Author	Title	Year	Journal/Proceedings	Reftype	DOI/URL
Abraham, J.H. and Baird, C.P.	**A case-crossover study of ambient particulate matter and cardiovascular and respiratory medical encounters among US military personnel deployed to southwest Asia.**	**2012**	**Journal of occupational and environmental medicine Vol. 54, pp. 733-739**	**article**	**DOI**
Abstract: To evaluate the impact of ambient particulate matter (PM) on acute cardiorespiratory morbidity among US military personnel in southwest Asia. We linked ambient PM data collected between December 2005 and June 2007 with personnel, medical, and meteorological data. We implemented a case-crossover analysis to estimate base-specific associations and pooled those estimates using meta-analytic methods. The adjusted odds ratios for a 10-µg/m increase in ambient PM2.5 and a qualifying medical encounter were 0.92 (95% confidence interval [CI]: 0.77 to 1.11) and 1.01 (95% CI: 0.95 to 1.07) for the current (lag_0) and previous (lag_1) days. The estimates for a 10-µg/m increase in PM10 were 0.99 (95% CI: 0.97 to 1.03) at lag_0, and 1.00 (95% CI: 0.97 to 1.02) at lag_1. No statistically significant associations between PM and cardiorespiratory outcomes were observed in this young, relatively healthy, deployed military population.					
Abraham, J.H., Eick-Cost, A., Clark, L.L., Hu, Z., Baird, C.P., DeFraites, R., Tobler, S.K., Richards, E.E., Sharkey, J.M., Lipnick, R.J. and Ludwig, S.L.	**A retrospective cohort study of military deployment and postdeployment medical encounters for respiratory conditions.**	**2014**	**Military Medicine Vol. 179(5), pp. 540-546**	**article**	**DOI URL**
Abstract: Deployed military personnel are exposed to inhalational hazards that may increase their risk of chronic lung conditions. This evaluation assessed associations between Operation Iraqi Freedom (OIF) deployment and postdeployment medical encounters for respiratory symptoms and medical conditions. This retrospective cohort study was conducted among military personnel who, between January 2005 and June 2007, were deployed to either of two locations with burn pits in Iraq, or to either of two locations without burn pits in Kuwait. Incidence rate ratios (IRRs) were estimated using two nondeployed reference groups. Rates among personnel deployed to burn pit locations were also compared directly to those among personnel deployed to locations without burn pits. Significantly elevated rates of encounters for respiratory symptoms (IRR = 1.25; 95% confidence interval [CI]: 1.20-1.30) and asthma (IRR = 1.54; 95% CI: 1.33-1.78) were observed among the formerly deployed personnel relative to U.S.-stationed personnel. Personnel deployed to burn pit locations did not have significantly elevated rates for any of the outcomes relative to personnel deployed to locations without burn pits. These results are consistent with the hypothesis that OIF deployment is associated with subsequent risk of respiratory conditions. Elevated medical encounter rates were not uniquely associated with burn pits.					
Shorr, A.F., Scoville, S.L., Cersovsky, S.B., Shanks, G.D., Ockenhouse, C.F., Smoak, B.L., Carr, W.W. and Petruccelli, B.P.	**Acute eosinophilic pneumonia among US Military personnel deployed in or near Iraq.**	**2004**	**JAMA Vol. 292, pp. 2997-3005**	**article**	**DOI**
Abstract: Acute eosinophilic pneumonia (AEP) is a rare disease of unknown etiology characterized by respiratory failure, radiographic infiltrates, and eosinophilic infiltration of the lung. To describe a case series of AEP, illustrate the clinical features of this syndrome, and report the results of an epidemiologic investigation. Epidemiologic investigation of cases of AEP identified both retrospectively and prospectively from March 2003 through March 2004 among US military personnel deployed in or near Iraq. Survivors were offered a follow-up evaluation. Morbidity and mortality related to AEP. There were 18 cases of AEP identified among 183,000 military personnel deployed in or near Iraq during the study period, yielding an AEP incidence of 9.1 per 100,000 person-years (95% confidence interval, 4.3-13.3). The majority of patients (89%) were men and the median age was 22 (range, 19-47) years. All patients used tobacco, with 78% recently beginning to smoke. All but 1 reported significant exposure to fine airborne sand or dust. Known causes of pulmonary eosinophilia (eg, drug exposures or parasitic disease) were not identified. Epidemiologic investigation revealed no evidence of a common source exposure, temporal or geographic clustering, person-to-person transmission, or an association with recent vaccination. Six patients underwent bronchoalveolar lavage (median eosinophilia of 40.5%). All patients developed peripheral eosinophilia (range, 8%-42%). Mechanical ventilation was required in 67% for a median of 7 (range, 2-16) days. Two soldiers died; the remainder responded to corticosteroids and/or supportive care. Twelve individuals were reevaluated a median of 3 months after diagnosis. At that point, 3 patients reported mild dyspnea and 1 reported wheezing. All patients had finished treatment and had either normal or nearly normal spirometry results. None had recurrent eosinophilia. AEP occurred at an increased rate among this deployed military population and resulted in 2 deaths. Failure to consider AEP in the differential diagnosis of respiratory failure in military personnel can result in missing this syndrome and possibly death. The etiology of AEP remains unclear, but the association with new-onset smoking suggests a possible link.					
Masiol, M., Mallon, C.T.M., Haines, K.M.J., Utell, M.J. and Hopke, P.K.	**Airborne Dioxins, Furans, and Polycyclic Aromatic Hydrocarbons Exposure to Military Personnel in Iraq.**	**2016**	**Journal of Occupational and Environmental Medicine Vol. 58, pp. S22-S30**	**article**	**DOI**
Abstract: OBJECTIVES: The objective of this study was to use ambient polycyclic aromatic hydrocarbon (PAH), polychlorinated dibenzo-p-dioxins (PCDD), and polychlorinated dibenzofurans (PCDF) concentrations measured at Joint Base Balad in Iraq in 2007 to identify the sources of these species and their spatial patterns. METHODS: The ratios of the measured species were compared with literature data for likely emission sources. Using the multiple site measurements on specific days, contour maps have been drawn using inverse distance weighting (IDW). RESULTS: These analyses suggest multiple sources, including the burn pit (primarily a source of PCDD/PCDFs), the transportation field (primarily as source of PAHs), and other sources of PAHs that include aircraft, space heating, and diesel power generation. CONCLUSIONS: The nature and locations of the sources were identified. PCDD/PCDFs were emitted by the burn pit. Multiple PAH sources exist across the base.					
Rohrbeck, P., Hu, Z. and Mallon, C.T.M.	**Assessing Health Outcomes After Environmental Exposures Associated With Open Pit Burning in Deployed US Service Members.**	**2016**	**Journal of Occupational and Environmental Medicine Vol. 58, pp. S104-S110**	**article**	**DOI**
Abstract: OBJECTIVE: This study assessed the long-term health impact of environmental exposures associated with open pit burning in deployed US service members. METHODS: Two hundred individuals deployed to Balad, Iraq, and Bagram, Afghanistan, with known exposure to open pits, were matched to 200 non-deployed service members. Both cohorts were observed for adverse health outcomes after returning from deployment. RESULTS: Slight increased risks were observed for respiratory diseases in the Bagram cohort (adj RR: 1.259), and for cardiovascular disease in the Balad cohort (adj RR: 1.072), but the findings were not significant. The combined deployed cohort showed lower risks for adverse health outcomes, suggesting a healthy deployer effect. CONCLUSIONS: In conclusion, this study did not find significantly increased risks for selected health outcomes after burn pit exposure during deployment among two deployed cohorts compared with a non-deployed cohort.					
National Academies of Sciences, E. and Medicine	**Assessment of the Department of Veterans Affairs Airborne Hazards and Open Burn Pit Registry**	**2017**		**book**	**DOI URL**
Abstract: Military operations produce a great deal of trash in an environment where standard waste management practices may be subordinated to more pressing concerns. As a result, ground forces have long relied on incineration in open-air pits as a means of getting rid of refuse. Concerns over possible adverse effects of exposure to smoke from trash burning in the theater were first expressed in the wake of the 1990-1991 Gulf War and stimulated a series of studies that indicated that exposures to smoke from oil-well fires and from other combustion sources, including waste burning, were stressors for troops. In January 2013, Congress directed the Department of Veterans Affairs (VA) to establish and maintain a registry for service members who may have been exposed to toxic airborne chemicals and fumes generated by open burn pits.					

Author	Title	Year	Journal/Proceedings	Reftype	DOI/URL
Conlin, A.M.S., DeScisciolo, C., Sevick, C.J., Bukowinski, A.T., Phillips, C.J. and Smith, T.C.	Birth outcomes among military personnel after exposure to documented open-air burn pits before and during pregnancy.	2012	Journal of Occupational and Environmental Medicine Vol. 54(6), pp. 689-697	article	DOI

Abstract: OBJECTIVE: To examine birth outcomes in military women and men with potential exposure to documented open-air burn pits before and during pregnancy. METHODS: Electronic data from the Department of Defense Birth and Infant Health Registry and the Defense Manpower Data Center were used to examine the prevalence of birth defects and preterm birth among infants of active-duty women and men who were deployed within a 3-mile radius of a documented open-air burn pit before or during pregnancy. RESULTS: In general, burn pit exposure at various times in relation to pregnancy and for differing durations was not consistently associated with an increase in birth defects or preterm birth in infants of active-duty military personnel. CONCLUSIONS: These analyses offer reassurance to service members that burn pit exposure is not consistently associated with these select adverse infant health outcomes.

Author	Title	Year	Journal/Proceedings	Reftype	DOI/URL
Magnusson, R., Hagglund, L. and Wingfors, H.	Broad Exposure Screening of Air Pollutants in the Occupational Environment of Swedish Soldiers Deployed in Afghanistan	2012	Military Medicine Vol. 177(3), pp. 318-325	article	DOI URL

Abstract: The main objective of this study was to perform an initial characterization of Swedish soldiers' exposure to air pollutants in Afghanistan and screen for potential health hazards. Stationary monitoring was performed in two military camps, International Security Assistance Force Headquarters in Kabul and Camp Northern Lights in Mazar-e Sharif, at both outdoor and indoor locations. A broad screening including particulate matter (PM10 and PM2.5), polycyclic aromatic hydrocarbons (PAHs), oxygenated PAHs, n-alkanes, nitrogen dioxide (NO2), sulfur dioxide, toxic metals, and volatile organic compounds (VOCs) was performed over 2 weeks in the autumn of 2009. The results were compared to current air quality guidelines. Particulate matter was identified as the main potential health hazard since military exposure guidelines for marginal effects were exceeded outdoors. In addition, especially in Kabul, levels of particle-bound PAHs and oxy-PAHs were high, whereas levels of toxic metals were generally low. Among gaseous pollutants, elevated NO2 levels in Kabul supported combustion as a major contributor to the poor air quality. VOC levels were generally low, but levels of some pollutants exceeded current guidelines. Because of elevated concentrations of particles with a high content of toxic organics, further monitoring and characterization of the occupational environment are warranted.

Author	Title	Year	Journal/Proceedings	Reftype	DOI/URL
Liu, J., Lezama, N., Gasper, J., Kawata, J., Morley, S., Helmer, D. and Ciminera, P.	Burn Pit Emissions Exposure and Respiratory and Cardiovascular Conditions Among Airborne Hazards and Open Burn Pit Registry Participants	2016	Journal of Occupational and Environmental Medicine Vol. 58(7)	article	DOI URL

Abstract: Objective: The aim of this study was to determine how burn pit emissions exposure is associated with the incidence of respiratory and cardiovascular conditions. Methods: We examined the associations between assumed geographic and self-reported burn pit emissions exposure and respiratory and cardiovascular outcomes in participants of the Airborne Hazards and Open Burn Pit Registry. Results: We found significant dose-response associations for higher risk of self-reported emphysema, chronic bronchitis, or chronic obstructive pulmonary disease with increased days of deployment within 2 miles of selected burn pits (P-trend=0.01) and self-reported burn pit smoke exposure (P-trend=0.0005). Conclusions: We found associations between burn pit emissions exposure and higher incidence of post-deployment self-reported respiratory and cardiovascular conditions, but these findings should be interpreted with caution because the surrogate measurements of burn pit emissions exposure in this analysis may not reflect individual exposure levels.

Author	Title	Year	Journal/Proceedings	Reftype	DOI/URL
Engelbrecht, J.P., McDonald, E.V., Gillies, J.A., Jayanty, R.K.M., Casuccio, G. and Gertler, A.W.	Characterizing mineral dusts and other aerosols from the Middle East--Part 1: ambient sampling.	2009	Inhalation Toxicology Vol. 21(4), pp. 297-326	article	DOI

Abstract: The purpose of the Enhanced Particulate Matter Surveillance Program was to provide scientifically founded information on the chemical and physical properties of dust collected over a period of approximately 1 year in Djibouti, Afghanistan (Bagram, Khowst), Qatar, United Arab Emirates, Iraq (Balad, Baghdad, Tallil, Tikrit, Taji, Al Asad), and Kuwait (northern, central, coastal, and southern regions). Three collocated low-volume particulate samplers, one each for the total suspended particulate matter, < 10 micro m in aerodynamic diameter (PM(10)) particulate matter, and < 2.5 micro m in aerodynamic diameter (PM(2.5)) particulate matter, were deployed at each of the 15 sites, operating on a '1 in 6' day sampling schedule. Trace-element analysis was performed to measure levels of potentially harmful metals, while major-element and ion-chemistry analyses provided an estimate of mineral components. Scanning electron microscopy with energy dispersive spectroscopy was used to analyze the chemical composition of small individual particles. Secondary electron images provided information on particle size and shape. This study shows the three main air pollutant types to be geological dust, smoke from burn pits, and heavy metal condensates (possibly from metals smelting and battery manufacturing facilities). Non-dust storm events resulted in elevated trace metal concentrations in Baghdad, Balad, and Taji in Iraq. Scanning-electron-microscopy secondary electron images of individual particles revealed no evidence of freshly fractured quartz grains. In all instances, quartz grains had rounded edges and mineral grains were generally coated by clay minerals and iron oxides.

Author	Title	Year	Journal/Proceedings	Reftype	DOI/URL
Engelbrecht, J.P., McDonald, E.V., Gillies, J.A., Jayanty, R.K.M.J., Casuccio, G. and Gertler, A.W.	Characterizing mineral dusts and other aerosols from the Middle East--Part 2: grab samples and re-suspensions.	2009	Inhalation toxicology Vol. 21, pp. 327-336	article	DOI

Abstract: The purpose of the Enhanced Particulate Matter Surveillance Program was to provide scientifically founded information on the chemical and physical properties of dust collected during a period of approximately 1 year in Djibouti, Afghanistan (Bagram, Khowst), Qatar, United Arab Emirates, Iraq (Balad, Baghdad, Tallil, Tikrit, Taji, Al Asad), and Kuwait (northern, central, coastal, and southern regions). To fully understand mineral dusts, their chemical and physical properties, as well as mineralogical inter-relationships, were accurately established. In addition to the ambient samples, bulk soil samples were collected at each of the 15 sites. In each case, approximately 1 kg of soil from the top 10 mm at a previously undisturbed area near the aerosol sampling site was collected. The samples were air-dried and sample splits taken for soil analysis. Further sample splits were sieved to separate the < 38 micro m particle fractions for mineralogical analysis. Examples of major-element and trace-element chemistry, mineralogy, and other physical properties of the 15 grab samples are presented. The purpose of the trace-element analysis was to measure levels of potentially harmful metals while the major-element and ion-chemistry analyses provided an estimate of mineral components. X-ray diffractometry provided a measure of the mineral content of the dust. Scanning electron microscopy with energy dispersive spectroscopy was used to analyze chemical composition of small individual particles. From similarities in the chemistry and mineralogy of re-suspended and ambient sample sets, it is evident that portions of the ambient dust are from local soils.

Author	Title	Year	Journal/Proceedings	Reftype	DOI/URL
King, M.S., Eisenberg, R., Newman, J.H., Tolle, J.J., Harrell, F.E.J., Nian, H., Ninan, M., Lambright, E.S., Sheller, J.R., Johnson, J.E. and Miller, R.F.	Constrictive bronchiolitis in soldiers returning from Iraq and Afghanistan.	2011	New England Journal of Medicine Vol. 365(3), pp. 222-230	article	DOI

Author	Title	Year	Journal/Proceedings	Reftype	DOI/URL
Abstract: BACKGROUND: In this descriptive case series, 80 soldiers from Fort Campbell, Kentucky, with inhalational exposures during service in Iraq and Afghanistan were evaluated for dyspnea on exertion that prevented them from meeting the U.S. Army's standards for physical fitness. METHODS: The soldiers underwent extensive evaluation of their medical and exposure history, physical examination, pulmonary-function testing, and high-resolution computed tomography (CT). A total of 49 soldiers underwent thoracoscopic lung biopsy after noninvasive evaluation did not provide an explanation for their symptoms. Data on cardiopulmonary-exercise and pulmonary-function testing were compared with data obtained from historical military control subjects. RESULTS: Among the soldiers who were referred for evaluation, a history of inhalational exposure to a 2003 sulfur-mine fire in Iraq was common but not universal. Of the 49 soldiers who underwent lung biopsy, all biopsy samples were abnormal, with 38 soldiers having changes that were diagnostic of constrictive bronchiolitis. In the remaining 11 soldiers, diagnoses other than constrictive bronchiolitis that could explain the presenting dyspnea were established. All soldiers with constrictive bronchiolitis had normal results on chest radiography, but about one quarter were found to have mosaic air trapping or centrilobular nodules on chest CT. The results of pulmonary-function and cardiopulmonary-exercise testing were generally within normal population limits but were inferior to those of the military control subjects. CONCLUSIONS: In 49 previously healthy soldiers with unexplained exertional dyspnea and diminished exercise tolerance after deployment, an analysis of biopsy samples showed diffuse constrictive bronchiolitis, which was possibly associated with inhalational exposure, in 38 soldiers.				
Baird, C.	**Deployment Exposures and Long-term Health Risks: The Shadow of War.**	**2016**	**U.S. Army Medical Department Journal, pp. 167-172**	**article**	**URL**
Abstract: The victory in Operations Desert Shield/Desert Storm has been "shadowed" by long-term health concerns among returning troops. During Operations Iraqi Freedom, New Dawn, and Enduring Freedom, the Department of the Army and Department of Defense implemented recommendations of the Institute of Medicine relating to environmental exposure assessment, hazard response, documentation of exposures, and risk assessment using environmental sampling data to evaluate potential health risks among deployed troops. Recommendations regarding risk communication proved more difficult to implement, however. Exposure to particulate matter and airborne hazards including burn pit emissions and chemical warfare agents have received attention from service members, the media, and in some cases, Congress. A combination of lack of clear and consistent messages, imperfect and sometimes seemingly contradictory science, and strong perceptions suggest that questions related to these exposures and their potential long-term health effects will persist.				
Morris, M.J., Rawlins, F.A., Forbes, D.A., Skabelund, A.J. and Lucero, P.F.	**Deployment-related Respiratory Issues.**	**2016**	**U.S. Army Medical Department Journal, pp. 173-8**	**article**	**URL**
Abstract: Military deployment to Southwest Asia since 2003 in support of Operations Enduring Freedom/Iraqi Freedom/New Dawn has presented unique challenges from a pulmonary perspective. Various airborne hazards in the deployed environment include suspended geologic dusts, burn pit smoke, vehicle exhaust emissions, industrial air pollution, and isolated exposure incidents. These exposures may give rise to both acute respiratory symptoms and in some instances development of chronic lung disease. While increased respiratory symptoms during deployment are well documented, there is limited data on whether inhalation of airborne particulate matter is causally related to an increase in either common or unique pulmonary diseases. While disease processes such as acute eosinophilic pneumonia and exacerbation of preexisting asthma have been adequately documented, there is significant controversy surrounding the potential effects of deployment exposures and development of rare pulmonary disorders such as constrictive bronchiolitis. The role of smoking and related disorders has yet to be defined. This article presents the current evidence for deployment-related respiratory symptoms and ongoing Department of Defense studies. Further, it also provides general recommendations for evaluating pulmonary health in the deployed military population.				
Morris, M.J., Lucero, P.F., Zanders, T.B. and Zacher, L.L.	Diagnosis and management of chronic lung disease in deployed military personnel	2013	Therapeutic Advances in Respiratory Disease Vol. 7(4), pp. 235-245	article	DOI
Aurell, J., Gullett, B.K. and Yamamoto, D.	**Emissions from open burning of simulated military waste from forward operating bases.**	**2012**	**Environmental Science & Technology Vol. 46(20), pp. 11004-11012**	**article**	**DOI**
Abstract: Emissions from open burning of simulated military waste from forward operating bases (FOBs) were extensively characterized as an initial step in assessing potential inhalation exposure of FOB personnel and future disposal alternatives. Emissions from two different burning scenarios, so-called "burn piles/pits" and an air curtain burner/"burn box", were compared using simulated FOB waste from municipal and commercial sources. A comprehensive array of emissions was quantified, including CO(2), PM(2.5), volatile organic compounds (VOCs), polyaromatic hydrocarbons (PAHs), polychlorinated dibenzodioxins and -furans (PCDDs/PCDFs), polybrominated dibenzodioxins and -furans (PBDDs/PBDFs), and metals. In general, smoldering conditions in the burn box and the burn pile led to similar emissions. However, when the burn box underwent periodic waste charging to maintain sustained combustion, PM(2.5), VOCs, and PAH emissions dropped considerably compared to smoldering conditions and the overall burn pile results. The PCDD/PCDF and PBDD/PBDF emission factors for the burn piles were 50 times higher than those from the burn box likely due to the dominance of smoldering combustion in the burn piles.				
Blasch, K.W., Kolivosky, J.E. and Heller, J.M.	**Environmental Air Sampling Near Burn Pit and Incinerator Operations at Bagram Airfield, Afghanistan.**	**2016**	**Journal of Occupational and Environmental Medicine Vol. 58, pp. S38-S43**	**article**	**DOI**
Abstract: OBJECTIVE: This study presents environmental air samples collected at a US military installation with a solid waste disposal facility (SWDF) containing a burn pit from 2005 through 2012 and compared these results with occupational (breathing zone) samples. METHODS: Particulate matter (PM) environmental samples were collected as part of the installation monitoring program. Service Members in four security positions were monitored for PM and acrolein occupational exposures. RESULTS: The highest recorded PM2.5 concentration occurred at the SWDF. A highly populated sampling site, the Bazaar site, had the highest mean PM10, with the SWDF following in second. Acrolein and respirable PM were considerably higher in the breathing zone samples than environmental samples. CONCLUSIONS: The diversity of results support the concept of a complex environment with multiple polluting sources and changing meteorological and operational conditions.				
Koch, T.R. and Emory, T.S.	**Evaluation of chronic gastrointestinal symptoms following Persian Gulf War exposure.**	**2005**	**Military medicine Vol. 170, pp. 696-700**	**article**	**DOI URL**
Abstract: This was a prospective study performed in a Department of Veterans Affairs Medical Center. The aim of this study was to use endoscopic and histological examinations to determine the potential diagnostic origins of chronic gastrointestinal symptoms among patients who were part of the deployment of troops to the Persian Gulf after August 1990. Twenty-four (8%) male patients (mean age, 42 years) of 308 patients in the Persian Gulf War Registry agreed to undergo endoscopic examination of chronic symptoms, including heartburn (29%), dyspepsia (33%), dysphagia (8%), diarrhea (63%), Hemoccult-positive stool (21%), and rectal bleeding (17%). There were 17 upper endoscopies, 18 colonoscopies, and 4 flexible sigmoidoscopies performed, all with biopsies. Five (33%) of 15 patients had positive serological findings for Helicobacter pylori. With upper endoscopy, major findings included esophagitis (12%), Schatzki's ring (12%), hiatal hernia (47%), antral erythema (59%), and duodenal erythema (29%). With lower endoscopy, major findings included ileitis (5%), lymphoid hyperplasia (9%), polyps (27%), diverticulosis (23%), and hemorrhoids (23%). Major histopathological findings included microscopic esophagitis (24%), gastritis with H. pylori (35%), gastritis without H. pylori (18%), Crohn's disease (5%), tubular adenoma (5%), hyperplastic polyps (18%), and melanosis coli (5%). Most patients with chronic heartburn or dyspepsia have evidence of esophagitis or H. pylori. Individuals with these chronic symptoms should undergo evaluation.				
on Gulf War, C., for Chronic Multisymptom Illness, H.T., on the Health of Select Populations, B. and of Medicine, I.	**Gulf War and Health: Treatment for Chronic Multisymptom Illness**	**2013**		**article**	**DOI**

Author	Title	Year	Journal/Proceedings	Reftype	DOI/URL
Abstract: Chronic multisymptom illness (CMI) is a serious condition that imposes an enormous burden of suffering on our nation's veterans. Veterans who have CMI often have physical symptoms (such as fatigue, joint and muscle pain, and gastrointestinal symptoms) and cognitive symptoms (such as memory difficulties). For the purposes of this report, the committee defined CMI as the presence of a spectrum of chronic symptoms experienced for 6 months or longer in at least two of six categories—fatigue, mood, and cognition, musculoskeletal, gastrointestinal, respiratory, and neurologic—that may overlap with but are not fully captured by known syndromes (such as CFS, fibromyalgia, and IBS) or other diagnoses. Despite considerable efforts by researchers in the United States and elsewhere, there is no consensus among physicians, researchers, and others as to the cause of CMI. There is a growing belief that no specific causal factor or agent will be identified. Many thousands of Gulf War veterans1 who have CMI live with sometimes debilitating symptoms and seek an effective way to manage their symptoms. Estimates of the numbers of 1991 Gulf War veterans who have CMI range from 175,000 to 250,000 (about 25-35% of the 1991 Gulf War veteran population), and there is evidence that CMI in 1991 Gulf War veterans may not resolve over time. Preliminary data suggest that CMI is occurring in veterans of the Iraq and Afghanistan wars as well. In addition to summarizing the available scientific and medical literature regarding the best treatments for chronic multisymptom illness among Gulf War veterans, Gulf War and Health: Volume 9: Treatment for Chronic Multisymptom Illness recommends how best to disseminate this information throughout the VA to improve the care and benefits provided to veterans, recommends additional scientific studies and research initiatives to resolve areas of continuing scientific uncertainty and recommends such legislative or administrative action as the IOM deems appropriate in light of the results of its review.					
Helmer, D.A., Rossignol, M., Blatt, M., Agarwal, R., Teichman, R. and Lange, G.	**Health and exposure concerns of veterans deployed to Iraq and Afghanistan.**	**2007**	**Journal of occupational and environmental medicine Vol. 49, pp. 475-480**	**article**	**DOI URL**
Abstract: OBJECTIVE: We report the clinical concerns of US veterans of Operations Iraqi Freedom and Enduring Freedom evaluated at the New Jersey War-Related Illness and Injury Study Center (NJ WRIISC) between June 2004 and January 2006. METHODS: We conducted a retrospective chart review of veterans' health and exposure concerns. RESULTS: Veterans (n=56) reported an average of 4 (standard deviation [SD] = 2.1; range, 0-9) physical health concerns, and 2.7 (SD=2.3; range, 0-10) exposure concerns. The majority of veterans (55%) had a mental health concern, most commonly, posttraumatic stress disorder. The most common exposure concerns were depleted uranium, multiple vaccinations, and poor air quality. Greater proportions of Reserve veterans reported genitourinary concerns and exposure to smoke from burning trash than active duty veterans. CONCLUSIONS: Veterans of military operations in Southwest Asia have deployment-related health and exposure concerns that will need to be addressed by their ambulatory care physicians.					
Mahan, C.M., Page, W.F., Bullman, T.A. and Kang, H.K.	**Health effects in Army Gulf War veterans possibly exposed to chemical munitions destruction at Khamisiyah, Iraq: Part I. Morbidity associated with potential exposure.**	**2005**	**Military medicine Vol. 170, pp. 935-944**	**article**	**DOI URL**
Abstract: In March 1991, U.S. troops detonated the Khamisiyah, Iraq, ammunition depot, possibly releasing two chemical warfare agents, sarin and cyclosarin. The long-term health effects associated with possible exposure to these chemical warfare agents are unknown. This study was undertaken to investigate whether possible exposure was associated with morbidity among Army Gulf War veterans using morbidity data for 5,555 Army veterans who were deployed to the Gulf region. Responses to 86 self-assessed health measures, as reported in the 1995 Department of Veterans Affairs National Health Survey of Gulf War Era Veterans, were evaluated. We found little association between potential exposure and health, after adjustment for demographic variables, and conclude that potential exposure to sarin or cyclosarin at Khamisiyah does not seem to have adversely affected self-perceived health status, as evidenced by a wide range of health measures.					
Page, W.F., Mahan, C.M., Kang, H.K. and Bullman, T.A.	**Health effects in Army Gulf War veterans possibly exposed to chemical munitions destruction at Khamisiyah, Iraq: Part II. Morbidity associated with notification of potential exposure.**	**2005**	**Military medicine Vol. 170, pp. 945-951**	**article**	**DOI URL**
Abstract: The purpose of this study was to examine the association of notification of potential exposure to chemical warfare agents in the 1991 Gulf War with subsequent self-reported morbidity. The study sample included 1,056 deployed Army Gulf War veterans who responded to the 1995 National Health Survey of Gulf War Era Veterans and who were resurveyed in 2000. One-half of the subjects had been notified of potential exposure to chemical warfare agents and one-half had not. Comparing notified and non-notified subjects, there were no statistically significant differences with respect to bed days, activity limitations, clinic visits, or hospital visits. Among 71 self-reported medical conditions and symptoms, there were 5 statistically significant differences, 4 of which were for lower rates of illness among notified subjects. Our findings contradict the prevailing notion that perceived exposure to chemical warfare agents should be considered an important cause of morbidity among Gulf War veterans.					
Pugh, M.J., Jaramillo, C.A., Leung, K.-W., Faverio, P., Fleming, N., Mortensen, E., Amuan, M.E., Wang, C.-P., Eapen, B., Restrepo, M. and Morris, M.J.	**Increasing Prevalence of Chronic Lung Disease in Veterans of the Wars in Iraq and Afghanistan.**	**2016**	**Military medicine Vol. 181, pp. 476-481**	**article**	**DOI URL**
Abstract: Research from the wars in Afghanistan and Iraq have focused on traumatic brain injury (TBI) and mental health conditions; however, it is becoming clear that other health concerns, such as respiratory illnesses, warrant further scientific inquiry. Early reports from theater and postdeployment health assessments suggested an association with deployment-related exposures (e.g., sand, burn pits, chemical, etc.) and new-onset respiratory symptoms. We used data from Veterans Affairs medical encounters between fiscal years 2003 and 2011 to identify trends in chronic obstructive pulmonary disease, asthma, and interstitial lung disease in veterans. We used data from Veterans Affairs and Department of Defense sources to identify sociodemographic (age, sex, race), military (e.g., service branch, multiple deployments) and clinical characteristics (TBI, smoking) of individuals with and without chronic lung diseases. Generalized estimating equations found significant increases over time for chronic obstructive pulmonary disease and asthma in both unadjusted and adjusted analyses. Trends for interstitial lung disease were significant only in adjusted analyses. Age, smoking, and TBI were also significantly associated with chronic lung diseases; however, multiple deployments were not associated. Research is needed to identify which characteristics of deployment-related exposures are linked with chronic lung disease.					
Mallon, C.T.M., Rohrbeck, M.P., Haines, M.K.M., Jones, D.P., Utell, M., Hopke, P.K., Phipps, R.P., Walker, D.I., Thatcher, T., Woeller, C.F., Baird, C.P., Pollard, H.B., Dalgard, C.L. and Gaydos, J.C.	**Introduction to Department of Defense Research on Burn Pits, Biomarkers, and Health Outcomes Related to Deployment in Iraq and Afghanistan.**	**2016**	**Journal of Occupational and Environmental Medicine Vol. 58, pp. S3-S11**	**article**	**DOI**
Abstract: OBJECTIVE: This paper provides an overview of our study that was designed to assess the health impact of environmental exposures to open pit burning in deployed troops. METHODS: The rationale for the study and the structure of the research plan was laid out. An overview of each article in the supplement was provided. The cohort of deployed Service members was assessed for airborne exposure, relevant biomarkers, and health outcomes following deployment to Balad, Iraq, and/or Bagram, Afghanistan. RESULTS: Polycyclic aromatic hydrocarbon (PAH) exposures were elevated, and serum biomarkers were statistically different postdeployment. Associations were noted between PAHs and dioxins and microRNAs. Some health outcomes were evident in deployers compared with nondeployers. CONCLUSIONS: Future research will examine the associations between demographic variables, smoking status, biomarker levels, and related health outcomes.					
Morris, M.J., Zacher, L.L. and Jackson, D.A.	**Investigating the respiratory health of deployed military personnel.**	**2011**	**Military medicine Vol. 176, pp. 1157-1161**	**article**	**DOI URL**

Author	Title	Year	Journal/Proceedings	Reftype	DOI/URL
Abstract: Recent news media articles have implied a direct relationship between environmental exposures such as burn pits during current deployments and the development of serious and debilitating chronic pulmonary disease. These articles suggest that the military is superficially investigating evidence that establishes a link between deployment and development of chronic lung disease. Anecdotal cases of military personnel with lung disease are detailed to suggest a systemic problem with undiagnosed and untreated pulmonary disease in deployed service members. Despite these contentions, the U.S. Army Medical Department and other agencies have been actively pursuing numerous scientific investigations into deployment-related lung disease to define the severity and prevalence of the issue. This article will review relevant research efforts by the U.S. military in the existing medical literature and address the current efforts planned by the services to systematically investigate the possibility of deployment-related pulmonary disease.					
Szema, A.M., Reeder, R.J., Harrington, A.D., Schmidt, M., Liu, J., Golightly, M., Rueb, T. and Hamidi, S.A.	**Iraq Dust Is Respirable, Sharp, and Metal-Laden and Induces Lung Inflammation With Fibrosis in Mice via IL-2 Upregulation and Depletion of Regulatory T Cells**	**2014**	**Journal of Occupational and Environmental Medicine Vol. 56(3)**	**article**	**DOI URL**
Abstract: Objectives: Determine whether surface dust grab samples taken from a large military base in Iraq are toxic and respirable. Methods: X-ray diffraction for mineral content, x-ray fluorescence for elemental content, in vivo mouse dust challenges for assessment of histological changes, bronchoalveolar lavage for cytokines, polarizing light microscopy for crystals in lung tissue, and Fluorescence Activated Cell Sorting for cell surface and intracellular markers were utilized. Results: Camp Victory, Iraq dust taken during wartime contains respirable particles 2.5 microns in size, constituting particulate matter air pollution. Dust particles are angular and have sharp edges. Trace metals (including titanium) calcium and silicon are present. Mice with airway instillation of dust have polarizable crystals in lung and septate inflammation. Regulatory T cells (CD4+CD25+FOXP3+) are decreased in thymus and spleen. Interleukin-2 (IL-2) is upregulated in bronchoalveolar lavage. Conclusions: Respirable Iraq dust leads to lung inflammation in mice similar to that seen in patients with polarizable crystals, which seem to be titanium.					
Weese, C.B.	Issues related to burn pits in deployed settings.	2010	U.S. Army Medical Department Journal, pp. 22-28	article	URL
Smith, T.C.	**Linking exposures and health outcomes to a large population-based longitudinal study: the Millennium Cohort Study.**	**2011**	**Military medicine Vol. 176, pp. 56-63**	**article**	**DOI URL**
Abstract: OBJECTIVE: To describe current efforts and future potential for understanding long-term health of military service members by linking the Millennium Cohort Study data to exposures and health outcomes. METHODS: The Millennium Cohort Study launched in 2001, before September 11 and the start of combat operations in Afghanistan and Iraq. Other substantial Department of Defense (DoD) health, personnel, and exposure databases are maintained in electronic form and may be linked by personal identifiers. RESULTS: More than 150,000 consenting members comprise the Millennium Cohort from all services, and include active duty, Reserve, and National Guard current and past members, and represent demographic, occupational, military, and health characteristics of the U.S. military. These prospective data offer symptom assessment, behavioral health, and self-reported exposures that may complement and fill gaps in capability presented by other DoD electronic health and exposure data. CONCLUSIONS: In conjunction with Millennium Cohort survey data, prospective individual-level exposure and health outcome assessment is crucial to understand and quantify any long-term health outcomes potentially associated with unique military occupational exposures.					
	Long-term health consequences of exposure to burn pits in Iraq and Afghanistan.	2015	Military medicine Vol. 180, pp. 601-603	article	DOI URL
Abbasi, J.	National Academies Report Cites Flaws in VA's Burn Pit Registry.	2017	JAMA Vol. 317(16), pp. 1614	article	DOI
Chalela, J.A.	New Onset Migraine Associated With a Civilian Burn Pit	2017	Military Medicine Vol. 182(5), pp. e1812-e1813	article	DOI
Jones, K.A., Smith, B., Granado, N.S., Boyko, E.J., Gackstetter, G.D., Ryan, M.A.K., Phillips, C.J. and Smith, T.C.	**Newly reported lupus and rheumatoid arthritis in relation to deployment within proximity to a documented open-air burn pit in Iraq.**	**2012**	**Journal of Occupational and Environmental Medicine Vol. 54(6), pp. 698-707**	**article**	**DOI**
Abstract: OBJECTIVE: To assess the relationship between possible exposure to smoke from documented open-air burn pits and newly reported lupus and rheumatoid arthritis among Millennium Cohort participants who have deployed in support of operations in Iraq and Afghanistan. METHODS: Prospectively assessed self-reported lupus and rheumatoid arthritis among deployers who completed both 2004-2006 and 2007-2008 questionnaires. RESULTS: After exclusions, more than 18,000 participants were deployed, including more than 3000 participants deployed within a 3-mile radius of a documented burn pit. After adjustment, proximity within 3 miles of a burn pit was not significantly associated with rheumatoid arthritis or lupus in general; however, one location was associated with lupus, although few cases were at this site (n = 2). CONCLUSIONS: Results indicate deployers potentially exposed to documented burn pits in the combined three-camp analysis were not at an elevated risk of lupus or rheumatoid arthritis.					
Smith, B., Wong, C.A., Smith, T.C., Boyko, E.J., Gackstetter, G.D. and for the Millennium Cohort Study Team, M.A.K.R.	**Newly reported respiratory symptoms and conditions among military personnel deployed to Iraq and Afghanistan: a prospective population-based study.**	**2009**	**American journal of epidemiology Vol. 170, pp. 1433-1442**	**article**	**DOI**
Abstract: Concerns about respiratory conditions have surfaced among persons deployed to Iraq and Afghanistan. Data on 46,077 Millennium Cohort Study participants who completed baseline (July 2001-June 2003) and follow-up (June 2004-February 2006) questionnaires were used to investigate 1) respiratory symptoms (persistent or recurring cough or shortness of breath), 2) chronic bronchitis or emphysema, and 3) asthma. Deployers had a higher rate of newly reported respiratory symptoms than nondeployers (14% vs. 10%), while similar rates of chronic bronchitis or emphysema (1% vs. 1%) and asthma (1% vs. 1%) were observed. Deployment was associated with respiratory symptoms in both Army (adjusted odds ratio = 1.73, 95% confidence interval: 1.57, 1.91) and Marine Corps (adjusted odds ratio = 1.49, 95% confidence interval: 1.06, 2.08) personnel, independently of smoking status. Deployment length was linearly associated with increased symptom reporting in Army personnel ($P < 0.0001$). Among deployers, elevated odds of symptoms were associated with land-based deployment as compared with sea-based deployment. Although respiratory symptoms were associated with deployment, inconsistency in risk with cumulative exposure time suggests that specific exposures rather than deployment in general are determinants of postdeployment respiratory illness. Significant associations seen with land-based deployment also imply that exposures related to ground combat may be important.					
Szema, A.M., Peters, M.C., Weissinger, K.M., Gagliano, C.A. and Chen, J.J.	**New-onset asthma among soldiers serving in Iraq and Afghanistan.**	**2010**	**Allergy and Asthma Proceedings Vol. 31(4), pp. 67-71**	**article**	**DOI**

Author	Title	Year	Journal/Proceedings	Reftype	DOI/URL
Abstract: Since June 4, 2004, asthma diagnosed and symptomatic after the age of 12 years has been an exclusion criterion for military enlistment unless exempted via medical waiver. The Department of Defense determined that 13% of U.S. Army Medic visits in Iraq are for new-onset acute respiratory illness; case reports of veterans with asthma that began in Iraq and Afghanistan War zones have surfaced. This prompted our study to determine whether new asthma is diagnosed more frequently among Iraq/Afghanistan War troops versus stateside-based troops. Retrospective review of asthma diagnoses among computerized charts for military personnel discharged from active duty and examined between March 1, 2004 and May 1, 2007, at the Veterans Affairs Medical Center (VAMC), Northport, NY, classified soldiers by (1) deployment status-whether they were stationed in Iraq/Afghanistan for a 1-year tour of duty or stationed in the United States, and (2) VA diagnosis of asthma per International Classification of Disease codes. Associations between deployment and asthma statuses were evaluated/stratified by gender/age group. Eligibility criteria entailed (1) residence in Long Island, (2) aged 18-45 years, and (3) both U.S. military service and discharge dates between March 1, 2004 and May 1, 2007. Out of 6233 patients who served between 2004 and 2007 and were followed at the Northport VAMC, 290 new-onset/prevalent asthma cases were identified. Deployment to Iraq was associated with a significantly higher risk of asthma compared with stateside soldiers (6.6% versus 4.3%; with a crude odds ratio, 1.58; 95% CI, 1.18, 2.11). These associations persist when stratified by gender and age group. Deployment to Iraq and Afghanistan is associated with new-onset asthma. Etiologic studies, surveillance, incidence, epidemiology, and assessing response to therapy are recommended.					
Blasch, K., Kolivosky, J. and Hill, B.	**Occupational exposures among personnel working near combined burn pit and incinerator operations at Bagram Airfield, Afghanistan.**	**2016**	**Inhalation Toxicology Vol. 28(5), pp. 216-225**	**article**	**DOI**
Abstract: Occupational air samples were collected at Bagram Airfield Afghanistan for security forces (SF) stationed at the perimeter of the solid waste disposal facility that included a burn pit, air curtain destructors, and solid waste and medical waste incinerators. The objective of the investigation was to quantify inhalation exposures of workers near the disposal facility. Occupational air sample analytes included total particulates not otherwise specified (PNOS), respirable PNOS, acrolein and polyaromatic hydrocarbons (PAH). Exposures were measured for four SF job specialties. Thirty 12-hour shifts were monitored from November 2011 to March 2012. The geometric means for respirable particulate matter and PAH for all job specialties were below the 12-hour adjusted American Conference of Governmental Industrial Hygienists threshold limit value time weighted averages (TLV-TWA). The geometric mean of the respirable particulate matter 12-hour TWAs for the four job specialties ranged from 0.116 to 0.134 mg/m(3). One measurement collected at the tower (3.1 mg/m(3)) position exceeded the TLV-TWA. Naphthalene and pyrene were the only PAHs detected in multiple samples of the 18 PAHs analyzed. The geometric mean concentration for naphthalene was 9.39E-4 mg/m(3) and the maximum concentration was 0.0051 mg/m(3). The geometric mean of acrolein for the four job specialties ranged from 0.021 to 0.047 mg/m(3). There were four exceedances of the Occupational Safety and Health Administration 8-hour permissible exposure limit- time weighted average (PEL-TWA), respectively, ranging from 0.13 to 0.32 mg/m(3).					
Szema, A.M.	**Occupational Lung Diseases among Soldiers Deployed to Iraq and Afghanistan.**	**2013**	**Occupational medicine & health affairs Vol. 1**	**article**	**DOI**
Abstract: Military personnel deployed to Iraq and Afghanistan, from 2004 to the present, has served in a setting of unique environmental conditions. Among these are exposures to burning trash in open air "burn pits" lit on fire with jet fuel JP-8. Depending on trash burned--water bottles, styrofoam trays, medical waste, unexploded munitions, and computers--toxins may be released such as dioxins and n-hexane and benzene. Particulate matter air pollution culminates from these fires and fumes. Additional environmental exposures entail sandstorms (Haboob, Shamal, and Sharqi) which differ in direction and relationship to rain. These wars saw the first use of improvised explosive devices (roadside phosphate bombs),as well as vehicle improvised explosive devices (car bombs), which not only potentially aerosolize metals, but also create shock waves to induce lung injury via blast overpressure. Conventional mortar rounds are also used by Al Qaeda in both Iraq and Afghanistan. Outdoor aeroallergens from date palm trees are prevalent in southern Iraq by the Tigris and Euphrates rivers, while indoor aeroallergen aspergillus predominates during the rainy season. High altitude lung disease may also compound the problem, particularly in Kandahar, Afghanistan. Clinically, soldiers may present with new-onset asthma or fixed airway obstruction. Some have constrictive bronchiolitis and vascular remodeling on open lung biopsy - despite having normal spirometry and chest xrays and CT scans of the chest. Others have been found to have titanium and other metals in the lung (rare in nature). Still others have fulminant biopsy-proven sarcoidiosis. We found DNA probe-positive Mycobacterium Avium Complex in lung from a soldier who had pneumonia, while serving near stagnant water and camels and goats outside Abu Gharib. This review highlights potential exposures, clinical syndromes, and the Denver Working Group recommendations on post-deployment health.					
Heller, J.M.	**Oil well fires of Operation Desert Storm--defining troop exposures and determining health risks.**	**2011**	**Military medicine Vol. 176, pp. 46-51**	**article**	**DOI URL**
Abstract: During Operation Desert Storm, in February 1991, Iraqi troops began burning Kuwaiti oil wells. Almost immediately there was concern about possible adverse health effects in U.S. personnel exposed to crude oil combustion products. Combustions products were predicted from the known composition of Kuwaiti crude oil. Monitoring sites were established in Saudi Arabia and Kuwait; about 5,000 environmental samples were studied. Data collected were used to develop health risk assessments for the geographic areas sampled. This initial approach to assessing risk had to be greatly expanded when Congress passed Public Law 102-190, requiring development of means to calculate environmental exposures for individual U.S. service members. To estimate daily exposure levels for the entire area over 10 months for all U.S. troops, air dispersion modeling was used in conjunction with satellite imagery and geographic information system technology. This methodology made it possible to separate the risk caused by oil fire smoke from the total risk from all sources for each service member. The U.S. military responses to health concerns related to the oil well fires and to Public Law 102-190 were reviewed. Consideration was given to changes in technology, practices, and policies over the last two decades that might impact a similar contemporary response.					
Rose, C., Abraham, J., Harkins, D., Miller, R., Morris, M., Zacher, L., Meehan, R., Szema, A., Tolle, J., King, M., Jackson, D., Lewis, J., Stahl, A., Lyles, M.B., Hodgson, M., Teichman, R., Salihi, W., Matwiyoff, G., Meeker, G., Mormon, S., Bird, K. and Baird, C.	**Overview and recommendations for medical screening and diagnostic evaluation for postdeployment lung disease in returning US warfighters.**	**2012**	**Journal of Occupational and Environmental Medicine Vol. 54(6), pp. 746-751**	**article**	**DOI**
Abstract: OBJECTIVE: To review inhalational exposures and respiratory disease risks in US military personnel deployed to Iraq and Afghanistan and to develop consensus recommendations for medical screening and diagnostic referral. METHODS: A Working Group of physicians and exposure scientists from academia and from the Departments of Defense and Veterans Affairs was convened in February 2010. RESULTS: Despite uncertainty about the number of people affected and risk factors for adverse pulmonary outcomes in this occupational setting, the Working Group recommended: (1) standardized approaches to pre- and postdeployment medical surveillance; (2) criteria for medical referral and diagnosis; and (3) case definitions for major deployment-related lung diseases. CONCLUSIONS: There is a need for targeted, practical medical surveillance for lung diseases and for a standardized diagnostic approach for all symptomatic deployed personnel.					
McFall, M., Tackett, J., Maciejewski, M.L., Richardson, R.D., Hunt, S.C. and Roberts, L.	**Predicting costs of Veterans Affairs health care in Gulf War veterans with medically unexplained physical symptoms.**	**2005**	**Military medicine Vol. 170, pp. 70-75**	**article**	**DOI URL**

Author	Title	Year	Journal/Proceedings	Reftype	DOI/URL
Abstract: Measures of post-traumatic stress disorder (PTSD) and depression were used to predict Veterans Affairs outpatient treatment costs among Persian Gulf War veterans with medically unexplained physical symptoms. Patients (N = 206) enrolled in a Veterans Affairs primary care clinic for Persian Gulf War veterans completed study assessments at the initial appointment or at a proximal follow-up visit. Costs of care for mental health, medical, and pharmacy services for these veterans were computed for the subsequent 6-month period. Depression and PTSD symptoms explained a significant share of variance in costs of mental health care and pharmacy services, after adjustment for covariates. None of the mental status measures was significantly related to costs of medical care. Models using global measures of mental health status were as robust as models using disorder-specific measures of PTSD and depression in predicting mental health care and pharmacy costs. The implications of these findings for anticipating costs of care for Persian Gulf War veterans are discussed.					
Barth, S.K., Dursa, E.K., Peterson, M.R. and Schneiderman, A.	**Prevalence of respiratory diseases among veterans of Operation Enduring Freedom and Operation Iraqi Freedom: results from the National Health Study for a New Generation of U.S. Veterans.**	**2014**	**Military medicine Vol. 179, pp. 241-245**	**article**	**DOI URL**
Abstract: This study investigated the population prevalence of asthma, bronchitis, and sinusitis among veterans deployed to Afghanistan and Iraq compared to nondeployed veterans. A 2009-2011 population-based health survey of 60,000 veterans (34% response rate) asked about the history of doctor-diagnosed respiratory disease. Analyses included smoking history, deployment status, and year of diagnosis. The prevalence of asthma, bronchitis, and sinusitis among those diagnosed during or after 2001 was 3.3%, 5.9%, and 6.9%, respectively, among the deployed veterans and 3.4%, 5.3%, and 5.6%, respectively, among the nondeployed veterans. Deployed veterans were 29% more likely to have been diagnosed with sinusitis during and after 2001 compared to nondeployed veterans (adjusted odds ratio = 1.30, 95% confidence interval = 1.13, 1.49). Deployed veterans are at increased risk for sinusitis compared to nondeployed. There was no significant difference in asthma or bronchitis risk between deployed and nondeployed veterans.					
Szema, A., Mirsaidi, N., Patel, B., Viens, L., Forsyth, E., Li, J., Dang, S., Dukes, B., Giraldo, J., Kim, P. and Burns, M.	**Proposed Iraq/Afghanistan War-Lung Injury (IAW-LI) Clinical Practice Recommendations: National Academy of Sciences' Institute of Medicine Burn Pits Workshop.**	**2015**	**American journal of men's health**	**article**	**DOI**
Abstract: High rates of respiratory symptoms (14%) and new-onset asthma in previously healthy soldiers (6.6%) have been reported among military personnel post-deployment to Iraq and Afghanistan. The term Iraq/Afghanistan War-Lung Injury (IAW-LI) is used to describe the constellation of respiratory diseases related to hazards of war, such as exposure to burning trash in burn pits, improvised explosive devices, and sandstorms. Burnpits360.org is a nonprofit civilian website which voluntarily tracks medical symptoms among soldiers post-deployment to the Middle East. Subsequent to initiation of the Burnpits360.org website, the Department of Veterans Affairs started the Airborne Hazards and Open Burn Pit registry. This paper: (a) analyzes the latest 38 patients in the Burnpits360.org registry, validated by DD214 Forms; (b) compares strengths and weaknesses of both registries as outlined at the National Academy of Sciences Institute of Medicine Burn Pits Workshop; (c) further characterizes the spectrum of disease in IAW-LI; (d) describes the risk factors of affected populations; (e) summarizes current practices regarding management of the condition; and (f) defines future research objectives.					
Powell, T.M., Smith, T.C., Jacobson, I.G., Boyko, E.J., Hooper, T.I., Gackstetter, G.D., Phillips, C.J. and Smith, B.	**Prospective assessment of chronic multisymptom illness reporting possibly associated with open-air burn pit smoke exposure in Iraq.**	**2012**	**Journal of Occupational and Environmental Medicine Vol. 54(6), pp. 682-688**	**article**	**DOI**
Abstract: OBJECTIVE: To investigate the relationship between chronic multisymptom illness (CMI) and possible exposure to an open-air burn pit at three selected bases among those deployed to operations in Iraq and Afghanistan. METHODS: Chronic multisymptom illness (reporting at least one symptom in at least two of the following symptom constructs: general fatigue; mood and cognition problems; and musculoskeletal discomfort) was assessed, differentiating by potential burn pit exposure, among deployers who completed 2004 and 2007 Millennium Cohort questionnaires. RESULTS: More than 21,000 Cohort participants were deployed in support of the current operations, including more than 3000 participants with at least one deployment within a 3-mile radius of a documented burn pit. After adjusting for covariates, no elevated risk of CMI was observed among those exposed. CONCLUSIONS: There was no increase in CMI symptom reporting in those deployed to three selected bases with documented burn pits compared with other deployers.					
Szema, A.M., Salihi, W., Savary, K. and Chen, J.J.	**Respiratory symptoms necessitating spirometry among soldiers with Iraq/Afghanistan war lung injury.**	**2011**	**Journal of Occupational and Environmental Medicine Vol. 53(9), pp. 961-965**	**article**	**DOI**
Abstract: OBJECTIVE: New-onset asthma rates are higher among US soldiers deployed to Iraq/Afghanistan than stateside, but overall respiratory symptom and spirometry rates among soldiers returning from Iraq/Afghanistan have not yet been addressed. We determined these rates in soldiers deployed to Iraq/Afghanistan versus troops stationed elsewhere. METHODS: Retrospective review of active-duty soldiers (2004 to 2010) registered at Veterans Affairs Medical Center, Northport, New York, with Long Island/New York City zip codes. Subjects were examined by physicians or physicians' assistants. We counted number of spirometries, which required respiratory symptoms, and the provider was required to submit a diagnosis as part of the request process. RESULTS: Twenty-five percent of 7151 troops went to Iraq/Afghanistan (n = 1816) and 75% went elsewhere (n = 5335), with more smokers in the Iraq/Afghanistan group (16.1% vs 3.3%). Rates of symptoms and spirometry were 14.5% and 1.8%, for Iraq/Afghanistan, versus troops deployed elsewhere, respectively (P < 0.001). Both groups had similar forced expired volume in 1 second/forced vital capacity ratios (78%). CONCLUSIONS: New-onset Iraq/Afghanistan war lung injury is common and rates of symptoms leading to a diagnosis requiring spirometry are high.					
Korzeniewski, K., Nitsch-Osuch, A., Konior, M. and Lass, A.	**Respiratory tract infections in the military environment.**	**2015**	**Respiratory Physiology & Neurobiology Vol. 209, pp. 76-80**	**article**	**DOI**
Abstract: Military personnel fighting in contemporary battlefields as well as those participating in combat training are at risk of contracting respiratory infections. Epidemiological studies have demonstrated that soldiers deployed to the harsh environment have higher rates of newly reported respiratory symptoms than non-deployers. Acute respiratory diseases are the principle reason for outpatient treatment and hospitalization among military personnel, with an incidence exceeding that of the adult civilian population by up to three-fold. Adenoviruses, influenza A and B viruses, Streptococcus pneumoniae, Streptococcus pyogenes, coronaviruses and rhinoviruses have been identified as the main causes of acute respiratory infections among the military population. Although infective pathogens have been extensively studied, a significant proportion of illnesses (over 40%) have been due to unknown causative agents. Other health hazards, which can lead to respiratory illnesses among troops, are extreme air temperatures, desert dust, emissions from burn pits, industrial pollutants, and airborne contaminants originating from degraded soil. Limited diagnostic capabilities, especially inside the area of operations, make it difficult to accurately estimate the exact number of respiratory diseases in the military environment. The aim of the study was to discuss the occurrence of respiratory tract infections in army personnel, existing risk factors and preventive measures.					
Masiol, M., Mallon, C.T.M., Haines, K.M.J., Utell, M.J. and Hopke, P.K.	**Source Apportionment of Airborne Dioxins, Furans, and Polycyclic Aromatic Hydrocarbons at a United States Forward Operating Air Base During the Iraq War.**	**2016**	**Journal of Occupational and Environmental Medicine Vol. 58, pp. S31-7**	**article**	**DOI**

Author	Title	Year	Journal/Proceedings	Reftype	DOI/URL
Abstract: OBJECTIVES: The objective was to apportion the sources of the ambient polycyclic aromatic hydrocarbon (PAH), polychlorinated dibenzo-p-dioxin (PCDD) and polychlorinated dibenzofuran concentrations measured at Joint Base Balad in Iraq. METHODS: Positive matrix factorization (PMF) was applied to the data to obtain the chemical profiles and contribution time series of the PAHs, PCDDs, and PCDFs. Conditional probability function (CPF) analyses were performed to assess the source directionality relative to the monitoring sites. RESULTS: Three source types were identified and apportioned. The sources were: the burn pit, diesel vehicles and generators, and aircraft emissions. The CPF plots were consistent with the assigned source types. CONCLUSIONS: The PCDDs and PCFDs originated primarily from the burn pit. Higher molecular weight PAHs were associated with vehicle emissions while the aircraft emissions were enriched in low molecular weight PAHs.					
Smith, B., Wong, C.A., Boyko, E.J., Phillips, C.J., Gackstetter, G.D., Ryan, M.A.K. and Smith, T.C.	**The effects of exposure to documented open-air burn pits on respiratory health among deployers of the Millennium Cohort Study.**	**2012**	**Journal of Occupational and Environmental Medicine Vol. 54(6), pp. 708-716**	**article**	**DOI**
Abstract: OBJECTIVE: To investigate respiratory illnesses and potential open-air burn pit exposure among Millennium Cohort participants who deployed to Iraq or Afghanistan. METHODS: Using multivariable logistic regression, newly reported chronic bronchitis or emphysema, newly reported asthma, and self-reported respiratory symptoms and possible burn pit exposure within 2, 3, or 5 miles were examined among Army and Air Force deployers surveyed in 2004 to 2006 and 2007 to 2008 (n = 22,844). RESULTS: Burn pit exposure within 3 or 5 miles was not associated with respiratory outcomes after statistical adjustment. Increased symptom reporting was observed among Air Force deployers located within 2 miles of Joint Base Balad; however, this finding was marginally significant with no evidence of trend. CONCLUSION: In general, these findings do not support an elevated risk for respiratory outcomes among personnel deployed within proximity of documented burn pits in Iraq.					
Matthews, T., Abraham, J., Zacher, L.L. and Morris, M.J.	**The impact of deployment on COPD in active duty military personnel.**	**2014**	**Military medicine Vol. 179, pp. 1273-1278**	**article**	**DOI URL**
Abstract: PURPOSE: To identify trends in chronic obstructive pulmonary disease (COPD) diagnoses among active duty U.S. military personnel based on deployment history and whether International Classification of Disease, 9th edition (ICD-9) coding meet criteria for the diagnosis of COPD. METHODS: A retrospective chart review using the electronic medical system was conducted for military personnel diagnosed with COPD based on ICD-9 codes for emphysema or chronic obstructive lung disease with at least three qualifying outpatient COPD-coded encounters. Clinical symptoms, smoking history, pulmonary function testing, and radiographs obtained during the diagnostic workup were reviewed. The established diagnosis of COPD was analyzed in relation to deployment. RESULTS: A total of 371 patients were identified during the study period (2005-2009). Of these patients, 194 (52.3%) deployed, whereas 177 (47.7%) did not deploy to Southwest Asia since 2003. Thirty-four percent had no documented smoking history despite the diagnosis of COPD. Airway obstruction was identified by spirometry in only 67% of individuals diagnosed with COPD. No statistically significant differences in pulmonary function testing values were identified between those deployed and nondeployed individuals. CONCLUSION: Despite evidence of increased respiratory symptoms in deployed military personnel, the impact of deployment on increased diagnosis of COPD or severity of disease appears minimal.					
Deeter, D.P.	**The Kuwait Oil Fire Health Risk Assessment Biological Surveillance Initiative.**	**2011**	**Military medicine Vol. 176, pp. 52-55**	**article**	**DOI URL**
Abstract: An important environmental concern during the first Gulf War (Operation Desert Storm) was assessing exposures and potential health effects in U.S. forces exposed to the Kuwait oil fires. With only 3 weeks for planning, a Biological Surveillance Initiative (BSI) was developed and implemented for a U.S. Army unit. The BSI included blood and urine collections, questionnaire administration, and other elements during the predeployment, deployment, and post-deployment phases. Many BSI objectives were accomplished. Difficulties encountered included planning failures, loss of data and information, and difficulty in interpreting laboratory results. In order for biological surveillance initiatives to provide useful information for future deployments where environmental exposures may be a concern, meaningful, detailed, and realistic planning and preparation must occur long before the deployment is initiated.					
Harrington, A.D., Schmidt, M.P., Szema, A.M., Galdanes, K., Tsirka, S.E., Gordon, T. and Schoonen, M.A.A.	The Role of Iraqi Dust in Inducing Lung Injury in United States Soldiers-An Interdisciplinary Study	2017	GeoHealth Vol. 1(5), pp. 237-246	article	DOI
Szema, A.M., Schmidt, M.P., Lanzirotti, A., Harrington, A.D., Lyubsky, S., Reeder, R.J. and Schoonen, M.A.A.	Titanium and Iron in Lung of a Soldier With Nonspecific Interstitial Pneumonitis and Bronchiolitis After Returning From Iraq	2012	Journal of Occupational and Environmental Medicine Vol. 54(1), pp. 1-2	article	DOI URL
Lentz, R.J., Fessel, J.P., Johnson, J.E., Maldonado, F., Miller, R.F. and Rickman, O.B.	Transbronchial Cryobiopsy Can Diagnose Constrictive Bronchiolitis in Veterans of Recent Conflicts in the Middle East.	2016	American Journal of Respiratory and Critical Care Medicine Vol. 193(7), pp. 806-808	article	DOI
Furlow, B.	US Institute of Medicine studies military burn pits	2010	The Lancet Oncology Vol. 11(4), pp. 316	article	DOI
		2010	**Review of the Department of Defense Enhanced Particulate Matter Surveillance Program Report**	**book**	
Abstract: Soldiers deployed during the 1991 Persian Gulf War were exposed to high concentrations of particulate matter (PM) and other airborne pollutants. Their exposures were largely the result of daily windblown dust, dust storms, and smoke from oil fires. On returning from deployment, many veterans complained of persistent respiratory symptoms. With the renewed activity in the Middle East over the last few years, deployed military personnel are again exposed to dust storms and daily windblown dust in addition to other types of PM, such as diesel exhaust and particles from open-pit burning. On the basis of the high concentrations observed and concerns about the potential health effects, DOD designed and implemented a study to characterize and quantify the PM in the ambient environment at 15 sites in the Middle East. The endeavor is known as the DOD Enhanced Particulate Matter Surveillance Program (EPMSP). The U.S. Army asked the National Research Council to review the EPMSP report. In response, the present evaluation considers the potential acute and chronic health implications on the basis of information presented in the report. It also considers epidemiologic and health-surveillance data collected by the USACHPPM, to assess potential health implications for deployed personnel, and recommends methods for reducing or characterizing health risks.					
				article	

Created by JabRef on 05/05/2018.