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The Impact of Environment and Occupation on the Health and Safety of Active Duty Air Force Members – Database Development



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14. ABSTRACT The overall goal of this project was to develop a database that will allow investigators to examine how environmental and occupational factors affect risk-taking behaviors and health outcomes among United States Air Force personnel. With an appropriate database, investigators will be able to explore the general hypothesis that environmental and occupational factors influence both health outcomes and risk-taking behavior of service members in certain career fields, with identification of high-risk career fields for targeted interventions. Additionally, low-risk career fields could be identified for potential protective factors. The result of this project was a comprehensive database that has been formatted and cleaned, which will enable investigators to identify environmental and occupational factors specific to the Air Force that impact health and safety outcomes. The analysis of the database will be conducted in Phase 2 of the project.					
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1.0 SUMMARY

The overall goal of this study was to investigate how environmental and occupational factors affect risk-taking behaviors and health outcomes among U.S. Air Force personnel. Due to the nature of their occupations, active duty Air Force members can face numerous hazards on a daily basis. These environmental and occupational hazards may directly influence an individual's physical and mental health. Previous literature has linked occupational factors to risk taking and health and safety outcomes for service members in distal, indirect ways, such as in diseases or injuries acquired while not directly performing job duties and responsibilities or as a result of stressors in the workplace. These conditions can be due to increased risk-taking behaviors or to medical issues influenced by, but not directly related to, an occupational or environmental exposure.

While the nature of the occupation of these service members can be a direct source of stress, these jobs also have the potential to provide beneficial aspects including social support or camaraderie within the organization or career field. The focus of this project was to develop a database that will allow investigators to examine how environmental and occupational factors affect risk-taking behaviors and health outcomes among U.S. Air Force personnel. With an appropriate database, investigators would be able to explore the general hypothesis that environmental and occupational factors influence both health outcomes and risk-taking behavior of service members in certain career fields, with high-risk career fields identified for targeted interventions.

Through the creation of this database, we intend to launch a study to identify environmental and occupational factors specific to the Air Force that impact health and safety outcomes. Based on those factors, results from this study may be used to develop policy recommendations aimed at improving these outcomes for active duty Air Force members. Finally, we plan to present manuscripts based on this research to peer-reviewed journals as well as presentations at scientific conferences.

2.0 BACKGROUND

Occupational safety is typically defined by potential environmental and occupational risk factors as well as incidents and accidents that occur on the job. However, job assignments and associated stress levels of individual service members can have major implications for safety off the clock as well. Individual workplaces in the Air Force have been examined for environmental and occupational risks; however, a broad Air Force perspective of all occupations and workplaces has not yet been conducted. The overall goal of this study is to investigate how environmental and occupational factors affect health outcomes and risk-taking behaviors among U.S. Air Force (USAF) personnel.

All workplaces on an Air Force installation are evaluated by an Aerospace Medicine team (typically Bioenvironmental Engineering, Public Health, and flight surgeons) to determine potential environmental and occupational exposures using nationally identified sources such as Air Force Occupational Safety and Health standards and Occupational Safety and Health Administration expanded standards. Once these exposures are identified, preventive measures are implemented and documented for high-risk workplaces (AF Form 2755 and 2766). Routine visits to each workplace are conducted by Aerospace Medicine to ensure that these preventive measures are utilized as well as to investigate any potential mishaps or any reported accidental

exposures. Any occupationally related injury or illness is reported to the Air Force Safety Center. Each base Bioenvironmental Engineering and Public Health office maintains a record for the high-risk workplaces on their installation; however, information for these workplaces has not yet been examined or analyzed Air Force wide.

In addition to direct environmental and occupational hazards, members of the military report higher psychological strain than the general population [1] and significant work stress [2]. These stressors may manifest in health and safety outcomes for service members in distal, indirect ways, such as in diseases (depression, [3]) or injuries acquired while not directly performing job duties and responsibilities. These outcomes can be due to increased risk-taking behaviors like drug use [4] and smoking [5] or to medical issues, such as poor diet [5] and obesity [6]). While the occupations of service members can be a source of stress, these jobs also have the potential to protect against stress and resulting issues [7].

3.0 METHODS

The purpose of this project was to develop a database that will allow investigators to examine how environmental and occupational factors affect risk-taking behaviors and health outcomes among USAF personnel. With an appropriate database, investigators will be able to explore the general hypothesis that environmental and occupational factors influence both health outcomes and risk-taking behavior of service members in certain career fields, with high-risk career fields identified for targeted interventions. Additionally, low-risk career fields could be identified for potential protective factors. The result of this project was a comprehensive database that has been formatted and cleaned, which will enable investigators to identify environmental and occupational factors specific to the Air Force that impact health and safety outcomes. The analysis of the data was not covered by this project, which only pertains to construction of the database (Phase 1).

Phase 1 (construction of the database) included funding to employ a full time equivalent (FTE) epidemiologist or data manager to coordinate the data collection and requests (including development of data use agreements) from six distinct data sources: Air Force Personnel Center (AFPC), Air Force Safety Center (AFSC), Standard Ambulatory Data Record (SADR), Standard Inpatient Data Record (SIDR), Air Force Reportable Event Surveillance System (AFRESS), and Preventive Health Assessments (PHAs). Additionally the FTE will compile the separate datasets into one database for future analysis.

Data were maintained at the USAF School of Aerospace Medicine, Epidemiology Consult Service at Wright-Patterson Air Force Base, in building 840, on existing computers that required appropriate access. An Institutional Review Board evaluation was conducted to review the protocol and ensure that the project did not meet the definition of Human Subjects Research. A waiver of consent was granted, since it was not practical or feasible to obtain informed consent for the large number of records (up to 1.5 million) included in this database.

4.0 RESULTS

This database only includes active duty Air Force (ADAF) members, approximately 300,000 per year, for the 5-year period from 1 January 2006 to 31 December 2010. Therefore, the database did not exceed 1.5 million subjects, since many individual AF members were in the dataset for multiple years. The number of subjects, inclusion/exclusion criteria, and age range

were determined by the data sources; no sub-sampling of the data was employed. There were no specific inclusion or exclusion criteria, so the age range is approximately 18-60 years old and the male to female ratio is about 3 to 1.

Since the purpose of the database was to link all records from multiple databases into one queriable database, no new data were collected. All existing data had been collected as part of routine surveillance/clinical care and came from multiple data sources. The FTE linked records between datasets by using Social Security numbers (SSN), family member prefix, date of birth (DOB), rank, and gender, as available in the datasets. Occupational data elements included Air Force Specialty Code, skill level, rank, date of rank, and organizational structure. Outcome data elements included personal safety incidents (e.g., traffic accidents and violations, alcohol abuse, and physical altercations), high-risk sexual behavior (e.g., unprotected sexual intercourse), and physical health issues, such as high blood pressure or anxiety. See Table 1 for outcome data elements and data source.

Table 1. Outcome Data Elements and Data Source

Potential Outcome	Variables	Data Source
Occupational injury	Patient SSN, DOB, rank, gender, diagnosis, acute or chronic injury, date of report, number of duty days lost, location of injury (shop name/number)	AFSC
Occupational Illness	Patient SSN, DOB, rank, gender, diagnosis, acute or chronic illness, date of report, number of duty days lost/duration of illness, location of illness (shop name/number)	AFSC
Traffic accident	Patient SSN, DOB, rank, gender, motor vehicle accident, date of report, duty status at time of accident (on/off duty), injuries sustained, outcome of accident (recovery/fatality), number of lost duty days	AFSC
Alcohol use/tobacco use	Sponsor/patient SSN, DOB, rank, gender, encounter date, answers to alcohol and tobacco use questions (section 8-tobacco use; section 9-alcohol use)	PHA
High-risk sexual activity	Sponsor/patient SSN, DOB, rank, gender, encounter date, answers to sexual activity questions (section 12-reproductive)	PHA
Sexually transmitted disease	Sponsor ID (SSN), dependent status, DOB, sponsor pay grade, gender, ICD-9 codes, date of diagnosis	SADR/SIDR and AFRESS
High blood pressure	Sponsor ID (SSN), DOB, sponsor pay grade, gender, ICD-9 codes, date of diagnosis	SADR/SIDR
Anxiety	Sponsor ID (SSN), DOB, sponsor pay grade, gender, ICD-9 codes, date of diagnosis	SADR/SIDR
Depression	Sponsor ID (SSN), DOB, sponsor pay grade, gender, ICD-9 codes, date of diagnosis	SADR/SIDR
Demographic data	SSN, DOB, grade (rank), date of rank, sex, PAFSC, DAFSC, duty location, service component, ethnic designator, squadron, unit, component status, race/ethnicity, marital status	AFPC

Note: DAFSC = duty Air Force Specialty Code; ICD-9 = International Classification of Diseases, Ninth Revision; PAFSC = primary Air Force Specialty Code.

The AFPC data consisted of 60 monthly files that were imported as text into five Access databases covering 2006 through 2010, totaling 20,207,203 records with 519,914 unique SSNs for all 5 years combined with 40 variable fields. Through data cleaning, several issues were identified and corrected including inconsistency in data entry of installation name; inconsistency of unit identification; missing codes in the supplementary tables; multiple DOB for unique SSN; switch in gender/sex across years for same SSN; contamination of active duty data with USAF Academy (USAFA) cadets, Guard/Reserve members, and dependents; and missing data in several fields.

Early in the database cleaning process, it was discovered that the installation names were inconsistently qualified in the data entry (Kirtland vs. Kirtland Air Force Base). This problem was resolved by developing mapping/transition matrices to ensure standardization of values and developing two additional variables to reflect the change in the personnel data. Additionally, the unit variable also exhibited inconsistency in data entry. This variable was not corrected at this time and will be considered to be condensed or grouped during the analysis phase of the study.

The supplementary tables were missing codes in several fields including Air Force Specialty Code (15% missing), Aviation Service Code (31% missing), Installation Kind (0.1% missing), and Subject Code (0.6% missing). Additionally, specific variables were missing data including Primary Air Force Specialty Code, Duty Air Force Specialty Code, Duty Title, Duty Status, and Higher Education (estimated 20,000 to 50,000 missing values per year). The missing data could not be verified and were left blank for the analysis phase of the study.

Approximately 520 SSNs had more than one DOB assigned to them; consequently, the age calculations were inaccurate and unique identification of an individual was limited. To resolve this issue, the latest DOB listed in the personnel data was used and, in some cases, the DOB was crosschecked in other databases for verification of accuracy. Another coding issue was noticed in the gender/sex field. Sixty-two SSNs were identified to have been coded as male and female in different files. Several possible solutions were utilized to correct this error including review of first name, view of chronological history and progression through the import files, checking the internet for common baby names or name origins, and crosschecking with other databases.

To limit the study to ADAF members only, the data were reviewed for questionable entries. It was discovered that the personnel data contained cadets from USAFA, generally with the rank of second lieutenant, no Air Force Specialty Code assigned (or limited to a student Air Force Specialty Code of 92M, 92T, 9T1, 9T2), and no Duty Status Code, a questionable date of rank. It was relatively easy to identify and remove most of the cadets by eliminating all USAFA members with the rank of second lieutenant and only retaining those members with a non-training related Air Force Specialty Code (indicative of instructor cadre).

The SADR (outpatient) and SIDR (inpatient) data also consisted of 60 monthly files that were imported as text into five Access databases covering 2006 through 2010. Once all duplicates and non-ADAF members were removed, the SADR database consisted of 896,959 records with 23 variables and the SIDR database consisted of 45,213 records with 23 variables.

To remove non-ADAF members from the SADR data, the initial data received were filtered on beneficiary category, dependent status, and sponsor status. The five yearly files were then combined into one Access database. Initially, the number of SADR records was 1,821,264, which was reduced to 909,142 after removal of duplicates and 903,362 after removal of name, leaving 896,959 records to be linked to the AFPC data after removal of non-ADAF members.

To properly link the data with the AFPC data, SSN and the import file field combination were utilized to ensure linkage to the correct person and ensure that the import date fell within the correct AFPC upload dates. Additionally, the data needed to ensure that diagnoses were properly coded into the proper ICD-9 categorization for the study (sexually transmitted diseases, alcohol/drug abuse, high blood pressure, and anxiety/depression). A mapping matrix of 776 lines was developed to ensure correct categorization.

The SADR data also suffered from the same data coding inconsistencies as the AFPC data with multiple DOBs per SSN (0.5% of data) due to possible mistakes in data entry or overlap with data from spouse or children and multiple gender listed for a unique SSN (0.01% of data). Additionally, the SADR data contained 544 SSNs that did not have a corresponding entry in the AFPC data. This problem was resolved by removing the records without a matching AFPC entry.

The SIDR data were run through the same filters as the SADR data to remove non-ADAF members and then the five yearly files were combined into one Access database. Initially, the number of SIDR records was 45,794, which were reduced to 45,754 after removal of duplicates and 45,752 after removal of name, leaving 45,213 records to be linked to the AFPC data after filtering for non-ADAF members.

The SIDR data were linked to the AFPC data using the same process as the SADR data with implementation of the same ICD-9 coding matrices developed for the SADR data. The SIDR data had minor coding issues with DOB (13 SSNs had two DOBs) and multiple genders (two SSNs had both gender assignments). The SIDR data contained 47 SSNs that did not have a corresponding entry in the AFPC data, which were removed from the data for the remainder of the database development.

The AFSC data consisted of one Excel file that was imported into an Access database consisting of data from 2006 through 2010. All mishap dates occurring after 2010 were removed from the database. Once all non-ADAF members were removed, the data consisted of 8,670 injury records with 42 variables and 992 illness records with 46 variables.

The AFSC injury data contained 1,004 SSNs that were either invalid (too many consistent 0s, 1s, 9s, or 5s) or did not match AFPC records. These records were crosschecked with the AFPC database to identify potential corrections and then non-matching records were deleted. The records were linked to the AFPC data using a similar process to the SADR data and the data were evaluated for inconsistencies in DOB and gender with no apparent duplication issues.

The AFSC illness data contained 80 records with a blank SSN (78 were matched to AFPC data using name and other demographic data) and 85 records with no matching SSN in the AFPC data (53 discovered to be Guard/Reserve, 17 reviewed and corrected, 15 eliminated). The records were linked to the AFPC data using a similar process to the SADR data and the data were evaluated for inconsistencies in DOB and gender with no apparent duplication issues.

The AFRESS data consisted of five yearly Excel files that were combined into one Access database file and non-ADAF members were removed. For 2006 through 2010, the data consisted of 24,999 records. The data were filtered for non-ADAF members, leaving 23,289 records with 32 variables.

The AFRESS data were again filtered to include only those entries indicating a reportable sexually transmitted disease. Several issues were determined when attempting to link the data to the AFPC data including the practice of using the sponsor SSN in place of the patient SSN to ensure accuracy, evaluation of the date of onset field versus date case created field to ensure

more accurate personnel data at the time of case onset, and data inconsistencies seen previously (1,710 SSNs did not match AFPC, 368 SSNs had multiple DOBs, 339 SSNs had multiple gender). These issues were created in the same format as previously described for SADR, SIDR, and AFSC data.

The PHA data consisted of a series of text files that were combined into an Access database. The data contained algorithmic data based on the Health Assessment conducted on a yearly basis by Air Force personnel. These data were compressed into a flat file based on encounters and responses. The requested Health Assessment data consisted of specific information relating to tobacco, alcohol, and sexual behaviors with 43 questions and 222 potential responses. For 2006 through 2010, the data consisted of 12,477,395 records. The data were filtered for non-ADAF members, leaving 9,313,452 records with six variables that were matched to the AFPC data.

Through the cleaning of the PHA data, several issues were identified and corrected including many Guard/Reserve records coded as active duty, duplicate PHAs present within the same calendar year (up to four or more PHAs per person per year), encounter dates not matching response dates, data from other branches of service entered into USAF system, and dependents completing the PHA. The original number of variables in the data was 15, which was reduced to 6 to simplify the data and ensure that only variables of interest in the study were included.

5.0 DISCUSSION

The completion of the database at the end of August 2013 allowed us to continue with the data analysis phase of the project (Phase 2). Data analysis will include an examination of occupational illness and injury as reported to the AFSC. We will utilize regression analysis to identify which career fields are associated with high risk of occupational illness and injury. Once these high-risk populations are identified, we will employ multivariable regression analysis to identify specific environmental and occupational exposures that directly relate to an increase in occupational injury and illness in these populations. Next, we will conduct more detailed analysis that will combine the results of the regression analysis with potential outcomes of interest. Our primary methodological focus will be on predicting both positive and negative health and safety outcomes for ADAF members, employing two primary approaches: regression analysis and hazard function analysis. Lastly, we will look at common variables between models produced above. This will allow identification of key drivers for risk for ADAF members. From this, we will offer results that may be utilized to form policy recommendations that may allow the USAF to reduce risk for its Airmen. For instance, if we find that particular career fields are a common element in negative health outcomes, we might recommend screening or prevention programs targeted to those particular career fields. If we find that peer support partially mitigates risk-taking behaviors, a potential recommendation would be setting up and promoting peer counseling and support groups.

The developed database will allow us the opportunity to describe the current utilization of military medical care by ADAF members through examination of direct outcomes that occur as a result of an occupational injury or illness as well as indirect outcomes that may manifest because of risk-taking behavior or additional occupational stressors. We expect to identify the most current medical and personnel data that are available for the purposes of this study. Through the phases of the study outlined previously, we will be able to characterize the occupational experience of high-risk career fields with respect to illness and injury. In addition, we will be

able to identify demographic variables associated with these occupational injuries and illnesses, as well as occupational stressors that may increase an individual's risk of injury or illness.

6.0 CONCLUSIONS

This study will allow us to develop pathways toward occupation-related human performance improvement by tailoring specific counseling and/or prevention programs that may be implemented to reduce the stress and stress-related outcomes experienced in specific occupations within the Air Force community in both garrison and deployed environments. The results of this study can be used to develop prevention strategies that can be presented to Air Force leaders as policy recommendations to ensure that Air Force members are able to operate efficiently and ensure full mission capabilities. The identified policy recommendations will be routed through the Air Force Surgeon General's office upon completion of the study.

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LIST OF ABBREVIATIONS AND ACRONYMS

ADAF	active duty Air Force
AFPC	Air Force Personnel Center
AFRESS	Air Force Reportable Events Surveillance System
AFSC	Air Force Safety Center
DOB	date of birth
FTE	full time equivalent
ICD-9	International Classification of Diseases, Ninth Revision
PHA	Preventive Health Assessment
SADR	Standard Ambulatory Data Record
SIDR	Standard Inpatient Data Record
SSN	Social Security number
USAF	U.S. Air Force