as defined by the Checklist-Military Version (Weathers et al., 1993)
** Depression as defined by the Primary Care Evaluation of Mental Disorders (Spitzer et al., 1996).
n.s. = statistically non-significant.

compared to non-deployed soldiers, or soldiers deployed elsewhere. However, these studies are characterized by a number of important limitations. Typically, deployed soldiers are younger, less educated, of lower socioeconomic status and military rank, and more often single [18, 28]. Allied soldiers deployed to Iraq experienced a number of potentially stressful exposures, apart from GW-specific factors, including being away from familiar territory, the desert climate, sand flies and an environment with different microbial composition from their natural habitat. More recent studies have linked such "low-intensity" but more chronic stressors, along with stress related to poor morale and administrative hazards to the risk to develop PTSD [40-43]. There is also no financial compensation scheme available to Iraqi soldiers as compared to Allied forces from, for example, the US and UK. All of these factors might be of relevance in identifying reasons for the increased reported rates of medical and mental symptoms in GW veterans since these variables differ systematically and non-randomly between GW veterans and non-deployed referents.

| Mental Disorder | Zone1 (n=168) N (%) | Zone2 (n=400) N (%) | Zone3 (n=587) N (%) | *P* |
|---|---|---|---|---|
| PSTD* | 0.0 | 0.0 | 0.0 | - |
| Number of PTSD symptoms, mean (SD) | 17.6(5.8) | 18.4(3.8) | 19.9(3.7) | <.0001 |
| Depression**<br>No depression<br>Minor depression<br>Major depression | 111 (66.1)<br>49 (29.2)<br>8 (4.8) | 332 (83.0)<br>59 (14.8)<br>9 (2.3) | 349 (59.5)<br>218 (37.1)<br>20 (3.4) | <.0001 |
| Number of Depression symptoms, mean (SD) | 1.3(1.8) | 0.8(1.4) | 1.4(1.5) | <.0001 |
| Dysthymia | 6(3.6) | 9(2.3) | 0(0.0) | <.001 |
| Panic Disorder | 12(7.1) | 12(3.0) | 36(6.13) | <.05 |

**Table 4. Mental health disorder diagnosed using a validated instrument by zones** [1,2,3]
Percentages are based on non-missing data.
Zone 1 = In Kuwait; Zone 2 = 100-199 kilometers from Kuwait; and Zone3 = 200-300 kilometers from Kuwait.
*Represents the p-value for ANOVA test.
** Represents the p-value for overall $\chi^2$ tests.

To the best of our knowledge, this is the first epidemiological study of the health of Iraqi soldiers being part of the GW operations in 1991. Moreover, we have assessed Iraqi civilians and have applied a theoretical dose-response model, based on the distance from Kuwait. The theoretical dose-response model is based on the a priori assumption that:

1: soldiers, as compared to civilians, controlling for distance from Kuwait, were hypothesized to have been more exposed to environmental agents, including biological and chemical warfare agents, oil fire smoke, as well as trauma.

2: soldiers closer to Kuwait were also hypothesized to exhibit higher cumulative harmful war-related exposures as compared to soldiers further away from Kuwait. The highest self-reported war-related exposure was predicted to be in the southwest of Iraq, where the largest chemical weapon storage and destruction took place, including aerial bombing by the Allied forces.

The odds ratios for depression and anxiety were elevated for soldiers as compared to civilians. This held true even after adjusting for possible confounders such as age, smoking status, and years of education. A number of studies of Allied forces also report an increased prevalence of mental disorders, including depression and anxiety, and chronic fatigue syndrome

among GW deployed versus non deployed soldiers [1, 11, 19, 24].

Our study confirms prior findings of GW veterans that mental disorders including depression and anxiety, appear to be the most systematically increased mental health disorders [1, 8, 18, 21, 28].

With regard to our á priori hypothesis of a dose-response relationship between the risks for mental health disorders and closeness to the Kuwait, we could not reject it with regard to depression. However, the risk for anxiety was increased for those having resided in either of the two zones closest to Kuwait. We do not believe our dose-response findings are spurious findings since it held true in civilians and soldiers alike. In reality, most of the fighting occurred in the first two zones, that is, within 200 kilometers from Kuwait. Environmental and war-specific exposures, including oil well smoke and aerial bombings were also most frequent in this area. We therefore concur with the suggestion by Wessely et al [44] that one need to take a broader view of hazards, including exposures to vaccines, smoke from oil fires, and mental stressors. The total exposures to such real or perceived hazards make up the cumulative burden of stress perceived by GW veterans, rather than merely more specific environmental agents. Self-reported war trauma exposure varied significantly across war zones, suggesting that self-reports might be a relevant proxy for distance from Kuwait. Self-reports reflect the fact that the highest war intensities following the collapse of the former Iraqi regime were in the southwestern part of Iraq.

An important difference from prior mental health studies of Allied soldiers deployed to Iraq is that none of our sample, despite the fact that we used a translated, validated and sensitive scale, met the criteria for PTSD. We do not believe this finding is spurious and due to systematic selection bias. Moreover, in analogy with prior studies of Allied soldiers, we did find an increased risk for depression and anxiety disorders among soldiers.

As reported in many studies of Allied forces, soldiers included in our sample, were less educated and had lower income [18, 24]. However, in contrast to many studies of Allied forces, soldiers in our sample were older [18, 28]. There were no differences in smoking habits between deployed soldiers and civilian controls. Overall, we believe our sample is representative for Iraqi soldiers and civilians in the areas studied.

There are some limitations to the current study. First, we were not able to sample a representative sample of soldiers and civilians. Rather, we selected people that accompanied patients to health clinics that offer care for free. There might have been a systematic bias in our selection. We controlled for known confounders, including education and age in our logistic regressions. We also carried out the survey 10 years after the completion of the war. It is possible that we would have gotten different results, should we have surveyed participants closer to the war. However, this was not possible due to lack of access and trust among potential participants during the prior regime. Our self-reported war trauma exposure scale attempted to assess participants' exposure to trauma considered to be of relevance in trauma research. The focus is on conditions where a person's own life was at risk or perceived being threatened. There might be other factors of relevance with regard to the future development of trauma-related mental health disorders. Finally, we used a geographical basis for the creation of three zones, based on how far

away from Kuwait participants resided during the war. These zones coincide well with more objective measures of war activities, with the second zone purportedly having the highest war intensity.

In conclusion, the current study of Iraqi GW veterans as well as civilians confirms many of the prior findings from Allied GW veterans. Moreover, Iraqi soldiers exhibited significantly more mental disorders than did civilians. Closeness to Kuwait was an independent risk factor for mental disorders. Since our sample is used to Iraq, its climate and culture and microbial characteristics, many of the confounders from prior epidemiological studies of Allied GW veterans can be eliminated as possible precipitators of GW-related symptoms and syndromes.

The study also provides new insights as to possible mental health effects from sustained exposure to socio-environmental stressors of relevance for further revisions of evidence-based models of post-trauma adjustment disorders.

Neither soldiers nor civilians residing in Iraq scored above the predetermined cut-off score on the PTSD scale. We believe the scale is culturally valid, since the same scale has been used repeatedly in Iraqi refugees that have relocated to the US finding a high prevalence of PTSD [31, 32]. We believe that as long as the participants are still living under highly stressful conditions, PTSD-like symptoms might be suppressed as part of an overall psycho-physiological coping mechanism [45]. Once a person is removed from highly stressful conditions that elicit the "fight-or-flight response", there is a drastic rebound effect, possible contributing to eliciting PTSD-like symptoms. Our findings point to the importance of studying where in the

relocation process, PTSD symptoms are being expressed. Such understanding might contribute to our efforts in preventing and treating PTSD.

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