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MEMORANDUM FOR Chief, Force Health Protection, HHC, U.S. Army Special Operations Command (AOMD/LTC Eric Kelly), Building 2929, Desert Storm Drive (Stop A), Fort Bragg, NC 28310-9110

SUBJECT: Technical Report No. S.0023939-15, Health Status of Personnel Formerly Deployed to Karshi-Khanabad (K2): A Comparative Assessment of Post-Deployment Medical Encounters

1. Enclosed is a copy of the Army Public Health Center (Provisional) report documenting results from a comparative assessment of acute and chronic disease up to ten years' post-deployment among U.S. military personnel who were deployed to Karshi-Khanabad in support of Operation Enduring Freedom.

2. The point of contact is Ms. Jessica Sharkey, Project Manager, at commercial 410-417-2876, DSN 867-2876, or e-mail at jessica.m.sharkey.civ@mail.mil.

FOR THE DIRECTOR:

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Technical Report No. S. 0023939-15, October 2015

Occupational and Environmental Medicine Portfolio
Environmental Medicine Program

Health Status of Personnel Formerly Deployed to Karshi-Khanabad (K2): A Comparative Assessment of Post-Deployment Medical Encounters

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1   Summary

1.1 Purpose

Between 2001 and 2005, Active Duty members of the United States (U.S.) Armed Forces occupied Karshi-Khanabad Air Base (K2), Uzbekistan, in support of Operation Enduring Freedom (OEF). General conditions at K2 were substandard and raised concern among Army, Air Force, Navy, and Marine Corps personnel deployed to the site. In order to investigate environmental exposure concerns identified by individual Service members, a U.S. Central Command (CENTCOM) Force Health Protection Officer requested that the U.S. Army Public Health Command (USAPHC), now the Army Public Health Center, Provisional (APHC (Prov)), conduct an evaluation of health outcomes among Active Duty military personnel with a history of deployment to K2. The APHC (Prov) subsequently conducted a comparative health assessment using one year of post-deployment medical follow-up. The U.S. Army Special Operations Command (USASOC) Surgeon has since requested that the analysis be extended to incorporate up to ten years of follow-up, using all available post-deployment medical encounter data (Department of the Army (DA) Memorandum, Appendix B). In response to this request, a retrospective cohort study was conducted in order to assess post-deployment health status among Service members formerly deployed to K2. This was accomplished by linking K2 deployment rosters from 2001–2005 with post-deployment inpatient and outpatient medical records from 2001–2011. Additionally, a reference group of personnel stationed in South Korea during the same time frame was selected for comparison.

1.2 Results

Findings for several health outcomes had statistically significant elevated age-adjusted relative risks among Service members deployed to K2 compared to U.S. military personnel located in South Korea. Statistically significant elevated rates of two cancer groups were observed in the K2 cohort relative to South Korea: malignant melanoma and malignant neoplasms of lymphatic and hematopoietic tissue (RR: 3.68; 95% CI: 1.35-10.04 and RR: 5.64; 95% CI: 1.70-18.70, respectively). However, the relative risk of melanoma was attenuated and no longer statistically significant after additional adjustment for Service branch and race (RR: 2.15; 95% CI: 0.71-6.54).

The age-adjusted relative risk of all circulatory outcomes in the K2 group was 9 percent less than in the South Korea group (RR: 0.91; 95% CI: 0.87-0.96). Deployment to K2 was associated with a statistically significant 16 percent decrease in the age-adjusted relative risk of all respiratory outcomes when compared to those personnel stationed in South Korea (RR: 0.84; 95% CI: 0.77-0.94). Significantly lower age-adjusted relative risk of all mental health disorders was seen in military personnel stationed at K2 relative to military personnel stationed in South Korea (RR: 0.81; 95% CI: 0.79-0.84).

1.3 Limitations
Several limitations should be acknowledged in the interpretation of the findings. Acute changes in health status during deployment may have been missed and were not evaluated in this investigation. Likewise, changes in health status that may be delayed beyond the available follow-

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up period are unobservable. Defining case status using medical encounter diagnosis codes can generate false positives (i.e., can identify illnesses when none were actually present). Also of consideration is loss to follow-up, which occurred in this investigation when personnel leave military service during the study period. Individual environmental exposure data were not available, although it is acknowledged that individual exposures can vary significantly among Service members. Residual confounding by factors which influence the risk of a health outcome and are also associated with, but not caused by, K2 deployment was also possible. Results for rare diseases, such as specific types of cancers, should be interpreted with caution due to the small case numbers observed. This investigation included the estimation of associations between K2 deployment and more than 20 health conditions; as the number of such comparisons increases, the greater the likelihood that the K2-deployed and South Korea-stationed groups will appear to differ with respect to at least one health outcome due to chance, even if there are truly no differences between the two groups.

Finally, although this investigation was conducted in response to a query by USASOC, Special Operations Forces (SOF) personnel could not be identified. SOF was not, therefore, evaluated as an independent risk factor or as a potential modifier of the associations between deployment and post-deployment health status. The results of this study may not be generalizable to populations with different prevalence or magnitude of modifiers of the associations between K2 deployment and health outcomes. Unfortunately, whether these results are generalizable to formerly deployed SOF personnel is a matter of speculation.

In light of these limitations, the results of this investigation should be considered preliminary. Within the context of other scientific evidence relevant to the relationship between military deployment and subsequent cancer incidence, these findings may motivate further investigation. However, the observed associations in no way imply causality; the investigators caution against using the relative risk estimates observed in this analysis as the basis for decision-making.

1.4 Recommendations

The APHC (Prov) recommends the following as a follow-up to this evaluation:

a. Conduct epidemiologic investigations to evaluate associations between deployment in support of OEF, Operation Iraqi Freedom (OIF), and Operation New Dawn (OND) and subsequent development of cancer among current and former U.S. Armed Forces personnel. Ideally, this recommendation will be implemented in partnership with the other Services and the Department of Veterans Affairs (VA). These investigations should leverage regularly-collected administrative, deployment, and medical data maintained by the Department of Defense (DOD) and the VA and include, but not be limited to, the specific cancers for which personnel deployed to K2 had increased risk (i.e., malignant melanoma and neoplasms of lymphatic and hematopoietic tissue).

b. Collaborate with USASOC Surgeon's Office and Special Operations Command (SOCOM) Surgeon's Office to identify whether, and how, current and former SOF personnel can be included in the study population(s) of the epidemiologic investigations recommended above.

c. In evaluating associations between deployment and cancer incidence, evaluate SOF as an independent cancer risk factor and potential modifier of associations between deployment and cancer.

2 References

See Appendix A for a listing of the references used in this report.

3 Background

After the attacks on the United States on September 11, 2001, the U.S. military sought to identify a regional base from which to support OEF. At the time, Uzbekistan appeared to be an advantageous partner, particularly for its air base located approximately 100 miles from the Afghanistan border, near the towns of Karshi and Khanabad.[1] From late 2001 through June 2005, the U.S. military used the Karshi-Khanabad Air Base (K2) as a logistics and air base providing support for OEF.

In the late 1970s, the Soviet military used K2 to support its operations in Afghanistan. During that time, the Soviet Air Force maintained a fleet of various bomber aircraft at K2, necessitating an underground fuel distribution system. Furthermore, construction of military equipment (including missiles) in the Soviet era used materials such as asbestos and radioactive material. In November 2001, the U.S. Army Center for Health Promotion and Preventive Medicine–Europe (now APHC (Prov)–Europe) performed an Environmental Baseline Survey (EBS)[2] at K2 that found underground jet-fuel plumes, surface dirt contaminated with asbestos, and radioactive uranium. Periodic high levels of dust and other particulate matter (PM) in the air due to seasonal dust storms were also noted. Although the EBS highlighted these findings, it is important to note that 1) measured fuel vapor levels were below Minimal Risk Levels established by the Agency for Toxic Substances and Disease Registry; 2) asbestos was not detected in the air and therefore likely not inhaled by Service members at K2; 3) the levels of radiation found were not substantial enough to penetrate the skin; radioactive dust was not found and thus not inhaled by Service members at K2; and Service members were not living or working directly over the radioactive areas of concern on the site; and 4) common symptoms from acute exposure to high levels of ambient PM typically resolve quickly when PM levels stabilize. Furthermore, chronic respiratory conditions and severe, long-term health effects of air pollution are generally not expected in the relatively young and healthy Service member population.

Despite the survey's conclusion that health effects from the short-term, low-dose exposures present at K2 were unlikely, efforts to remediate the environmental health risks were undertaken (e.g., covering contaminated areas with clean dirt and declaring them "off-limits"), since exposure to any of the constituents mentioned above during deployment to K2 was plausible and because long-term, chronic health effects had not yet been investigated. As such, the current investigation focused on identifying the frequency of post-deployment medical encounters for health outcomes consistent with exposure to the toxicants identified by the EBS, with a particular emphasis on cancer. Medical encounters for respiratory and circulatory diseases as well as for mental health disorders were also summarized.[3-12]

4 Authority

a. This investigation is being conducted at the request of the USASOC.

b. Department of Defense Instruction (DoDI) 6490.03, Deployment Health,[13] establishes the requirement to identify and assess occupational and environmental health hazards during deployments, to mitigate the short- and long-term health risk to the extent feasible in an

operational environment, and to monitor and track health conditions that may result from those exposures.

   c. In accordance with Army Regulation (AR) 40–5, Preventive Medicine,[14] the APHC (Prov) will provide and support comprehensive health surveillance for the U.S. Army and DOD and will review, interpret, and respond to assessment and surveillance data for the purpose of identifying, preventing, and controlling new or evolving health problems.

5   Methods

5.1 Objectives

The objective of this analysis was to estimate the frequency of a specified set of post-deployment health conditions (see Table 1), as documented by diagnosis in post-deployment medical records (inpatient and outpatient encounters) among Service members formerly deployed to K2, and to assess the relative frequency of post-deployment health conditions among personnel who had deployed to K2 in support of OEF, compared to a population of Active Duty Service members who had been stationed in South Korea.

5.2 Data Sources

Data from three sources were used to conduct the retrospective cohort study: the Coalition Forces Land Component Command (CFLCC), the Defense Manpower Data Center (DMDC), and the Defense Medical Surveillance System (DMSS). The CFLCC supplied K2 deployment roster information; DMDC provided both military personnel location and demographic data; and DMSS contained both inpatient and outpatient post-deployment medical diagnosis records. Data from the DMDC and DMSS databases were received from the Division of Data and Analysis within the Armed Forces Health Surveillance Center, now the Armed Forces Health Surveillance Branch (AFHSB); the APHC (Prov) maintains the CFLCC roster.

5.3 Study Population

The study population consisted of Active Duty U.S. military personnel who had been deployed to K2 between 2001 and 2005 and, for comparison, a group of Active Duty personnel who had been stationed in South Korea during the same time frame. Deployment rosters and military personnel location data were linked with both demographic data and up to ten years of post-deployment inpatient and outpatient medical encounter records for these individuals. Personnel who were deployed to K2 and also stationed in South Korea during the time frame of the study were assigned to the K2 group only, and individuals who spent less than 30 days at the location of interest (either K2 or South Korea) were excluded.

The CFLCC roster included the following data: social security number, Service branch, arrival and departure dates, and location code. The roster did not identify whether or not Service members were SOF personnel. Although the investigators do not know with certainty, it is likely that SOF personnel were not enumerated in the CFLCC roster due to mission classification and additional Force Protection measures. As such, this evaluation did not include identification of SOF as a specific risk factor.

5.4 Research Design

A retrospective cohort study using existing electronic databases was conducted. In order to assess the frequency of post-deployment health conditions among personnel deployed to K2 during the years 2001–2005, up to 10 years of inpatient and outpatient medical encounter records were identified and analyzed. In order to provide an estimate of relative disease frequency of post-deployment health outcomes among K2-based personnel had they never been deployed to K2, the frequency of post-deployment health outcomes among a sample of Active Duty military personnel formerly stationed in South Korea during the same period of time was also assessed.

Health outcome case status was defined according to qualifying International Classification of Diseases–Clinical Modification, 9th Revision (ICD-9-CM) encounter codes as well as diagnostic procedure codes (hospitalization data), current procedural terminology (CPT) codes (outpatient data), and supplemental classification of factors influencing health status and contact with health services codes (V-codes), when applicable (Table 1). Whenever possible, standard case definitions defined by the AFHSB were utilized in order to promote consistency across epidemiologic analyses throughout the DOD (http://www.afhsc.mil/Home/CaseDefinitions).

A single medical encounter with a qualifying diagnosis code was considered positive for that health outcome. Repeated instances for diagnoses in the same health outcome category were excluded, such that a single individual could contribute, at most, one health outcome in each category. Defined secondary analyses were used to assess the impact on the results of using relatively sensitive case definitions in the primary analysis.

In addition to assessing the frequency of the four groups of health conditions defined below, the frequency and relative frequency of specific medical encounters for different types of cancers were determined.

Table 1. Health Outcome Case Definitions

Health Outcome Category	Health Outcome	ICD-9-CM Code(s)	V-Code(s)	CPT Code(s)	Procedure Code(s)	Sensitive Case Definition	Specific Case Definition
Cancer	Malignant Melanoma	172		11100, 11101, 11600-11604, 11606, 11620-11624, 11626, 11640-11644, 11646, 11300-11303, 11305-11308, 11310-11313, 11703, 17310-17315, 38500, 38505, 38510, 38520, 38525, 38530, 38792, 39542, 41100-41108, 67810, 68100, 69100, 69105, 78195, 92225, 92226, 96904	40.3-40.5, 86.1, 86.4, 91.6	One (1) medical encounter with a defining diagnosis in the first diagnositic position	Two (2) or more medical encounters with a defining diagnosis in the first diagnostic position following at least one medical encounter with a diagnositic procedure commonly used to evaluate clinically suspicious lesions - OR - Five (5) or more medical encounters with a defining diagnosis in the first diagnostic position
	Malignant Neoplasms of Lip, Oral Cavity, and Pharynx	140-149	V58.0-V58.12			One (1) medical encounter with a defining diagnosis in the first or second diagnostic position	One (1) inpatient medical encounter with a defining diagnosis in the first diagnositic position (or in the second diagnostic position if the first code was a V-code indicating radiotherapy or chemotherapy treatment) - OR - Three (3) or more outpatient medical encounters with a defining diagnosis in the first or second diagnostic position
	Malignant Neoplasm of Digestive Organs and Peritoneum (excluding Colon and Rectum Neoplasms)	150-152, 154.2-154.8, 155-158, 159.1-159.9					
	Malignant Neoplasm of the Colon and Rectum	153-154.1, 159.0					
	Malignant Neoplasm of Respiratory and Intrathoracic Organs (excluding Neoplasm of Lung and Bronchus)	160, 161, 162.0, 163-165					
	Malignant Neoplasm of the Lung and Bronchus	162.2-162.5, 162.8, 162.9					
	Malignant Neoplasms of Bone, Connective Tissue, Skin, and Breast (excluding Melanoma and Female Breast Neoplasms)	170, 171, 173, 175, 176					
	Malignant Neoplasm of the Female Breast	174					
	Malignant Neoplasms of Genitourinary Organs (excluding Cervical, Prostate, and Testis Neoplasms)	179, 181-184, 187-189					
	Cervical Cancer	180					
	Prostate Cancer	185					
	Malignant Neoplasm of Testis	186					
	Malignant Neoplasms of Other and Unspecified Sites	190, 192-195					
	Brain Cancer	191					
	Malignant Neoplasms of Lymphatic and Hematopoietic Tissue (excluding Non-Hodgkin Lymphoma and Leukemia)	201, 202.3-202.7, 203					
	Non-Hodgkin Lymphoma	200, 202.0-202.2, 202.8-202.9					
	Leukemia	204-208					
	Malignant Neoplasms of Plasma Cells	238.6					
Diseases of the Circulatory System		401-405, 410-417, 420-438, 440-449, 451-453, 457-459				One (1) medical encounter with a defining diagnosis in any diagnostic position	One (1) inpatient medical encounter - OR - Two (2) outpatient medical encounters with a defining diagnosis in the first or second diagnostic position
Diseases of the Respiratory System		416, 460-466, 470-478, 480-488, 490-496, 500-508, 510-519				One (1) medical encounter with a defining diagnosis in any diagnostic position	One (1) inpatient medical encounter - OR - Two (2) outpatient medical encounters with a defining diagnosis in the first or second diagnostic position
Mental Health Disorders		290-298, 300-301, 303-305, 307-312, 316				One (1) medical encounter with a defining diagnosis in any diagnostic position	One (1) inpatient medical encounter - OR - Two (2) outpatient medical encounters with a defining diagnosis in the first or second diagnostic position

5.5 Data Analysis

SAS/STAT software, Version 9.2 of the SAS System for Windows (Copyright 2002–2008, SAS Institute Inc., Cary, NC, USA), was used for all data management and analysis. The cumulative incidence of health outcomes was adjusted for factors which were thought to affect the risk of the selected health conditions that were likely to be unequally distributed between the K2 and South Korea-based personnel, to the extent that information was available on these factors. These potential confounders included age, gender, Service branch, rank, and calendar period of deployment. We also stratified the analyses by duration of time spent at the respective location. Modification of the association between K2 deployment and the medical encounters by these factors was also assessed. To estimate the relative frequency of medical encounters among the K2 and South Korea personnel, we conducted univariate and stratified analysis (PROC FREQ), as well as multivariate modeling [Binomial regression (PROC GENMOD)]. Age-adjusted relative risks and 95% confidence intervals were calculated using the Mantel-Haenszel method to pool estimates across age strata. Though limited by small cancer case counts, multivariate-adjusted relative risk estimates comparing K2 to South Korea personnel were obtained by exponentiating the beta coefficient corresponding to the deployment location variable in each model. In addition to age, relative risk estimates for selected cancer outcomes were adjusted for Service branch (Army vs. non-Army) and race (Caucasian vs. non-Caucasian).

In primary analysis, only the first qualifying incidence of a medical encounter for a given health outcome was included and used to define an incident outcome event (a case). Subsequent follow-up time for cases was censored in analyses of that specific health outcome, but cases remained in the risk pool for the other health conditions assessed in this investigation. In sensitivity analyses, increasingly strict case criteria were applied, such that multiple medical encounters were required in order for an incidence to be considered a case.

6   Results

6.1 Summary of Demographic and Service-related Characteristics

Table 2 summarizes the demographic and Service-related covariates of the study population. A total of 35,029 Service members were identified for inclusion in the study, 7,005 of whom met the inclusion criteria for the K2-deployed group   The South Korea group consisted of 28,024 Service members. Notably, the K2-deployed group was disproportionately composed of U.S. Air Force airmen. Age, race, and rank profiles also differed between the K2-deployed and South Korea-stationed groups.

6.2 Adjusted Relative Risks for All Health Outcomes

Location-specific age-adjusted relative risks for all health outcomes are presented in Table 3. Statistically significant elevated rates of two groups of cancers were observed in the K2 cohort relative to the personnel formerly stationed in South Korea: malignant melanoma and neoplasms of lymphatic and hematopoietic tissue (RR: 3.68; 95% CI: 1.35-10.04 and RR: 5.64; 95% CI: 1.70-18.70, respectively). (Refer to the blue shaded areas in Table 3.)

The relative risk of melanoma was attenuated after additional adjustment for Service branch and race, and no longer statistically significant (RR: 2.15; 95% CI: 0.71-6.54). The relative risk of

neoplasms of lymphatic and hematopoietic tissue was qualitatively similar after additional adjustment for Service branch and race (RR: 6.50; 95% CI: 2.08-20.28).

The age-adjusted relative risk of all circulatory outcomes in the K2 group was 9 percent lower than in the South Korea group (RR: 0.91; 95% CI: 0.87-0.96). Deployment to K2 was associated with a statistically significant 16-percent decrease in the age-adjusted relative risk of all respiratory outcomes when compared to those personnel stationed in South Korea (RR: 0.84; 95% CI: 0.77-0.94). Significantly lower age-adjusted relative risk of all mental health disorders was seen in military personnel stationed at K2 relative to military personnel stationed in South Korea (RR: 0.81; 95% CI: 0.79-0.84). (Refer to the blue shaded areas in Table 3.)

Table 2. Demographic and Military Characteristics of the Study Population

	K2	Korea
	n (%)	n (%)
	7,005	28,024
Age		
<20 years	198 (2.8)	3,335 (11.9)
20-29 years	4,031 (57.5)	15,642 (55.8)
30-39 years	2,200 (31.4)	7,139 (25.5)
40+ years	576 (8.2)	1,908 (6.8)
Sex		
Male	6,339 (90.5)	23,344 (83.3)
Female	666 (9.5)	4,680 (16.7)
Race		
Asian	197 (2.8)	1,270 (4.5)
African American	874 (12.5)	7,054 (25.2)
Caucasian	5,096 (72.7)	15,701 (56.0)
Hispanic	472 (6.7)	2,518 (9.0)
Indian	59 (0.8)	198 (0.7)
Other	74 (1.1)	471 (1.7)
Unspecified	233 (3.3)	812 (2.9)
Rank		
E1-E4	2,991 (42.7)	16,280 (58.1)
E5-E9	2,684 (38.3)	8,780 (31.3)
O1-O3 or WO1-WO2	1,005 (14.3)	2,113 (7.5)
O4-O10 or WO3-WO5	324 (4.6)	849 (3.0)
Unspecified	1 (0.0)	2 (0.0)
Service Branch		
Army	1,192 (17.0)	19,896 (71.0)
Air Force	5,711 (81.5)	7,493 (26.7)
Marine Corps	89 (1.3)	438 (1.6)
Navy	13 (0.2)	197 (0.7)
Service Component		
Active Duty	6,960 (99.4)	27,519 (98.2)
National Guard	20 (0.3)	228 (0.8)
Reserve	25 (0.4)	277 (1.0)
Time at Location		
0-3 months	1,943 (27.7)	13,840 (49.4)
3-6 months	4,317 (61.6)	5,859 (20.9)
6-9 months	684 (9.8)	2,695 (9.6)
9-12 months	29 (0.4)	2,544 (9.1)
12+ months	32 (0.5)	3,086 (11.0)

Legend:
E – enlisted; O – officer; WO – warrant officer

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Table 3. Age-Adjusted Relative Risks and Corresponding 95% Confidence Intervals for Health Outcomes, Comparing U.S. Military Personnel Deployed to K2 to U.S. Military Personnel Stationed in South Korea

Outcome	K2 N = 7,005 Age*				Korea N = 28,024 Age*				Age-Adjusted	
	Young		Old		Young		Old		Relative Risk (RR)	95% Confidence Intervals (CI)
	n	%	n	%	n	%	n	%		
Cancer Outcomes										
All Cancer	11	0.39	50	1.21	41	0.28	133	1.00	1.23	0.92-1.65
Brain Cancer	1	0.04	4	0.10	0	0.00	8	0.06	2.04	0.68-6.09
Cervical Cancer	0	0.00	0	0.00	1	0.01	0	0.00	0.00	--
Leukemia	0	0.00	1	0.02	5	0.03	4	0.03	0.43	0.05-3.63
Malignant Melanoma	1	0.04	7	0.17	3	0.02	5	0.04	3.68	1.35-10.04
Neoplasm of Bone/Connective Tissue/Skin/Breast	1	0.04	3	0.07	5	0.03	9	0.07	1.06	0.35-3.22
Neoplasm of Colon/Rectum	2	0.07	3	0.07	2	0.01	9	0.07	1.60	0.57-4.51
Neoplasm of Digestive Organs/Peritoneum	0	0.00	1	0.02	1	0.01	6	0.05	0.48	0.06-3.95
Neoplasm of Female Breast	1	0.04	3	0.07	1	0.01	9	0.07	1.35	0.43-4.24
Neoplasm of Genitourinary Organs	1	0.04	4	0.10	2	0.01	8	0.06	1.74	0.60-5.08
Neoplasm of Lip/Oral Cavity/Pharynx	1	0.04	3	0.07	0	0.00	6	0.05	2.18	0.64-7.49
Neoplasm of Lung/Bronchus	0	0.00	4	0.10	0	0.00	0	0.00	--	--
Neoplasm of Lymphatic and Hematopoietic Tissue	2	0.07	5	0.12	6	0.04	0	0.00	5.64	1.70-18.70
Neoplasm of Respiratory/Intrathoracic Organs	0	0.00	0	0.00	0	0.00	2	0.02	0.00	--
Neoplasm of Testis	1	0.04	2	0.05	8	0.05	12	0.09	0.57	0.17-1.91
Non-Hodgkin Lymphoma	0	0.00	3	0.07	4	0.03	8	0.06	0.89	0.25-3.26
Prostate Cancer	0	0.00	4	0.10	0	0.00	18	0.14	0.71	0.24-2.10
Neoplasm of Other and Unspecified Sites	0	0.00	3	0.07	3	0.02	27	0.20	0.33	0.10-1.09
Neoplasm of Uncertain Behavior (Plasma Cells)	0	0.00	0	0.00	0	0.00	0	0.00	--	--
Circulatory Disease Outcomes	282	9.75	1,025	23.77	1,259	8.43	3,856	27.70	0.91	0.87-0.96
Respiratory Disease Outcomes	189	6.51	270	6.43	965	6.44	1,160	8.58	0.84	0.77-0.94
Mental Health Disorder Outcomes	1,536	43.72	1,820	37.14	10,073	50.86	8,330	48.27	0.81	0.79-0.84

Notes:
*Age was stratified on the median, 25 years of age, where the "young" category is defined as any Service member 25 years of age or younger, and the "old" category is defined as any Service member 26 years of age or older.
Values shaded in blue represent statistically significant results (as described in paragraph 6.2).

7   Discussion

A retrospective cohort design was implemented in order to evaluate the post-deployment health status among Service members formerly deployed to K2. This was accomplished by linking K2 deployment rosters from 2001–2005 with post-deployment inpatient and outpatient medical records from 2001–2011. A reference group of personnel stationed in South Korea during the same time frame was selected for comparison because these Service members are stationed overseas for an extended period of time and are more likely to have a baseline health status similar to that of OEF-deployed personnel, relative to never-deployed personnel stationed in the Continental U.S.

This investigation focused on identifying the frequency of post-deployment medical encounters for health outcomes consistent with the toxicants (jet fuel, radiation, asbestos, and high levels of dust and particulate matter) identified as potential exposures by an Occupational and Environmental Baseline Survey performed at K2 in November 2001. We particularly emphasized cancer due to concerns of a number of personnel previously stationed at K2. Medical encounters for respiratory and circulatory diseases as well as for mental health disorders were also summarized.

Several limitations should be acknowledged in the interpretation of the findings. The analysis conducted was based on healthcare encounter diagnoses following redeployment. As a result, any acute changes in health status during deployment related to the outcomes evaluated that were due to exposures in theater may have been missed. Likewise, changes in health status that may be delayed beyond the available follow-up period are unobservable, particularly cancers with longer

latency periods. The use of medical encounter diagnosis codes for case definition can also result in false positives. Also of noteworthy consideration is loss to follow-up, which occurs when personnel leave military service during the study period. Individual environmental exposure data were not available, although it is acknowledged that individual exposures can vary significantly among Service members, despite their having been deployed to the same location. Residual confounding by factors which influence the risk of a health outcome and are also associated with, but not caused by, K2 deployment was also possible. For example, the risk of melanoma may be higher among Caucasian personnel than among personnel of other races and the proportion of Caucasian Service members is higher among K2 personnel compared to South Korea-stationed personnel. However, relative rate estimates from models adjusting for age, race, and Service branch were qualitatively similar to those from models adjusting only for age.

Similarly, information on individual risk factors that could potentially confound the observed associations was unavailable. For example, if the prevalence of smoking was higher among personnel based at K2 relative to South Korea-stationed personnel than relative rate estimates would be biased upwards for outcomes where smoking increases the risk. Furthermore, results for rare diseases, such as specific types of cancers, should be interpreted with caution due to small case numbers observed. For example, although the underlying groups are large, the relative rate estimates for melanoma and neoplasms of lymphatic and hematopoietic tissue were based on a total of 16 and 13 cases, respectively. This investigation included the estimation of associations between K2 deployment and more than 20 health conditions. It is noted that, in general, as the number of such comparisons increases, the greater the likelihood that the K2-deployed and South Korea-stationed groups will appear to differ with respect to at least one health outcome due to chance, even if there are truly no differences between the two groups.

Finally, although this investigation was conducted in response to a query by USASOC, SOF personnel could not be identified. SOF was not, therefore, evaluated as an independent risk factor or as a potential modifier of the associations between deployment and post-deployment health status. The results of this study may not be generalizable to populations with different prevalence or magnitude of modifiers of the associations between K2 deployment and health outcomes. Unfortunately, whether these results are generalizable to formerly deployed SOF personnel is a matter of speculation.

In this exploratory investigation, elevated age-adjusted relative risks were observed for approximately half of the cancer outcomes evaluated (i.e., 9 of 19 estimated risk ratios were greater than 1), comparing the K2 deployers to the Service members located in South Korea, though only two of these observed associations were statistically significant. Because of the small number of incident cancers evaluated in this investigation (61 and 174 cancer cases in the K2 and South Korea cohorts, respectively) as well as the other limitations noted above, the results of this investigation should be considered preliminary. Within the context of other scientific evidence relevant to the relationship between military deployment and subsequent cancer incidence, these findings may motivate further investigation. However, the observed associations in no way imply causality; the investigators caution against using the relative risk estimates observed in this analysis as the basis for decision-making.

8   Recommendations

The APHC (Prov) recommends the following as a follow-up to this evaluation:

a. Conduct epidemiologic investigations to evaluate associations between deployment in support of OEF, OIF, and OND and subsequent development of cancer among current and former U.S. Armed Forces personnel. Ideally, this recommendation will be implemented in partnership with the other Services and the VA. These investigations should leverage regularly collected administrative, deployment, and medical data maintained by the DOD and the VA, and should include, but not be limited to, the specific cancers for which personnel deployed to K2 had increased risk (i.e., malignant melanoma and neoplasms of lymphatic and hematopoietic tissue).

b. Collaborate with the USASOC Surgeon's Office and SOCOM Surgeon's Office to identify whether, and how, current and former SOF personnel can be included in the study population(s) of the epidemiologic investigations recommended above.

c. In evaluating associations between deployment and cancer incidence, evaluate SOF as an independent cancer risk factor and potential modifier of associations between deployment and cancer.

9   Point of Contact

The APHC (Prov) point of contact is Ms. Jessica Sharkey, Epidemiologist, Environmental Medicine Program, commercial 410-417-2876 or e-mail at jessica.m.sharkey.civ@mail.mil.

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Approved:

COLEEN P. BAIRD
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Appendix A

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Appendix B

Department of the Army Memorandum for USAPHC
Environmental Medicine Program

DEPARTMENT OF THE ARMY
HEADQUARTERS, UNITED STATES ARMY
SPECIAL OPERATIONS COMMAND
2929 DESERT STORM DRIVE (STOP A)
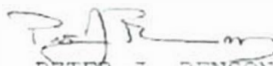FORT BRAGG, NORTH CAROLINA 28310-9110

REPLY TO
ATTENTION OF

AOMD   02 March 2012

MEMORANDUM FOR USAPHC Institute of Public Health Environmental Medicine Program (MCHB-IP-MEM), 5159 Blackhawk Rd, APG, MD

SUBJECT: Comparative Health Assessment of Deployers to Karshi-Kanabad Air Base, Uzbekistan

1. In the past several years it has been observed that a number of personnel assigned or attached to US Army Special Operations Command who were deployed to Karshi-Kanabad (K2) Air Base, Uzbekistan have developed various types of cancer.

2. In an effort to better understand if possible exposures at K2 could be related to the health status of USASOC personnel we request an expansion of the comparative assessment of acute and chronic disease in K2 deployers up to ten years post-deployment.

3. This memorandum confirms the intent of USASOC to support the conduct of the aforementioned study by the USPHU Institute of Public Health Environmental Medicine Program.

4. POC is LTC Jennifer Caci, USASOC HSO, at COMM 910-432-9884, DSN 239 9884 or jennifer.caci@us.army.mil.

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