

FINAL REPORT

Illness and Injury among US Marines during Operation Desert Storm

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BACKGROUND

When Operation Desert Shield began, the need for disease surveillance among the troops deployed to the Middle East was recognized. In mid-August of 1990, a U.S. Navy preventive medicine physician/epidemiologist established a surveillance system to track illness and injury patterns among U.S. Marine Corps (USMC) personnel deployed with the First Marine Expeditionary Force (IMEF). As each Marine Corps unit arrived in country, they were added to the surveillance system. Statistics were accumulated and reported on a weekly basis in order to track the occurrence of diseases and injuries that were not the result of combat (disease and non-battle injuries (DNBIs)). After the air war began, record keeping and reporting of DNBIs was less consistent. When the ground war started and units were on the move, communication became increasingly difficult and documentation of medical visits diminished further. As the conflict intensified for the ground units, individuals with minor illnesses and injuries were less likely to seek medical attention in the face of greater threats to survival. Due to the above factors, there were significant gaps in the DNBI statistics beginning on January 17, 1991, when Operation Desert Shield was transformed by the air war into Desert Storm.

With the declaration of a cease fire for Desert Storm on February 28, 1991, marking the end of armed hostilities between the Coalition Forces and Iraq, a new and potentially serious hazard filled the skies over Kuwait and northeastern Saudi Arabia. Smoke billowed from 611 oil wells in Kuwait deliberately set afire by retreating Iraqi forces¹. Numerous international efforts were undertaken to rapidly assess the types and levels of pollutants being discharged by the burning oil^{2,3}. Parallels were drawn between the Agent Orange exposures of the Vietnam era and the unknown threat of "Agent Oil".

To assess the disease, injury and exposure experience of USMC personnel during Operation Desert Storm, a questionnaire survey was designed by members of the Navy's Preventive Medicine Augmentation Team (PMAT) in consultation with members of the EPA Interagency Task Force². The PMAT was based in Al Jubayl, Saudi Arabia, during the Desert Shield/Storm operation in 1990-91 and was tasked with providing preventive medicine (PM) assistance beyond the capabilities of organic USMC PM assets (Appendix A). The team included preventive medicine physicians, environmental health officers, entomologists, industrial hygienists and preventive medicine technicians.

This report presents the final results of the Desert Storm Survey conducted among U.S. Marines in the Kuwait Theater of Operations (KTO) during March 28-31, 1991. A preliminary report summarizing the results of the survey was presented to the Armed Forces Epidemiology Board on June 21, 1991 at the Walter Reed Army Institute of Research (WRAIR), Washington, D.C.

GOALS/OBJECTIVES

The two major goals of the Desert Storm Survey were:

- (1) to provide information on the magnitude and severity of acute health problems possibly related to the air pollution from the oil fires;
- (2) to complement the ongoing epidemiologic surveillance program for monitoring illness and injury, and to reconstruct the health-related problems encountered during a period of intense conflict by sampling a large number of Marine Corps personnel.

METHODS

The Desert Storm Survey was developed, field-tested and administered over an 18-day period from March 14-31, 1991. The short time line was dictated by the acute concern over the health effects of exposure to smoke from the oil well fires and the need to administer the questionnaires before the return of USMC units to the United States. During the four-day period from March 28-31, the self-administered questionnaire was completed by 2,715 Marines who represented a conservatively estimated five percent sample of USMC personnel based on land in the KTO.

Three groups of Marines participated in the cross-sectional survey. The first group (Group I) of 897 Marines had the longest exposure (approximately five weeks at the time of the survey) and were located closest to the burning oil wells. Marines in Group I entered Kuwait from Saudi Arabia during the latter part of February, moved north through the oil fields of Kuwait and then remained on the outskirts of Kuwait City up to and beyond the time of the survey. At this location, burning oil wells were visible at night. Depending on the winds, this area was periodically enveloped in smoke to the extent that flashlights were required to read during the day. This encampment was located in the fields of an agricultural research area.

The second group (Group II) of 987 Marines had short-term exposure to the oil fires. Members of Group II moved through the oil fields of southern Kuwait during the ground war period which occurred the last week of February and then withdrew to Manifah Bay, Saudi Arabia, following the cease fire on February 28th. Located about 120 kilometers south of the Kuwait border, Manifah Bay is a coastal site where, depending on wind conditions, smoke from the southern oil fields of Kuwait was clearly visible. Floating oil on the

waters of the gulf and oil-soaked shoreline were also present at this site.

The third group (Group III) of 831 Marines had no direct exposure in or near the oil fields, having spent the entire Desert Storm period in Al Jubayl, Saudi Arabia, which is located approximately 200 kilometers south of the nearest oil fields in southern Kuwait. At this location, a distant smoky haze was visible on the northern horizon.

From the 2715 Marines, the responses of 47 participants were eliminated from the final analysis yielding a total of 2668 responses (Group I - 892, Group II - 978, Group III - 798). Females were excluded due to their small number (N=36) and the possibility of their differential rate of self-reporting of disease symptoms*. Additionally, the responses of two Red Cross workers and nine persons who provided an answer other than "male" or "female" to the sex identifier were not analyzed.

The questionnaire asked about illness and injury which had occurred since Operation Desert Storm began on January 17, 1991 to minimize recall bias and to achieve the goal of retrieving information for the conflict period (Appendix B). Demographic information on the age, sex, unit, military occupational specialty (MOS), principal job during this period, total length of deployment since the beginning of Desert Shield, and years of total military service was collected on each answer sheet. Information on use of sick call, influenza (flu) vaccination status and use of chemical/biological warfare (CBW) protective medications was also collected. Smoking status (current, ex-smoker, never smoked) and history of previous diagnosis of asthma, hay fever, medication allergies, emphysema or bronchitis were ascertained. Questions on health status were grouped into four categories: 1) injuries; 2) respiratory (wheezing, cough, chest pain, etc.); 3)

gastrointestinal (loose stools, stomach cramps, nausea or vomiting); and 4) other (skin rash and ocular effects). Experiences with irritation from blowing dust and sand as well as from oil fire smoke were ascertained in separate questions.

In order to evaluate outcomes experienced by different occupations, it was necessary to group the various military occupational specialties (MOS) into larger categories. The six major categories used were Administration (e.g., personnel clerk, aviation supply clerk); Field (e.g., rifleman, mortarman, field radio operator); Maintenance (e.g., small arms repairer/technician, helicopter mechanic); Pilot/Naval Flight Officer; Navy; and Food Service. The Navy category was primarily composed of hospital corpsmen (HMs) and religious programs assistants (RPs). Comparisons of illness and injury experience were made among occupational categories within Groups I, II or III. However, comparisons of illnesses and injuries by occupation between groups were avoided, because the more usual roles of different specialties are often redefined in combat.

Instructions were read to all the participants prior to completion of the questionnaire in order to minimize problems with interpretation and completion of the survey (Appendix B). Personnel were told that participation in the survey was voluntary. A small number of individuals chose not to participate.

Data from the questionnaires were initially entered into a DBASE III[®] file for initial analysis and were later converted to SAS format, version 6.4, for more extensive analysis.

For the purposes of analysis, the "NO" response for a variable was defined as a reply of "none" or "mild" for that symptom, to reduce the number

of false positive replies. A "YES" was coded for a reply of "moderate" or "severe". Furthermore, inconsistent replies to different questions about the same symptom were treated as negative responses for that symptom. For example, if a positive response was given for question #5, which asked whether a person had "three or more loose (unformed) bowel movements in a 24 hour period," and a negative response was given for question #22, which asked about the duration of diarrhea, then the subject was assigned a negative value for diarrhea.

For the respiratory symptoms (wheeze, cough, chest pain, fever with cough, runny nose, sore throat, and cold), logistic analysis was used to compare prevalence rates among exposure groups after adjusting for smoking status, previous respiratory disease (asthma, hay fever, emphysema, or bronchitis), and flu inoculation. First, for each respiratory symptom, the two-way interactions with each group (smoking status by group, previous disease by group and flu inoculation by group) were tested simultaneously using the likelihood ratio test. If this test was not significant, the interactions were removed from the model, and a likelihood ratio test was used on the resulting main effects model to test for differences among groups. If significant differences were found, the Wald test was used to compare Group I to Group III, and Group II to Group III.

For the non-respiratory symptoms, logistic analysis was used to compare prevalence rates among exposure groups. First, a likelihood ratio test was used to test for differences among groups. Again, if significant differences were found, the Wald test was used to compare Group I to III, and Group II to III. All testing was performed using $\alpha=.05$. Wald-type confidence intervals were also computed.

FINDINGS

Data from a total of 2,668 questionnaires were analyzed. The mean age of all respondents was 24.8 years; the average length of service was 5.5 years; and the mean number of days of deployment in the KTO was approximately 120 days. Marines in Group III tended to be slightly older, have more years of service, and a greater length of deployment at the time of the survey (Table 1).

The distribution of job assignments was distinctly different among the three groups (Table 1). In Groups I and II, 79% and 74% of the respondents, respectively, were in the "Field" category. In contrast, the majority (55%) of Marines in Group III were assigned to the "Maintenance" category.

The prevalence of risk factors for respiratory disease such as smoking status, history of asthma, hay fever, and emphysema/bronchitis, and the receipt of influenza vaccination were examined for all three Groups (Table 2). Overall, 35.3% of Marines were current smokers, with the highest proportion (40.2%) in Group I. Approximately 4.9% of Marines noted a previous history of asthma; 14.6% gave a history of hay fever; and 8.6% had a previous diagnosis of either emphysema or bronchitis. Overall, 86.6% of respondents reported receiving the flu vaccine. No significant differences in reported risk factors associated with respiratory disease were found among the three groups.

Self-reported illnesses, injuries and symptoms were classed into four groups: 1) gastrointestinal (e.g., diarrhea, nausea/vomiting, stomach cramps); 2) respiratory (e.g., wheezing, cough, chest pain, sore throat, cold); 3) injuries (medically and non-medically attended); and 4) other (burning eyes, red eyes, skin rash). During the survey period, 25% of Marines in Group I experienced one or more significant diarrheal episodes, compared to

approximately 13% of the Marines in Groups II and III (Table 3). Marines in Group I reported experiencing the greatest frequency of respiratory symptoms followed by Group II, with Marines in Group III reporting the fewest symptoms with the exception of colds. A similar pattern of symptoms was noted for burning and red eyes, with Group I reporting the greatest frequency. For injuries, Group III had the highest proportion of medically attended injuries (20.2%) while Group I had the most injuries that were not medically attended.

Respiratory Symptoms

The prevalence of reported respiratory symptoms was examined according to: 1) smoking status; 2) history of previous respiratory disease; 3) individual response to blowing dust/sand or oil fire smoke; and 4) receipt of the flu vaccine. Adjusting for flu vaccination, history of respiratory disease, and smoking status, Group I reported wheezing, cough, runny nose, and sore throat significantly more frequently than Group III (Table 4). Examining the interactions between groups using a logistic model, the prevalence odds ratios did not vary significantly among the three smoking groups, between influenza vaccination groups, and between groups with a previous history of respiratory disease. No differences were noted between Groups I and III for the prevalence of colds, chest pain, or fever with cough. Group II had significantly fewer reported colds than Group III. When the prevalence of respiratory symptoms within groups by job class was examined, no prominent patterns were observed (Table 5). Group III personnel in maintenance assignments tended to report symptoms more frequently.

For wheezing, cough, sore throat and runny nose, when stratified by flu inoculation and smoking status, Marines in Group I generally reported higher prevalences of symptoms compared to Groups II and III (Figures 1A-D). Current

smokers, regardless of group, consistently reported more frequent respiratory symptoms (Figures 2A-B).

One third of the Marines in Groups I and II (36.5% and 32.3%, respectively) found blowing sand and dust to be moderately to severely irritating compared to 13.2% of Marines in Group III (Table 6). In all three groups, a greater proportion of smokers than nonsmokers found the sand and dust irritating. Respondents in Groups I and II (41.2% and 42.3%, respectively) found the oil fire smoke moderately to severely irritating, compared to 5.8% of Marines in Group III. In all three groups, a smaller proportion of smokers complained of oil fire smoke irritation than nonsmokers. Individuals from all groups who found either the dust/sand or oil smoke irritating were more likely to report respiratory symptoms (Table 7).

Gastrointestinal Symptoms

Group I experienced a significantly greater prevalence of diarrhea, stomach cramps, nausea and vomiting, and blood in the feces than Group III (Table 8). No differences were noted between Groups II and III. Similarly, no differences were observed among all the Groups for symptoms of fever with diarrhea and gas from CBW medication.

Most of those with diarrhea (72.3%) were living in the field with no running water or flush toilets (Table 9). Group I experienced diarrhea almost twice as frequently as the other two groups (43.3% compared to 29.8% for Group II and 26.9% for Group III). Living quarters, however, did not appear to account for the difference observed in the prevalence of diarrhea, as 93% of diarrheal cases in Group I lived in the field, compared to 89% of cases in Group II. No sick call or laboratory records are available to corroborate these reports or to shed light on the etiology of the diarrhea.

Injuries

Examining the prevalence odds ratios and the likelihood ratios, Group III had significantly more injuries than Group I and Group II (Table 8). This relationship was noted for all injuries and for those which received medical attention.

Of the injuries experienced that were medically attended, 54% were related to noncombat job performance, 40% to physical training, sports and other free time activities, and 6% were directly related to combat (Table 10). As anticipated, the combat injuries occurred exclusively in Groups I and II, with Group III experiencing the highest proportion of noncombat job injuries. The distribution of injuries overall was similar to the distribution of personnel assigned to those job groups. Maintenance personnel reported 60% of injuries in Group III and they constituted 55% of that group (Table 1). Field personnel reported 78% and 71% of injuries in Groups I and II respectively while accounting for 79% and 74% of all job assignments. Physical training and sports activities accounted for between 28% and 42% of injuries regardless of severity (Table 11).

STRENGTHS AND LIMITATIONS

The large number of personnel (N = 2715) surveyed and the fact that the exposure groups were of comparable size are major strengths of this survey, increasing the stability of the prevalence estimates and facilitating intergroup comparisons. The four day period over which the survey was administered also enhances intergroup comparisons. Each group responded based on experiences which occurred during the same period. Participants were asked to recollect symptoms which occurred during an approximate ten week period

between January 17th and the end of March 1991, rather than their entire deployment periods to lessen recall bias. The survey population was young, healthy and relatively homogeneous with an expected low rate of chronic health problems. The survey format enabled rapid assessment to be conducted.

The chief limitation of this survey is that it relies on the self-reporting of symptoms. There were neither the means nor the facilities to validate the complaints by physical examination or performing medical testing. A medical record review was not feasible in this field situation.

No detailed information was gathered on the movements and interim locations of the many units that participated. Although the personnel in Group I and Group II were surveyed in specific locations, the various units that made up these groups took a variety of routes through northeastern Saudi Arabia and Kuwait to reach their destinations. There are no measurements of exposure levels for oil smoke, dust or pollens that can be correlated with troop locations.

The questionnaire was designed, tested, printed and administered to all 2715 participants in a period of 18 days. The main factor which influenced this time period was the rapid return of troops to the U.S. which occurred in late March and early April of 1991. Some of the units scheduled to be surveyed departed on short notice before they could participate. This problem affected the sample size of Group III, which had the smallest number of participants.

Although field testing eliminated some problem areas, subsequent analysis revealed that some of the questions could be misinterpreted. In some cases, the available answer choices did not include all of the important factors, and thus were unsuitable for detailed analysis (e.g., question 24,

response B, does not indicate the sanitary conditions at warehouse sites).

CONCLUSIONS

1. Marines in Group I who were stationed in Kuwait at the time of the survey reported significantly greater proportions of wheezing, cough, runny nose, and sore throat than Marines in Group II (who had spent a short time in Kuwait) and Group III (stationed in Saudi Arabia). This constellation of symptoms is consistent with respiratory irritation. Risk factors examined in the survey, including smoking, history of respiratory disease, or receipt of flu vaccination, could not account for the observed differences. Conditions in Kuwait, where the Marines were located--including blowing sand and dust, increased pollen from the agricultural site and/or air pollution from the oil fires--may have accounted for the observed differences. Marines in both Groups I and II did find the sand and oil smoke moderately to severely irritating. High levels of airborne particulates due both to blowing sand and pollution from the oil fires during this period have been reported³. The respiratory irritation reported by the Marines in Group I is consistent with these measurements. The limitations of this survey make a more precise attribution of the source of the differences in reported respiratory symptoms impossible.
2. Marines in Group I reported a significantly greater proportion of diarrhea, stomach cramps, nausea and vomiting, and bloody stools than either Groups II or III. Differences in living conditions such as lack of running water or flush toilets did not appear to account for this observation. Whether a diarrheal outbreak occurred during this time in

Group I could not be independently corroborated. Flies were a problem at all sites. They may have been a greater source of disease transmission for Groups I and II living in the field without enclosed dining facilities. Preventive medicine surveillance during Desert Shield identified outbreaks of diarrheal disease related to contaminated food sources. Sufficient information was not available from this survey to identify the potential source of the increased reports of gastrointestinal symptoms.

3. Job-related, noncombat injuries accounted for majority of all injuries that required medical attention, followed by physical training/sports activity/free time injuries. Combat injuries constituted 5.9% of all injuries requiring medical attention. Overall, Group III experienced the greatest frequency of injury for which medical attention was sought. This difference may be explained in part by the fact that access to medical care in the Group III area remained relatively stable throughout the Desert Storm period. The facilities were fixed and the troops were not on the move. Thus, injured personnel in Group III would have found it easier to get medical attention for an injury.
4. This survey demonstrates the ability of preventive medical units to conduct field epidemiology in the post-war situation to provide commanders and policy makers current information on health risks and outcomes.

RECOMMENDATIONS

1. A follow-up survey to determine the health status of the Marines who participated in this survey should be conducted. Despite the limitations of this survey, recent concerns regarding the health status of military personnel who served in the KTO suggest the value of using the information gained in this survey to determine whether or not experiencing symptoms in February/March 1991 is related to current health status. This cohort of Marines may provide valuable information regarding the potential for long-term health effects of service in the KTO.
2. Provisions should be made to institute preventive medicine surveillance early in all future conflicts and deployments. Such surveillance is valuable in monitoring the health of troops, in identifying and controlling the sources of disease outbreaks and injury problems, and in responding to unexpected problems such as environmental sabotage.

REFERENCES

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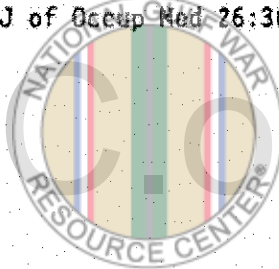
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TABLE 1 - Group Characteristics, Desert Storm Survey, U.S. Marines, March 1991

Variable	Group I	Group II	Group III	Total
	(N=892)	(N=978)	(N=798)	(N=2668)
Age - years*	24.1 (4.0)**	24.8 (5.3)	25.6 (5.4)	24.8 (5.0)
Service - years*	4.7 (3.6)	5.5 (5.0)	6.5 (5.2)	5.5 (4.7)
Deployment - days*	92.8 (35.8)	113.5 (56.3)	156.9 (72.5)	119.6 (61.9)
Job Group	# (%)	# (%)	# (%)	
Administration	23 (2.6)	85 (8.7)	168 (21.1)	--
Field	704 (78.9)	720 (73.6)	145 (18.2)	--
Maintenance	105 (11.8)	87 (8.9)	438 (54.9)	--
Pilot/NFO	2 (0.2)	1 (0.1)	21 (2.6)	--
Navy (HMs & RPs)	55 (6.2)	77 (7.9)	12 (1.5)	--
Food Service	3 (0.3)	8 (0.8)	14 (1.7)	--

*means

**standard deviation



TABLE 2 - Risk Factors, Desert Storm Survey, U.S. Marines, March 1991

Risk Factor	Group I # (%)	Group II # (%)	Group III # (%)	Total # (%)
Smoking				
Current	359 (40.2)	321 (32.8)	262 (32.9)	942 (35.3)
Former	85 (9.5)	109 (11.1)	117 (14.7)	311 (11.7)
Never	448 (50.2)	548 (56.0)	418 (52.4)	1414 (53.0)
Asthma	41 (4.6)	47 (4.9)	41 (5.2)	129 (4.9)
Hay Fever	140 (15.7)	146 (14.9)	103 (12.9)	389 (14.6)
Emph/Bronchitis	88 (9.9)	80 (8.2)	60 (7.5)	228 (8.6)
Flu Shot*	805 (90.8)	809 (82.9)	685 (86.6)	2299 (86.6)

*Just before or during deployment

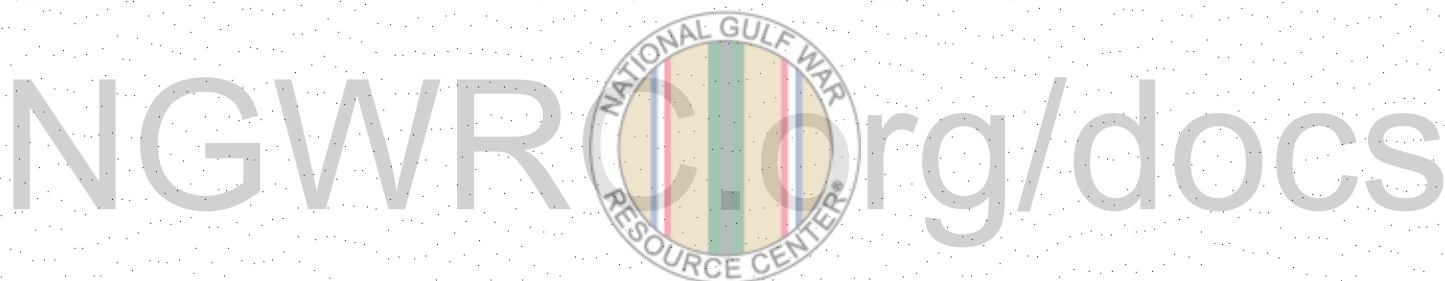


TABLE 3 - Prevalence of Symptoms, Desert Storm Survey, U. S. Marines, March 1991

Symptoms	Group I (%)	Group II (%)	Group III (%)	Total (%)
Gastrointestinal				
Diarrhea	25.0	12.9	13.2	17.0
Stomach Cramps	14.1	8.3	8.3	10.2
Nausea/Vomiting	6.7	3.6	3.6	4.6
Blood/Mucus/Feces	3.0	1.1	2.1	2.1
Fever/Diarrhea	3.6	2.2	2.3	2.7
Gas with CBW*	22.2	18.4	20.8	20.4
Respiratory				
Wheezing	8.9	4.0	3.0	5.3
Cough	18.9	15.5	12.5	15.7
Chest Pain	5.2	3.4	4.1	4.2
Fever/Cough	2.0	1.9	2.0	2.0
Runny Nose	27.6	23.4	20.6	24.0
Sore Throat	11.6	9.2	8.2	9.7
Cold	24.7	19.7	26.3	23.3
Other				
Burning Eyes	6.3	5.3	4.5	5.4
Red Eyes	1.9	1.9	1.8	1.9
Skin Rash	8.1	4.0	6.2	6.0
Injury				
Medical	9.0	12.0	20.2	13.4
No Medical**	44.1	32.5	37.6	37.9

*CBW - Chemical/Biological Warfare medications (pyridostyrgmine, ciprofloxacin)

**Minor injury not requiring medical attention

TABLE 4 - Respiratory Symptoms: Desert Storm Survey, U.S. Marines, March 1991

Symptom	Group	POR*	95% CI**	Likelihood Ratio	Interactions
Wheezing	I vs. III II vs. III	3.08 1.30	1.92 - 4.95 0.77 - 2.18	p<.01 NS	NS*** --
Cough	I vs. III II vs. III	1.54 1.27	1.17 - 2.02 0.96 - 1.67	p<.01 NS	NS --
Chest pain	I vs. III II vs. III	1.24 0.82	0.78 - 1.96 0.50 - 1.34	NS NS	NS --
Fever/Cough	I vs. III II vs. III	0.96 0.98	0.48 - 1.92 0.50 - 1.93	NS NS	NS --
Runny nose	I vs. III II vs. III	1.48 1.18	1.17 - 1.86 0.94 - 1.48	p<.01 NS	NS --
Sore throat	I vs. III II vs. III	1.45 1.11	1.05 - 2.02 0.80 - 1.56	p<.05 NS	NS --
Cold	I vs. III II vs. III	0.91 0.68	0.73 - 1.13 0.54 - 0.86	NS p<.01	NS --

*Prevalence odds ratio, adjusted for smoking, history of respiratory disease, and receipt of influenza vaccine
 **95% confidence interval
 ***non-significant

TABLE 5 - Prevalence of Respiratory Symptoms by Job Class, Desert Storm Survey,
U. S. Marines, March 1991

Symptom	Group I (%)			Group II (%)			Group III (%)		
	Field N=704	Maint N=105	Others* N=83	Field N=720	Maint N=87	Others N=170	Field N=145	Maint N=438	Others N=215
Wheezing	8.0	10.5	14.3	3.3	0.0	8.8	3.5	3.4	1.9
Cough	16.5	30.5	24.1	12.4	19.5	26.3	10.3	13.3	12.6
Chest Pain	5.0	5.7	6.0	3.6	1.2	3.5	3.5	4.6	3.7
Fever/Cough	2.0	1.9	2.4	1.1	3.5	4.7	3.5	2.1	0.9
Runny Nose	26.7	34.6	26.5	20.9	25.3	34.9	9.7	25.5	17.7
Sore Throat	11.6	14.4	8.4	8.1	9.2	14.0	6.3	9.9	6.0
Cold	24.5	24.8	26.5	16.5	17.2	34.3	16.6	31.8	21.4

*Others = Administration, Pilot/MIO, Navy and Food Service

TABLE 6 - Effects of Sand and Oil Fire Smoke; Desert Storm Survey,
U.S. Marines, March 1991

	Group I (%)	Group II (%)	Group III (%)	Total (%)
Blowing Dust/Sand*				
Smoker	38.7	35.2	14.5	30.7
Never Smoked	34.8	30.7	12.6	26.7
Total	36.5	32.3	13.2	28.0
Oil Fire Smoke*				
Smoker	40.1	39.4	3.8	29.7
Never Smoked	41.9	42.8	6.3	31.8
Total	41.2	42.3	5.8	31.0

*Reporting moderate or severe irritation



TABLE 7 - Respiratory Symptoms by Response to Dust/Sand or Oil Smoke; Desert Storm Survey,
U.S. Marines, March 1991

SYMPTOMS	GROUP I				GROUP II				GROUP III			
	DUST		OIL SMOKE		DUST		OIL SMOKE		DUST		OIL SMOKE	
	Yes*	No	Yes*	No	Yes*	No	Yes*	No	Yes*	No	Yes*	No
Wheezing	17.8	3.7	18.8	1.9	8.9	1.7	7.0	1.8	11.4	1.7	13.0	2.4
Cough	29.8	12.6	28.3	12.3	26.3	10.3	21.7	11.0	30.5	9.8	23.9	11.9
Chest Pain	9.2	2.8	8.7	2.7	6.4	2.0	6.1	1.4	12.4	2.9	8.7	3.9
Fever/Cough	3.4	1.2	3.5	1.0	4.1	0.9	3.2	1.1	5.7	1.4	8.7	1.6
Runny Nose	40.6	20.1	37.3	20.8	36.0	17.4	30.3	18.3	35.6	18.3	30.4	20.0
Sore Throat	17.8	8.0	16.3	8.3	16.5	5.7	13.3	6.2	20.2	6.4	17.4	7.6
Cold	35.9	18.2	36.2	16.7	27.0	16.2	23.2	17.1	37.1	24.6	37.0	25.6

*Reported moderate or severe irritation from dust/sand or smoke exposure.

TABLE 8 - Gastrointestinal, Skin & Eye Symptoms and Injuries: Desert Storm Survey
U.S. Marines, March 1991

Symptom	Group	POR ^a	95% CI ^b	Likelihood Ratio ^c	Wald Test
Diarrhea	I vs. III	2.19	1.70 - 2.83	p<.01	I>III
	II vs. III	0.98	0.74 - 1.29	NS	--
Stomach cramps	I vs. III	1.82	1.33 - 2.50	p<.01	I>III
	II vs. III	1.00	0.71 - 1.41	NS	--
Nausea/vomiting	I vs. III	1.91	1.21 - 3.01	p<.01	I>III
	II vs. III	0.99	0.60 - 1.63	NS	--
Blood in feces	I vs. III	1.43	0.78 - 2.65	p<.05	***
	II vs. III	0.52	0.24 - 1.12	NS	--
Fever w/ diarrhea	I vs. III	1.61	0.90 - 2.90	NS	--
	II vs. III	1.00	0.53 - 1.88	NS	--
Gas with CBM	I vs. III	1.09	0.86 - 1.37	NS	--
	II vs. III	0.86	0.68 - 1.09	NS	--
Burning eyes	I vs. III	1.42	0.92 - 2.18	NS	--
	II vs. III	1.18	0.77 - 1.83	NS	--
Red eyes	I vs. III	1.09	0.53 - 2.22	NS	--
	II vs. III	1.10	0.55 - 2.22	NS	--
Skin rash	I vs. III	1.34	0.92 - 1.95	NS	--
	II vs. III	0.63	0.41 - 0.97	p<.01	I<III
Injuries - all	I vs. III	0.82	0.68 - 1.00	p<.01	I<III
	II vs. III	0.58	0.48 - 0.71	p<.01	I<III
Injuries - medical	I vs. III	0.39	0.29 - 0.52	p<.01	I<III
	II vs. III	0.54	0.41 - 0.70	p<.01	I<III

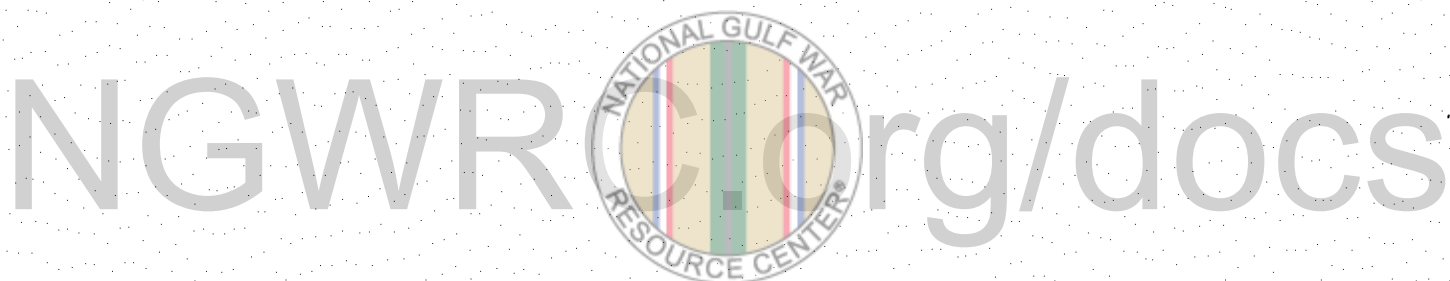
^aPrevalence odds ratio; unadjusted

^b95% confidence interval

^coverall test significant at p<.05 using likelihood ratio test, but pairwise Wald test was not significant

**TABLE 9 - Diarrhea by Living Conditions; Desert Storm Survey, U.S. Marines,
March 1991**

Living Condition	Group I #	Group II #	Group III #	Total # (%)
Ware House	13	9	7	29 (2.9)
Field (No Running H ₂ O)	395	262	57	714 (72.3)
Camp (H ₂ O & Flush Toilets)	5	8	181	194 (19.6)
Other Living Quarters	15	15	21	51 (5.2)
Total	428 (43.3)	294 (29.8)	266 (26.9)	988 (100.0)



**TABLE 10 - Injuries Requiring Medical Attention by Source of Injury;
Desert Storm Survey, U.S. Marines, March 1991**

	PT* # (%)	Job NC** # (%)	Combat # (%)	Total # (%)
Group I	34 (42.5)	39 (48.8)	7 (8.7)	80 (22.3)
Group II	40 (34.2)	63 (53.8)	14 (12.0)	117 (32.7)
Group III	70 (43.5)	91 (56.5)	0.0	161 (45.0)
Total	144 (40.2)	193 (53.9)	21 (5.9)	358 (100.0)

*Physical training, sports activities, free time injuries

**Job, non-combat injuries



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TABLE 11 - Source of Injury by Job Group; Desert Storm Survey, U. S. Marines, March 1991

Site	Job Group	PT* #(%)	Job NC** #(%)	Combat #(%)	Total #(%)
I	Field	158 (43.1)	177 (48.2)	32 (8.7)	367 (77.6)
	Maintenance	10 (14.1)	50 (70.4)	11 (15.5)	71 (15.0)
	Others	20 (57.1)	14 (40)	1 (2.9)	35 (7.4)
	Total	188 (39.8)	241 (50.9)	44 (9.3)	473 (100.0)
II	Field	97 (31.6)	162 (52.8)	48 (15.6)	307 (70.9)
	Maintenance	11 (21.2)	36 (69.2)	5 (9.6)	52 (12.1)
	Others	15 (20.3)	54 (73.0)	5 (6.7)	74 (17.0)
	Total	123 (28.4)	252 (58.2)	58 (13.4)	433 (100.0)
III	Field	21 (31.8)	45 (68.2)	0	66 (14.3)
	Maintenance	113 (40.8)	160 (57.8)	4 (1.4)	277 (60.1)
	Others	60 (50.8)	58 (49.2)	0	118 (25.6)
	Total	194 (42.1)	263 (57.0)	4 (0.9)	461 (100.0)

*Physical training, sports activities, free-time injuries

**Job, but not in combat, injuries

FIGURE 1-A

Prevalence of Wheezing

Desert Storm Survey, US Marines, March 1991

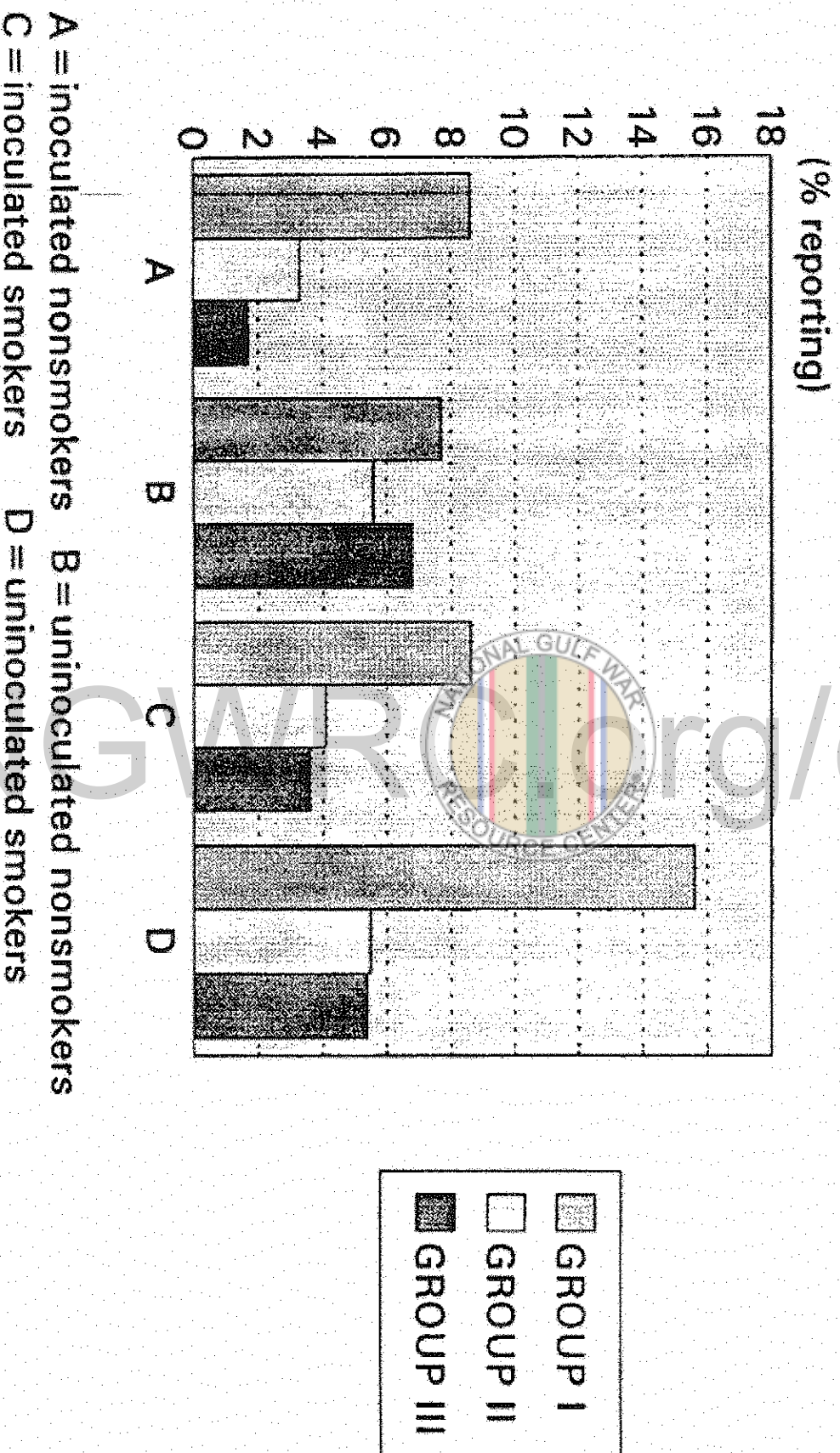


FIGURE 1-B

Prevalence of Cough

Desert Storm Survey, US Marines, March 1991

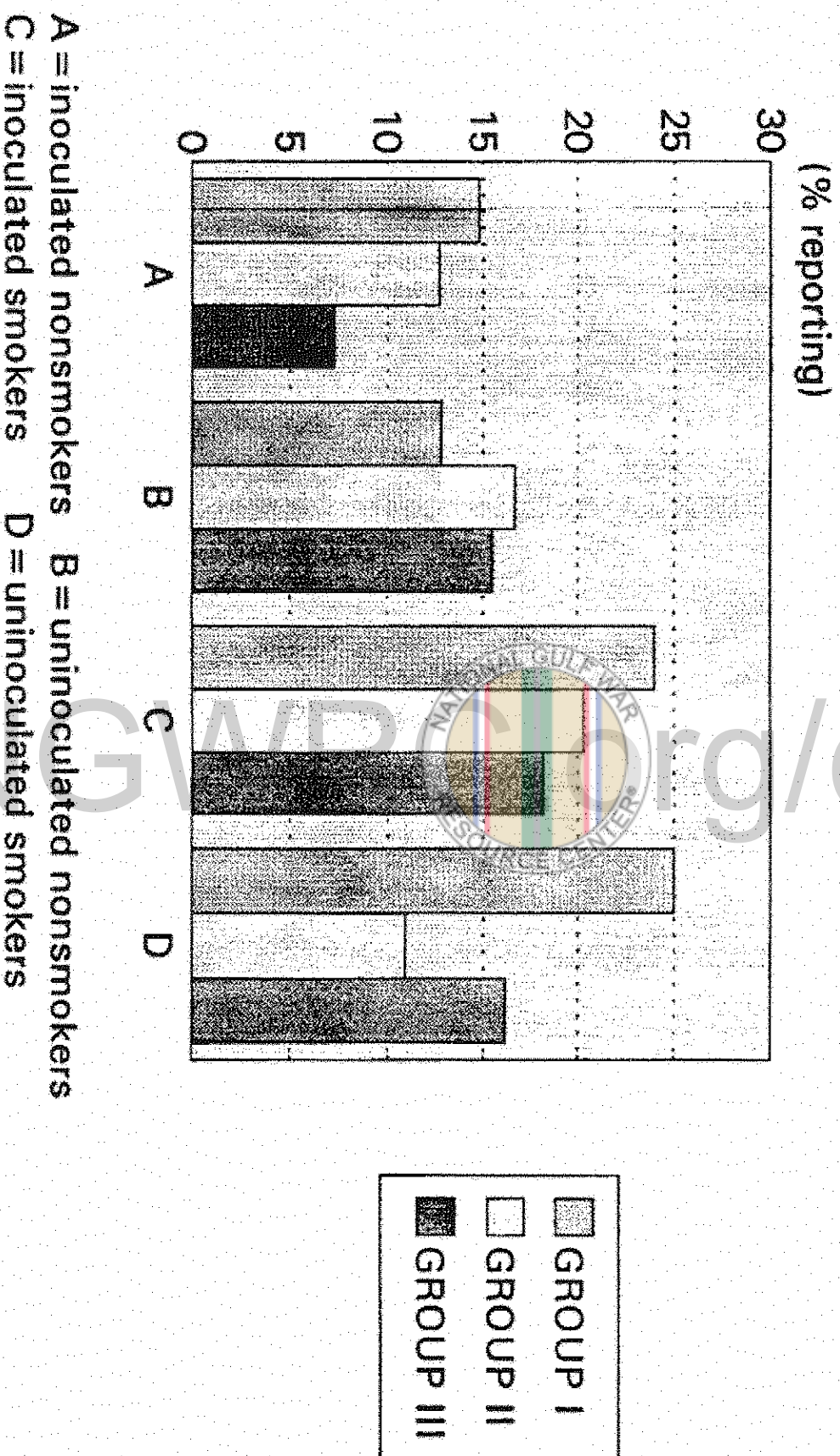


FIGURE 1-C

Prevalence of Sore Throat

Desert Storm Survey, US Marines, March 1991

