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IMPACT OF ILLNESS AND NON-COMBAT INJURY DURING OPERATIONS IRAQI FREEDOM AND ENDURING FREEDOM (AFGHANISTAN)

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Abstract. Historically, non-combat injuries and illnesses have had a significant impact on military missions. We conducted an anonymous cross-sectional survey to assess the prevalence and impact of common ailments among U.S. military personnel deployed to Iraq or Afghanistan during 2003–2004. Among 15,459 persons surveyed, diarrhea (76.8% in Iraq and 54.4% in Afghanistan), respiratory illness (69.1%), non-combat injuries (34.7%), and leishmaniasis (2.1%) were commonly reported. For all causes, 25.2% reported that they required intravenous fluids, 10.4% required hospitalization, and 5.2% required medical evacuation. Among ground units, 12.7% reported that they missed a patrol because of illness, and among air units, 11.7% were grounded because of illness. The incidence of diarrhea and respiratory infections doubled from the pre-combat to combat phases, and the perceived adverse impact of these illnesses on the unit increased significantly during the combat phase. Despite technologic advances in warfare and preventive medicine, illness and non-combat injuries have been common during operations in Iraq and Afghanistan, resulting in frequent transient decreases in operational efficiency.

INTRODUCTION

The United States military is currently transforming to meet the operational requirements of the 21st century.[1] Through the incorporation of advanced technological systems, the standard military unit is shrinking and is becoming more mobile to rapidly respond to global threats.[2] One of the advantages of this transformation is the ability to use fewer people to accomplish military objectives.[3] However, the use of smaller military units enhances the importance of the individual, meaning that reduced personal readiness may translate to a significant decrease in the operational efficiency of the unit.

Combat-related injuries are typically the most severe and dramatic health risks encountered during wartime operations, as has been true for the current military operations in Afghanistan and Iraq.[4,5] However, non-combat injuries and illnesses have also been shown to have a significant adverse impact on military operations, resulting in more hospitalizations and lost person-days than combat casualties in every war from the American Revolution through the Gulf War.[6–8] Since the United States currently has more than 140,000 troops deployed to Afghanistan and Iraq, military health care planners and providers should have a clear understanding of all health risks encountered in the region and the impact of common infections and non-combat injuries on the military mission. The four most commonly reported diagnoses during U.S. military deployments over the last 15 years have been non-combat orthopedic injuries, respiratory infections, skin diseases, and gastrointestinal infections.[9] A recent study reported detailed rates of diarrhea on U.S. military personnel deployed to Iraq and Afghanistan.[10] In addition, infections such as leishmaniasis,[11,12] malaria,[13] pneumonia,[14] and brucellosis[15] have been reported. However, to date, no studies have evaluated the impact of illness and non-combat injury among troops deployed to the regions during current campaigns. To assess this, we conducted a systematic survey among soldiers currently on deployment or returning to the United States after their initial tour in Iraq and Afghanistan.

METHODS

Study subjects. Military personnel leaving Iraq or Afghanistan at the completion of their deployment or who were participating in a rest and recuperation program were eligible for participation. From January through March 2004, approximately 100,000 of the 130,000 soldiers deployed to Iraq began returning home after being replaced by new troops. Also, during that same time, many of the 10,000 personnel in Afghanistan were returning home. The remaining U.S. military personnel deployed to both countries were participating in the rest and recuperation program, either going home for two weeks or receiving four days off at a regional base.

Study sites. Study personnel were placed in the terminals of two airports, Rhein-Main Air Base, Germany and Incirlik Air Base, Turkey, which are commonly used to transport personnel to and from Iraq and Afghanistan. Additionally, study personnel were stationed at Camp As Sayliyah, Doha, Qatar, the primary site for the rest and recuperation program. Study personnel conducted a convenience sampling of troops whose flights were transiting these airbases. Troops were met as they exited the plane and were asked if they would participate in the project. Researchers systematically distributed the study forms to the participants and subsequently collected the completed forms. Each volunteer completed only one form.

Study questionnaire. A previously tested questionnaire[10] assessing diarrhea prevalence, associated symptoms, treatment, and mission impact was significantly expanded to include questions concerning general health, respiratory illness, and non-combat injuries, as well as health risk behaviors and attitudes. A total of 199 questions were asked on the expanded questionnaire. However, because of time constraints of the transiting personnel and the anticipated large number of participants, the expanded questionnaire was divided into 20 separate single-page forms to ensure a representative dis-

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tribution of responses across all health categories. The single-page forms were composed of eight demographic and two clinical questions that were found on every form and 9–12 additional questions. The constant demographic and clinical questions were placed on multiple forms to later test for internal survey validity.

Mission impact was assessed through certain indicator questions. For personnel reporting that they participated in patrols, missing a patrol was the index used to assess impact. For personnel on flight status or from air units, being grounded was used as the index. These indexes would be familiar to the respective specialties, but would also provide a valid estimate of disease/injury impact.

Data entry and analysis. Data was entered into MS Access® (Microsoft, Inc., Redmond, WA). Data accuracy and data integrity checks were performed on all 20 single-page forms. The demographic data that was present on all 20 forms was statistically tested to ensure internal validity of results using the chi-square test (sex, rank, branch of service, and military component) and the Kruskal-Wallis test (time-in-country and age).

For statistical testing of continuous variables, normality testing was conducted, followed by either parametric (Student's *t*-test or analysis of variance) or non-parametric (Kruskal-Wallis test) analysis. Categorical variable (proportions) were statistically tested using chi-square or Fisher's exact tests. Point estimates and 95% confidence intervals (CIs) for all variables of interest were calculated by using OpenEpi version 8 statistical software (Stata Corporation, College Station, TX). Poisson regression was used to evaluate factors associated with differential incidence estimates. SAS version 8.software 2 (SAS, Cary, NC) was used for all other statistical analyses. All statistical tests were two-tailed and significance was defined as $P < 0.05$.

Operation Iraqi Freedom (OIF) was divided into three periods as defined by the Department of Defense that denoted both time and activity: pre-combat operations (prior to March 19, 2003), combat operations (March 19, 2003 through April 30, 2003), and post-combat operations (after April 30, 2003).[16] The survey questions assessing self-reported symptoms and impact referred to these phases by name only. Dates were used to calculate cumulative person-time for these phases to estimate incidence.

This study was conducted as an anonymous survey and was reviewed and approved by the Institutional Review Board of the Naval Medical Research Unit, No. 3 (Cairo, Egypt) under work unit number 6000.RAD1.D.E0301.

RESULTS

The study was conducted from January 1 through March 30, 2004. Of the approximately 140,000 U.S. military personnel who were deployed to Iraq (OIF) or Afghanistan (Operation Enduring Freedom [OEF]) in the previous year, 15,459 completed a study form. Personnel described themselves as being deployed to support OIF, OEF, or both operations. The demographic variables (Table 1) of age, sex, rank, and military component and the two clinical questions were similar across all 20 forms ($P > 0.05$). Time in country ranged from a median of 333 days to a median of 345 days across the forms.

Use of health care resources for any medical reason was commonly reported, with 25.2% receiving intravenous fluids during the deployment, 10.4% reporting hospitalization, and 5.2% requiring medical evacuation. Approximately one-quarter believed that combat unit effectiveness had been negatively affected by these common illnesses and injuries (Table 2). In Iraq, the self-reported incidence of diarrhea and respiratory infections nearly doubled from the pre-combat phase to the combat phase and then decreased considerably in the post-combat phase (Table 2). The perceived impact of these common illnesses on the combat unit effectiveness also increased significantly during the combat operations phase, and although it decreased in the post-combat operations phase, it never returned to the pre-combat phase perception level.

Diarrhea was the most commonly reported illness affecting troops in both Iraq and Afghanistan with 74.5% of the respondents stating they had at least one episode of diarrhea during their deployment (Table 3). Diarrhea was reported more commonly among personnel deployed to Iraq compared with Afghanistan (76.8% versus 54.4%, $P < 0.0001$) even when controlling for the demographic differences in the two groups. Additionally, troops in Iraq tended to have more severe symptoms and a longer duration of illness along with a higher likelihood of having more than one episode of diarrhea during their time in the country compared with troops stationed in Afghanistan (Table 3). Nearly half of the troops who developed diarrhea stated it was severe enough for them to seek medical care at least once, translating to a monthly estimated incidence of six clinic visits per 100 person-months for treatment of diarrhea. Combining results from Iraq and Afghanistan, 46.1% of the episodes of diarrhea were reported to result in decreased job performance for an average of two days. Extrapolated to the entire population, we estimate 13 days of job performance (95% CI = 12–14 days) were decreased because of diarrhea per 100 person-months. In 14.2% of the cases, diarrhea resulted in the troops being confined to bed for a median of two days, and 1.8% were hospitalized, resulting in an estimated 3.7 days (Poisson 95% CI = 3.4–4.0 days) of complete work loss per 100 person-months.

Respiratory illnesses were reported by 69.1% of all personnel during their deployment. In 17.0% of the cases, the episode was sufficiently severe for the individual to seek medical care (Table 4). Inquiries about tobacco use showed that 38.9% of the troops smoked at least half a pack of cigarettes per day and of the smokers, 47.6% either began smoking or restarted smoking during the deployment.

Non-combat injuries were reported by 34.7% of the respondents, with 77.0% of those with injuries requiring medical evaluation (Table 5). No significant differences were noted in non-combat injuries among troops stationed in Iraq compared with those in Afghanistan. A variety of different etiologies of the injuries were reported, with the largest single identified cause being sports or physical training. Additionally, numerous sites of injuries were reported, with the back being the most common single site of injury.

A diagnosis of leishmaniasis was reported by 2.1% of the respondents (95% CI = 1.1–3.5%). The regular use of N,N-diethyl-*m*-toluamide (DEET) is an effective repellent against the sand fly bites responsible for the spread of leishmaniasis.[17] However, data for all study respondents demonstrated that although 68.5% of the troops knew DEET was readily

TABLE 1
Demographics of volunteers among U.S. military personnel deployed to support OIF or OEF, 2003–2004, (n = 15,459)*

	OIF only	OEF only	Both
Male sex, n (%)†	8,424 (90.3)	841 (85.8)	3,798 (88.9)
Age in years, median (IQR)†	26 (22–32)	27 (22–36)	26 (22–34)
Days in country, median (IQR)†	337 (298–349)	211 (140–324)	340 (313–352)
Branch, n (%)†			
Army	9,106 (97.4)	882 (90.0)	4,078 (95.3)
Air Force	201 (2.2)	75 (7.7)	168 (3.9)
Marine	5 (< 0.1)	10 (1.0)	5 (0.1)
Navy	7 (< 0.1)	4 (0.4)	1 (< 0.1)
Other	3 (0.3)	9 (0.9)	27 (0.6)
Rank, n (%)†			
E1–E4	4,611 (49.5)	463 (47.5)	2,126 (50.0)
E5–E6	2,879 (30.9)	298 (30.6)	1,564 (36.8)
E7–E9	605 (6.5)	103 (10.6)	308 (7.2)
Warrant	150 (1.6)	17 (1.7)	42 (1.0)
O1–O3	871 (9.4)	65 (6.7)	165 (3.9)
O4–O6	196 (2.1)	29 (3.0)	49 (1.2)
Military component, n (%)†			
Regular	7,780 (83.3)	603 (61.7)	2,714 (63.5)
Reserve	397 (4.3)	104 (10.6)	541 (12.7)
National Guard	1,143 (12.2)	267 (27.3)	1,005 (23.5)
Other	15 (0.2)	4 (0.4)	13 (0.3)
Unit type, n (%)			
Ground	195 (51.6)	9 (30.0)	70 (42.4)
Air	26 (6.9)	3 (10.0)	13 (7.9)
Support	141 (37.3)	14 (46.7)	74 (44.9)
Command	6 (1.6)	2 (6.7)	2 (1.2)
Special Operations	3 (0.8)	0	2 (1.2)
Other	7 (1.9)	2 (6.7)	4 (2.4)
Frequency of patrol off military compound			
Never	150 (39.3)	18 (60.0)	63 (39.1)
Daily	138 (36.1)	7 (23.3)	53 (32.9)
Weekly	65 (17.0)	3 (10.0)	27 (16.8)
Monthly	29 (7.6)	2 (6.7)	18 (11.2)
Duration of patrol off military compound			
1–2 hours	31 (13.3)	3 (25.0)	12 (12.2)
3–6 hours	123 (52.8)	4 (33.3)	40 (40.8)
7–12 hours	49 (21.0)	2 (16.7)	33 (33.7)
13–24 hours	18 (7.7)	1 (8.3)	8 (8.2)
1–3 days	5 (2.2)	1 (8.3)	3 (3.1)
> 3 days	7 (3.0)	1 (8.3)	2 (2.0)
On flight status, n (%)	42 (11.6)	7 (26.9)	16 (10.7)
Prior deployment to Middle East, n (%)	106 (20.1)	11 (23.4)	55 (22.3)
Reason for traveling, n (%)			
Rest and recuperation	71 (17.0)	32 (54.2)	42 (21.4)
Redeployment home	340 (81.1)	27 (45.8)	155 (77.1)
Other	8 (1.9)	0	3 (1.5)

* Military Unit distribution, description of patrols, and flight status were derived from a single survey, n = 574. OIF = Operation Iraqi Freedom; OEF = Operation Enduring Freedom; IQR = interquartile range.
† $P < 0.001$ by chi-square test, across groups.

available, only 14.6% of troops reported using DEET more than occasionally and 51.2% never used DEET. Specific questions regarding why usage was low were not asked, but only 41.1% of the respondents believed DEET to be effective and only 21.6% believed the product was safe. Beliefs about DEET were not associated with the sex, service, or rank of the responder.

DISCUSSION

In the current study, we provide the first comprehensive, systematically collected data on the frequency and impact of illnesses and non-combat injuries among U.S. military personnel deployed in Iraq and Afghanistan. Access to a large numbers of troops within a short period of time allowed for the collection of detailed information on various medical conditions, demonstrating that non-combat injuries and illnesses caused significant morbidity in both regional operations. Although there have been more than 10,000 combat casualties in Afghanistan and Iraq,[5] data from this study, combined with data on combat-related injuries, indicate that medical evacuations for non-combat injuries and illness were 3–6 times more common than evacuation for combat-related wounds.[18]

In previous wars, rates of illness and non-combat injuries have been recorded through the Disease Non-Battle Injury (DNBI) system, but this data has been difficult to obtain in the current conflict. Even when reported from past conflicts, the DNBI system has been shown to dramatically underestimate rates of illness and injury and their impact on the mission.[19] Assessing the actual impact of illnesses and non-combat injuries on the ability of the troops to perform their mission is difficult, requiring specific knowledge of the mis-

TABLE 2

Impact of common illnesses and non-battle injuries among U.S. military personnel deployed to Iraq or Afghanistan, 2003–2004*

	%	95% CI
Health care utilization		
Hospitalized for any reason	10.4	8.3–12.4
Medically evacuated (MEDEVAC) for any reason	5.2	3.6–6.9
Intravenous fluids for any reason	25.2	22.1–28.3
Clinic visit for common injury or illness		
Diarrhea	48.3	44.4–52.2
Respiratory	17.0	14.2–19.7
Injury	31.4	28.0–35.1
Operational impact of common injury or illness		
Ever miss patrol due to any illness	12.7	9.2–16.2
Ever grounded from flight duty due to any illness	11.7	5.2–18.2
Minimum incidence (per 100 person weeks) of common illnesses or non-combat injuries by operation phase†		
Pre-combat operations		
Diarrhea	6.0	4.1–8.4
Respiratory	4.6	3.0–6.8
Injury	5.1	3.3–7.5
Combat operations		
Diarrhea	12.6	11.2–14.1
Respiratory	8.4	7.3–9.6
Injury	5.5	4.6–6.6
Post-combat operations		
Diarrhea	1.0	0.9–1.1
Respiratory	0.6	0.5–0.7
Injury	0.3	0.2–0.3
Overall incidence (per 100 person weeks) of common illnesses or non-combat injuries‡		
Diarrhea	9.1	9.0–9.2
Respiratory	3.3	3.2–3.6
Injury	2.0	1.9–2.1
Experienced decreased individual performance effectiveness during deployment due to injury or illness		
Diarrhea	46.1	42.2–50.1
Respiratory	14.1	11.6–17.0
Injury	17.6	14.6–21.0
Experienced decreased unit effectiveness due to injury or illness†		
Pre-combat operations		
Diarrhea	5.5	3.8–7.2
Respiratory	5.6	3.9–7.3
Injury	7.3	5.4–9.2
Combat operations		
Diarrhea	14.3	11.7–16.9
Respiratory	8.8	6.7–10.9
Injury	10.2	8.0–12.4
Post-combat operations		
Diarrhea	11.3	9.0–13.7
Respiratory	6.3	4.5–8.1
Injury	7.7	5.7–9.6
Feel that unit effectiveness was negatively affected by		

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Diarrhea	27 (4.8)	11 (19.4)	180 (31.7)	142 (25.0)	109 (19.2)
Respiratory	26 (4.5)	106 (18.4)	194 (33.6)	146 (25.3)	105 (18.2)
Injury	31 (5.4)	119 (20.6)	194 (33.6)	143 (24.8)	90 (15.6)

* CI = confidence interval; OIF = Operation Iraqi Freedom; OEF = Operation Enduring Freedom.
† Analysis of this section excluded those personnel only deployed in support of OEF.
‡ Incidence rate for diarrhea and respiratory different between OIF and OEF.

TABLE 3

Impact of diarrhea among U.S. military personnel deployed to Iraq and Afghanistan, 2003–2004*

N	Iraq, n (%)	Afghanistan, n (%)	*P*
Experienced diarrhea	7,553 (76.8)	543 (54.4)	< 0.0001
Number of episodes	5 (2–8)†	2 (2–5)†	0.0003
Duration (days)	4 (1.5–4)†	1.5 (1.5–4)†	0.008
Maximum number loose stools per day	5 (2.5–5)†	2.5 (2.5–5)†	< 0.0001
Reported more than 6 stools per day	1,166 (20.8)	55 (14.0)	

Illness characteristics combined from Iraq and Afghanistan‡

	%	95% CI
Sought care for diarrhea	40.2	38.0–42.5
Number of clinic visits§	2	1–2
Fever with diarrhea	25.8	22.3–29.2
Vomiting with diarrhea	18.0	15.0–21.1
Vomiting without diarrhea	16.5	14.0–19.1
Persistent diarrhea (> 14 days)	9.8	7.5–12.1
Chronic diarrhea (> 30 days)	3.3	1.9–4.7
Disposition		
Confined to quarters (bedrest)	14.2	11.5–16.9
Days in quarters§	2	1–2
Hospitalized	1.8	0.7–2.8
Personal/unit impact		
Access to flush toilet during diarrhea episode	13.3	10.4–16.5
Fecal incontinence due to diarrhea/unable to access toilet	31.9	27.8–36.0
Decreased job performance	46.1	42.2–50.0
Days of decreased job performance§	2	1–3
Back-up personnel required	11.9	9.3–14.4
Missed patrol	8.7	5.7–11.7
Grounded	6.1	1.4–10.9
Availability within the military system (limited to Iraq)		
Pre-combat operation phase		
Military food	81.3	78.2–84.1
Safe water	80.3	77.4–83.3
Combat operation phase		
Military food	69.6	66.1–73.0
Safe water	64.7	61.1–68.2
Post-combat operation phase		
Military food	90.9	88.8–93.0
Safe water	89.9	89.9–94.0

* CI = confidence interval.
† Values in parentheses are interquartile ranges.
‡ No statistical differences were observed for these characteristics between sites.
§ Values for these characteristics are median and interquartile range.

sion (combat versus support), human resources, environmental conditions, and personnel safety issues.[20] Although some objective measures of impact can be obtained from official measurements,[16] such as casualty, hospitalization, and medical evacuation rates, other assessment tools are necessary to account for the multitude of other mission impact outcomes. The most direct way to account for these variables and measure impact is to conduct post-mission surveys among persons directly involved in the operation. The Department of Defense routinely performs pre- and post-deployment health assessment surveys on every deployable member of the U.S. military,[21,22] which are updated and reported regularly.[23] Unlike these surveys, which are designed to ensure medical fitness prior to deployment and to identify medical conditions and/or exposures of concern following deployment, our survey was designed to assess the incidence, perceived impact on the mission, and associated attitudes and risk behaviors of commonly occurring illnesses and non-combat injuries among combat personnel. The success of this study may lead to the development of additional survey tools and other studies designed to assess the actual impact of these complaints, including cost-benefit analysis of treatment and prevention strategies.

TABLE 4
Impact of respiratory illness among U.S. military personnel deployed to Iraq or Afghanistan, 2003–2004*

	%	95 CI
Number of respiratory infections (cough or cold) during deployment		
None	30.9	27.6–34.4
1	19.1	16.4–22.2
2–3	35.6	32.3–39.2
> 3	14.4	12.0–17.2
Sought medical care for a respiratory infection	17.0	14.2–19.8
Received medicine from a provider for a respiratory infection	17.8	14.9–20.7
Self-medicated for respiratory infection	29.3	26.2–32.5
Experienced an allergy attack	22.5	19.4–25.6
Experienced an asthma attack	3.6	2.2–5.0
Developed pneumonia	2.6	1.4–3.8
Started/re-started smoking	47.6	41.7–53.6
Number of packs/day		
None	61.0	57.2–64.7
½	17.5	14.6–20.4
1	14.5	11.8–17.2
> 1	7.0	5.1–9.0
Smoke Iraqi cigarettes	72.2	66.8–77.5

* CI = confidence interval.

Approximately 75% of all troops reported having at least one episode of diarrhea, and multiple episodes were common. Also, diarrheal illness was often moderately severe, with nearly 16.5% requiring intravenous fluids, 14.2% being restricted to bed for a median of two days, and almost 2% being hospitalized to treat their diarrhea. Other inconveniences caused by illness are less obvious, but potentially important in terms of mission impact. For example, only 13.4% of the volunteers with diarrhea had access to flush toilets and nearly one-third reported that they were unable to find any toilet facility during a diarrhea episode.

TABLE 5
Impact of non-battle injuries among U.S. military personnel deployed to Iraq or Afghanistan, 2003–2004*

	% reporting	95% CI
Number of non-combat injuries during deployment		
None	65.3	61.8–68.7
1	15.9	13.3–18.7
2–3	15.6	13.1–18.4
Any	34.7	31.3–38.1
Sought care for most serious injury	77.0	71.8–82.1
Number times sought care†	1.5	1.5–3.5
Medicine received from provider		
Ibuprofen	62.8	57.1–68.6
Narcotic	17.0	12.6–21.5
Splint/brace/immobilization	21.0	16.1–25.8
Self-medication for injury	29.4	26.2–32.6
Duration of pain (days) for most severe†	5.5	2.5–42
Site of injury		
Lower back	23.5	20.1–27.0
Upper back	8.5	6.2–10.7
Neck	5.7	3.8–7.6
Shoulders	12.4	9.7–15.0
Arm	8.8	6.5–11.1
Hand/fingers	22.6	19.2–26.0
Knee	18.2	15.1–21.4
Ankle/foot	22.2	18.8–25.5
Eye	6.7	4.7–8.8
Mechanism of injury		
Parachute	0.7	0.1–2.5
Jump/fall	13.7	10.0–18.5
Heavy loads	14.4	10.6–19.3
Sports	23.0	18.2–28.5
Vehicle accident	5.6	3.3–9.2
Other	42.6	36.7–48.7

* CI = confidence interval.
† Values for these characteristics are median and interquartile range.

As with prior studies demonstrating an increase in both battle- and non-battle–related injuries and illnesses during the period of combat,[24,25] diarrhea and respiratory infections were observed to be more common during the combat phase of operations in Iraq. Although unproven, the combination of an increased pace of operations along with a breakdown in the ability to provide clean water and food, appropriate hygiene, and medical resources likely led to the increase in illness.[26] The perceived impact of these illnesses also increased dramatically during combat operations, an expected finding when loss of any individual can be seen to have a negative effect on unit efficiency. As logistical infrastructure was reestablished in the post-combat operations phase, the incidence of non-combat injuries and illnesses decreased significantly, but the perceived impact of these ailments only decreased slightly. This likely reflects the continued high pace of operations and the continued need for both individual and unit effectiveness and efficiency.

Past studies have shown that even relatively minor upper respiratory tract infections can have significant impact on military operations.[27] In this survey, respiratory illnesses were not as common as diarrhea, but more than two-thirds of troops had at least one respiratory illness and 17% of these individuals sought medical care for their condition. Concern has been raised about a perceived increase in the expected frequency of pneumonia among personnel deployed to Iraq.[14] In the current study, 2% of the troops reported having been diagnosed with pneumonia but it appears the condition was typically mild, not requiring hospitalization. An association between smoking, especially cigarettes from Iraq, and eosinophilic pneumonia has been proposed.[28] However, we were unable to show any association between smoking Iraqi cigarettes and development of any respiratory illness, which is consistent with past surveys of deployed personnel.[7] As in the Persian Gulf War,[29,30] of the 39% reporting that they were smokers, almost half reported starting or restarting smoking during this deployment.

Non-combat injuries were less likely to be reported as seen in past surveys,[31] but of the 34% of the troops reporting non-combat injuries, 77% sought care multiple times. The impact of these injuries on the mission can be underestimated if the main measures are medical evacuation or hospitalization because extensive outpatient care is often provided at lower echelon–level clinics.[31] For instance, 21% of the respondents required immobilization or splinting and 17% received narcotics for pain. This extensive outpatient care likely maintained troop numbers in the field, but it is difficult to measure the decreased capabilities of patients treated in this manner. Systems have been developed to project and measure both casualty rates and non-combat injuries and illnesses,[31,32] but further enhancements are needed to account not only for time completely lost but also diminished abilities.

The self-reported use of DEET in Iraq and Afghanistan is extremely low and puts troops at increased risk of various arthropod-borne infections. This is a critical issue because 2.1% of the respondents report having been diagnosed with

leishmaniasis, and the treatment of cutaneous leishmaniasis has accounted for an average of 4.4% of the monthly medical evacuations from the Iraqi theater.[18] The limited use of DEET appears to be primarily due to a misunderstanding of its safety profile and documented efficacy. DEET has been associated with a few case reports of seizures in young children,[33] and there have been concerns expressed about potential neurologic complications resulting from DEET in veterans of the Persian Gulf War of 1991.[34] However, after nearly 50 years of widespread use, there is a strong consensus among toxicologists and epidemiologists that DEET is extremely safe and efficacious.[33,35–37] A survey of military personnel found similarly poor results in the use of DEET,[38] and another report has emphasized the need for troop commanders and field leaders to enforce the use of DEET.[39] However, our survey found that officers and senior enlisted personnel were just as likely to be misinformed about the safety and efficacy of DEET as junior enlisted personnel. It is therefore clear that preventive medicine educational efforts are needed to overcome the misperceptions regarding the use of DEET.

This study had several potential limitations that should be mentioned. As with any survey, there is a possibility of recall bias, especially differential recall (i.e., those with an illness or injury may be more likely to recall exposures or impact). There is also the issue of selection bias. Personnel who were medically evacuated and not returned to duty because of a severe illness or injury would likely not have been available for this survey, potentially resulting in an underestimate of the impact of illness and injury. Special operations units or task forces, which may have been exposed to especially austere or dangerous conditions, may have had separate transportation capabilities and could be under-represented. Furthermore, a recent study found that those involved in combat operations in Iraq and Afghanistan may be at significant risk of mental health problems.[40] This study was not designed to assess the impact of combat stress or mental health problems, but the issue certainly needs further study as well as significant preparations for providing appropriate care to those affected.[41,42]

A novel aspect of the current study was the use of multiple small data collection forms that were sub-parts of a larger, detailed questionnaire. Collection of demographic data (age, sex, rank, and service) on every study subject allowed the statistical comparisons across each form. Since there was no significant difference across the demographics, it is likely the derived point estimates for each question are generalizable to the entire population.

The military is undergoing a major systematic transformation to deal with the challenges of the 21st century, using advances in technology and communication to improve operational efficiency.[43] It is clear from the data presented that despite modern preventive medicine measures, illnesses and non-combat injuries are common and may have significant impact on military readiness and operational efficiency. Therefore, the transformation of the military should include continued improvements in surveillance, prevention, and management of common disabling illnesses and non-combat injuries.

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