Summer 6-2016

Psychological Health Outcomes Within USAF Remotely Piloted Aircraft Support Career Fields

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PSYCHOLOGICAL HEALTH OUTCOMES WITHIN USAF REMOTELY PILOTED AIRCRAFT SUPPORT CAREER FIELDS

by

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A Dissertation Submitted to the College of Aviation
in Partial Fulfillment of the Requirements for the Degree of
Doctor of Philosophy in Aviation

Embry-Riddle Aeronautical University
Daytona Beach, Florida
June 2016

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This Dissertation was prepared under the direction of the candidate's Dissertation Committee Chair, Dr. Mark A. Friend, Professor, Daytona Beach Campus; and Dissertation Committee Members Dr. Haydee M. Cuevas, Assistant Professor, Daytona Beach Campus; Dr. Ian R. McAndrew, Professor, Worldwide Campus; and Dr. Jean L. Otto, External Member, and has been approved by the Dissertation Committee. It was submitted to the College of Aviation in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Aviation

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ABSTRACT

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Title: PSYCHOLOGICAL HEALTH OUTCOMES WITHIN USAF REMOTELY PILOTED AIRCRAFT SUPPORT CAREER FIELDS

Institution: Embry-Riddle Aeronautical University

Degree: Doctor of Philosophy in Aviation

Year: 2016

Remotely piloted aircraft are now commonplace in modern warfare. Enlisted intelligence personnel in the U.S. Air Force (USAF) who support these activities have reported personal accounts of posttraumatic stress and fatigue, possibly due to viewing high-definition, full-motion-video, remote warfare. Rates of mental health diagnoses and counseling are unknown in this population. Incidence rates of 12 specific mental health outcomes were calculated for all enlisted active duty USAF Intelligence Specialists in the 1N1 and 1N0 career fields from 1 January 2006 through 31 December 2010, while considering various demographic and military variables. The incidence rates were compared to RPA sensor operators and aircraft armament technicians that have similar initial and subsequent psychiatric medical standards and occupational scheduling demands as enlisted active duty USAF intelligence specialists, but differ in the viewing of high-definition, full-motion-video, remote warfare. Unadjusted incidence rates of posttraumatic stress disorder among RPA intelligence specialists (n=7,988), RPA sensor operators (n=196), and aircraft armament technicians (n=11,340) were 3.4 per 1,000 person-years, 2.0 per 1,000 person-years, and 1.5 per 1,000 person-years, respectively. Incidence rate ratios, adjusted for age, gender, time in service, and number of deployments, for posttraumatic stress disorder were: 1) 1.34, 95% confidence interval = 0.19-9.64, for RPA intelligence specialists compared to RPA sensor operators, 2) 1.83, 95% confidence interval = 1.31-.2.55, for RPA intelligence specialists compared to aircraft armament technicians, and 3) 1.36, 95% confidence interval = 0.19-9.85, for RPA sensor operators compared to aircraft armament technicians. Enlisted RPA intelligence specialists displayed significantly higher incidence rates for substance abuse/dependence, family circumstance problems, and maltreatment related mental health categories, and for all mental health outcomes combined compared to RPA sensor operators after adjusting for differences in the two cohorts. Enlisted RPA intelligence specialists also displayed statistically higher incidence rates for life circumstance problems and posttraumatic stress disorder as compared to aircraft armament technicians after adjusting for differences in the two cohorts. Within the surveillance period, RPA intelligence specialists experienced 1.83 times ($p < 0.001$) the rate of posttraumatic stress disorder compared to aircraft armament technicians, after adjusting for differences in the two cohorts. The statistical findings indicating increased incidence rates of mental health outcomes within RPA intelligence specialists corroborate the theoretical perspective that modern intelligence personnel within the DCGS may be at a higher psychological risk similar to traditional combat veterans, and will likely experience emotional stress, burnout, and PTSD. Military policymakers and clinicians should recognize that RPA intelligence personnel have increased mental health risk while performed their duties.

ACKNOWLEDGEMENTS

I would like to thank my family, friends, and colleagues for their support during the past seven years of this academic endeavor. The encouragement and patience of my committee chair, Dr. Mark Friend, were instrumental to this study's completion, as was the assistance of my committee members, Dr. Haydee Cuevas, Dr. Ian McAndrew, and Dr. Jean Otto. I would also like to thank the United States Air Force School of Aerospace Medicine for their support of this research by dedicating the time and effort necessary to first approving such a project, and then compiling the raw data. I would also like to acknowledge Embry-Riddle Aeronautical University for creating an academically rigorous aviation doctoral program that still allowed its students to continue their education from the comforts of the United States, or during the demands of hostile lands during military deployment.

Dr. Mark Friend: Your honed grammatical skills were equaled only by your patience as my unpredictable comma placement, no doubt, left you flabbergasted. In all seriousness, your encouragement and support throughout this grueling process is appreciated more than my words can convey

Dr. MaryJo Smith: To one of the few people that can make statistics fun, while at the same time being every student's biggest fan. Thank you for your friendship, as well as your support when there were few around.

To my son, Jason Ostrowski: I've been working on completing this degree just about as long as you've been alive. I've been around without really being around, and by doing so I've lost valuable time we could've spend together. When you read this, many years from now, I hope you feel I've made up for that lost time, and, maybe, you're even

a little proud of me for trying to make myself a better person while also setting myself and the family up for future success. I love you very much.

To my wife, Karen Ostrowski: You've taken care of literally everything while I worked on this degree for seven years. Your support has been unwavering, even during times of frustration – I don't know how you did it. It's time for us to start enjoying life a little more, and for me to take as much of the load off you, as possible. I love you more than you'll ever know.

TABLE OF CONTENTS

LIST OF TABLES

Page

Table

LIST OF FIGURES

Page

Figure

CHAPTER I

INTRODUCTION

The health effects of United States Air Force (USAF) remotely piloted aircraft (RPA) operations on personnel tasked to pilot and support these missions remain critical to the Department of Defense (DoD) as well as the American public (Chappelle, Prince, Goodman, Thompson, Cowper, and Ray-Sannerud, 2014b; Chappelle, Salinas, & McDonald, 2011b; Prince, Chappelle, McDonald, Goodman, Cowper & Thompson, 2015). As RPA combat air patrols continue to be in high demand for the foreseeable future, USAF leadership and aeromedical physicians are concerned that continuous, 24 hours-a-day, 365 days-a-year operations may have unrealized, resultant health impacts within the RPA community (Chappelle, Salinas, & McDonald, 2011b). Popular newspaper and magazine articles relate individual accounts of former RPA operators and intelligence-support personnel who received psychiatric treatment as a result of their participation in high-definition, full-motion-video, remote warfare ("Confessions," 2014; Power, 2013; Watson, 2014; Zucchino, 2012). These narratives heighten public awareness of the possible mental effects RPA operations may be having and ultimately act as a catalyst for continued research.

Several studies have already identified self-reported, psychological health factors within the primary, two-person RPA crew. These studies specifically targeted the RPA officer pilot and enlisted sensor operator. Collectively, studies such as Chappelle, McDonald, Christensen, Prince, Goodman, Thompson, and Hayes, (2013), Chappelle, McDonald, Thompson, and Swearengen (2012), Chappelle, Prince, Goodman, Thompson, Cowper, and Ray-Sannerud, (2014a), Chappelle, Salinas, and McDonald

(2011b), Michielsen, De Vries, and Van Heck (2003), Otto and Webber (2013), Ouma, Chappelle, and Salinas, (2011), Prince, Chappelle, McDonald, and Goodman,(2012), Tvaryanas, Lopez, Hickey, DaLuz, Thompson, and Caldwell, (2006), Tvaryanas and Macpherson (2009), and Tvaryanas and Thompson (2006) are dated; however, they represent the most recent research conducted by the DoD within this specific population. The researchers within these studies elected to utilize survey data to compare groups and determine the presence of psychological stressors instead of attempting to use direct measurement. For instance, results from a USAF survey suggests increased levels of perceived fatigue within RPA operators, and those levels were related more to the presence of general work or shift-system factors rather than specific RPA tasks (Tvaryanas & Thompson, 2006). In 2009, Tvaryanas and Macpherson administered a different RPA operator survey and found significantly increased levels of chronic fatigue, as well as burnout and emotional exhaustion; these mental effects were previously correlated to fatigue by Michielsen, De Vries, and Van Heck (2003). Chappelle, Salinas, and McDonald (2011b) later surveyed various RPA operators and mission intelligence coordinators who are considered support personnel, and reported the main source of their self-reported stress arose from occupational effects such as long hours, low manning, shift work, human-machine interface difficulties, and the geographic location of the work centers. These collective results seem to contradict popular media claims that the sources of RPA-operator psychological stress arise substantially from *telewarfare*, or ”the direct participation in ISR and weapons deployment [utilizing RPA]” (Chappelle et al, 2014b, p.63), rather than occupational limitations; however, research considering actual clinically observed mental health rates is needed to fully understand remaining research gaps. To this end, Otto and Webber (2013) utilized actual mental health diagnoses and counseling rates, or clinically observed rates, from USAF RPA pilots identified between 1 October 2003 through 31 December 2011 using electronic health care records maintained within the DoD Defense Medical Surveillance System (DMSS). As compared to traditional, manned aircraft pilots, there were no significant differences in the clinically observed mental health rates of RPA pilots; however, rates from both groups of pilots were significantly lower than the general USAF population (Otto & Webber, 2013). Strict, aviation-duty medical prerequisites and standards may adequately explain the difference in rates between the pilots and non-aviator general population, but the similar rates between pilot groups suggest telewarfare does not increase the risk of mental health outcomes beyond what is seen in traditional combat (Otto & Webber, 2013). While similar studies are needed to measure clinically observed mental health rates of RPA sensor operators, commensurate research is also needed specifically within the largely unrecognized enlisted RPA intelligence community, especially since the enlisted RPA intelligence community is a critical component to successful RPA operations and may have greater exposure to the same graphic videos and wartime consequences. For this study, the RPA enlisted intelligence community was composed of the USAF Operations Intelligence and USAF Geospatial Intelligence career fields.

As mentioned previously, survey-related research has been conducted on RPA pilots and sensor operators to include mission intelligence coordinators; however, those intelligence coordinators alone are not representative of the greater enlisted RPA intelligence community. Therefore, any associated research conclusions cannot be easily generalized to the greater USAF RPA enlisted intelligence population. The RPA enlisted intelligence community, for the purposes of this study, was primarily identified by two Air Force Specialty Codes (AFSCs): 1N0X1 – Operations Intelligence, and 1N10X1 – Geospatial Intelligence. People in these two intelligence AFSCs generally work in consolidated locations geographically separated from the RPA operational crews; however, they are an integral component in telewarfare operations and support the RPA pilot and sensor operator via real-time communications and continuous analyses of the same video images seen by the operational crew. While the Operations Intelligence specialist "analyzes multiple sources of information developing, evaluating, and disseminating intelligence on potential threats to U.S. and allied forces" (USAF Personnel Center, 2014, p. 59) the Geospatial Intelligence specialist "performs intelligence activities and functions including exploitation, development, and dissemination of multi-sensor geospatial and target intelligence products to support war fighting operations and other activities" (US AFPC, 2014, p. 60). These two duties, along with other supporting intelligence roles, combine to form an overall intelligence operation that communicates with the RPA pilot and sensor operator via an intelligence liaison embedded with the crew, namely the mission intelligence coordinator. Members of the 1N0X1 community are selected to temporarily become mission intelligence coordinators. Since previously documented research has concentrated on the RPA flight crew and the mission intelligence coordinator, the majority of the geographically separated, intelligence community supporting RPA operations has been largely overlooked in terms of associated research.

The intent of this study was to first determine the clinically observed rates of mental health outcomes for the 1N0X1 and 1N1XI career fields, as recorded within the

U.S. Air Force School of Aerospace Medicine's medical epidemiology database, representative of the enlisted RPA intelligence community. These rates were then adjusted for covariates as identified within the literature review. The adjusted rates were statistically contrasted with selected comparison groups, employing the methods used by Otto and Webber (2013). The clinically observed mental health rates of manned aircraft and RPA pilots within Otto and Webber's (2013) study were expectedly lower than comparison groups such as health care, administrative, and certain combat-specific career field workers, as well as USAF members overall, meaning USAF pilots did not experience or did not seek or receive mental health counseling or diagnoses as often as airmen in other occupations. For the USAF, both manned aircraft pilots and RPA pilots must pass stringent psychological requirements before entry to the career field and must maintain specific mental health criteria throughout their service (USAF, 2014b). Therefore, in a medical and practical sense, manned aircraft pilots served as a good comparison group for RPA pilots in examining traditional combat versus remote combat within Otto and Webber's (2013) study since both groups met similar psychological entry characteristics at the beginning of their service. The psychiatric criteria required of USAF pilots stand in contrast to the majority of other USAF career fields that either do not require as strict of initial ratings, or they allow individuals to continue their duties while seeking various psychological treatments. Lower clinically observed mental health rates of manned aircraft and RPA pilots may be a reflection of both entry requirements and an individual's propensity to either not seek mental health assistance or discreetly seek this type of treatment outside of the military healthcare system which cannot, therefore, be tracked. The same methodology used by Otto and Webber (2013) to select psychologically similar comparison groups was utilized within the current study.

This research identified crude, or unadjusted, and adjusted clinically observed rates of mental health outcomes among enlisted RPA intelligence specialists and statistically compared them to the rates experienced by three groups: RPA sensor operators, aircraft armament systems technicians, and the general USAF enlisted population. The USAF describes separate physical and mental health standards used for entry into enlisted specialties known as the *physical profile serial system* (USAF, 2014b). This comprehensive medical indicator system included six factors which are: physical capacity/stamina, upper extremities, lower extremities, hearing and ears, eyes, and psychiatric; the first or second letter of each indicator forms the acronym PULHES (USAF, 2014b). Each of these factors is graded with specific criteria on a 1-4 scale; however, the psychiatric component of this system was of particular interest within this epidemiological study since comparison groups should begin as medically similar as possible. The PULHES psychiatric scale is described as:

> 1—Diagnosis or treatment results in no impairment or potential impairment of duty function, risk to the mission, or ability to maintain security clearance;
>
> 2—World Wide Qualified, and diagnosis or treatment result in low risk of impairment or potential impairment that necessitates command considerations of changing or limiting duties;
>
> 3—World Wide Qualified, and diagnosis or treatment result in medium risk due to potential impairment of duty function, risk to the mission, or ability to maintain security clearance;

> 4—Diagnosis or treatment result in high to extremely high risk to the [USAF] or patient due to potential impairment of duty function, risk to the mission, or ability to maintain security clearance and which has already undergone an [medical evaluation board] or [assignment limitation code] fast track as determined by the [deployment availability working group] (USAF, 2014b, p. 10).

Enlisted RPA intelligence personnel meet similar initial and subsequent psychiatric medical standards as manned aircraft pilots, RPA pilots, and sensor operators. In reviewing the three groups, it became immediately apparent that RPA sensor operators were the best comparison group of the three. This was due to the fact they had similar responsibilities, educational backgrounds, and demographics as enlisted RPA intelligence specialists. This study also statistically compared enlisted RPA intelligence technicians to a comparison group who had similar PULHES entry and career psychiatric requirements, worked a rotating shift schedule, and had similar demographics, but who do not view combat operations through high-definition, full-motion-video as part of their daily duties. Within the USAF, aircraft armament systems technicians met those criteria. The USAF Personnel Center (2014) defines an *aircraft armament systems technician*, identified by an AFSC of 2W100, as a person who:

> Loads and unloads nuclear and nonnuclear munitions, explosives, and propellant devices on aircraft. Manages, controls, maintains, and installs aircraft bomb, rocket, and missile release, launch, suspension, and monitor systems; guns and gun mounts; and related munitions handling, loading, and test equipment. (p. 185)

In addition to aircraft armament systems technicians, the clinically observed mental health rates of enlisted RPA intelligence specialists were compared to the clinically observed mental health rates of the general USAF enlisted population, similar to the efforts utilized by Otto and Webber (2013). This study postulated that is similar mental health incidence rates were discovered between the enlisted RPA intelligence specialists, RPA sensor operators, and the aircraft armament systems technician groups, yet those same rates were still lower than the general population, the data may reinforce the literature suggesting general occupational limitations such as manpower and shift schedules were mentally affecting the populations more than RPA operation-specific limitations. Alternatively, a significant difference between enlisted RPA intelligence specialists and the aircraft armament systems technician comparison group would have suggested a unique characteristic of intelligence specialists that was not based in general occupational limitations, but perhaps indicated an operational risk associated with participating in high-definition, full-motion-video, RPA combat operations.

The objective of this study was to identify crude and adjusted clinically observed medical incidence rates of mental health diagnosis and counseling within enlisted RPA intelligence specialists and statistically compare them to three groups: RPA sensor operators, aircraft armament systems technicians, and the general USAF enlisted population. To accomplish the objective, this research compared the epidemiological relationship between RPA support personnel, specifically USAF enlisted RPA intelligence specialists within the 1N0X1 and 1N1X1 career fields, with actual mental health diagnosis and counseling incidence rates.

Significance of the Study

This study was the first to document the frequencies and incidence rates of mental health diagnosis and counseling rates among USAF enlisted RPA intelligence specialists in the 1N0X1 and 1N1X1 career fields, as well as statistically compare those results with other USAF populations. These were important considerations to the military community as numerous research initiatives have investigated the primary RPA operators but have given comparatively less attention to ancillary, but related, RPA occupations, namely enlisted RPA intelligence specialists. The results of this study were intended to contribute to understanding the medical and psychological health concerns within RPA ancillary occupations and encourage further complementary research, identified unrecognized health risks to the USAF, and provided additional information to DoD leadership to facilitate policy change.

Statement of the Problem

The relationship between RPA operations and the actual mental health outcomes of those participating in these operations was not thoroughly understood. At the time of this study, the Distributed Common Ground System (DCGS) was the USAF's primary means to collect, process, exploit, analyze, and disseminate information gained through intelligence, surveillance, and reconnaissance (ISR) (AF DCGS, 2014). While performing their duties, ISR personnel create emotional connections with the coalition ground troops they are overseeing through various electronic means; therefore, when those same troops come under attack and take casualties, ISR personnel may experience a sense of helplessness, especially when they must utilize increased magnification to confirm the dead (Zucchino, 2012). Previous research efforts utilized survey methods where individuals from the DCGS were asked about their psychological symptoms with the assumption those symptoms were a result of their work experiences and environment; however, surveys based upon an individual's memory are often problematic, subjective, and, based upon the studies' limitations, are not able to capture information from the entire population or account for formal psychological diagnoses (Otto & Webber, 2013). In 2013, Otto and Webber performed the first study to identify the incidence of actual mental health effects as experienced by specific members of the DCGS enterprise, namely RPA pilots. The furtherance of these research efforts as expanded to other members of the DCGS, such as sensor operators and associated intelligence personnel, may be critical to understanding the still unknown medical and psychological consequences of their unique duties and environment. The results of continued research can then be used by other researchers, military commanders, and medical personnel to discover and minimize the potential causal factors of negative mental health outcomes, and also to provide mental health assistance, if necessary, to past DCGS members who have since separated from military service but are still experiencing lasting mental health problems influencing their civilian lives. As of 2015, there were no other efforts within the literature investigating actual mental health outcome rates for occupations other than the primary RPA crew. Therefore, the USAF may not have been fully informed of the medical and psychological consequences associated with enlisted RPA intelligence specialist duties as part of the DCGS.

Purpose Statement

The purpose of this study was to 1) document frequencies and rates of mental health outcomes among RPA intelligence specialists, and 2) determine if enlisted RPA intelligence support personnel exhibit statistically different adjusted mental health incidence rates as compared RPA sensor operators, aircraft armament technicians, and the general USAF enlisted population. This research identified the actual mental health diagnoses and counseling rates of enlisted RPA intelligence specialists and statistically compared them to other USAF occupations in order to identify potential differences. In achieving this goal, medical data from electronic health care records were extracted from the U.S. Air Force School of Aerospace Medicine's medical epidemiology database.

Hypothesis

This research addressed one primary question regarding the relationship between enlisted RPA intelligence support personnel and negative health outcomes: What are the mental health incidence rate statistical differences among enlisted RPA intelligence support personnel, RPA sensor operators, aircraft armament technicians, and the general USAF enlisted population? Three hypotheses resulted from this research question:

H1: USAF enlisted RPA intelligence specialists exhibit statistically different incidence rates of mental health outcomes as compared to USAF RPA sensor operators.

H2: USAF enlisted RPA intelligence specialists exhibit statistically different incidence rates of mental health outcomes as compared to USAF aircraft armament systems technicians.

H3: USAF enlisted RPA intelligence specialists exhibit statistically different incidence rates of mental health outcomes as compared to the general USAF enlisted population.

Delimitations

This study was based upon the perceived, increased mental health risks associated with USAF RPA operations established by previous research using survey instruments as well as popular media opinion. This research did not attempt to establish causal relationships, but rather attempted to identify and discuss any significant correlations for future investigation and understanding.

USAF enlisted RPA intelligence specialists, specifically the 1N0X1 and 1N1X1 career fields, were the primary group of interest within this study. Results from this research are generalizable within this particular group; however, since other related but ancillary RPA support career fields were not included in this study, findings are not generalizable to all groups within RPA operations.

RPA operate within other countries, as well as multiple U.S. DoD branches such as the Navy, Marines, and Army; however, this study specifically limited its population of interest to the USAF. Additionally, data were purposefully limited to active-duty USAF members due to the numerous confounders associated with using Air National Guard and USAF Reserve populations. Findings are not generalizable to other military services or components.

While there are several different types of RPA within the USAF, each conducting different missions, this study limited its investigation and comparisons to enlisted sensor operators identified with the AFSC of 1U0X1. Effectively, this limited the resultant RPA sensor operator population to medium-weight aircraft such as the MQ-1B Predator, MQ-9 Reaper, and previously unknown aircraft such as the RQ-180. Missions conducted by operators of these types of aircraft involve kinetic strike capability, as well as ISR operations; therefore, the choice to use the 1U0X1 AFSC as a comparison group was commensurate with the goals of this research.

Limitations and Assumptions

This research did not attempt to diagnose mental illnesses; rather, it was used to identify statistical, incidence-rate correlations of interest as compared to pre-determined groups. Significant medical epidemiological differences among the predetermined groups should be used for subsequent causal research efforts, preferably utilizing specialized medical authorities.

The literature review was limited to electronic database queries conducted through the Embry-Riddle Aeronautical University Hunt Library, as well as non-classified U.S. DoD technical reports accessed through the Defense Technical Information Center website. The literature review process took place December 2014 through April 2015. Since the U.S. military population of this study was relatively inaccessible to the general public, this circumstance likely limited extensive research efforts. While some of the referenced articles were dated, they perceivably represented the most current research within the subject matter.

Also stated within the study performed by Otto and Webber (2013), mental health incidence rates within DMSS likely underestimate actual rates. At the time of this study, DMSS, as well as the U.S. Air Force School of Aerospace Medicine's medical epidemiology database, only accounted for clinically detected outcomes, did not record treatment sought outside of the Department of the Air Force medical system, and assumed ideal access to care.

U.S. Air Force School of Aerospace Medicine's medical epidemiology database records, at the time of this study, did not reflect the severity of recoded mental health diagnoses, only the presence or absence of the condition. The analysis also did not consider repeat mental health diagnoses. Due to these limitations, actual mental health illness experienced by those affected may be more severe and persistent than what the results imply.

A comprehensive surveillance period within this study would include data from 1 October 2003 through 31 December 2014, since 1 October 2003 is when the USAF first formally codified RPA pilots, and therefore RPA operations, within its personnel systems. The most current data available from the U.S. Air Force School of Aerospace Medicine was from 1 January 2006 through 31 December 2010, and limited this study's surveillance period. Data limitations can exist within epidemiological-based studies, especially those utilizing data from large populations such as the United States. The American Cancer Society acknowledges medical data, such as cancer incidence and mortality statistics, can typically lag three to four years behind the current year (Cancer Facts and Statistics, 2015). Medical data lag within epidemiological studies are commonly a result of "the time required for data collection, compilation, quality control, and dissemination" (Siegel, Ma, Zou, & Jemal, 2014, p. 14; Strom, Kimmel, & Hennessy, 2013). The U.S. School of Aerospace Medicine stated data collected before 2006 and after 2010 had not yet been prepared for analysis, and were unavailable for use within this study (U.S. School of Aerospace Medicine, personal communication, November 4, 2015).

In order to make health comparisons among USAF personnel, groups should be as similar as possible upon entry to the career field. Each of the comparison groups was assumed to have a similar staffing level as the other groups within this research. Additionally, the USAF Enlisted Classification Directory identified specific physical and mental health prerequisites within the PULHES nomenclature for the primary study group, enlisted RPA intelligence specialists within the 1N0X1 and 1N1X1 AFCSs. At the time of this study, the USAF required applicants within these AFSCs to have the physical component of the PULHES rated as a 3, or "…significant defect(s) or disease(s) under good control. Capable of all basic work commensurate with grade and position" (USAF, 2014b, p. 10) and the psychiatric component rated as a 1 as previously described (US AFPC, 2014). The aircraft armament systems career field, AFSC 2W1X1, had the same physical and psychiatric PULHES ratings as the enlisted RPA intelligence specialists; therefore, served as a valid comparison group especially since demographics and work schedules were similar. Enlisted RPA sensor operators, however, differed from enlisted RPA intelligence specialists within the PULHES system in that they were required to be physically rated as a 1 instead of a 3, defined as "free from any identified organic defect or systemic disease" (USAF, 2014b, p 10; US AFPC, 2014). It was assumed different entry physical criteria will not confound mental health conclusions. Table 1 summarizes the characteristics of the three main groups in this study.

Table 1

Characteristics of Groups

Group (AFSC)	Shiftwork	Rank	PULHES	Views Combat Ops
RPA Intelligence (1N0, 1N1)	Y	Enl	3,3,3,2,3,1	Y
RPA Sensor Operator (1U0)	Y	Enl	3,3,3,2,3,1	Y
Aircraft Armament (2W1)	Y	Enl	3,3,3,1,3,1	N

Definitions of Terms

Aircraft Armament Systems Technician - defined by an AFSC of 2W100, an aircraft armament systems technician “loads and unloads nuclear and nonnuclear munitions, explosives, and propellant devices on aircraft. Manages, controls, maintains, and installs aircraft bomb, rocket, and missile release, launch, suspension, and monitor systems; guns and gun mounts; and related munitions handling, loading, and test equipment” (US AFPC, 2014, p. 185).

Enlisted RPA intelligence specialists – For the purposes of this research, this term will be defined by inclusion of both USAF operations intelligence specialist and geospatial intelligence specialist career fields.

Exhibit – Within the context of psychological health, *exhibit* is the presence of a qualifying mental health diagnoses within the person's electronic medical record. The term can also apply to groups of selected individuals where one group may have a different incidence rate than another.

Geospatial Intelligence Specialist – defined by an AFSC of 1N1X1, a geospatial intelligence specialist "performs intelligence activities and functions including exploitation, development, and dissemination of multi-sensor geospatial and target intelligence products to support war fighting operations and other activities" (US AFPC, 2014, p. 60).

High-definition, full-motion-video, RPA combat operations – Telewarfare operations utilizing cameras to observe the remote combat environment in fine detail.

Higher – a comparison of two numbers where one is statistically greater ($\rho \leq .05$) as identified by a statistical test; however, the term does not imply a practical difference.

Operations Intelligence Specialist – defined by an AFSC of 1N0X1, an operations intelligence specialist "analyzes multiple sources of information developing, evaluating, and disseminating intelligence on potential threats to U.S. and allied forces" (US AFPC, 2014, p. 59).

PULHES - The USAF describes separate physical and mental health standards used for entry into enlisted specialties known as the *physical profile serial system*. This comprehensive medical indicator system includes six factors which are: physical capacity/stamina, upper extremities, lower extremities, hearing and ears, eyes, and psychiatric; the first or second letter of each indicator forms the acronym PULHES (USAF, 2014b)

Remotely Piloted Aircraft Crew – Limited to medium-weight USAF remotely piloted aircraft, the primary crew consists of one pilot and one sensor operator.

Remotely Piloted Aircraft Pilot – Within the USAF, a specially trained and designated officer who is primarily responsible for a remotely piloted aircraft's operation, weapons employment, and surveillance capabilities.

Remotely Piloted Aircraft Enlisted Intelligence Community - For the purposes of this research, this term will be limited to the USAF operations intelligence specialist and geospatial intelligence specialist career fields.

Remotely Piloted Aircraft Senor Operator – Within the USAF, a specially trained and designated who is enlisted and is primarily responsible for the technical aspects of remotely piloted aircraft operations, weapons employment, and surveillance.

Same - a comparison of two numbers where there is no statistical difference ($\rho \geq .05$) as identified by a statistical test; however, the term does not imply a practical equality.

Statistical Significance – the result of a statistical test where $\rho \leq .05$

Telewarfare - "the use of unmanned vehicles, ships, aircraft, weapons, or other devices that are remotely controlled, often at great distances from the battlefield or other locations, in direct support of military operations by providing real-time [ISR] and attack capabilities" (Fisher, Stanczyk, & Ortega, 2011, p. 1).

List of Acronyms

AFSC	Air Force Specialty Code
DoD	Department of Defense
DCGS	Distributed Common Ground System
DMSS	Defense Medical Surveillance System
ISR	Intelligence, Surveillance, and Reconnaissance
PED	Process, Exploit, and Disseminate
RPA	Remotely Piloted Aircraft
US	United States of America
USAF	United States Air Force

CHAPTER II

REVIEW OF THE RELEVANT LITERATURE

USAF DCGS intelligence personnel, specifically imagery analysts to include Operations Intelligence and Geospatial Intelligence, serve critical roles to ensure the DCGS's success. Popular media claims of increased PTSD incidence among these personnel engaged in telewarfare have increased the general population's awareness of this community; however, public health concerns are rarely scoped to a single predictor or outcome. Exploring the academic literature to ascertain the psychological effects of combat on traditional warfighters, as well as those now engaged in combat from afar, will help scope the current study and aide in identifying likely predictors and confounding variables. Due to the unique nature of telewarfare, occupational stressors may now be important considerations within those engaged in combat but still separated from the battlefield by great physical distances. The negative psychological outcomes associated with emotional distress, occupational burnout, as well as the direct and indirect health effects of shift work, should be considered in the context of the DCGS imagery analyst's work environment and duties. By gaining a greater understanding of the possible health effects arising from DCGS operations, USAF leadership will be better informed about how to maintain a healthy workforce and may have a greater ability to implement changes that ultimately sustain operations with more efficiency and individual ease, with less absenteeism and attrition.

USAF Distributed Common Ground System

The USAF DCGS is a complex environment enabled by modern technology and must be understood by its leaders in order to appreciate the stressors its personnel are exposed. At the time of this study, the DCGS was the USAF's primary means to collect, process, exploit, analyze, and disseminate information gained through ISR (AF DCGS, 2014). Currently composed of 27 geographically separated sites within the U.S., the DCGS network receives information from ISR sensors on airborne platforms such as the U-2, RQ-4 Global Hawk, MQ-1B Predator, MQ-9 Reaper, and MC-12 Liberty (AF DCGS, 2014; USAF, 2014b). Those information sources typically operate in multiple theaters of operation simultaneously and may receive coordinated taskings from theater command and control elements, as well as internal DCGS command authorities (AF DCGS, 2014). Each of the 27 DCGS sites is populated with a mixture of individuals, including imagery analysts from the 1N0X1 and 1N1X1 USAF career fields, support personnel, and leadership from active-duty, Air National Guard, Air Force Reserve, and coalition partner units (AF DCGS, 2014). It is their collective responsibility to process, exploit, and disseminate (PED) in near-real time intelligence collected by sources 24/7 in order to ultimately support U.S. and coalition warfighters down to the lowest levels on the battlefield (AF DCGS, 2014).

The MQ-1B Predator and MQ-9 Reaper are unique RPA within the DCGS weapon system. While most other DCGS information sources are able to gather intelligence through sophisticated multi-spectral sensors, the MQ-1B and MQ-9 have the added capability of carrying and deploying munitions such as laser-guided missiles (Chappelle, McDonald, & McMillan, 2011). The MQ-1B and MQ-9 are similar in that they both are unmanned but utilize a remote, two-person crew consisting of an officer pilot who controls the aircraft and an enlisted sensor operator who is responsible for reconnaissance and targeting (Chappelle et al., 2011). Each aircraft is equipped with sophisticated full-motion video cameras for day, night, and variable weather and is also fitted with an advanced targeting system to include electro-optical, infrared, laser designation, and laser illumination capabilities (Chappelle et al., 2011). While the MQ-1B is considered a medium-altitude, long-endurance aircraft retrofitted to carry precision-strike munitions, the MQ-9 was specifically designed as a high-altitude, long-endurance *hunter-killer* aircraft with specialized abilities to identify, target, and destroy enemies and enemy assets (Chappelle et al., 2011). The MQ-1 and MQ-9 are able to loiter over a target for up to 24 hours while continuously sending full-motion video through the network to imagery analysts within the DCGS (Chappelle et al., 2011). DCGS intelligence personnel must analyze and interpret vast amounts of data. In 2010, Predator and Reaper aircraft collected over 22,400 hours of full-motion video per day in the U.S. Central Command Area of Responsibility (AOR) This figure does not include other information sources, the six complementary AORs, technology growth, or the USAF's desire to attain greater amounts of RPA (USAF, 2010).

Despite impinging fiscal constraints, both President Barack Obama and the Secretary of Defense highlighted the nation's commitment to fully funding ISR operations and initiatives within the 2012 Department of Defense Strategic Guidance Plan. Indeed, since 2010, the USAF has been transitioning RPA full-motion video sensors from a single video feed per aircraft state, to one where a single aircraft can now provide 50 video streams (USAF, 2010). Within the Fiscal Year 2015 Budget Overview, the USAF outlines the continued growth of a global ISR presence by increasing steady-state MQ-1B/MQ-9 combat air patrols (CAPs) from 50 to 55 by FY 2019, while maintaining the ability to surge to 65 when needed (USAF, 2014a). Each CAP covers a specific area of operations, requiring multiple aircraft and up to 180 individuals, including pilots, sensor operators, communications experts, and intelligence Airmen, in order to be successful (Kelsey, 2014). Despite Budget Overview statements, the reality of steady-state, daily DCGS operations is punctuated by the USAF launching its 65th CAP in May 2014, alluding to the enterprise's near constant-state surge tempo (Chappelle et al., 2011a; Chappelle et al., 2011b; Chappelle et al., 2014b; Kelsey, 2014). This high operations tempo supports the DCGS's figures of supporting more than 70 ISR sorties, reviewing 580 hours of motion imagery, producing approximately 3,000 signals intelligence reports, and exploiting approximately 2,000 still images, all on a daily basis (AF DCGS, 2014). While DCGS intelligence personnel are physically separated from the combat environment, they are still highly integrated within theater combat operations by exploiting and communicating real-time data to support U.S. and allied forces (Prince, Chappelle, McDonald, & Goodman, 2012).

Distributed Common Ground System personnel. DCGS personnel operate from secure, continental U.S. locations and utilize multiple sources of data, including high-definition full-motion video to monitor enemy movement, establish patterns of life, and facilitate redirection of ground and air forces to engage enemy combatants (Prince et al., 2012). As with their RPA pilot and sensor operator counterparts, DCGS intelligence personnel are required to support real-time combat operations while maintaining similar

12-hour duty shift patterns. DCGS personnel typically work six work periods where they may be on-duty for 12 hours and then have 12 hours off, followed by two periods off (Chappell, McDonald, & King, 2010; Chappelle et al., 2011b). While maintaining the previous work schedule, DCGS intelligence personnel also work rotating shift patterns where start times shift from mornings to afternoons to nights every 30 to 90 days, all while they work at small stations with limited mobility and with a decreased ability to spontaneously leave the workstation (Chappell, McDonald, & King, 2010; Chappelle et al., 2011b). The nature of current day global ISR requirements and RPA endurance results in an unending need for continuous intelligence exploitation 24 hours per day, 7 days a week, 365 days per year (Chappelle, McDonald, Thompson, & Swearengen, 2012). Due to the unique challenges faced by DCGS intelligence personnel, USAF military and medical leadership have become concerned regarding the sources, levels, and impact of stress upon their people (Chappelle et al., 2012). Previous researchers identified several operational and combat-related stressors within the DCGS environment (Chappelle et al., 2011b; Ouma, Chappelle, & Salinas, 2011). DCGS operational stressors include manpower concerns, fatigue-inducing schedules, and a lack of general resources available to accomplish a task (Chappelle et al., 2014; Tvaryanas, 2006). The results of these stressors are typically longer work hours, employment of a rotating shift work schedule, and a cumulative strain on an individual's ability to sustain vigilance as they attempt to process audio and visual data throughout their shift (Chappelle et al., 2014; Tvaryanas, 2006). DCGS combat-related stressors are associated with tracking, targeting, and destroying enemy combatants through the direct use of high-definition video and weapons deployments by DCGS personnel while providing support to allied ground forces during combat and providing post-battle assessments (Chappelle et al., 2014). Commanders ultimately make the decision to destroy a target, while RPA pilots and sensor operators carry out the attack; however, DCGS intelligence personnel often make decisions and recommendations that lead to the destruction of enemy personnel and assets, all while witnessing their efforts in high-definition video (Chappelle et al., 2014). Chappelle, Salinas, and McDonald (2014) and Chappelle et al. (2014) suggest DCGS intelligence personnel may become psychologically attached to the allied ground troops they protect from danger, and even the enemy personnel they seek to destroy, especially when they are monitored for long periods of time. As a result, DCGS intelligence personnel may experience grief from the loss of allied ground forces, collateral damage and fratricide, and even from killing a designated enemy after becoming familiar with their daily lives. Viewed holistically, modern intelligence personnel within the DCGS may be at a higher psychological risk similar to traditional combat veterans, and will likely experience emotional stress, burnout, and PTSD. These reactions are exacerbated by continuous rotating shift work (Chappelle et al., 2011b; Ouma, Chappelle, & Salinas, 2011; Tvaryanas, 2006; Verona et al., 2005). Authors of popular media articles claim DCGS intelligence personnel are experiencing negative mental health outcomes as a result of their occupation; however, it is still uncertain whether these outcomes are correlated with specific telewarfare duties or traditional occupational hazards.

Media claims. Military claims, technical reports, and academic research alone may not completely inform the general public of the possible health problems experienced by military personnel. Therefore, popular media stories from sources such as The Washington Times, The Los Angeles Times, Gentleman's Quarterly, The National Defense Magazine, and other internet-based articles may provide evidence to the perceptions held by many regarding the DCGS ISR community and the resulting research it has prompted.

In 2010, the USAF deputy chief of staff for ISR stated that the evolving technology would result in a situation where the amount of available aircraft sensors and data would be overwhelming (Magnuson, 2010). At the same time, the acting Deputy Undersecretary of Defense for Portfolio, Programs, and Resources suggested the USAF would not be able to process this growing quantity of information; yet, the commander of the USAF ISR agency implied no additional manpower would be provided to organizations in favor of a future technology that would presumably reduce the workload (Magnuson, 2010). The Undersecretary of Defense for Intelligence stated that the world-wide gathering of intelligence drives operations; therefore, until new technology is proven, intelligence personnel will have to contend with an even higher workload than previously experienced (Magnuson, 2010).

RPA operators and imagery analysts have both come forward in the media to convey their personal experiences of operations and the resulting psychological impacts upon their lives. One specific RPA sensor operator served in his position for five years and witnessed the direct killing of 13 individuals while his squadron was responsible for killing 1,626 people (Watson, 2014). However, the commander of the USAF ISR agency suggests it takes comparatively "little effort in the end to either kill or capture [enemy combatants]" (Magnuson, 2010, para. 13). More time is spent following an individual's daily life for months to establish patterns of life and assess threats before an airstrike is actually ordered (Watson, 2014). Regardless of the precautions taken, watching explosions, some with civilian casualties, likely produces psychological injuries, especially since ISR personnel see the high-definition carnage of their efforts (Watson, 2014). USAF sensor operators and imagery analysts have stated they experience insomnia, depression, and nightmares as a result of their participation in telewarfare. These disorders have occurred up to three years after having completing their military service, and those who have experienced them subsequently diagnosed with PTSD ("Alone," 2013; "Confessions," 2014; Power, 2013; Watson, 2014; Zucchino, 2012). While performing their duties, ISR personnel create emotional connections with the coalition ground troops they are overseeing through various electronic means; therefore, when those same troops come under attack and take casualties, ISR personnel may experience a sense of helplessness, especially when they must utilize increased magnification to confirm the dead (Zucchino, 2012). The stress of operations, rotating shift work, workload, and the fear of making a miscalculation that could prove fatal to coalition forces, all seem to take an emotional toll on ISR personnel ("Alone," 2013; "Confessions," 2014; Power, 2013; Watson, 2014; Zucchino, 2012). These psychological effects are compounded when those same ISR personnel leave a 12-hour shift and then in less than an hour are dealing with typical domestic issues but are unable to discuss their work due to its level of classification (Zucchino, 2012).

As the USAF begins to acknowledge the possible psychological impacts of this unique type of warfare, it is now assigning chaplains and psychologists to DCGS ISR squadrons; however, since only a few ISR personnel have been diagnosed with PTSD, a disparity exists between popular media claims, the elimination of personal danger, and the estimated clinical presentation of psychological impacts ("Confessions," 2014; Watson, 2014; Zucchino, 2012). The current literature was reviewed to examine the psychological impacts of traditional killing in combat as contrasted with remote killing experienced by DCGS personnel.

Traumatic Stress

Several individual psychiatric disorders are associated with traditional military combat from real, as well as perceived exposures; however, the collective symptoms of PTSD, first termed Post-Vietnam Syndrome, have been traced to the U.S. Civil War and were prominent in describing a condition resulting from short- and long-term exposure to extreme psychological stress (APA, 2013; Smith et al., 2009). The American Psychiatric Association (APA) (2013) continues to evolve its definition of PTSD, and the condition is now considered a disorder related to trauma and stress rather than anxiety. The APA (2013) states PTSD must result from "exposure to actual or threatened death, serious injury or sexual violation" (Sec 309.81) and must result from one or more of the following in which the individual:

- Directly experiences the traumatic event;
- Witnesses the traumatic event in person;
- Learns that the traumatic event occurred to a close family member or close friend (with the actual or threatened death being either violent or accidental); or
- Experiences first-hand repeated or extreme exposures to aversive details of the traumatic event (not through media, pictures, television or movies unless work-related) (Sec 309.81).

This definition of PTSD will be utilized in the context of combat, and combat's psychological repercussions are examined further.

Combat veterans. PTSD and psychiatric diagnostic criteria, as well as associated research, within the military community have evolved considerably over the past 35 years; however, formal study within the subject area has only recently been enhanced by the introduction of electronic health records, and then only after complaints prompted formal study of Vietnam and even Persian Gulf war veterans (Hoge, Auchterlonie, & Milliken, 2006; Proctor et al., 1998). MacNair (2002) utilized data collected in the 1980s from the National Vietnam Readjustment Study where war-related killing was studied in comparison to PTSD severity. Researcher analysis utilizing The Mississippi Scale for Combat-Related PTSD, a self-report measure that assesses combat-related PTSD in veteran populations, suggested those individuals who were involved in killing were associated with significantly higher PTSD scores and a very large effect size (Cohen's $d = .97$) compared to those who were not involved with killing (MacNair, 2002). MacNair (2002) also provided supporting evidence that individuals who witnesses, but do not actively take part in the killing of civilians, prisoners, elderly, or children, were correlated with significantly higher PTSD scores and a large effect size (Cohen's $d = .74$), similar to active participants of such atrocities (Cohen's $d = .74$). This research would tend to support the possibility of PTSD prevalence in DCGS intelligence personnel who witness and are indirectly responsible for killing; however, an enhanced understanding of PTSD, its associated psychiatric epidemiology, and related demographic factors identifying those who are at higher risk is needed.

Hoge et al. (2002) utilized DoD DMSS data collected between 1990 and 1999 to establish comparison data of all recorded U.S. military mental disorders for over 4.8 million active-duty personnel. Their analysis suggested 6% of the population received ambulatory services for mental disorders annually; 13% of all hospitalizations were due to mental disorders; and of those hospitalizations, 47% left military service within six months. Younger age, enlisted status, female gender, and single/divorced marital status correlated with higher rates of incidence and hospitalization. In terms of ethnicity, Caucasian, African-American, and Hispanic ethnicities had similar rates. Asian/Pacific Islanders had slightly lower, while American Indian/Alaskan Natives experienced higher rates (Hoge et al., 2002; Mota et al., 2012; Smith et al., 2008; Smith et al., 2009). Almost half (47%) of the individuals who were first hospitalized for a mental health disorder left military service within six months, establishing they were significantly (CI = 95%) more likely to do so compared to the 12% attrition rate for those not associated with a mental health disorder (Hoge et al., 2002).

These compiled rates obtained by Hoge et al. (2002) provide context for those obtained after the start of the Iraq and Afghanistan war campaigns at the beginning of the 21st century. Of the Army soldiers and Marines returning from deployment, 35% of Iraq veterans received mental health services within a year, and 19.1% met the criteria for a mental health concern, while those deployed to Afghanistan and other locations experienced mental health concerns of 11.3% and 8.5%, each significantly different from each other (Hoge, Auchterlonie, & Milliken, 2006). Within that group of Iraq veterans diagnosed with PTSD, 79.6% reported “witnessing persons being wounded or killed or engaging in direct combat during which they discharged their weapon” (Hoge et al., 2006, p. 1028) compared to those who screened negative for PTSD; no such PTSD increases were seen in non-deployed veterans (Vasterling et al., 2010). These results are consistent with a linear relationship between frequency and intensity of combat experiences noted in an earlier study conducted on Persian Gulf, Iraq, and Afghanistan veterans (Hoge et al., 2004; Proctor et al., 1998); however, studies also noted an individual's perceptions of encountered stress, as well as exposure to indirect killing predicted PTSD severity independent of actual combat experienced (Maguen et al., 2010; Smith et al., 2008; Vasterling et al., 2010). While many studies focus on the diagnosis and prevalence of PTSD, others highlight its significant prediction of related consequences of the disorder such as substance abuse, unemployment, job loss, separation/divorce, as well as depression and spouse/partner abuse (Maguen et al., 2010; Prigerson, Maciejewski, & Rosenheck, 2002). In sum, the severity of an individual's experienced or perceived stress seems to correlate with increases in PTSD severity following deployments, but consideration should also be given to associated behavior outcomes and their effect within the workplace and household.

Limitations in accepted diagnostic criteria and historic survey methods may have resulted in underreported PTSD prevalence in military personnel (Smith et al., 2009). For instance, PTSD was only first recognized in 1980 as a formal diagnosis within the American Psychiatric Association's third edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-III), a resource used by mental health professionals to aid diagnosing patients (Smith et al., 2009). Since that time, formal examination and patient diagnosing of PTSD has proven difficult due the multitude of possible causes, inadequate understanding of the condition, and its association with delayed and intermittent symptoms (Smith et al., 2009). With each subsequent edition, the DSM has broadened its definition of PTSD, along with its associated symptoms, the most recent being DSM-V, released in 2013 (Smith et al., 2009). Therefore, as academic research continues to further the field's knowledge of PTSD, it also highlights the increased likelihood the condition was underreported in historic literature and clinical practice (Smith et al., 2009). Hoge et al. (2006) suggested the DoD's post-deployment screening method, used only once shortly after a veteran's return from combat was inadequate in identifying associated mental health problems such as PTSD. In response, Milliken, Auchterlonie, and Hoge (2007) evaluated a longitudinal post-deployment mental-health assessment and found twice as many new cases (20.3%) were identified among soldiers than what would have been identified with the previous method, indicating a significant difference in assessment methods. During the course of their study, Milliken et al. (2007) also noted most soldiers utilizing mental health services were not identified or referred by existing assessment methods, and the existing health and family services at the time were inadequate, possibly deterring others from accessing treatment; similar results were attained by Erbes, Westermeyer, Engdahl, and Johnsen (2007). While mental health disorder diagnosis and identification has steadily improved, historic incidence rates of mental health disorders among DCGS intelligence personnel may also be underreported.

Vicarious trauma exposure. PTSD symptoms may also be experienced by service providers such as sexual assault counselors and police officers who have frequent exposure to victims; however, symptoms in these cases are more accurately termed *secondary traumatic stress*, an occupational stress associated with vicarious trauma and burnout (Baird & Jenkins, 2003; Figley, 1995; Martin, McKean, & Velkamp, 1986; Schauben & Frazier, 1995). Since DCGS intelligence personnel should not readily experience the threat of personal harm, a characteristic of PTSD, their exposure to vicarious trauma may parallel the experiences of sexual assault counselors. Vicarious trauma experienced by individuals does not necessarily involve all PTSD aspects, but rather involves cognitive shifts to include intrusive imagery (Baird & Jenkins, 2003). Within therapists, these negative cognitive shifts are associated with disruptions in safety, trust, esteem, intimacy, and self-control which negatively manifest themselves in the individual's feelings, relationships, and non-work life, as well as professional life (Baird & Jenkins, 2003). Counselors have shown an increased prevalence of secondary trauma if they have a personal history of traumatic events, while other studies have shown correlations with younger age and/or less experienced individuals, resulting in lowered job satisfaction, increased attrition, and absenteeism (Baird & Jenkins, 2003). To be clear, secondary traumatic stress and vicarious trauma are similar but distinct, and more often associated with persons who are exposed to someone recovering from a traumatic event; however, the former includes PTSD-symptoms with quick onset, whereas the latter has a more gradual, covert, and permanent onset (Baird & Jenkins, 2003). Secondary traumatic stress and vicarious trauma may not adequately explain the possible effects DCGS intelligence personnel may be experiencing, but the existence of these PTSD-associated occupational stressors within other industries opens the potential to similar phenomenon within individuals engaging in telewarfare.

DCGS intelligence, surveillance, and reconnaissance personnel. As a better understanding of the emotional difficulties experienced by traditionally deployed military members is reached, public and DoD attention seems to be sensitive to the unique challenges of telewarfare within groups of DCGS intelligence personnel, especially after some individuals have publically stated they are experiencing negative emotional repercussions as a result of their duties. Several researchers studied various members of the DCGS community such as RPA pilots, sensor operators, and intelligence personnel, and provide a better understanding of the emotional stress involved with such duties.

Despite the media's focus on combat operations as a major health concern of DCGS personnel, academic research suggests operational stressors are the most prominent concern (Chappelle et al., 2014). In the context of telewarfare, combat-related stressors are associated with "direct participation in ISR and weapons deployment missions and include the use of high-definition video feeds to track, target, and destroy enemy combatants and assets; provide force protection to ground troops; and provide surveys of post battle damage" (Chappelle et al., 2014, p. 63). Operational stressors are associated with "available manpower, equipment, training, schedules, and general resources to accomplish occupational tasks and objectives" (Chappelle et al., 2014, p. 63) and include specific human system integration stressors such as long duty days, rotating shift work, maintaining alertness, and mentally processing visual and auditory information during flight operations (Tvaryanas, 2006).

Utilizing previously established reliable survey methods, Chappelle et al. (2014) sought to better understand PTSD and the psychological distress experienced by Predator/Reaper pilots, sensor operators, mission intelligence coordinators, and a non-combatant control group, as compared to results of a study conducted by Chappelle, McDonald, Thompson, and Swearengen (2012). Between the two timeframes, those meeting the criteria of high PTSD symptomology dropped from 3-6% to 1%-3%; however, the likelihood of PTSD symptoms rose from 2.9% (95% CI: 1.4-6.3) to approximately four times (95% CI: 1.36-11.16) in those who worked more than 50 hours per week (Chappelle et al., 2012; Chappelle et al., 2014). High clinical distress prevalence was also studied and those meeting criteria dropped from 20% to 11%; however, working shift work, 51 or more hours per week, and being assigned to duties for 24 or more months were significant predictors ($p < .05$) of total distress scores (Chappelle et al., 2012; Chappelle et al., 2014). Qualitative analysis of participants' responses cited their sources of stress were consistent with other organizations having to sustain continuous operations, long hours, and shift work while maintaining high levels of vigilance under routine and emergency conditions with possible low manning (Chappelle et al., 2012; Chappelle et al., 2014). Therefore, these results seem to indicate DCGS personnel may be experiencing an increased psychological response, namely emotional distress and burnout, as a result of occupational working conditions, rather than a pronounced effect from PTSD symptoms. The occupational health effects of professions with increased stress, workload, and low manning, such as medical personnel and law enforcement officers have been studied within the academic literature and may provide useful insights expandable to the DCGS intelligence worker population.

Occupational Health Effects

Unmitigated occupational stress leads to burnout, which can negatively affect a person's personal and professional life, leading to psychological distress and absenteeism (Sihag & Bidlan, 2014). Since DCGS personnel are engaged in combat but still physically separated from the battlefield, they may be exposed to occupational stressors more traditionally related to those in the civilian industry, as well as non-deployed military personnel. *Emotional distress* is a term used to refer to a state characterized by negative emotional, behavioral, physical, and cognitive changes in an individual's functioning (Prince, Chappelle, McDonald, & Goodman, 2012). Symptoms of emotional stress include: increased anger, irritability, agitation, hopelessness, sadness, difficulty socializing or working with others, difficulty sleeping, fatigue, muscle tension, headaches, as well as difficulty concentrating and sustaining attention (Prince et al., 2012).

Emotional distress can be encountered with occupational burnout, especially given the demanding nature of DCGS intelligence operations; however, occupational burnout is an academic research construct and is not formally recognized as a mental health disorder by the American Psychological Association or World Health Organization as it is problematically close by definition to depressive disorders (Bianchi, Truchot, Laurent, Brisson, & Schonfeld, 2014; Chappelle et al., 2011; Chappelle et al., 2013; Langley, 2012; Maslach, Jackson, & Leiter, 1996; Prince et al., 2012). Maslach et al. (1996) operationalizes the construct of occupational burnout as being composed of three aspects: 1) emotional exhaustion - a depletion of emotional energy due to work related stress, 2) cynicism/depersonalization – indifference, a distant attitude, and/or a decreased sense of enthusiasm towards work, and 3) personal efficacy – sense of satisfaction with work accomplishments (Chappelle et al., 2013). Some of the main risk factors associated with burnout include a work environment with routinely high levels of interpersonal demands and inadequate structural support for addressing those demands (Baird & Jenkins, 2003). Van Der Linden, Keijsers, Eling, and Van Schaijk (2005) demonstrated a significant association between the magnitude of burnout symptoms and number of cognitive failures, as well as inhibition errors and performance variability within attention tasks, all of which would be serious impediments to those within the DCGS profession. The associations between burnout and age and burnout and years of experience have been generally inconclusive, or at least not generalizable past the populations studied, although studies have found compelling evidence to suggest at least a weak negative correlation may exist between both sets (Ahola, Honkonen, Virtanen, Aromma, & Lonnqvist, 2008; Brewer & Shapard, 2004). If true, DCGS intelligence personnel may be at a higher risk for burnout since their force is mostly composed of younger enlisted airmen. Both emotional distress and occupational burnout have been studied among DCGS personnel.

Compared to non-combatant groups, DCGS personnel typically have a higher incidence rate of emotional exhaustion and a lower level of cynicism and professional efficacy, components within the burnout construct (Chappelle et al., 2011; Chappelle et al., 2013; Ouma, Chappelle, & Salinas, 2011). Shift work, shift changes, and hours worked are most often associated with individuals experiencing high occupational stress, and were specifically cited by DCGS personnel as prominent concerns over those stressors attributable to combat (Chappelle et al., 2013; Ouma et al., 2011). Although Global Hawk RPA operators do not release weapons, they were, nonetheless, associated with the highest levels of emotional exhaustion and cynicism, and both Global Hawk and Predator/Reaper operators experience a high incidence rate of emotional exhaustion/fatigue compared to non-combatant support/logistic personnel (Chappelle et al., 2011). While combat operations may still have an effect on DCGS operators, traditional occupational stressors seem to have a greater effect within the community, as evidenced by cited stress being experienced by Global Hawk personnel. Within most DCGS groups, personnel are composed of both civilian/contractors, as well as active-duty military personnel; therefore, it is important to distinguish these two groups when making broad assertions.

Within DCGS operations, active-duty and civilian/contractors perform similar duties; however, active-duty personnel are significantly more likely to experience higher amounts of emotional exhaustion and cynicism, resulting in an increased risk of clinical distress (Chappelle et al., 2013). Chappell et al. (2013) explains DCGS leaders are not as able to adjust civilian/contractor schedules and workload; therefore, active-duty personnel are typically over utilized by leadership to meet mission demands, and this may explain why respondents listed leadership/organizational issues as a primary stressor in addition to concerns within operations tempo/workload/manning, and shift work. These collective results may explain why DCGS subject matter experts list *emotional strength and resilience to shift work* as critical psychological attributes for new accessions (Chappelle, McDonald, & King, 2010; Chappelle, McDonald, & McMillan, 2011; Cotton, Chappelle, Heaton, & Salinas, 2011).

While shift work, shift changes, and hours worked were typically listed as primary sources of high occupational stress within DCGS operations, combat stressors were not substantial, although they still remain a concern (Chappell et al., 2011; Chappelle et al., 2012; Chappelle et al., 2013; Chappelle et al., 2014; Langley, 2012; Ouma et al., 2011; Prince et al., 2012). When considering DCGS active-duty military personnel, group differences may exist between those conducting operations and those engaged in support duties.

Emotional distress and occupational stress may be abstract concepts as compared to the occupational health ramifications experienced by DCGS intelligence personnel. Within the DCGS, there are support and operations personnel; survey results indicate operations personnel are more likely to forgo any type of physical exercise in a given week compared to support personnel, have poor nutritional habits, and are at heightened risk for obesity (Chappelle et al., 2014; Fisher, Stanczyk & Ortega, 2011). Additionally, operations personnel were associated with increased alcohol, tobacco, and caffeine use, as well as musculoskeletal injury/pain, sleep problems, and emotional distress created or made worse by factors within their occupational environment (Chappelle et al., 2014). These results are not uncommon, as military shift work has been noted as an occupational stress in several previous studies, although they were not necessarily linked to the broader context of emotional stress and occupational burnout (Thompson, 2006; Thompson, Lopez, Hickey, DaLuz, Caldwell, & Tvaryanas, 2004; Tvaryanas & Macpherson, 2009; Tvaryanas, Platte, Swigart, Colebank, & Miller, 2008; Tvaryanas & Thompson, 2006;). Operations personnel reported increases in mental health care and over-the-counter medication use associated with sleep difficulties, despite limited access to care due to work hours (Chappelle et al., 2014). The previous DCGS studies utilized traditional

PTSD and emotional stress survey methods, although they may not be as comprehensive in the unique telewarfare environment.

Prince, Chappelle, McDonald, and Goodman (2012) state while several combat-exposure measures to PTSD exist, none is easily applicable to the current-day, technology-based vicarious nature of DCGS operations. Utilizing an experimental survey method, Prince et al. (2012) noted individuals who indicated greater vicarious exposure to combat were associated with higher scores for emotional exhaustion and distress; however, to date, there seems to be only one source of literature that attempted to compare actual mental health diagnoses and counseling rates amongst DCGS personnel, specifically RPA pilots. In their study, Otto and Webber (2013) noted no significant differences in rates of mental health diagnoses between traditionally manned aircraft pilots and RPA pilots. These results suggest both groups have similar mental health risk profiles; however, the results should be viewed in the context of the group's access to care and the career ramifications of seeking such treatment (Otto & Webber, 2013). Additionally, RPA pilots and sensor operators have been shown to have a perception of being able to handle stressful situations on their own (Chappelle, McDonald, & McMillan, 2011; Craig-Grey, Chappelle, & Salinas, 2011). Otto and Webber's (2013) study helps illuminate the need for further research within DCGS intelligence personnel utilizing medical diagnoses in order to compare with past studies using surveys that measure self-reported symptoms. Occupational stress is not limited to DCGS personnel; therefore, greater insight may be gained by reviewing research associated with healthcare, law enforcement, and other types of military career fields.

Healthcare professionals. Healthcare professionals experience a significant risk of occupational stress and burnout; therefore, many studies have been conducted on this population that give insight into relevant predictors and effective coping strategies (Bidlan & Sihag, 2014a; Bidlan & Sihag, 2014b; Sihag & Bidlan, 2014). Nurses presented a positive relationship between emotional exhaustion and depersonalization, but similar to DCGS intelligence personnel, nurses maintained high perceptions of personal accomplishment despite self-reported ratings of high burnout (Onder & Basim, 2008; Xie & Chen, 2011). Xie and Chen's (2011) findings lent support to the association between emotional exhaustion and burnout, with significant predictors of emotional exhaustion being higher work hours per week and the engagement of rotating shift work; however, job reward predicted cynicism/depersonalization. While Sihag and Bidlan (2014a; 2014b) suggest appropriate staffing levels should be the main priority of organizations when attempting to reduce and prevent burnout, job reward in the form of bonuses, salary increments, and other materialistic and non-materialistic rewards, as well as positive professional identity can enhance interest and motivation levels and decrease cynicism/depersonalization (Senter, Morgan, Serna-McDonald, & Bewley, 2010). Since these employee benefits may serve as a protective response to burnout, employers utilizing such techniques may reduce the prevalence of burnout within their organizations, as opposed to addressing the concern once it has already occurred (Maslach & Leiter, 1997; Senter et al., 2010). When translated to the military environment, sequestration and modern day governmental concerns may not lend themselves to financial dividends for individuals; however, military merit in terms of ribbons, medals, and individual recognition have a long tradition. The Distinguished

Warfare Medal was specifically designed to acknowledge and reward the efforts of telewarfare personnel such as DCGS personnel; unfortunately, shortly after this medal was publically announced by the DoD in 2013, it was retracted after considerable public consternation (“Medals”, 2014). Therefore, the DoD has no specific accolade to reward those military members engaging in combat from a distance, and the resultant perceptions of how the public views DCGS personnel contributions may now weigh heavily on those same individuals, possibly contributing negatively to their psychological health. Further study into occupational stress and burnout as experienced by healthcare professionals suggests differences may exist depending on specific groups, geographic location, and gender; therefore, continued exploration into this literature should enhance understanding of the topic.

Bidlan and Sihad (2014a; 2014b) suggest a person’s work environment has a significant impact on occupational stress, and their hypothesis was supported when their results revealed that nurses are the most stressed medical professionals, followed by support staff and physicians, at least in the hospital setting. Of those professionals, gender differences in the component aspects of burnout existed. Specifically, male professionals were significantly more likely to experience emotional exhaustion and depersonalization, whereas females scored higher on the personal efficacy dimension of burnout (Bidlan & Sihag, 2014b). While evaluating the effect of different settings, Senter, Morgan, Serna-McDonald, and Bewley (2010) noted correctional psychologists experienced higher life satisfaction scores over their non-correctional peers, in contradiction to their *a priori* hypothesis. This may be partially explained by the thought that the process of exiting a secure facility may have a protective factor against work related stress and burnout affecting an individual's personal life (Senter et al., 2010). This explanation is particularly relevant to DCGS personnel as they work in secure facilities; however, the classification of their work and inability to talk about it outside of that setting may negate any beneficial facility effects. The predictors of occupational stress may be influenced by the individual's personal life in addition to the workplace.

Occupational stress may have a severe impact on the individual and organization, although this relationship is also confounded by the effects of domestic stress upon workplace stress and performance (Fiedler et al., 2000; Wu, Zhu, Wang, & Wang, 2007). While several studies suggest the effects of domestic stress can carry over to the individual's workplace, occupational stress within medical professionals, specifically shift work, accounted for a significantly greater amount of variance in personal well-being beyond that of work and family demands, as well as personal characteristics (Bacharach, Bamberger, & Conley, 1991; Barnes-Farrell et al., 2008; Fiedler et al., 2000). Specifically, higher weekly hours, to include work on Sundays, are associated with increased levels of work-to-family conflict; a fixed night shift was related to significantly decreased physical as well as mental well-being (Barnes-Farrell et al., 2008). The results within this medical population imply a slow-rotating shift schedule is almost as beneficial to an individual as a fixed-day schedule, but also counter intuitively suggests longer work days are associated with higher mental well-being scores (Barnes-Farrell et al., 2008). These results are likely confounded, as the authors' suggest, by the ability of some civilian organizations to allow preferred shift arrangements; therefore, the individual may choose to work a pattern where they work longer shifts in order to receive greater amounts of time off (Barnes-Farrell et al., 2008). While the specific shift within a rotating shift pattern influences a person's well-being, Courtney, Francis, and Paxton (2013) found sleep quality followed by depression and age explained the greatest amount of variance in shift workers' fatigue scores. Shift work is a well-established precursor to poor sleep quality and is also associated with anxiety, stress, poor mental health, and decreased levels of physical activity (Courtney, Francis, & Paxton, 2013). Intuitive recommendations to reduce the impact of occupational stress upon burnout and negative physical health is to limit work duration to less than 40 hour weeks for individuals and to modify personal nutritional habits (Berger & Hobbs, 2006; Brooks, 2000). These conclusions imply the psychological and physiological outcomes of occupational stress may be managed by medical professionals, but it is the organizational leadership, especially in the context of military service DCGS personnel, who have the greater ability to apply systemic countermeasures to reduce the effects of occupational stress, and to also utilize medical resources to educate their personnel on proper nutritional habits (Blair, 2012; Brown, 2009; Courtney et al., 2012; Onder & Basim; 2008).

Law enforcement and other military. Stress is an everyday component among law enforcement professionals who choose to serve their community. Those officers who primarily work evenings and nights experience a significantly higher number of duty-related stressful events compared to their daytime counterparts; however, despite these events, officers still cited administrative/professional pressure concerns with higher frequency than physical/psychological threats (Ma et al., 2014). Work stress has been offered as a mediator between shift work and negative health outcomes and was the most important predictor of burnout independent of gender (Ma et al., 2014; McCarty, Zhao, &

Garland, 2007). These factors continue to be relevant within the military community as 26%-27.4% of all USAF members, independent of combat-related deployments, report significant work stress, and that stress was negatively associated with work performance and increases in missed work days (Pflanz, 2002; Pflanz, 2006). Pflanz (2002; 2006) was able to generalize findings to report two-thirds of all USAF military personnel experience adverse physical health effects as a result of work stress, with as much as one-quarter experiencing several physical health effects; however, only a minority of those reporting physical and mental health effects actually sought medical care. The most common sources of job stress continue to be inadequate staffing, work overload, and long duty hours, and those who do report work stress are at much greater risk for having physical and emotional illness within one year (Pflanz, 2002; Pflanz, 2006).

Supervision seems to be an important link within the work stress and burnout components. In a U.S. Army study, Whealin et al. (2007) noted enlisted personnel who scored lower on the personal accomplishment subscale of burnout reported poorer relationships with leadership and peers; higher emotional exhaustion was associated with perceptions of less effective non-commissioned officers, and higher levels of cynicism were associated with perceptions of less effective and supportive officers. Brasher, Dew, Kilminster, and Bridger (2010) supported this premise as 84% of their submariner sample was satisfied with their supportive and approachable leaders, and the authors noted associated decreased levels of stress. To this end, submariners did not experience significantly increased levels of stress as compared to similar personnel aboard ships; they cite submariner prestige, self-selection bias, isolation from family demands, and increased age all helped mitigate stress, while cramped/confined physical work environment, poor leader support, and poor peer support were associated with increased levels of stress (Brasher, Dew, Kilminster, & Bridger, 2010). As was noted earlier, DCGS intelligence personnel are typically younger, confined to small workstations, exposed to family demands, and are seemingly associated with a less prestigious form of warfare than their traditional counterparts, making them presumably more likely to experience work stress. As shift work has been noted as a precursor to work stress and burnout in several previously mentioned studies, an enhanced understanding of this topic will be further explored.

Shift work within the DCGS. DCGS RPA operations are plagued with human factors challenges that are heightened due to the fact that the aircraft and the operators are not necessarily co-located (McCarley & Wickens, 2004). The vehicles are typically controlled from the continental United States but are physically in sustained flight on the other side of the world. However, not all the human factors challenges are unique to DCGS RPA operations as most have been witnessed within aviation and military contingencies for countless years. Increased amounts of personal fatigue are typically invoked by the very nature of military operations. In a study of 241 U.S. Army pilots, 72% reported they had flown aircraft when they could have easily fallen asleep while 45% indicated they have fallen asleep in the cockpit (Caldwell, Gilreath, Erickson, & Smythe, 2001). USAF aircrew members are partially protected from greater amounts of debilitating fatigue by applicable regulations which are meant to protect U.S. assets and allies. However, the relatively recent introduction of military RPA poses new fatigue-related challenges to aircrew operators, as well as DCGS intelligence personnel, such as sustained shift-work that is not minimized by legacy regulations. In 2005, the Office of the Secretary of Defense stated, “crew duty periods are now irrelevant to aircraft endurance since crew changes can be made on cycles based on optimum periods of sustained human performance and attention” (p. 73). However, with limited DCGS scientific literature, inadequate research is available to establish operator duty limitations (McCarley & Wickens, 2005). Due to the remarkable endurance of unmanned aircraft and their keen ability to offer clandestine surveillance and protection of ground assets, most associated DCGS operations and support personnel face extended duty days and varying shift schedules (Tvaryanas et al., 2006). Therefore, it should not be surprising that the USAF continues to exponentially increase its RPA operations despite sustained complaints from the DCGS community indicating a growing need to implement new, creative fatigue-management strategies. Tvaryanas and Macpherson (2009) conducted a longitudinal one-year study of 66 DCGS RPA pilots to assess if reported fatigue dropped as the population became accustomed to shift work. The study reported no significant reduction in fatigue levels, but noted cumulative months of shift work, reduced quality of sleep, and instability within family and social activities were correlated to reported fatigue (Tvaryanas & Macpherson, 2009). In terms of preventable aviation mishaps, increased amounts of DCGS RPA operator fatigue and disturbances in personal life are also accompanied by a significantly higher rate of destroyed RPA aircraft as compared to manned aircraft with the same mission type (Tvaryanas & Thompson, 2008). The Human Factors and Analysis Classification System currently in use by the USAF has been used to estimate that 56-69% of DCGS RPA mishaps involve active human factor failures (Tvaryanas & Thompson, 2008). Fatigue was determined to be a factor within only 10% of RPA mishap reports despite a continuous operator shift schedule with limited manning (Tvaryanas & Thompson, 2008). Caldwell (1997) suggests the true prevalence of fatigue may be grossly underestimated since the proper tools to assess the relationship between sleep loss and human error are unavailable. An alternative explanation of the low reports of fatigue within USAF mishap investigations is that the causal factors of an accident are often credited to human error or mechanical malfunction "without recognition of the systemic factors that made such errors inevitable" (Tvaryanas et al., 2006, p. 729).

Shift work. Shift work entails employment outside the typical day schedule of 0800-1700 (local time) Monday through Friday as dictated by organizational needs (Presser, 2003). Eight hour shift durations may include evening work periods of 1500-2300 (local time), or night work periods of 2300-0700 (local time), but may be individually tailored to the needs of the organization. Employees who work rotating shift patterns, such as air traffic controllers, alternate between each of the three shifts, sometimes all within the same week. There are also slower shift rotations where only one shift is worked during each particular month before being switched to a different shift, not unlike the types of shift experienced by DCGS personnel (Nesthus, Cruz, Hackworth, & Boquet, 2006; Tvaryanas, 2006; Tvaryanas & Macpherson, 2009). Shift work rotation patterns may go forward (i.e., day-evening-night), or in reverse (i.e., night-evening-day), and may include variations such as the use of 12-hour shifts. Due to these varying hours, employees who work shift/rotating shift schedules must alter their typical activity-rest cycle, and as a result, are more likely to suffer from sleepiness and/or insomnia with negative effects on the individual's physical and mental health, family life, quality of life, and productivity (Figueiro & White, 2013; Perrucci et al., 2007).

Rotating shift work has specifically been associated with increased risk of coronary heart disease, stroke, Type II diabetes, and cancer (Figueiro & White, 2013). In a review of related peer-reviewed studies between 1993 and 2006, Tucker and Knowles (2008) noted the majority of evidence supported the assertion individual differences, such as personality, flexibility, and a person's preference for waking up around sunrise, or *morningness*, influenced sleep disturbances, which are known to affect fatigue and psychological symptoms (Ognianova, Dalbokova, & Stanchev, 1998). Those psychological symptoms may then also affect chronic physical health to include cardiovascular and gastrointestinal disorders (Tucker & Knowles, 2008). In a different synthesis of shift work related literature, Perrucci et al. (2007) relate background variables such as education, age, and occupation impact work predictors such as work schedule, compensation and benefits, and job demands; however, moderating variables such as social support, martial conflict, spouse/child activities, supervisor interactions, and control over work conditions acted as moderators to the litany of outcome variables such as physical and mental health, marital quality and stability, and job satisfaction/commitment (Estryn-Behar, Van der Heijden, & the NEXT Study Group, 2012; Perrucci et al., 2007). When considering differences affecting individual tolerance to shift work, younger workers were more tolerant to the effect of shift work in the majority of associated studies, while older workers were less tolerant; however, in some cases the *healthy worker effect* created a situation where groups of shift work tolerant workers remained after those less tolerant succumbed to attrition (Bourdouxhe et al., 2010; Tucker & Knowles; 2008). Because personnel working within the DCGS community are generally younger, a natural assumption may presume they are less prone to the negative effects of shift work; however, it is important to consider age is only one factor within a complex list of predictors and mediating variables. For instance, Winwood, Bakker, and Winefield (2007) demonstrated significant correlations between alleviating work-induced stress between successive work periods, with common leisure behaviors generating positive feelings of fulfillment and personal reward, such as exercise, hobbies, and social activity; ironically, those same work schedules may preclude ready participation in such activities. A more thorough review of the specific literature relating to shift work, fatigue, and human physiology follows.

Sleep, fatigue, and alertness. Longer work days, shorter recovery periods, and 24/7 operations are not unique to the military setting. The global economy has evolved to a point where the speed of business practices has prompted a 24/7 society (Dawson, Noy, Harma, Akerstedt, & Belenky, 2011). Supercenter stores require extended operating hours, if not continuous operations, in lieu of overnight deliveries, and potential profit within the emerging interconnected 24-hour global economy. The worker population is then forced to accept the increased workload and lengthened duty periods as a new benchmark despite psychosocial workload and insufficient sleep that leads to fatigue (Akerstedt, 1995). Today’s society is accepting of fatigue as a near universal occurrence in everyday life in face of its insidious and sometimes detrimental effects. Dawson et al. (2011) convey the effects of fatigue may be best assessed as a range, from mild and occasional complaints, to severe, incapacitating symptoms including burnout, overstrain, or chronic fatigue syndrome. Acute and chronic sleep deprivation leads to increased levels of fatigue; however, differing fatigue levels will not necessarily affect an individual's alertness and performance equally. Training and increased levels of experience have been shown to lessen the performance decrements caused by fatigue, but natural internal processes will typically influence a person's abilities over the course of a large enough time span (Walters, Archer, & Yow, 2000).

Processes underlying sleepiness and alertness. In relation to RPA operations and for the purposes of this discussion, the definition of fatigue will be constrained to the alertness and performance effects brought about by one, or a combination of several physiological factors that are, in turn, influenced by external factors. The Merriam-Webster's dictionary broadly defines alertness as being quick to act or respond, or additionally, as being watchful and prompt in responding to danger or emergency ("Alertness", n.d.). A person's alertness over the course of a day is mainly influenced by the homeostatic process, circadian rhythm, and sleep inertia, but sleep debt, sleep quantity, and sleep quality are critical components as well (Caldwell & Caldwell, 2003).

Homeostatic process. The homeostatic process is determined by the length of continued wakefulness and generally related to the need for sleep (Caldwell & Caldwell, 2003). At the beginning of a typical day, the need for sleep is low since sleep has just been accumulated over the previous night. As the day progresses and the time since the last sleep period extends, the homeostatic process, or the need for sleep, increases. Caldwell and Caldwell (2003) compared the homeostatic process to that of hunger in that after a meal the feeling of hunger has been satisfied; however, as the day continues, the feelings of hunger slowly return and continue to escalate until food is again consumed. Just as with the feeling of hunger, the homeostatic process dictates that the feelings for the need for sleep will continue to escalate during continued wakefulness until it becomes all-consuming.

Circadian rhythm. The human body operates on an internal rhythm that is slightly longer than 24 hours in length and is the other main component of alertness. This circadian rhythm basically amounts to an internal clock, or pacemaker, that is based more on the time of day rather than the length of continued wakefulness (Caldwell & Caldwell, 2003). The main peaks of the average circadian rhythm occur in the late morning and early evening, while the main trough occurs in the 0300-0500 timeframe, in addition to a small dip just past noon (Caldwell, Caldwell, & Schmidt, 2008; Caldwell, 1997; Folkard & Tucker, 2003). Environmental or external influences affect the circadian pacemaker and are termed zeitgebers. These cues assist in keeping the circadian rhythm consistent and its internal cycles and processes synchronized (Caldwell & Caldwell, 2003). Sunlight is generally considered the most substantial zeitgeber that sets our circadian rhythms to daytime activity and nighttime rest periods, but there are others, such as social factors that include meals, work activity, and practiced routines (Caldwell & Caldwell, 2003; Caldwell et al., 2008).

The circadian rhythm also regulates several different internal body functions on specific cycles as short as a minute and others that are measured in days or months (Caldwell et al., 2008). The internal cycles within the main circadian rhythm prompt various bodily functions to either increase or decrease at various times. For example, increased heart rate, body temperature, and blood pressure correlate with increased alertness and performance normally occurring during the daytime (Van Dongen & Dinges, 2005). Conversely, these functions along with hydrocortisone production are decreased during the night while plasma melatonin increases (Van Dongen & Dinges, 2005). Collectively, these are measurable phenomenon within the body used to estimate the circadian cycle.

Humans, based on our circadian rhythms, are diurnal animals, or those that physiologically prefer to be alert during the day and rest at night. Disruptions to this schedule occurring due to overnight work or time zone changes affect the body's ability to remain alert or to sleep (Caldwell et al., 2008).

Combined effects of the homeostatic process and circadian rhythm. The interactions between the homeostatic process and circadian rhythm produce a cumulatively stable alertness throughout the day (Caldwell & Caldwell, 2003). Assuming the average individual awakes in the vicinity of 0600, the circadian rhythm is still midway between its trough at approximately 0300 and its main peak around noon. However, the homeostatic process largely compensates for the diminished state in the circadian rhythm as it has just accumulated the needed sleep it requires. As the day progresses, the homeostatic process creates feelings of increasing need for sleep, but the circadian rhythm, especially in the early evening hours, again compensates with its second, yet less pronounced peak as compared to the main noon peak (Waterhouse, 2012). As the evening progresses, both processes decline resulting in decreased alertness and ultimately the need for rest.

Individuals who work on rotating shift schedules, such as RPA operators, are prone to the effects of performing during less than physiologically optimum periods of the day. Swing shift workers, generally those who work from the late afternoon to around the midnight timeframe, are biologically operating during the period where alertness and thus, performance, is decreasing. Those workers, however, may be able to keep a relatively normal sleep period. Caldwell and Caldwell (2003) state circadian rhythms may vary from person to person favoring either the early morning or late evening time periods; therefore, some individuals may be better able to adapt to a swing shift than others. Overnight workers must overcome the lows of both the homeostatic process and circadian rhythm which makes that shift the most difficult from the physiological reference. Whether those effects are experienced in a manned aircraft or during RPA overnight operations, alertness, performance, and safety are in serious jeopardy (Caldwell & Caldwell, 2003).

Sleep inertia. Sleep inertia, in addition to the homeostatic process and circadian rhythm, is an important process underlying sleepiness and alertness (Caldwell & Caldwell, 2003). Sleep inertia is grogginess felt just after waking up and may persist for hours (Waterhouse, 2012). While sleep inertia is an inconvenience in the daylight hours, it may prove more serious for those with early daytime shift schedules. For instance, in addition to a forward rotating shift schedule, RPA operators also have staggered reporting times. As a result, some daytime operators are required to be on duty by 0500 to 0600.

Since they likely wake around 0400, those individuals will experience the effects of their circadian rhythm low and sleep inertia as they drive into work, not yet considering the added effects of sleep debt which will be discussed shortly.

Sleep quantity. It is generally accepted that the average person needs approximately seven to eight hours of sleep per night; however, that claim has been disputed in recent years (Basner, 2011). Anecdotally, individuals may notice that certain people are better able to withstand shortened sleep duration than others, but there may be scientific merit behind these observations. Research suggests strong supporting evidence that inter-individual differences in neurobehavioral impairment that occur during sleep deprivation present similar to trait-like or genetic phenotypes (Van Dongen, Baynard, Maislin, & Dinges, 2004). In different supported research, degradations in simulator flight performance ranged from 0.6% to 135% in USAF pilots that were sleep deprived for 37 hours (Caldwell et al., 2004). It also appears that someone who is resistant to the effects of fatigue on one particular occasion will likely be resistant in others, but it is yet to be determined if that resistance remains over the course of several years or a lifetime (Mallis et al., 2001; Van Donger, Baynard, Nosker, & Dinges, 2002). Therefore, it is likely that there is a yet undefined genetic predisposition within individuals to the effects of sleep loss and sleep debt that may influence how well they tolerate physiologically abnormal work/sleep schedules like those imposed by rotating shift-work operations.

Sleep debt and sleep quality. Sleep debt is the difference between how much sleep an individual person needs and the amount they are actually accruing on a daily basis (Van Dongen, Maislin, Mullington, & Dinges, 2003). One method to determine how much sleep a particular person needs is to allow a natural sleep pattern without the influence of an alarm clock or other external cues (Caldwell & Caldwell, 2003). While sleep duration may initially increase due to a multitude of factors, including remediating previous lost sleep, the average duration should remain relatively constant after the recovery period lapses. Sleep debt, therefore, is the cumulative difference in the sleep the body needs and what the body actually received, but it is not simply a mathematical formula as sleep quality must also be considered (Caldwell et al., 2003). Sleep debt may also be accrued by unrestful sleep, despite a sleep period of eight hours. For instance, overnight shift workers who sleep during the day are not as likely to attain the amount of quality sleep their body requires if simply attempting to sleep for what they consider a normal length of time (Caldwell et al., 2003). Despite the need for sleep as driven by the homeostatic process, the circadian rhythm, especially as influenced by sunlight, will attempt to keep the individual awake. Even when the person falls asleep, the sleep quality during the day is not as likely to be as restful as the same amount of sleep during the night (Caldwell & Caldwell, 2003). Ultimately, it is the amount of quality restful sleep that will satisfy the homeostatic process; any less will accrue sleep debt that will result in decreased alertness and fatigue (Caldwell & Caldwell, 2003).

Effects and consequences of fatigue. The effects of fatigue are numerous, but it is especially known to degrade mental abilities, performance, and psychological well-being (Matthews, Desmond, Neubauer, & Hancock, 2012). Caldwell and Caldwell (2003, p. 19) list some of the known fatigue effects:

- Accuracy and time degrade.
- Lower standards of performance unconsciously become acceptable.
- Attentional resources are difficult to divide effectively.
- The ability to integrate information efficiently is lost.
- Activities become more difficult to perform.
- Performance becomes increasingly inconsistent.
- Social interactions decline.
- Attitude and mood deteriorate.
- The ability to reason logically is impaired.
- The ability to maintain a clear picture of the overall situation diminishes.
- Attention wanes.
- Involuntary lapses into sleep begin to occur.

Each of these effects may be hazardous by themselves, but combinations may prove especially deadly in the aviation environment and even more so in the military aviation environment where life and death situations are commonplace in daily activities.

Based on the previous constrained definition of fatigue, the consequences of sleep loss-induced fatigue may be categorized into short-term and long-term effects. Short-term effects are most generally related to poor safety outcomes, while long-term effects are related to one or a combination of reduced physical and psychological health (Gaba & Howard, 2002).

Some of the most prevalent effects of prolonged fatigue exposure include greater psychological troubles as well as increased subjective health concerns and cardiovascular disease (Caruso, Hitchcock, Dick, Russo, & Schmit, 2004). Recently, Van Cauter, Spiegel, Tasali, and Leproult (2008) established a link between reduced sleep duration, obesity, and diabetes that suggests a mechanism between work-related fatigue and poor health outcomes.

Short-term effects of sleep loss induced fatigue are seemingly more benign and insidious. Whether an individual's fatigue is due to inadequate sleep quantity or quality, research indicates its effects lead to "decreased alertness and impaired performance in a variety of cognitive psychomotor tests" (Dawson & Reid, 1997, p. 235). Further research clearly identifies shift work induced fatigue as a significant risk factor that increases the probability of a mishap or injury (Dembe, Erickson, Delbos, & Banks, 2006). While the authors of the referenced studies did not specifically address fatigue impairment in the RPA setting, the associated likelihood of human performance errors resulting in accidents or unplanned operations are readily apparent.

Effects of fatigue on cognitive performance. Most individuals relate subjective accounts of decreased cognitive abilities as fatigue levels increase. These mental abilities may be influenced by lack of sleep quantity or quality, or as a function of increased amounts of hours awake. Dawson and McCulloch (2005) ascertained that relatively small amounts of sleep loss, approximately 2-3 hours with the assumption of an average eight hours of normal rest, produced increases in impairment on several tasks as measured in the laboratory and real-world settings. In a landmark study, Dawson and Reid (1997) equated performance impairment as a result of sustained wakefulness to alcohol induced impairment. In their study, participants who had a sustained wakefulness of 17 hours, referenced from an 8:00 am start point, exhibited decreased cognitive psychomotor performance equivalent to an individual with a blood alcohol concentration of 0.05% (Dawson & Reid, 1997). As those individuals continued their wakefulness to 24 hours, they exhibited equivalent performance to someone with a 0.10% blood alcohol concentration (Dawson & Reid, 1997). Therefore, since fatigue impairment is typically not easily quantified, this study allows an easily related frame of reference in which to compare. Dawson et al. (2011) stated performance deficits occurring as a result of chronic partial restrictions of sleep can be equivalent or greater to what is experienced during instances of acute fatigue. Since Dawson and Reid's (1997) original research was conducted utilizing fully rested individuals, it is logical to conclude observed performance measurements would likely be even worse for those with chronic partial restrictions in their sleep. Akerstedt (2005) estimated that 10% of night and rotating shift workers had been classified with a resulting sleep disorder. While general society would not approve of individuals who are alcohol impaired in the workplace, equivalent impairment due to fatigue is widely accepted. Those realizations should be considered in light of commercial long-haul operations that require aircrew to fly passengers during overnight hours and in the military setting during DCGS RPA operations that employ a continuous 24/7 rotating shift schedule.

Sleep debt combined with circadian rhythm desynchrony. DCGS RPA operators are especially vulnerable to the effects of sleep debt and circadian rhythm desynchrony as they typically operate on a slow forward shift rotation. In this type of rotation, the operators transition from day shift to the swing shift to the midnight shift on an approximately monthly basis, as opposed to transitioning backward from the midnight shift to swings and then eventually days. While each DCGS squadron within the USAF is allowed to determine their own schedule to meet 24/7 mission needs, one popular pattern within the monthly shift rotation is that of working six periods and then having three off. When operators first transition to the midnight shift, they are undoubtedly suffering from sleep debt as well as circadian rhythm desynchrony. The sleep debt likely arises from poor sleep quality and quantity while attempting to sleep during the daylight hours. Anecdotally, some operators choose to simply wake as late in the day as possible during their first overnight work period and simply stay awake until the end of their shift some 24 hours later. The circadian rhythm influences almost every part of alertness and performance (Van Dongen & Dinges, 2005). Caldwell et al. (2008) point out that the speed and quality of human performance is similar to the pattern of internal body temperature, which, in turn, closely follows the peaks and troughs of the circadian rhythm. The lowest body temperatures are often recorded between the times of 0300 and 0500 and are associated with “lower alertness, slower reaction time, and poorer accuracy than periods of higher body temperature” (Caldwell et al., 2008, p 259). Cumulatively, RPA operators are battling slept debt compounding by circadian rhythm influences that affect their alertness and performance. Science, therefore, reinforces common sense as Folkard and Tucker (2003) relate overnight workers typically perform at lower levels as compared to their daytime counterparts. In addition to decreased performance during overnight operations, it is more common for a person to experience sleep episodes that range from short micro sleeps that are unbeknownst to the operator and result in decreased brain activity, to full onset sleep episodes (Neri et al., 2002; Samel, Wegmann, & Vejvoda, 1997; Wright & McGowan, 2001). As previously stated, environmental, or external influences, are an aid to synchronizing the body’s circadian rhythm; therefore, any overnight operation that occurs in extremely low lighting conditions, such as RPA operations, are more likely to experience the performance decrements associated with sleep debt and lowered body alertness as a result of circadian rhythm desynchrony. While these same effects are experienced by overnight workers throughout the world, RPA operations are unique because those same operators who are sleep deprived and working against their body's natural rhythms in a dark environment are the military officers and enlisted who are in control of multi-million dollar armed aircraft that typically support ground forces who are in close-combat conditions. As technology evolves to meet the nation's defense needs of the 21st century, so too must the ways we employ our operators of those systems. Fatigue countermeasures encompass several strategies of lowering the risks associated with 24/7 operations; in this particular instance, once RPA operations draw upon the well-documented history of human performance research, more effective ways of increasing operator performance may be attained while reducing the likelihood of repeating past mistakes.

Statistical Approach

A review of the relevant literature suggested the use of generalized linear modeling as the primary method within this study. This type of modeling included descriptive statistics and incidence rate ratios to understand the epidemiological relationship between USAF RPA support personnel, specifically the 1N0X1 and 1N1X1 intelligence career fields, and actual mental health diagnosis and counseling incidence rates. This methodological approach was specifically informed by Otto and Weber's (2013) work on determining the mental health and counseling relationship between USAF active-duty, manned-aircraft, and RPA pilots. Otto and Webber's (2013) study, as well as numerous protocols within the relevant literature, demonstrated the necessity for the proposed research to thoroughly define the specific mental health outcome constructs, time-related predictor variables, predictor variables, and confounding variables in order to make valid comparisons and conclusions based on the hypotheses.

Epidemiology is the "study of the occurrence and distribution of health-related states or events in specified populations, including the study of determinants influencing such states, and the application of this knowledge to control health problems" (Porta, 2014, p. 81). The application of statistics within the epidemiology context is termed *biostatistics* and is used to obtain valid and precise estimates regarding the effect of a potential cause on the occurrence of an illness (Greenland & Rothman, 2008). Within epidemiology, the occurrence of an illness is often measured using discrete, non-negative count data; however, it is also necessary to take into account the time elapsed after exposure to a specific environment or agent, before the illness actually occurs (Greenland & Rothman, 2008). Of course, health outcomes are seldom inevitable or even always observed during the period of a particular study. In these situations, it is useful to define the period of time that each individual was likely susceptible to the health outcome, regardless if the event occurred or not (Greenland & Rothman, 2008). When a specific population is being observed, like the ones with this study, it is useful to determine the time-weighted average of individual rate, namely the *incidence rate*, as defined by Silva's (1999) equation:

$$\text{Incidence Rate} = \frac{No.of\ new\ cases\ of\ illness\ arising\ in\ a\ defined\ population\ over\ a\ given\ time\ period}{Total\ person{-}time\ at\ risk\ during\ that\ period} \quad (1)$$

The components of Equation 1 will be expounded upon later in Chapter 3. While Equation 1 is conventional, it is greatly complicated when controlling for numerous confounding variables while attempting to identify statistical differences between groups; therefore, the use of statistical regressions simplify and accelerate the process. Since epidemiological count data was not likely to be Gaussian, or a normal distribution, non-parametric generalized linear modeling, in this case a regression, was preferred (Silva, 1999).

Epidemiological regression modeling was advantageous for several reasons to include it did not require definition of which explanatory variables were the exposure and which ones were the potential confounders, as they were all treated the same (Silva, 1999). Generalized linear modeling (GzLM) was the main type of analytical approach used within this study's research method. Whereas general linear modeling assumes a dependent variable is a linear function of a set of independent variables with normal distribution, GzLMs include a family of models specifically developed for regressions with non-normal dependent variables (Duntman & Ho, 2006). This research utilized epidemiological, discrete, non-negative *count data*, or the frequency of times an event occurred within a given time period, which was not normally distributed, but rather positively skewed since the majority of cases were unlikely to exhibit the psychological outcomes of interest (Duntman & Ho, 2006). The Poisson distribution is applicable to discrete count data and modeling rates of rare events and is applied when time is a central factor defining the units of observation (Rothman & Greenland, 1998). Explanatory variables within this type of regression are generally categorical; therefore, continuous data such as age were coded as previously defined strata (Rothman & Greenland, 1998). The assumptions of the Poisson regression model are:

1. the logarithm of the disease rate changes linearly with equal-increment increases in the exposure variable;

2. changes in the rate from the combined effects of different exposures or risk factors are multiplicative;
3. that at each level of the covariates, the number of cases has variance equal to its mean;
4. observations are independent (Rothman & Greenland, 1998).

Based upon a review of the relevant literature, the following confounders were considered within the regression and the context of this study: age, number of deployments, time in service, prior history of mental health outcomes, sex, race/ethnicity, marital status, education level, total time deployed, and military rank.

Summary

Intelligence analysts serve a critical role within the USAF DCGS intelligence enterprise and are exposed to various psychological and occupational stressors, despite their physical distance from the combat they support. Popular media has emphasized PTSD prevalence within DCGS personnel; however, academic literature suggests traditional occupational stressors may be associated with a stronger effect on those workers. This effect does not negate the possibility of PTSD and other PTSD associated physiological diagnoses since reports indicate their presence is factual within DCGS personnel; rather, the academic literature helped explain the seemingly low incidence of those rates. Alternatively, academic studies conducted specifically on DCGS intelligence personnel to include imagery analysts, suggest they may be exposed to occupational stressors resulting in emotional distress and occupational burnout. These stressors included, but were not limited to, rotating shift work, staffing level concerns, chronic fatigue, and circadian rhythm disruptions. All of these factors were associated with negative mental health outcomes, whether they are direct or indirect. Cross-sectional survey-based studies indicate DCGS personnel were suffering from a pronounced psychological effect from occupational and, to a lesser extent, combat operations. What was still unknown was if these results were reflected in higher rates of DCGS personnel, specifically imagery analysts, utilizing mental health services. To date, there have been no studies investigating actual mental health diagnoses rates within DCGS enlisted intelligence specialists to complement the literature. This present study seeked to discover information critical to understanding the still unknown medical consequences inherent to DCGS duties and its environment, and can be used by other researchers, military commanders, and medical personnel to discover and minimize the causal factors, and also to provide medical assistance, if necessary, to past DCGS members who have since separated from military service, but are still experiencing lasting medical problems influencing their civilian lives.

CHAPTER III

METHODOLOGY

The purpose of this study was to 1) document frequencies and rates of mental health outcomes among RPA intelligence specialists, and 2) determine if enlisted RPA intelligence support personnel exhibited statistically different adjusted mental health incidence rates as compared to RPA sensor operators, aircraft armament technicians, and the general USAF enlisted population. The results of this study contribute to understanding the medical health concerns within RPA ancillary occupations and encourage further associated studies, identify unrecognized health risks to the USAF, and provides DoD leadership information to facilitate policy change. To this end, this research identified the actual crude and adjusted mental health diagnosis and counseling rates of enlisted RPA intelligence specialists and statistically compared them to RPA sensor operators, aircraft armament technicians, and the general USAF enlisted population. To achieve this goal, medical data from existing health care records were utilized from the U.S. Air Force School of Aerospace Medicine's epidemiological database containing USAF medical surveillance data. Based on the stated hypotheses, the results of this work provided supporting evidence as to whether the enlisted RPA intelligence specialists experience negative mental health indicators that were correlated with combat-related origins or traditional occupational stressors.

Population/Sample

This study was based upon an observational, analytic, retrospective cohort study. Historical medical data for USAF active-duty RPA intelligence specialists, USAF RPA sensor operators, and USAF aircraft armament personnel was collected from the U.S. Air Force School of Aerospace Medicine’s epidemiological database and analyzed to make psychological health observations. A cohort study is a type of observational research in which the study population is selected to specifically determine which subjects are to be included based on particular characteristics related to an illness or based upon exposure to a possible precondition (Silva, 1999). While USAF active-duty RPA intelligence specialists were the primary subjects of interest within this study, USAF active-duty RPA sensor operators, USAF active-duty aircraft armament systems technicians, and the general USAF active-duty enlisted population served as comparison groups in order to make valid comparisons, draw conclusions, and test hypotheses.

The comparison groups in this research were specifically chosen to determine if telewarfare operations were correlated with mental health outcomes within the USAF RPA intelligence specialist population. USAF RPA sensor operators and USAF active-duty RPA intelligence specialists have similar responsibilities, educational background, and demographics, and both groups are continuously exposed to telewarfare operations. USAF aircraft armament systems technicians and USAF active-duty RPA intelligence specialists also have similar physical and psychological health screening requirements and work a rotational shift schedule, but the former group is not exposed to telewarfare operations. Similar to the efforts validated by Otto and Webber (2013), the general USAF enlisted population served as a control group to compare clinically observed mental health rates.

Sources of the Data

All medical and demographic data used in this research were obtained from electronic health care records maintained in the U.S. Air Force School of Aerospace Medicine's medical epidemiology database and limited to a surveillance period of 1 January 2006 through 31 December 2010. The U.S. Air Force School of Aerospace Medicine's medical epidemiology database is similar to DMSS, where it is a continuously expanding database that documents military and medical information; however, unlike DMSS it is limited to data collected from USAF service members throughout their careers (School of Aerospace Medicine, personal communication, 5 November, 2015, DMSS, 2014). At the time of this study, the U.S. Air Force School of Aerospace Medicine's medical epidemiology database was the central repository of medical surveillance data for the USAF and contains present and historical data on experienced diseases and medical events, as well as longitudinal data on personnel and deployments (School of Aerospace Medicine, personal communication, 5 November, 2015). Within the U.S. Air Force School of Aerospace Medicine's medical epidemiology database, USAF active-duty intelligence specialists were defined by the 1N0X1 and 1N1X1 AFSC career fields; USAF RPA sensor operators were defined by the 1U0X1 career field; and USAF aircraft armament personnel were defined by the 2W100 career field.

Epidemiological research is based on the ability to quantify the occurrence of a health related event in a specific population (Silva, 1999). In order to accomplish this, the following criteria was clearly defined from the U.S. Air Force School of Aerospace Medicine's medical epidemiological database:

(1) What is meant by a *case*.

(2) The population from which the case originates.

(3) The period over which the data were collected (Silva, 1999, p 57).

The populations for this study have been previously defined; however, case definition and time period must still be explained.

For the purposes of this study the time period for USAF active-duty RPA intelligence specialists, USAF RPA sensor operators, and USAF aircraft armament personnel to be eligible to receive a mental health outcome, began 30 days after their AFSC was first awarded, and then either concluded at the individual's separation from active-duty or at the end of the surveillance period, whichever came first. The specific timeframe associated with an outcome, or the time from the beginning of exposure to the time an outcome was recorded, was the difference between the date the outcome was recorded and the beginning of the defined surveillance period, measured in years. Along similar protocols used by Otto and Webber (2013), individuals with mental health outcomes identified before the stated study timeframe were considered prevalent cases and were subsequently ineligible to become an incident case for that specific mental health outcome. Each individual who received multiple mental health diagnoses were considered an incident case for each individual outcome; however, duplicate diagnoses for the same condition were only counted for the first occurrence in order to maintain independence for statistical analyses (Otto & Webber, 2013). Chronological covariates such as an individual's age were assessed at the start of the surveillance period or at entry into active military status for those who entered after the surveillance period started.

The construct of mental health outcome was informed by the literature review and was categorized and defined along similar protocols as Otto and Webber's (2013) study:

- Mental health outcomes were categorized into two groups: actual mental health diagnoses defined by ICD-9-CM codes and mental health counseling defined by V-codes and E-codes (see Table 2)
- For all mental health outcomes excluding suicide attempts or ideation, cases were defined by at least one hospitalization record with the applicable diagnosis in the first or second diagnostic position, or two records of ambulatory encounters within 180 days with the relevant diagnosis in the first or second diagnostic position, or one ambulatory encounter in a psychiatric or mental health care specialty setting with the relevant diagnosis in any diagnostic position
- Cases of "suicide attempt" and "suicide ideation" were defined by one ambulatory encounter or hospitalization with that diagnosis (p 4)

Table 2

Mental Health Outcomes and ICD-9-CM Case-Defining V Codes and E Codes

Outcome	**ICD-9-CM codes**
Adjustment disorder	309.0x-309.9x (exclude 309.81)
Alcohol abuse and dependence	303.xx-305.0x
Anxiety disorder	300.00-300.09, 300.20-300.29, 300.3
Depressive disorder	296.20-296.35, 296.50-296.55, 296.9x, 300.4, 311
Posttraumatic stress disorder	309.81
Substance abuse/dependence	304.xx, 305.2x-305.9x
Suicide attempt/ideation	V62.84, E950.xx-E958.x
Partner relationship problems	V61.0x, V61.1, V61.10 (exclude V61.11, V61.12)
Family circumstance problems	V61.2, V61.23, V61.24, V61.25, V61.29, V61.8, V61.9
Maltreatment related	V61.11, V61.12, V61.21, V61.22, V62.83, 995.80-995.85
Life circumstance problems	V62.xx (exclude V62.6, V62.83)
Mental, behavioral problems and substance abuse counseling	V40xx (exclude V40.0, V40.1, V65.42)

Treatment of the Data

Within epidemiological-based studies such as this, Silva (1999) recommends the Mantel-Haenszel method be used to obtain preliminary crude effect estimates, as well as effect estimates adjusted for each confounding variable separately before conducting subsequent regression analyses to simultaneously adjust for confounders. This method is generally performed on parametric data when there are few confounding variables in order to first observe the most important relationships and interactions within the data, and to also detect any errors and inconsistencies before performing a regression analysis. The crude incidence rate of occurrence typically includes all the subjects in a study sample and provides an overall estimate of the effect of the exposure on the outcomes of interest (Silva, 1999). Founded in Equation 1, a crude incidence rate is defined as:

$$\text{Crude incidence rate Per 1,000 person-yrs} = \frac{\text{No. new cases arising in a defined population in a specific period of time}}{\text{Total person-years at risk in that population during that period of time}} \text{ X } 1{,}000 \qquad (3)$$

While Equation 3 may be used to calculate strata specific adjusted results for potential confounding variables, summary effect estimates take adjusted results and pools them by calculating a set of weights that maximizes the statistical precision of the adjusted effect estimate as conducted within a Chi-square Mantel-Haenszel analysis (Silva, 1999). Rate ratios do not have a parametric distribution since the minimum value is zero, whereas the maximum is infinity; however, logarithmic transformations may result in symmetrical data. (Silva, 1999). If not, a Poisson regression may be necessary, and is explained in later sections. The formula for the Mantel-Haenszel summary estimate of the common rate ratio is defined as:

$$RR_{MH} = \frac{\sum a_i y_{0i}/y_i}{\sum b_i y_{1i}/y_i} \qquad (4)$$

given the criteria in Table 3,

Table 3

Criteria for the Mantel-Haenszel Summary Estimate of the Common Rate Ratio

CONFOUNDER Strata$_1$	OUTCOME		TOTAL
	Exposed	Non-Exposed	
Cases:	a_1	b_1	n_1
Person-yrs at risk:	y_{11}	y_{01}	y_1
Rate per 100,000 pyrs	r_1	r_{01}	r_1
CONFOUNDER Strata$_2$	OUTCOME		TOTAL
	Exposed	Non-Exposed	
Cases:	a_2	b_2	n_2
Person-yrs at risk:	y_{12}	y_{02}	y_2
Rate per 100,000 pyrs	r_{12}	r_{02}	r_2

The 95% confidence of the Mentel-Haenszel rate ratio can be estimated by first computing the standard error (SE) as:

$$SE(\ln \mathrm{RR}_{MH}) = \sqrt{\frac{\sum V(a_i)}{(\sum a_i y_{0i}/y_i)(\sum b_i y_{1i}/y_i)}} \tag{5}$$

Where, V = variance, and the 95% confidence intervals may be computed following equations 6 and 7.

$$\ln \mathrm{RR}_{MH} \pm 1.96 \times (\ln \mathrm{RR}_{MH}) = \ln \mathrm{CI}_1 \ \& \ \ln \mathrm{CI}_2 \tag{6}$$

$$95\% \ \mathrm{CI}\ (\mathrm{RR}_{MH}) = e^{lnCI_1} \ \& \ e^{lnCI_2} \tag{7}$$

The Mantel-Haenszel χ^2 (see equation 8) test can be used to determine the value for the overall test of significance given by:

$$\chi^2 = \sum O(a_i) - \sum E(a_i)^2 / \sum V(a_i) \tag{8}$$

given,

(i) observed value of a_i = $O(a_i)$ = a_i

(ii) expected value of a_i = $E(a_i)$ = $n_i y_{1i}/y_i$

(iii) variance of a_i = $V(a_i)$ = $n_i y_{1i} y_{0i}/y_i^2$

The review of the relevant literature suggested potential confounding variables may include: age, number of deployments, time in service, gender, and history of any mental health outcome; therefore, they were included as possible covariates to adjust incidence rates as defined by the following criteria:

age: 18-24, 25-29, 30-34, 35-39, 40+

number of deployments: 0, 1, 2, 3+

time in service: <6 years, 6-10 years, 11-15 years, 16+ years

gender: male, female

prior history of mental health outcome: yes, no

Based on Silva's (1999) recommendation to obtain preliminary crude effect estimates and effect estimates adjusted for each confounder separately, the four primary confounders in this study would result in 160 preliminary tables (5X4X4X2). This methodology becomes increasingly problematic when potential additional confounders are included such as sex, race/ethnicity, marital status, education level, total time deployed, and military rank. Instead, automated regression modeling can summarize the effects between an outcome variable and several explanatory variables in efficient fashion (Silva, 1999). It is important to understand the underlying methodology as conveyed within the previous pages, within automated regression, despite the fact they could not be feasibly used within this study.

The review of the applicable literature suggested the data in this research were not likely to be parametric, and would include numerous covariates; therefore, the use of Poisson regression became the simplest statistical method to utilize, and was also consistent with Otto and Webber's (2013) research. The Poisson regression assumptions, as defined in Chapter 2, were addressed within the context of this study:

- Assumption 1: is understood when observing the Poisson regression equation expresses the log outcome rate as a linear set of predictors: The Poisson regression equation is:

$$\log e \ (Y) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots \varepsilon \qquad (9)$$

- Assumption 2: is better understood when exponentiating Equation 9 which can be illustrated by the equation:

$$Y = (e^{\beta 0}) \left(e^{\beta 1 X 1}\right) \left(e^{\beta 2 X 2}\right) (\varepsilon) \qquad (10)$$

- Assumption 3: In order to assume a Poisson distribution, a histogram of the dependent variable should display a positively skewed form with a mean greater than zero. The Poisson distribution is defined as:

$$P_y \ (n) = \frac{v^n e^y}{n!} \qquad (11)$$

Before assessing overdispersion, or a model's variance is greater than its mean, the goodness of fit for the model should be calculated. Goodness of fit can be determined by calculating the difference in the regressions deviance and degrees of freedom for each level of predictor variable. The significance may easily be found in a Chi-squared distribution table based upon the change in deviance and degrees of freedom.

Within the statistical software for a Poisson regression, plots can be made of the residuals versus the mean at different levels of the predictor variable (Rothman & Greenland, 1998). Any tendencies of the data within the plot may indicate overdispersion or underdispersion and may be mediated by the inclusion of additional independent variables in an attempt to reduce the discrepancy. Additional independent variables may include those found within the demographic data. If additional independent variables do not correct the discrepancy, excess zeros may suggest a zero inflated model; or, if excess zeros are not present, a Negative Binomial Distribution may be suggested as it is robust to Poisson violations of dispersion. Excess zeros, or heterogeneity, is a situation where more zero counts would be encountered than presumed by a Poisson distribution. Within this research, excess zero would mean there was an outside influence or data source increasing the likelihood of individuals not experiencing mental health rates. For the purposes of this research, heterogeneity was assumed to be null, and overdispersion managed by additional independent variables, or with Negative Binomial Distribution.

- Assumption 4: In order for the observations within this study to be independent, it was necessary to ensure one count outcome did not influence another. Based on the literature review, it was assumed an individual experiencing a mental health condition did not influence clinically observed mental health occurrences in other people. Within the same individual, this study only recorded the first occurrence of any one mental health outcome, but allowed for other diagnostic codes to be recorded. These research procedures were assumed to maintain the premise which stated recorded observations were independent.

Descriptive statistics. Descriptive statistics were observed for USAF enlisted RPA intelligence specialists within the 1N0X1 and 1N1X1 career fields, RPA sensor operators, and aircraft armament personnel. Specific demographic and military characteristic data included: sex, age, race/ethnicity, marital status, education level, number of deployments, total time deployed, military rank, time in USAF prior to AFSC, and prior mental health outcomes. These statistics were used to identify group differences, interpret results, as well as adjust incident rates for age, number of deployments, time in service, and history of mental health outcomes.

In addition to basic descriptive data, incidence rates adjusted for independent and confounding variables were described for each reference group for the following mental health outcomes: any mental health diagnosis, any mental health counseling, any mental health outcomes, and all mental health outcomes. The term *any* in this context was defined as the number of unique individuals who satisfied the case definition for at least one of the outcomes, while the term *all* was defined as the total number of times an individual satisfied a case definition for the outcome of interest.

Hypothesis testing. In order to test the hypotheses of the research, an iterative set of analyses was undertaken to test the following hypotheses:

H1: USAF enlisted RPA intelligence specialists exhibit statistically different incidence rates of mental health outcomes as compared to USAF RPA sensor operators.

H2: USAF enlisted RPA intelligence specialists exhibit statistically different incidence rates of mental health outcomes as compared to USAF aircraft armament systems technicians.

H3: USAF enlisted RPA intelligence specialists exhibit statistically different incidence rates of mental health outcomes as compared to the general USAF enlisted population.

The first step was to discover the unadjusted, or crude, incident rates for each group for each mental health outcome construct to include additional outputs for any mental health diagnosis, any mental health counseling, any mental health outcome, and all mental health outcomes. Adjusted incident rates were then computed for the same criteria for comparison. Once the incident rates were determined, unadjusted incident rate ratios were calculated for the aforementioned outcomes from a Poisson regression with no additional variables besides the group-defining variable. These preceding steps were necessary to fully understand the final step of hypotheses testing accomplished through determining incident rate ratios adjusted for independent and covariates from a Poisson regression. Within this step, the categorical group variable was translated via dummy coding so the reference group was the USAF enlisted RPA intelligence specialists. The outcome variables were each of the 12 mental health outcome groups shown in Table 2, in addition to the four major groups of: 1) any mental diagnosis, 2) any mental health counseling, 3) any mental health outcome, and 4) all mental health outcomes. Therefore, if H1 was supported there should have been a significant difference in incident rate ratios associated with the USAF RPA sensor operator predictor group for any of the outcome groups. If H2 was true, there should have been a statistically significant difference in incident rate ratios associated with the USAF aircraft armament systems technicians group for any of the outcome groups. If H3 wasa true, there should have been a statistically significant difference in incident rate ratios associated with the general USAF enlisted population group for any of the outcome groups.

This research identified mental health diagnosis and counseling rates of USAF enlisted RPA intelligence specialists and statistically compared them to USAF RPA sensor operators, USAF aircraft armament technicians, and the general USAF enlisted population. Medical data from existing health care records were utilized from the U.S. School of Aerospace Medicine's epidemiological database containing USAF medical surveillance data. Non-parametric data with numerous covariates was more efficiently and effectively analyzed by Poisson regression, and was also consistent with Otto and

Webber’s (2013) research. Hypothesis testing was then be accomplished using the statistical results of the data analyses.

CHAPTER IV

RESULTS

In January 2016, the U.S. Air Force School of Aerospace Medicine provided deidentified medical records limited to a surveillance period of 1 January 2006 through 31 December 2010, for the purpose of this research. The original data consisted of 16,647,398 recorded medical encounters from 417,258 USAF enlisted service members. Between January 2016 and March 2016, the medical data were structured and analyzed using IBM® SPSS ® Version 23 and Stata ® Version 14.1 statistical programs in order to generate results and form conclusions. During this time, the medical records from 9,696 (2.3% of original total) enlisted service members were removed from the analysis as they indicated only one recorded ambulatory medical encounter; therefore, they did not meet inclusionary case definition. By removing these cases, subsequent Poisson regressions were nonsignificant for overdispersion. The records of 229 (< 0.001% of original total) enlisted service members indicated they performed duties as both RPA intelligence specialists as well as RPA sensor operators during the surveillance period. By removing these cases, mutually exclusive groups were maintained for the main comparison groups in order to reduce confounding. The remaining records were categorized into general USAF functional areas, such as aircrew operations, healthcare, and mission support personnel; remaining records were categorized under the title "Other." The top three occupations that constitute the "Other" category included, aerospace maintenance, security forces, and civil engineering. Ultimately, data from 407,333 enlisted service members served as the foundation for the analysis and conclusions within this research.

Descriptive Statistics

A total of 7,988 USAF service personnel were identified during the surveillance period as RPA intelligence specialists, 196 as RPA sensor operators, 11,340 as aircraft armament technicians, and 387,809 personnel from ancillary career fields (see Appendix C, Tables C1, C2, and C3). The three main cohorts were relatively similar in regards to demographics and military characteristics; however, statistical analyses were used to ascertain statistically different covariates. Statistical analyses within this dataset resulted in *Time in Service, Number of Deployments, Gender, and Age* as the statistically relevant covariates for this research.

There was a statistically significant, F (2,417248) = 674.358, $p < 0.001$, difference within service members' time in service (*Time in Service*) between main comparison groups as determined by one-way analysis of variation (ANOVA). Tukey *post-hoc* tests highlighted RPA intelligence specialists' *Time in Service* (M = 4.47, SD = +/- 5.98) was significantly lower ($p < 0.001$) than aircraft armament technicians (M = 5.75, SD = +/- 6.88). Tukey post hoc tests also highlighted RPA sensor operators' *Time in Service* (M = 3.24, SD = +/- 4.98) was statistically lower ($p < 0.001$) than aircraft armament technicians. There were no statistically significant differences between RPA intelligence specialists and RPA sensor operators ($p > 0.05$). *Time in Service* was included as a statistically significant covariate within subsequent Poisson regressions.

There was a statistically significant, F (7, 417248) = 205.355, $p < 0.001$, deployment quantity difference (*Number of Deployments*) between main comparison groups as determined by one-way ANOVA. Tukey *post-hoc* tests highlighted RPA intelligence specialists' *Number of Deployments* (M = 0.62, SD = +/- 0.93) were significantly greater ($p < 0.001$) than aircraft armament technicians (0.53 +/- 0.80). There were no statistically significant ($p > 0.05$) differences between RPA intelligence specialists and RPA sensor operators or RPA sensor operators and aircraft armament technicians. *Number of Deployments* was included as a statistically significant covariate within subsequent Poisson regressions.

There was a statistically significant gender (*Gender*) difference between main comparison groups as determined by Chi-Square Tests. Compared to RPA intelligence specialists, RPA sensor operators had a greater percentage of males (93.4% versus 70.7%), Chi-Square Test, $X(1) = 47.989$, $p < 0.001$, as did aircraft armament technicians (90.2% versus 70.7), Chi-Square Test, $X(1) = 1223.76$, $p < 0.001$; RPA sensor operators and aircraft armament technician genders were not statistically different (93.4% versus 90.2%), Chi-Square Test, $X(1) = 2.168$, $p > 0.05$. *Gender* was included as a statistically significant covariate within subsequent Poisson regressions.

There was a statistically significant, F 7, 417248) = 607.938, $p < .001$ age (*Age*) difference between main comparison groups as determined be one-way ANOVA. Tukey *post-hoc* tests highlights the age of RPA intelligence specialists ($M = 24.55$, SD = +/- 6.30) were significantly less ($p < .001$) than the age of aircraft armament technicians ($M = 25.24$, SD = +/- 7.08). Tukey *post-hoc* test also highlights the age of RPA sensor operators ($M = 23.41$, SD +/- 5.37) was significantly less ($p < .05$) than aircraft armament technicians ($M = 25.24$, SD +/- 7.08). *Age* was included as a statistically significant covariate within subsequent Poisson regressions.

One-way ANOVA and Chi-Square tests suggests statistical main comparison group differences within the demographic and military characteristics data of this research. Statistical analyses within this dataset resulted in *Age, Time in Service, Gender,* and *Number of Deployments* as the final covariates for this research. Unadjusted incidence rates and incidence rate ratios of mental health outcomes were calculated, followed by incidence rate ratios adjusted for covariates.

Unadjusted Incidence Rates and Incidence Rate Ratios

Utilizing Equation 3 (see Chapter 3) through the Stata® statistical program, crude incident rates were calculated for the three main comparison groups, as well as other representative USAF enlisted service personnel groups (see Tables 4, 5, and 6). In addition to the mental health outcomes categories shown in Table 2 (see Chapter 3), additional categories for “Any mental health diagnosis,” “Any mental health counseling,” “Any mental health outcomes,” and “All mental health outcomes” were used to describe the data. Within the data categories of this study, the use of the term *any* refers to the number of different enlisted service members who satisfied the condition of at least one applicable mental health outcome, as opposed to the use of the term *all* describing the total number of times enlisted service members satisfied a mental health condition in any of the categories. Approximately 16% (1243/7988) of RPA intelligence specialists, 7% (14/196) of RPA sensor operators and 15% (1677/11,340) of aircraft armament technicians had at least one mental health outcome (see Table 3).

Table 4

Unadjusted Mental Health Outcome Incidence Rates for USAF Enlisted RPA Intelligence Specialists, RPA Sensor Operators, and Aircraft Armament technicians

		RPA Intelligence Specialists		RPA Sensor Operators		Aircraft Armament	
Mental health outcomes		No.	IR[a] (95% CI)	No.	IR[a] (95% CI)	No.	IR[a] (95% CI)
Diagnoses	Adjustment disorders	489	19.4 (17.8-21.2)	3	6.0 (1.9-18.7)	609	16.5 (15.2-17.9)
	Alcohol abuse/dependence	139	5.4 (4.6-6.4)	2	4.0 (1.0-15.9)	281	7.5 (6.7-8.5)
	Anxiety disorder	277	10.9 (9.7-12.2)	3	6.0 (1.9-18.7)	316	8.5 (7.6-9.5)
	Depressive disorder	366	14.5 (13.1-16.0)	4	8.0 (3.0-21.2)	454	12.3 (11.2-13.4)
	Posttraumatic stress disorder	87	3.4 (2.7-4.2)	1	2.0 (0.3-14.1)	58	1.5 (1.2-2.0)
	Substance abuse/dependence	12	0.5 (0.3-0.8)	0	0.0	43	1.1 (0.8-1.5)
	Any mental health diagnosis	971	40.0 (37.6-42.6)	11	23.0 (12.7-41.5)	1277	35.8 (33.9-37.8)
Counseling	Suicide ideation/attempt	55	2.1 (1.6-2.8)	2	4.0 (1.0-15.9)	70	1.9 (1.5-2.3)
	Partner relationship problems	185	7.3 (6.3-8.4)	2	4.0 (1.0-15.9)	214	5.7 (5.0-6.6)
	Family circumstance problems	36	1.4 (1.0-1.9)	0	0.0	37	1.0 (0.7-1.4)
	Maltreatment related	19	0.7 (0.5-1.2)	0	0.0	19	0.5 (0.3-0.8)
	Life circumstance problems	281	11.1 (9.8-12.4)	3	6.1 (2.0-18.8)	303	8.1 (7.3-9.1)
	Mental, behavioral problems, substance abuse	96	3.7 (3.1-4.6)	1	2.0 (0.3-14.0)	207	5.5 (4.8-6.3)
	Any mental health counseling	575	23.1 (21.3-25.1)	7	14.3 (6.8-29.9)	741	20.3 (18.9-21.8)
Any mental health outcome		1243	52.5 (49.7-55.5)	14	29.6 (17.5-50.0)	1677	48.0 (45.7-50.3)

Note. [a]Unadjusted incidence rates per 1,000 person-years. CI = confidence interval; IR = incidence rate. *All mental health outcomes* category not explicitly shown due to a statistical program limitation.

Table 5

Unadjusted Mental Health Outcome Incidence Rates for USAF Enlisted Aircrew Operations Personnel and Healthcare Technicians

		Aircrew Operations		Healthcare	
Mental health outcomes		No.	IR[a] (95% CI)	No.	IR[a] (95% CI)
Diagnoses	Adjustment disorders	620	12.2 (11.3-13.2)	3275	30.5 (29.4-31.5)
	Alcohol abuse/dependence	246	4.8 (4.2-5.4)	753	6.8 (6.3-7.3)
	Anxiety disorder	247	4.8 (4.2-5.4)	2033	18.6 (17.8-19.4)
	Depressive disorder	356	6.9 (6.3-7.7)	3133	29.2 (28.2-30.3)
	Posttraumatic stress disorder	94	1.8 (1.5-2.2)	649	5.8 (5.4-6.3)
	Substance abuse/dependence	26	0.5 (0.3-0.7)	123	1.1 (0.9-1.3)
	Any mental health diagnosis	1144	22.8 (21.5-24.2)	6819	67.8 (66.2-69.4)
Counseling	Suicide ideation/attempt	96	1.9 (1.5-2.3)	354	3.2 (2.8-3.5)
	Partner relationship problems	322	6.3 (5.6-7.0)	1231	11.2 (10.6-11.8)
	Family circumstance problems	62	1.2 (0.9-1.5)	174	1.5 (1.3-1.8)
	Maltreatment related	18	0.3 (0.2-0.6)	106	0.9 (0.8-1.1)
	Life circumstance problems	535	10.5 (9.6-11.4)	1784	16.3 (15.5-17.0)
	Mental, behavioral problems, substance abuse	234	4.5 (4.0-5.2)	577	5.2 (4.8-5.6)
	Any mental health counseling	1092	21.9 (20.6-23.2)	3615	34.0 (33.0-35.2)
Any mental health outcome		1783	36.5 (34.8-38.2)	8420	86.7 (84.8-88.5)

Note. [a]Unadjusted incidence rates per 1,000 person-years. CI = confidence interval; IR = incidence rate. *All mental health outcomes* category not explicitly shown due to a statistical program limitation.

Table 6

Unadjusted Mental Health Outcome Incidence Rates for USAF Enlisted Mission Support Personnel and Other USAF Personnel

		Mission Support		Other	
Mental health outcomes		No.	IR[a] (95% CI)	No.	IR[a] (95% CI)
Diagnoses	Adjustment disorders	786	20.7 (19.3-22.3)	18044	18.3 (18.0-18.6)
	Alcohol abuse/dependence	144	3.7 (3.1-4.3)	7245	7.2 (7.1-7.4)
	Anxiety disorder	493	12.8 (11.7-14.0)	9582	9.6 (9.4-9.8)
	Depressive disorder	822	21.8 (20.3-23.3)	14857	15.0 (14.8-15.3)
	Posttraumatic stress disorder	120	3.1 (2.6-3.7)	3004	3.0 (2.9-3.1)
	Substance abuse/dependence	16	0.4 (0.2-0.7)	866	0.9 (0.8-0.9)
	Any mental health diagnosis	1667	46.2 (44.0-48.5)	38268	40.2 (39.8-40.7)
Counseling	Suicide ideation/attempt	85	2.2 (1.8-2.7)	2221	2.2 (2.1-2.3)
	Partner relationship problems	332	8.6 (7.7-9.6)	7488	7.5 (7.3-7.7)
	Family circumstance problems	53	1.4 (1.0-1.8)	1245	1.2 (1.2-1.3)
	Maltreatment related	43	1.1 (0.8-1.5)	660	0.7 (0.6-0.7)
	Life circumstance problems	467	12.1 (11.1-13.3)	10108	10.1 (10.0-10.3)
	Mental, behavioral problems, substance abuse	112	2.9 (2.4-3.4)	5942	5.9 (5.8-6.1)
	Any mental health counseling	948	25.3 (23.7-27.0)	24093	24.8 (24.5-25.1)
Any mental health outcome		2100	59.9 (57.4-62.5)	50891	54.9 (54.4-55.4)

Note. [a]Unadjusted incidence rates per 1,000 person-years. CI = confidence interval; IR = incidence rate; other = USAF general enlisted population. *All mental health outcomes* category not explicitly shown due to a statistical program limitation.

Utilizing Equation 6 through Stata®, unadjusted incidence rate ratios were calculated for the three main comparison groups for all criteria. As shown in Table 7, RPA intelligence specialists have a statistically significant (p < 0.05, 0.01, or 0.001) higher unadjusted incidence rate for *adjustment disorders*, *any mental health outcome*, and *all mental health outcomes* compared to RPA sensor operators. For example, the rate of having *any mental health outcome* among RPA intelligence specialists was 1.77 times that of RPA sensor operators. Additionally, RPA intelligence specialists have a higher unadjusted incidence rate for *substance abuse/dependence, family circumstance problems,* and *maltreatment related* outcomes as compared to RPA sensor operators since

RPA sensor operators did not experience any qualifying mental health outcomes. For example, the rate of having a *substance abuse/dependence* outcome among RPA intelligence specialists was infinitely higher than that of RPA sensor operators. In another comparison, RPA intelligence specialists have statistically significant ($p < 0.05$, 0.01, or 0.001) higher unadjusted incidence rates for 10 conditions, including *adjustment disorders*, *anxiety disorders*, *depressive disorder*, *posttraumatic stress disorder*, *any mental health diagnosis*, *partner relationship problems*, *life circumstance problems*, *any mental health counseling*, *any mental health outcome*, and *all mental health outcomes* diagnoses as compared to aircraft armament technicians (see Table 5). For example, the rate of *adjustment disorders* among RPA intelligence specialists was 1.18 times that of aircraft armament technicians. RPA sensor operators did not have any statistically significant different unadjusted incidence rates than those of aircraft armament technicians.

Table 7

Unadjusted Mental Health Outcome Incidence Rate Ratios for USAF Enlisted RPA Intelligence Specialists, RPA Sensor Operators, and Aircraft Armament Technicians

Mental health outcomes		Intel-Sensor Unadjusted IRR (95% CI)	Intel-Acft Arm Unadjusted IRR (95% CI)	Sensor-Acft Arm Unadjusted IRR (95% CI)
Diagnoses	Adjustment disorders	3.22 (1.04-10.03)*	1.18 (1.04-1.33)**	0.36 (0.12-1.13)
	Alcohol abuse/dependence	1.37 (0.34-5.52)	0.72 (0.59-0.88)**	0.53 (0.13-2.12)
	Anxiety disorder	1.80 (0.58-5.62)	1.28 (1.09-1.51)**	0.71 (0.23-2.22)
	Depressive disorder	1.81 (0.68-4.86)	1.18 (1.03-1.35)*	0.65 (0.24-1.74)
	Posttraumatic stress disorder	1.7 (0.24-12.23)	2.19 (1.57-3.06)***	1.29 (0.18-9.29)
	Substance abuse/dependence	undefined	0.41 (0.21-0.77)***	undefined
	Any mental health diagnosis	1.74 (0.96-3.16)	1.12 (1.03-1.22)**	0.64 (0.35-1.16)
Counseling	Suicide ideation/attempt	0.54 (0.13-2.20)	1.15 (0.81-1.63)	2.14 (0.52-8.72)
	Partner relationship problems	1.82 (0.45-7.34)	1.26 (1.04-1.54)*	0.69 (0.17-2.79)
	Family circumstance problems	undefined	1.42 (0.90-2.25)	undefined
	Maltreatment related	undefined	1.46 (0.77-2.76)	undefined
	Life circumstance problems	1.83 (0.59-5.70)	1.36 (1.16-1.60)***	0.74 (0.24-2.32)
	Mental, behavioral problems, substance abuse	1.89 (0.26-13.55)	0.67 (0.53-0.86)**	0.36 (0.05-2.55)
	Any mental health counseling	1.62 (0.77-3.42)	1.14 (1.02-1.28)*	0.70 (0.33-1.48)
Any mental health outcome		1.77 (1.05-3.00)*	1.09 (1.02-1.18)*	0.62 (0.36-1.04)
All mental health outcomes		2.08 (1.39-3.11)***	1.13 (1.08-1.19)***	0.54 (0.36-0.81)***

Note. Unadjusted incidence rates ratios per 1,000 person-years. Acft Arm = aircraft armament technicians; CI = confidence interval; Intel = RPA intelligence specialists; Sensor = RPA sensor operators; IRR = incidence rate ratio. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ for IRRs greater than 1.

Additional comparison groups were utilized to compute unadjusted incidence rate ratios for RPA intelligence specialists as compared to various other enlisted service member groups within the USAF (see Tables 8 and 9). As shown in Table 8, RPA intelligence specialists have statistically significant (p < 0.05, 0.01, or 0.001) higher unadjusted incidence rates for eight conditions, including *adjustment disorders, anxiety disorder*, *depressive disorder*, *posttraumatic stress disorder*, *any mental health diagnosis*, *maltreatment related*, *any mental health outcomes*, and *all mental health outcomes* as compared to aircrew operations personnel. For example, the rate of *adjustment disorders* among RPA intelligence specialists was 1.59 times that of aircrew operations personnel.

Additionally, RPA intelligence specialists did not have any statistically significant unadjusted incidence rates that exceeded those of healthcare personnel.

Table 8

Unadjusted Mental Health Outcome Incidence Rate Ratios for USAF Enlisted RPA Intelligence Specialists, Aircrew Operations Personnel, and Healthcare Personnel

Mental health outcomes		Intel-Aircrew Ops Unadjusted IRR (95% CI)	Intel-Healthcare Unadjusted IRR (95% CI)
Diagnoses	Adjustment disorders	1.59 (1.41-1.80)***	0.64 (0.58-0.70)***
	Alcohol abuse/dependence	1.13 (0.92-1.40)	0.80 (0.67-0.96)*
	Anxiety disorder	2.27 (1.91-2.69)***	0.59 (0.52-0.66)***
	Depressive disorder	2.09 (1.80-2.42)***	0.50 (0.44-0.55)***
	Posttraumatic stress disorder	1.86 (1.39-2.49)***	0.58 (0.47-.73)***
	Substance abuse/dependence	0.92 (0.47-1.83)	0.42 (0.23-0.77)***
	Any mental health diagnosis	1.75 (1.61-1.91)***	0.59 (0.55-0.63)***
Counseling	Suicide ideation/attempt	1.15 (0.82-1.60)	0.68 (0.51-0.90)**
	Partner relationship problems	1.15 (0.96-1.38)	0.65 (0.56-0.76)***
	Family circumstance problems	1.16 (0.77-1.75)	0.90 (0.63-1.29)
	Maltreatment related	2.11 (1.11-4.03)*	0.78 (0.48-1.27)
	Life circumstance problems	1.05 (0.91-1.22)	0.68 (0.60-0.77)***
	Mental, behavioral problems, substance abuse	0.82 (0.65-1.04)	0.72 (0.58-0.90)**
	Any mental health counseling	1.06 (0.95-1.17)	0.68 (0.62-0.74)***
Any mental health outcome		1.44 (1.34-1.55)***	0.61 (0.57-0.64)***
All mental health outcomes		1.43 (1.35-1.50)***	0.62 (0.59-0.64)***

Note. Unadjusted incidence rates ratios per 1,000 person-years. Aircrew Ops = aircrew operations personnel; CI = confidence interval; Healthcare = healthcare personnel; Intel = RPA intelligence specialists; IRR = incidence rate ratio. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ for IRRs greater than 1.

Table 9

Unadjusted Mental Health Outcome Incidence Rate Ratios for USAF Enlisted RPA Intelligence Specialists, Mission Support Personnel, and Other Personnel

Mental health outcomes		Intel-Mission Spt Unadjusted IRR (95% CI)	Intel-Other Unadjusted IRR (95% CI)
Diagnoses	Adjustment disorders	0.94 (0.84-1.05)	1.06 (0.97-1.16)
	Alcohol abuse/dependence	1.47 (1.17-1.86)**	0.75 (0.63-0.89)**
	Anxiety disorder	0.85 (0.73-0.98)*	1.13 (1.00-1.28)*
	Depressive disorder	0.66 (0.59-0.75)***	0.96 (0.87-1.07)
	Posttraumatic stress disorder	1.10 (0.83-1.45)	1.13 (0.92-1.40)
	Substance abuse/dependence	1.14 (0.54-2.41)	0.54 (0.31-0.96)*
	Any mental health diagnosis	0.87 (0.80-0.94)*	0.99 (0.93-1.06)
Counseling	Suicide ideation/attempt	0.98 (0.70-1.38)	0.97 (0.74-1.26)
	Partner relationship problems	0.84 (0.70-1.01)	0.97 (0.83-1.12)
	Family circumstance problems	1.03 (0.68-1.57)	1.13 (0.81-1.58)
	Maltreatment related	0.67 (0.39-1.15)	1.13 (0.71-1.78)
	Life circumstance problems	0.91 (0.79-1.06)	1.09 (0.97-1.23)
	Mental, behavioral problems, substance abuse	1.30 (1.00-1.71)*	0.63 (0.51-0.78)***
	Any mental health counseling	0.91 (0.82-1.01)	0.93 (0.86-1.01)
Any mental health outcome		0.88 (0.81-0.94)**	0.96 (0.90-1.01)
All mental health outcomes		0.89 (0.85-0.94)**	0.98 (0.95-1.02)

Note. Unadjusted incidence rates ratios per 1,000 person-years. CI, confidence interval; Intel, RPA intelligence specialists; IRR, incidence rate ratio; Mission Spt, mission support personnel; Other = USAF general enlisted population. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ for IRRs greater than 1.

As shown in Table 9, RPA intelligence specialists have a statistically significant (p < 0.05, 0.01, or 0.001) higher unadjusted incidence rate of *alcohol abuse/dependence* compared to mission support personnel. The rate of *alcohol abuse/dependence* among RPA intelligence specialists was 1.47 times that of mission support personnel. Additionally, RPA intelligence specialists have a statistically significant (p < 0.05, 0.01, or 0.001) higher unadjusted incidence rate of *anxiety disorder* compared to the general enlisted USAF population listed as “Other.” The rate of *anxiety disorder* among RPA intelligence specialists was 1.13 times that of the general enlisted USAF population listed as "Other."

Adjusted Incidence Rate Ratios

Multiple Poisson regressions were conducted through Stata®, controlling for the covariates: *Age*, *Time in Service*, *Gender*, and *Number of Deployments*. Adjusted incident rates ratios were calculated for the three main comparison groups, as well as other representative USAF enlisted service personnel groups (see Tables 10, 11, and 12).

Table 10

Adjusted Mental Health Outcome Incidence Rate Ratios for USAF Enlisted RPA Intelligence Specialists, RPA Sensor Operators, and Aircraft Armament Technicians

Mental health outcomes		Intel-Sensor Adjusted IRR[b] (95% CI)	Intel-Acft Arm Adjusted IRR[b] (95% CI)	Sensor-Acft Arm Adjusted IRR[b] (95% CI)
Diagnoses	Adjustment disorders	2.73 (0.88-8.50)	1.02 (0.91-1.15)	0.37 (0.12-1.16)
	Alcohol abuse/dependence	1.54 (0.38-6.23)	0.78 (0.64-0.96)*	0.51 (0.13-2.04)
	Anxiety disorder	1.57 (0.50-4.89)	1.14 (0.97-1.34)	0.73 (0.23-2.27)
	Depressive disorder	1.46 (0.54-3.90)	1.00 (0.87-1.14)	0.69 (0.26-1.84)
	Posttraumatic stress disorder	1.34 (0.19-9.64)	1.83 (1.31-2.55)***	1.36 (0.19-9.85)
	Substance abuse/dependence	undefined	0.44 (0.23-0.83)*	undefined
	Any mental health diagnosis	1.53 (0.84-2.77)	1.00 (0.92-1.09)	.66 (0.36-1.19)
Counseling	Suicide ideation/attempt	0.50 (0.12-2.06)	1.08 (0.76-1.54)	2.15 (0.53-8.77)
	Partner relationship problems	1.71 (0.42-6.87)	1.19 (0.98-1.45)	0.70 (0.17-2.80)
	Family circumstance problems	undefined	1.32 (0.83-2.08)	undefined
	Maltreatment related	undefined	1.17 (0.62-2.20)	undefined
	Life circumstance problems	1.54 (0.49-4.80)	1.18 (1.01-1.40)*	0.77 (0.25-2.41)
	Mental, behavioral problems, substance abuse	2.05 (0.29-14.68)	0.71 (0.56-0.91)**	0.35 (0.05-2.49)
	Any mental health counseling	1.50 (0.71-3.15)	1.06 (0.95-1.18)	0.71 (0.34-1.49)
Any mental health outcome		1.59 (0.93-2.69)	0.99 (0.92-1.07)	0.63 (0.40-1.06)
All mental health outcomes		1.85 (1.23-2.76)**	1.03 (0.98-1.09)	0.56 (0.37-0.83)**

Note. Adjusted incidence rates ratios per 1,000 person-years. [b]Adjusted for age, gender, time in service, and number of deployments. Acft Arm = aircraft armament personnel; CI = confidence interval; Intel = RPA intelligence specialists; Sensor = RPA sensor operators; IRR = incidence rate ratio. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ for IRRs greater than 1.

Table 11

Adjusted Mental Health Outcome Incidence Rate Ratios for USAF Enlisted RPA Intelligence Specialists, Aircrew Operations Personnel, and Healthcare Personnel

	Mental health outcomes	Intel-Aircrew Ops Adjusted IRR[b] (95% CI)	Intel-Healthcare Adjusted IRR[b] (95% CI)
Diagnoses	Adjustment disorders	1.14 (1.02-1.29)*	0.79 (0.72-0.86)**
	Alcohol abuse/dependence	0.91 (0.74-1.12)	0.71 (0.59-0.85)**
	Anxiety disorder	1.72 (1.45-2.05)***	0.74 (0.65-0.84)**
	Depressive disorder	1.47 (1.28-1.71)***	0.68 (0.61-0.76)***
	Posttraumatic stress disorder	1.67 (1.24-2.23)***	0.69 (0.55-0.86)**
	Substance abuse/dependence	0.62 (0.31-1.23)	0.42 (0.23-0.77)***
	Any mental health diagnosis	1.32 (1.21-1.43)***	0.72 (0.68-0.77)***
Counseling	Suicide ideation/attempt	0.77 (0.55-1.08)	0.76 (0.58-1.02)
	Partner relationship problems	0.96 (0.80-1.15)	0.73 (0.63-0.85)**
	Family circumstance problems	0.98(0.65-1.48)	1.15 (0.80-1.65)
	Maltreatment related	1.38 (0.72-2.64)	1.02 (0.63-1.67)
	Life circumstance problems	0.75 (0.65-0.87)**	0.83 (0.74-0.95)*
	Mental, behavioral problems, substance abuse	0.68 (0.54-0.87)**	0.61 (0.49-0.76)***
	Any mental health counseling	0.82 (0.74-0.90)*	0.75 (0.69-0.82)**
Any mental health outcome		1.10 (1.02-1.18)*	0.71 (0.67-0.76)***
All mental health outcomes		1.06 (1.01-1.11)*	0.74 (0.71-0.77)***

Note. Adjusted incidence rates ratios per 1,000 person-years. [b]Adjusted for age, gender, time in service, and number of deployments. Aircrew Ops = aircrew operations personnel; CI = confidence interval; Healthcare = healthcare personnel; Intel = RPA intelligence specialists; IRR = incidence rate ratio. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ for IRRs greater than 1.

Table 10 constitutes the principal analyses of this research, and shows several significant findings. RPA intelligence specialists had 1.85 times the rate of *all mental health outcomes* compared to RPA sensor operators after adjusting for *Age*, *Time in Service*, *Gender*, and *Number of Deployments*. RPA intelligence specialists also had statistically significant (p < 0.05, 0.01, or 0.001) higher adjusted incidence rates for *posttraumatic stress disorder and life circumstance problems*, compared to aircraft armament technicians. For instance, RPA intelligence specialists had 1.83 times the rate of *posttraumatic stress disorder* compared to aircraft armament technicians, after adjusting for differences in the two cohorts. RPA sensor operators did not have any statistically significant different adjusted incidence rates than those of the aircraft armament population.

As shown in Table 11, RPA intelligence specialists have statistically significant ($p < 0.05$, 0.01, or 0.001) higher incidence rates within seven criteria, including *adjustment disorders*, *anxiety disorder*, *depressive disorder*, *posttraumatic stress disorder*, *any mental health diagnosis*, *any mental health outcome*, *and all mental health outcomes* as compared to aircrew operations personnel. For instance, RPA intelligence specialists had 1.72 times the rate of *anxiety disorder* outcomes as compared to aircrew operations personnel. RPA intelligence specialists did not have any statistically significant different adjusted incidence rates than those of the healthcare population.

As shown in Table 12, RPA intelligence specialists have a statistically significant ($p < 0.05$) higher incidence rate within *posttraumatic stress disorder*, as compared to mission support personnel. RPA intelligence specialists had 1.14 times the rate of *posttraumatic stress disorder* as compared to mission support personnel. RPA intelligence specialists did not have any statistically significant different incidence rates as compared to those of the general enlisted USAF population listed as “Other.”

Table 12

Adjusted Mental Health Outcome Incidence Rate Ratios for USAF Enlisted RPA Intelligence Specialists, Mission Support Personnel, and Other Personnel

Mental health outcomes		Intel-Mission Spt Adjusted IRR[b] (95% CI)	Intel-Other Adjusted IRR[b] (95% CI)
Diagnoses	Adjustment disorders	1.04 (0.93-1.17)	0.93 (0.85-1.01)
	Alcohol abuse/dependence	1.00 (0.79-1.26)	0.73 (0.61-0.86)*
	Anxiety disorder	1.06 (0.92-1.23)	1.03 (0.92-1.16)
	Depressive disorder	0.91 (0.81-1.04)	0.85 (0.77-0.94)*
	Posttraumatic stress disorder	1.37 (1.04-1.80)*	1.05 (0.85-1.30)
	Substance abuse/dependence	0.85 (0.40-1.80)	0.50 (0.29-0.89)*
	Any mental health diagnosis	1.00 (0.93-1.09)	0.89 (0.84-0.95)*
Counseling	Suicide ideation/attempt	0.87 (0.62-1.23)	0.85 (0.65-1.11)
	Partner relationship problems	0.93 (0.77-1.11)	0.91 (0.78-1.05)
	Family circumstance problems	1.45 (0.95-2.22)	1.09 (0.78-1.52)
	Maltreatment related	0.79 (0.46-1.36)	0.93 (0.59-1.47)
	Life circumstance problems	1.01 (0.87-1.17)	0.95 (0.84-1.07)
	Mental, behavioral problems, substance abuse	0.80 (0.61-1.05)	0.60 (0.49-0.74)*
	Any mental health counseling	0.90 (0.81-1.0)	0.85 (0.78-0.92)*
Any mental health outcome		0.96 (0.89-1.03)	0.86 (0.82-0.92)*
All mental health outcomes		0.98 (0.93-1.03)	0.88 (0.85-0.92)*

Note. Adjusted incidence rates ratios per 1,000 person-years. [b]Adjusted for age, gender, time in service, and number of deployments. CI = confidence interval; Intel = Intelligence Specialists; IRR = incidence rate ratio; Mission Spt = mission support personnel; Other = USAF general enlisted population. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ for IRRs greater than 1.

Hypothesis Testing

This research addressed one primary question regarding the relationship between enlisted RPA intelligence specialists and mental health outcomes: What are the comparative incidence rates of various mental health outcomes among enlisted RPA intelligence specialists, RPA sensor operators, aircraft armament technicians, and the general USAF enlisted population? Three hypotheses resulted from this research question and will be addressed consecutively.

Hypothesis 1. Hypothesis 1 stated:

H1: USAF enlisted RPA intelligence specialists exhibit statistically different incidence rates of mental health outcomes as compared to USAF RPA sensor operators.

As shown in Figure 1, enlisted RPA intelligence specialists did not display statistically significant incidence rates for 13 mental health categories as compared to RPA sensor operators after adjusting for confounding variables. Enlisted RPA intelligence specialists did, however, display higher incidence rates for *substance abuse/dependence, family circumstance problems,* and *maltreatment related* mental health categories, and for *all mental health outcomes* combined compared to RPA sensor operators after adjusting for differences in the two cohorts. Except for the *all mental health outcomes* category, these three infinitely high incidence rate ratios were caused by RPA intelligence specialists having one or more recorded outcomes, whereas RPA sensor operators recorded none (see Table 3). In consideration of this statistical finding, this research cannot reject the null hypothesis (H_{01}) and concludes that USAF enlisted RPA intelligence specialists exhibit statistically similar incidence rates for 12 mental health outcomes as compared to USAF RPA sensor operators. However, for *substance abuse/dependence, family circumstance problems, maltreatment related problems,* and *all mental health outcomes* combined, this research rejects the null hypothesis and accept the alternative hypothesis, concluding that RPA intelligence specialists and RPA sensor operators show statistically different incidence rates for these four outcomes.

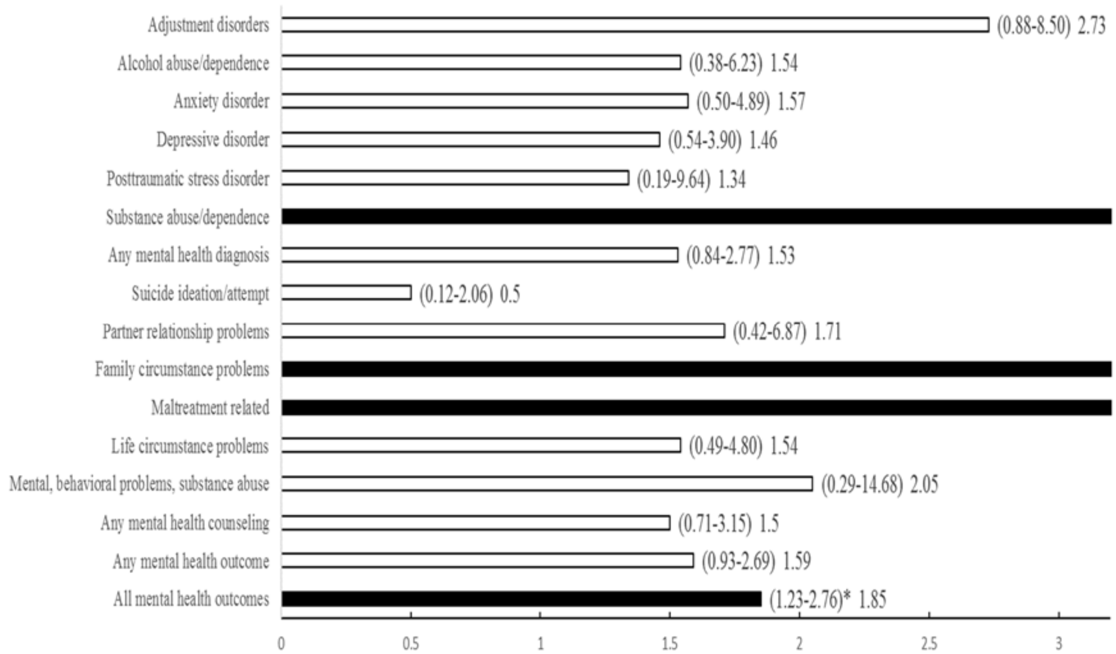

Figure 1. Adjusted mental health outcome incidence rate ratios for USAF enlisted RPA intelligence specialists as compared to RPA sensor operators. Incidence rate ratios per 1,000 person-years. Adjusted for age, gender, time in service, and number of deployments. * = $p < 0.05$, $p < 0.01$, or $p < 0.001$ (see Table 9 for more information).

Hypothesis 2. Hypothesis 2 stated:

H2: USAF enlisted RPA intelligence specialists exhibit statistically different incidence rates of mental health outcomes as compared to USAF aircraft armament systems technicians.

As shown in Figure 2, enlisted RPA intelligence specialists did not display statistically significant incidence rates for 11 mental health categories as compared to aircraft armament technicians after adjusting for confounding variables. Enlisted RPA intelligence specialists did, however, display higher incidence rates for *posttraumatic stress disorder* and *life circumstance problems* after adjusting for differences in the two cohorts. Enlisted RPA intelligence specialists also displayed lower incidence rates for *alcohol/abuse dependence, substance/abuse dependence,* and *mental, behavioral problems, substance abuse* after adjusting for differences in the two cohorts. In consideration of these statistical findings, this research cannot reject the null hypothesis (H_{02}) and concludes that USAF enlisted RPA intelligence specialists exhibit statistically similar incidence rates for 11 mental health outcomes as compared to aircraft armament technicians. However, for *posttraumatic stress disorder, life circumstance problems, alcohol/abuse dependence, substance/abuse dependence,* and *mental, behavioral problems, substance abuse* this research rejects the null hypothesis and accepts the alternative hypothesis, concluding that RPA intelligence specialists and aircraft armament technicians show statistically different incidence rates for these five outcomes.

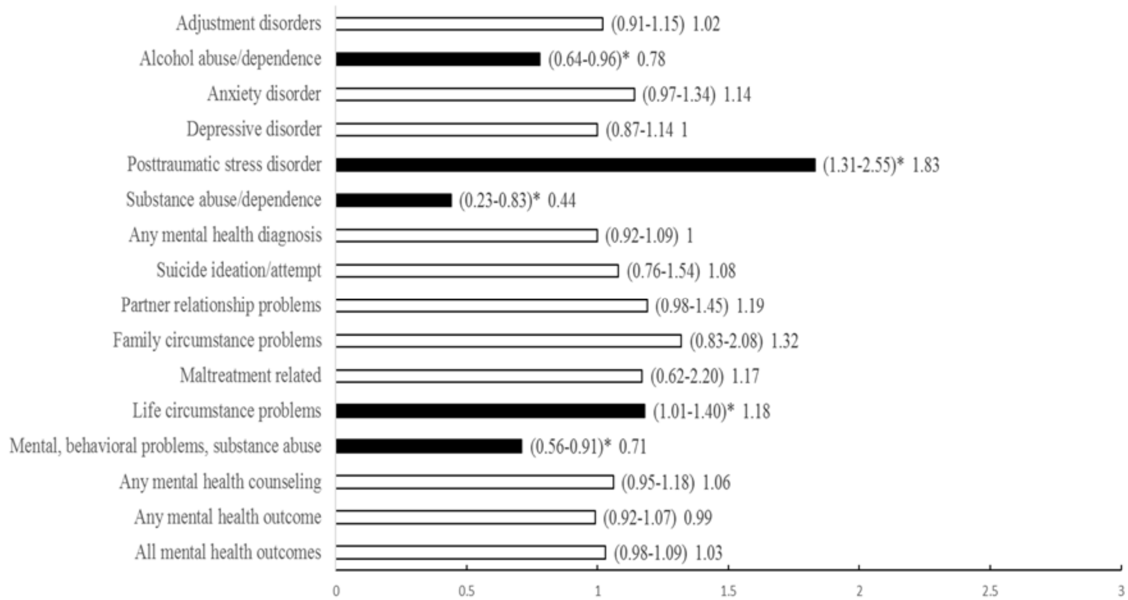

Figure 2. Adjusted mental health outcome incidence rate ratios for USAF enlisted RPA intelligence specialists as compared to aircraft armament technicians. Incidence rate ratios per 1,000 person-years. Adjusted for age, gender, time in service, and number of deployments. * = $p < 0.05$, $p < 0.01$, or $p < 0.001$ (see Table 9 for more information).

Hypothesis 3. Hypothesis 3 stated:

H3: USAF enlisted RPA intelligence specialists exhibit statistically different incidence rates of mental health outcomes as compared to the general USAF enlisted population.

As shown in Figure 3, enlisted RPA intelligence specialists did not display statistically significant incidence rates for eight mental health categories as compared to the general USAF enlisted population after adjusting for confounding variables. Enlisted RPA intelligence specialists did, however, display lower incidence rates for *alcohol abuse/dependence, depressive disorder, substance abuse/dependence*, and *mental,* *behavioral, substance abuse* mental health categories, and for *any mental health counseling, any mental health diagnosis, any mental health outcomes, and all mental health outcomes* combined compared to the general USAF enlisted population after adjusting for differences in the two cohorts. In consideration of these statistical findings, this research cannot reject the null hypothesis (H_{03}) and concludes that USAF enlisted RPA intelligence specialists exhibit statistically similar incidence rates for eight mental health outcomes as compared to the general USAF population. However, for *alcohol abuse/dependence, depressive disorder, substance abuse/dependence,* and *mental, behavioral, substance abuse* mental health categories, and for *any mental health counseling, any mental health diagnosis, any mental health outcomes, and all mental health outcomes* combined this research rejects the null hypothesis and accepts the alternative hypothesis, concluding that RPA intelligence specialists and the general USAF population show statistically different incidence rates for these eight outcomes.

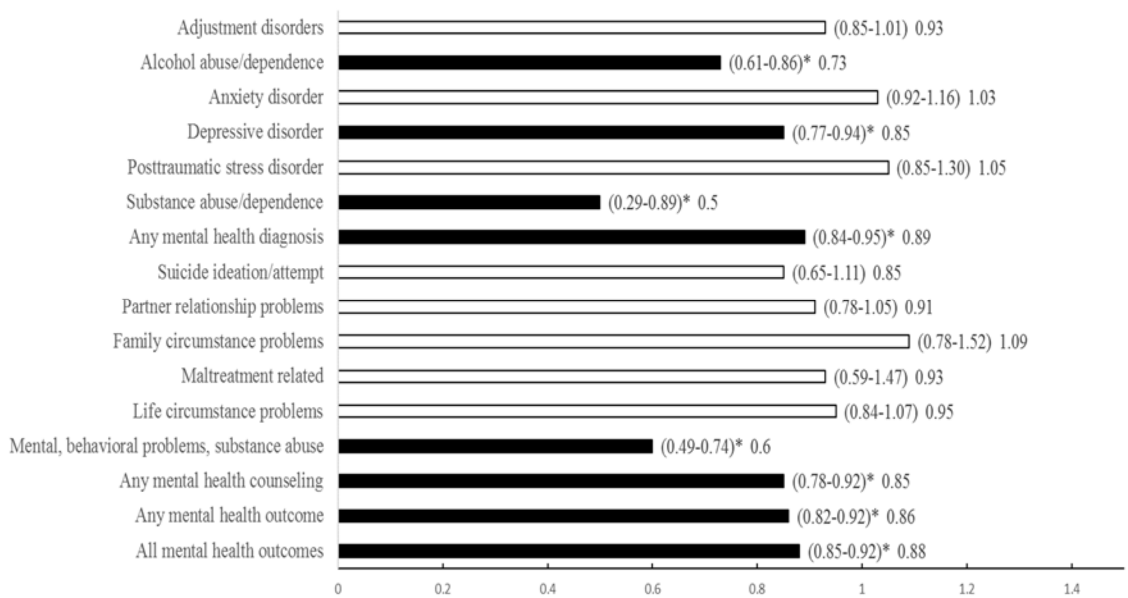

Figure 3. Adjusted mental health outcome incidence rate ratios for USAF enlisted RPA intelligence specialists as compared to the USAF enlisted general population. Incidence rate ratios per 1,000 person-years. Adjusted for age, gender, time in service, and number of deployments. * = $p < 0.05$, $p < 0.01$, or $p < 0.001$ (see Table 9 for more information).

CHAPTER V

DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

Popular newspaper and magazine articles relate individual accounts of former RPA operators and intelligence-support personnel who received psychiatric treatment as a result of their participation in high-definition, full-motion-video, remote warfare ("Confessions," 2014; Power, 2013; Watson, 2014; Zucchino, 2012). These narratives heightened public awareness of the possible mental effects RPA operations may be having and ultimately act as a catalyst for continued research. Past research results seem to contradict popular media claims that the sources of RPA-operator psychological stress arise substantially from *telewarfare*, or "the direct participation in ISR and weapons deployment [utilizing RPA]" (Chappelle et al, 2014b, p.63), rather than occupational limitations; however, research considering actual clinically observed mental health rates is needed to fully understand remaining research gaps. To this end, Otto and Webber (2013) utilized actual mental health diagnoses and counseling rates by analyzing electronic health care records maintained within the DoD Defense Medical Surveillance System (DMSS). While similar studies are needed to measure objective mental health rates of RPA sensor operators, commensurate research is also needed specifically within the largely unrecognized enlisted RPA intelligence community, especially since the enlisted RPA intelligence community is a critical component to successful RPA operations and may have greater exposure to the same graphic videos and wartime consequences. For this study, the RPA enlisted intelligence community was composed of the USAF Operations Intelligence and USAF Geospatial Intelligence career fields. The intent of this study was first to determine the clinically observed rates of mental health outcomes for the 1N0X1 and 1N1XI career fields, as recorded within the U.S. Air Force School of Aerospace Medicine's medical epidemiology database, representative of the enlisted RPA intelligence community. The rates were then adjusted for covariates and then statistically contrasted with selected comparison groups, employing the methods used by Otto and Webber (2013).

The purpose of this study was to 1) document frequencies and rates of mental health outcomes among RPA intelligence specialists, and 2) determine if enlisted RPA intelligence personnel exhibit statistically different mental health incidence rates as compared to RPA sensor operators, aircraft armament technicians, and the general USAF enlisted population. The study (a) collected medical data from the U.S. Air Force School of Aerospace Medicine consisting of 16,647,398 recorded medical encounters from 417,258 USAF enlisted service members limited to a surveillance period of 1 January 2006 through 31 December 2010, (b) structured and analyzed the data using IBM® SPSS ® Version 23 and Stata ® Version 14.1, (c) determined frequencies and rates of mental health outcomes among RPA intelligence specialists, and (d) statistically compared the rates of those outcomes to identified groups in order to generate results and form conclusions. An interpretation of the results is presented for the analysis performed, followed by conclusions and recommendations.

Discussion

The main method used in this study was a Poisson regression in order to identify mental health outcome incidence rates while controlling for identified covariates. Possible covariates to use within the Poisson regression were first identified within the literature review, although final determinations were made based upon statistical analyses of the demographic data. The three main cohorts were similar in regards to demographics and military characteristics; however, statistical analyses were used to ascertain statistically different covariates. Statistical analyses within this dataset resulted in *Time in Service, Number of Deployments, Gender, and Age* as the statistically relevant covariates for this research. Statistical differences, however, do not imply practical differences. For instance, there was a statistically significant, F (7, 41750) = 205.355, $p < 0.001$, deployment quantity difference (*Number of Deployments*) between main comparison groups as determined by one-way ANOVA. Tukey *post-hoc* tests highlighting RPA intelligence specialists' *Number of Deployments* (M = 0.62, SD = +/- 0.93) were significantly greater ($p < 0.001$) than aircraft armament technicians (0.53 +/- 0.80). While *Number of Deployments* means of 0.62 and 0.53 are statistically different, a practical difference is unlikely. *Number of Deployments* was included as a statistically significant covariate within subsequent Poisson regressions; however, its effect was likely minimal. The covariates *Time in Service, Gender, and Age* have both statistical and practical significance as they contributed to the ultimate research findings. The findings within this study indicate there are statistically significant differences in the rates of mental health outcomes between RPA intelligence specialists and RPA sensor operators, as well as with aircraft armament technicians.

USAF Enlisted RPA Intelligence Specialists as Compared to RPA Sensor Operators. Enlisted RPA intelligence specialists did not display statistically significant incidence rates for 13 mental health categories as compared to RPA sensor operators after adjusting for confounding variables. Enlisted RPA intelligence specialists did, however, display higher incidence rates for *substance abuse/dependence, family circumstance problems*, and *maltreatment related* mental health categories, and for *all mental health outcomes* combined compared to RPA sensor operators after adjusting for differences in the two cohorts.

Enlisted RPA intelligence specialists meet similar initial and subsequent medical standards as RPA sensor operators, and both career fields operate as part of the DCGS enterprise by viewing high-definition, full-motion-video, remote warfare. Both enlisted RPA intelligence specialists and RPA sensor operators are required to maintain a higher security clearance than the general USAF enlisted population, and part of those security requirements include additional considerations for alcohol and substance abuse issues. Therefore, increased substance abuse incidence rates are noteworthy since individuals are well aware of the associated detrimental career ramifications of their actions. Instead of viewing RPA intelligence specialists with inflated incidence rates for *substance abuse/dependence, family circumstance problems*, and *maltreatment related* mental health categories, an alternate explanation could include abnormally low incidence rates for those categories within RPA sensor operators. RPA sensor operators incidence rates were recorded at zero for the categories of *substance abuse/dependence*, *family circumstance problems*, and *maltreatment related* mental health categories. This is a curious finding and may indicate an issue with the data integrity, or, alternatively, a protective quality for those categories within RPA sensor operators. For instance, the RPA sensor operator career field may employ targeted proactive programs that reduce the incidence rates within *substance abuse/dependence*, *family circumstance problems,* and *maltreatment related* mental health categories.

Enlisted RPA intelligence specialists displayed higher incidence rates for *all mental health outcomes* combined compared to RPA sensor operators after adjusting for differences in the two cohorts. Both enlisted RPA intelligence specialists and RPA sensor operators work rotating shift schedules; therefore, external influences may account for the differences in recorded mental health outcomes between the two groups. Previous RPA operator studies indicated increased levels of perceived fatigue, chronic fatigue, and their correlations with burnout and emotional exhaustion; however, those increased levels were related more to the presence of general work or shift system factors rather than specific RPA tasks (Michielsen, De Vries, & Van Heck (2003); Tvaryanas & Macpherson, 2009; Tvaryanas & Thompson, 2006). Chappelle, Salinas, and McDonald (2011b) surveyed various RPA operators and mission intelligence coordinators who were considered support personnel, and reported the main source of their self-reported stress arose from occupational effects such as long hours, low manning, shift work, human-machine interface difficulties, and the geographic location of the work centers. While these studies do not dismiss the possibility of job-specific tasks influencing recorded mental health outcomes, they do indicate a greater effect is likely experienced from differences in occupational effects.

USAF Enlisted RPA Intelligence Specialists as Compared to Aircraft Armament Technicians. Enlisted RPA intelligence specialists did not display statistically significant different incidence rates for 11 mental health categories as compared to aircraft armament technicians after adjusting for confounding variables. Enlisted RPA intelligence specialists did, however, display higher incidence rates for *posttraumatic stress disorder* and *life circumstance problems* after adjusting for differences in the two cohorts. Enlisted RPA intelligence specialists also displayed lower incidence rates for *alcohol/abuse dependence*, *substance/abuse dependence*, and *mental, behavioral problems, substance abuse* after adjusting for differences in the two cohorts.

Enlisted RPA intelligence specialists meet similar initial and subsequent medical standards as aircraft armament technicians, and both career fields work rotating shift patterns; however, the former group views combat operations while the latter does not. This research found significant differences in incidence rates for some mental health outcomes between the two groups. RPA intelligence specialists displayed lower incidence rates for four mental health outcomes, indicating the possible presence of a protective influence within the career field. One possible explanation of this finding is that enlisted RPA intelligence specialists are required to maintain a higher security clearance than aircraft armament technicians, and part of those security requirements include additional considerations for alcohol and substance abuse issues. Therefore, the additional requirement of enlisted RPA intelligence specialists having to maintain a higher level of security clearance than aircraft armament technicians may correlate to a protective mental health outcome response, especially in the alcohol and substance abuse categories.

Within the surveillance period, RPA intelligence specialists experienced a *posttraumatic stress disorder* incidence rate 1.83 (1.31-2.55 CI, $p < 0.001$) times that of the incidence rate recorded for aircraft armament technicians. Additionally, within the surveillance period, RPA intelligence specialists experienced a *life circumstance problems* incidence rate 1.18 (1.01-1.40 CI, $p < 0.05$) times that of the incidence rate recorded for aircraft armament technicians. Within the ICD-9-CM (World Health Organization, 1992) the mental health counseling category of *life circumstance problems* includes:

- Unemployment
- Adverse effects of work environment
- Other occupational circumstances or maladjustment
  - Personal current military deployment status
  - Personal history of return from military deployment
  - Other occupational circumstances or maladjustment
- Educational circumstances
- Social maladjustment
- Legal circumstances
- Other psychological or physical stress not elsewhere classified
  - Interpersonal problems, not elsewhere classified
  - Bereavement, uncomplicated
  - Suicidal ideation
  - Homicidal ideation
  - Other psychological or physical stress, not elsewhere classified
- Unspecific psychosocial circumstance

Within the ICD-9-CM, the World Health Organization (1992) describes the *posttraumatic stress disorder* mental health outcome diagnosis category (section 309.81):

Clinical Information

- A class of traumatic stress disorders with symptoms that last more than one month. There are various forms of post-traumatic stress disorder, depending on the time of onset and the duration of these stress symptoms. In the acute form, the duration of the symptoms is between 1 to 3 months. In the chronic form, symptoms last more than 3 months. With delayed onset, symptoms develop more than 6 months after the traumatic event.
- Acute, chronic, or delayed reactions to traumatic events such as military combat, assault, or natural disaster.
- An anxiety disorder precipitated by an experience of intense fear or horror while exposed to a traumatic (especially life-threatening) event. The disorder is characterized by intrusive recurring thoughts or images of the traumatic event;

avoidance of anything associated with the event; a state of hyperarousal and diminished emotional responsiveness. These symptoms are present for at least one month and the disorder is usually long-term.

- An anxiety disorder that develops in reaction to physical injury or severe mental or emotional distress, such as military combat, violent assault, natural disaster, or other life-threatening events. Having cancer may also lead to post-traumatic stress disorder. Symptoms interfere with day-to-day living and include reliving the event in nightmares or flashbacks; avoiding people, places, and things connected to the event; feeling alone and losing interest in daily activities; and having trouble concentrating and sleeping.
- Post-traumatic stress disorder (PTSD) is a real illness. You can get PTSD after living through or seeing a traumatic event, such as war, a hurricane, rape, physical abuse, or a bad accident. PTSD makes you feel stressed and afraid after the danger is over. It affects your life and the people around you. PTSD can cause problems like:
    - flashbacks, or feeling like the event is happening again
    - trouble sleeping or nightmares
    - feeling alone
    - angry outbursts
    - feeling worried, guilty or sad

    PTSD starts at different times for different people. Signs of PTSD may start soon after a frightening event and then continue. Other people develop new or more severe signs months or even years later. PTSD can happen to anyone, even children. Medicines can help you feel less afraid and tense. It might take a few weeks for them to work. Talking to a specially trained doctor or counselor also helps many people with PTSD. This is called talk therapy.

Enlisted RPA intelligence specialists displayed an incidence rate for *posttraumatic stress disorder*, after adjusting for differences in the two cohorts, that was nearly double that of aircraft armament technicians. While it is possible enlisted intelligence specialists were more prone to a traumatic event outside of their occupation than aircraft armament technicians, it seems more likely that the influence is related to their specific RPA duties. Distributed Common Ground System (DCGS) combat-related stressors are associated with tracking, targeting, and destroying enemy combatants through the direct use of high-definition video and weapons deployments by DCGS personnel while providing support to allied ground forces during combat and providing post-battle assessments (Chappelle et al., 2014). Commanders ultimately make the decision to destroy a target, while RPA pilots and sensor operators carry out the attack. DCGS intelligence personnel, however, often make decisions and recommendations that lead to the destruction of enemy personnel and assets, all while witnessing their efforts in high-definition video (Chappelle et al., 2014). Chappelle, Salinas, and McDonald (2014) and Chappelle et al. (2014) suggest DCGS intelligence personnel may become psychologically attached to the allied ground troops they protect from danger, and even the enemy personnel they seek to destroy, especially when they are monitored for long periods of time. As a result, DCGS intelligence personnel may experience grief from the loss of allied ground forces, collateral damage, and fratricide, and even from killing a designated enemy after becoming familiar with their daily lives. Viewed holistically, modern intelligence personnel within the DCGS may be at a higher psychological risk similar to traditional combat veterans, and will likely experience emotional stress, burnout, and PTSD. The findings within this research seems to support such a claim.

USAF Enlisted RPA Intelligence Specialists as Compared to the USAF Enlisted General Population. Enlisted RPA intelligence specialists did not display statistically significant incidence rates for eight mental health categories as compared to the general USAF enlisted population after adjusting for confounding variables. Enlisted RPA intelligence specialists did, however, display lower incidence rates for *alcohol abuse/dependence, depressive disorder, substance abuse/dependence,* and *mental, behavioral, substance abuse* mental health categories, and for *any mental health* *counseling, any mental health diagnosis, any mental health outcomes, and all mental health outcomes* combined compared to the general USAF enlisted population, after adjusting for differences in the two cohorts. Therefore, RPA intelligence specialists displayed lower incidence rates for eight mental health outcomes, indicating the possible presence of a protective influence within the career field. The USAF describes separate physical and mental health standards used for entry into enlisted specialties known as the *physical profile serial system* (USAF, 2014b). The differences in medical standards required by individual enlisted specialties, as well as job specific requisites likely induce a protective response. As mentioned earlier, enlisted RPA intelligence specialists are required to maintain a higher level of security clearance, and this level of security clearance exceeds that of the general USAF enlisted population. Part of those security requirements include additional considerations for alcohol and substance abuse issues, as well as generally stringent psychological requirements. Therefore, the additional requirements of enlisted RPA intelligence specialists having to maintain a higher level of security clearance and career field specific requirements may correlate to a protective mental health outcome response, as compared to the general USAF enlisted population.

Conclusions

The purpose of this study was to 1) document frequencies and rates of mental health outcomes among RPA intelligence specialists, and 2) determine if enlisted RPA intelligence support personnel exhibit statistically different adjusted mental health incidence rates as compared to RPA sensor operators, aircraft armament technicians, and the general USAF enlisted population. The U.S. Air Force School of Aerospace

Medicine provided deidentified medical records limited to a surveillance period of 1 January 2006 through 31 December 2010, and consisted of 16,647,398 recorded medical encounters from 417,258 USAF enlisted service members. All medical data were structured and analyzed using IBM® SPSS ® Version 23 and Stata ® Version 14.1 statistical programs in order to generate results and form conclusions by identifying covariates between main statistical groups, and also calculating mental health outcome incidence rates adjusted for identified covariates. The methodology used within this research was commensurate with previously used methods by Otto and Webber (2013) in a similar setting. In summary, the findings of this research were:

1) Approximately 16%, or one in six, RPA intelligence specialists, 7%, or one in 14, RPA sensor operators, and 15%, or one in nearly seven, aircraft armament technicians had at least one mental health outcome during the surveillance period;
2) adjustment disorder, depressive disorder, and anxiety disorder were the three most common diagnoses among RPA intelligence specialists as well as among all other cohorts, while life circumstance and partner relationship problems were the most common counseling codes;
3) enlisted RPA intelligence specialists did not display statistically significant incidence rates for 12 mental health categories as compared to RPA sensor operators after adjusting for confounding variables;
4) enlisted RPA intelligence specialists displayed higher incidence rates for *substance abuse/dependence*, *family circumstance problems*, and *maltreatment related* mental health categories, and for *all mental health*

outcomes combined compared to RPA sensor operators after adjusting for differences in the two cohorts;

5) enlisted RPA intelligence specialists did not display statistically significant incidence rates for 11 mental health categories as compared to aircraft armament technicians after adjusting for confounding variables;
6) enlisted RPA intelligence specialists did display higher incidence rates for *posttraumatic stress disorder* and *life circumstance problems* compared to aircraft armament technicians after adjusting for differences in the two cohorts;
7) enlisted RPA intelligence specialists displayed lower incidence rates for *alcohol/abuse dependence*, *substance/abuse dependence*, and *mental, behavioral problems, substance abuse* compared to aircraft armament technicians after adjusting for differences in the two cohorts;
8) enlisted RPA intelligence specialists did not display statistically significant incidence rates for eight mental health categories as compared to the general USAF enlisted population after adjusting for confounding variables;
9) enlisted RPA intelligence specialists displayed lower incidence rates for *alcohol abuse/dependence, depressive disorder, substance abuse/dependence,* and *mental, behavioral, substance abuse* mental health categories, and for *any mental health counseling, any mental health diagnosis, any mental health outcomes, and all mental health outcomes* combined compared to the general USAF enlisted population after adjusting for differences in the two cohorts.

As described in Finding 5, RPA intelligence specialists who view combat operations have 1.83 time the rate of PTSD than aircraft armament technicians who do not view combat operations. This finding suggests that viewing combat operations is associated with PTSD; however, RPA sensor operators who also view combat operations did not have an increased incidence rate of PTSD as compared to aircraft armament technicians who do not see combat. At least two explanations could account for these observations: 1) because of the small cohort numbers within RPA sensor operators, specifically 196 personnel, there may not be enough statistical power to detect a difference if there was one, and 2) the RPA sensor operators career field may include selection criteria that induces a protective response against particular mental health and counseling outcomes, while the RPA intelligence specialists career field does not include the same selection criteria. The statistical findings indicating increased incidence rates of mental health outcomes within RPA intelligence specialists corroborate the theoretical perspective that modern intelligence personnel within the DCGS may be at a higher psychological risk similar to traditional combat veterans, and will likely experience emotional stress, burnout, and PTSD. As such, while this research does not imply a causal relationship between individuals taking part in remote warfare and mental health outcomes, it does support the possibility of such a relationship that may apply to other military occupations that view traumatic activity. Military policymakers and clinicians should recognize RPA intelligence personnel may have increased mental health risks while performing their duties. This study was the first to document the frequencies and incidence rates of mental health diagnosis and counseling rates among USAF enlisted RPA intelligence specialists in the 1N0X1 and 1N1X1 career fields, as well as statistically compare those results with other USAF populations. The results of this study contribute to understanding the medical and psychological health concerns within RPA ancillary occupations and encourage further complementary research, identify unrecognized health risks to the USAF, and possibly facilitate policy change for the DoD.

This study was the first to document incidence rates of mental health diagnosis and counseling rates, using objective data, within a DCGS cohort other than RPA pilots; however, several limitations existed throughout the research. First, mental health incidence rates within the U.S. Air Force School of Aerospace Medicine's medical epidemiology database likely underestimates actual rates since it only accounts for clinically detected outcomes, does not record treatment sought outside of the Department of the Air Force medical system, and assumes ideal access to care. Second, the U.S. Air Force School of Aerospace Medicine's medical epidemiology database records did not reflect the severity of recoded mental health diagnoses, only the presence or absence of the condition. Due to this limitations actual mental health illness experienced by those affected may have been more severe and persistent than what the results imply. Finally, the most current data available from the US. Air Force School of Aerospace Medicine was from 1 January 2006 through 31 December 2010; however, a comprehensive study would include data from 1 October 2003 through the present.

Recommendations

The findings of this research are the first to contribute to the understanding of the mental and psychological health concerns within RPA ancillary occupations; therefore, any conclusions should be interpreted with caution. Further objective research should be conducted replicating the methods of this study, as well as expanding the surveillance period to gain an enhanced longitudinal perspective. Additional research should also expand upon the objectives and methods used in this study by including a trend analysis across the surveillance period in order to correlate job specific operational surges or considerations over time. While it was beyond the scope of this research, this study identified 229 individuals who performed duties as both RPA intelligence specialists and RPA sensor operators. Performing additional research within this specific group may identify increased mental health incidence rates due to concentrated activity within the DCGS enterprise, or even reveal lower incidence rates when compared to other groups that indicate a unique protective quality within this group. Additionally, future studies should explore the perspectives of specialists in epidemiology, biostatistics, and military mental health medicine. The literature review within this research found many studies relating to the DCGS enterprise; however, most were dated, and all but one utilized subjective methods. An increased emphasis to expand the knowledge in this area should be undertaken while utilizing objective methods.

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APPENDIX A

Permission to Conduct Research

Embry-Riddle Aeronautical University
Application for IRB Approval
Exempt Determination

Principle Investigator: Dr. Mark Friend **Other Investigators:** Kris Ostrowski, Dr. Haydee Cuevas, Dr. Ian McAndrew, Dr. Jean Otto **Role:** Student **Campus:** World Wide
College: COA

Project Title: Psychological Health Outcomes Within USAF Remotely Piloted Aircraft Support Career Fields

Submission Date: 7/23/2015 **Determination Date:** 8/14/2015

Review Board Use Only

Initial Reviewer: Teri Gabriel/M.B. McLatchey

Exempt: Yes

Approved: Teri GAbriel M.B. McLatchey
Pre-Reviewer Signature / Chair of the IRB Signature

Brief Description: The health effects of United States Air Force (USAF) remotely piloted aircraft (RPA) operations on personnel tasked to pilot and support these missions remain critical to the Department of Defense as well as the American public. This study will be the first to document the frequencies, incidence rates, and trends of mental health diagnosis and counseling rates among USAF enlisted RPA intelligence specialists, as well as compare those results with other USAF populations The purpose of this study is to 1) document frequencies, rates and trends of mental health outcomes among RPA intelligence specialists, and 2) determine if enlisted RPA intelligence support personnel exhibit statistically different adjusted mental health incidence rates as compared RPA sensor operators, aircraft armament technicians, and the general USAF enlisted population.

This research falls under the **exempt** category as per 45 CFR 46.101(b) under:

☐(1) Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

☐(2) Research involving **only** the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures (of adults), interview procedures (of adults) or observation of public behavior. Participant information obtained will remain anonymous or confidential.

☐(3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section if: (i) the human subjects are elected

APPENDIX B

Tables

Table B1

Demographic and Military Characteristics of United States Air Force Specialty Code Groups, 1 January 2006 – 31 December 2010, Intelligence Specialists, Sensor Operators, and Aircraft Armament

		United States Air Force Specialty Code Groups					
		Intelligence Specialists		Sensor Operators		Aircraft Armament	
		No.	%	No.	%	No.	%
Total		7.988	100	196	100	11,340	100
Sex	Male	5,647	70.7	183	93.4	10,235	90.3
	Female	2,341	29.3	13	6.6	1,105	9.7
Age	17-24	5,031	63	139	70.9	7,001	61.7
	25-29	1,566	19.6	29	14.8	1,840	16.2
	30-34	603	7.5	16	8.2	851	7.5
	35-39	450	5.6	11	5.6	955	8.4
	40+	338	4.2	1	0.5	693	6.1
Race/ethnicity	White Non-Hispanic	6,063	75.9	159	81.1	7,978	70.4
	Black Non-Hispanic	862	10.8	17	8.7	1,857	16.4
	Hispanic	352	4.4	9	4.6	640	5.6
	Asian/Pacific Islander	334	4.2	8	4.1	457	4
	Other	377	4.7	3	1.5	408	3.6
Marital Status	Single	4,738	59.3	122	62.2	6,075	54
	Married	2,915	36.5	68	34.7	4,788	42.2
	Divorced	334	4.2	6	3.1	466	4.1
	Other	1	0	0	0	11	0.1
Education level	High School Grad, Equiv, or less	2,447	30.6	90	45.9	3,559	31.4
	Some College, no Degree	4,082	51.1	91	46.4	6,649	58.6
	Two-year Degree	970	12.1	13	6.6	899	7.9

	Bachelors Degree, Graduate Work	463	5.8	2	1	208	1.8
	Graduate Degree, Doctorate, or Professional Degree	26	0.3	0	0	25	0.2
No. of Deployments	0	4,774	59.8	149	76	7,000	61.7
	1	2,031	25.4	23	11.7	2,980	26.3
	2	835	10.5	15	7.7	1,072	9.5
	3+	348	4.4	9	4.6	288	2.5
Military rank grouped	Amn-SrA	5,504	68.9	146	74.5	7,166	63.2
	SSgt-TSgt	2,009	25.2	45	23.0	3,252	28.7
	MSgt-CMSgt	475	5.9	5	2.6	922	8.1
Time in Service Grouped	<6 years	5,778	72.3	156	79.6	7,703	67.9
	6-10 years	1,084	13.6	17	8.7	1,452	12.8
	11-15 years	463	5.8	16	8.2	688	6.1
	16+ years	663	8.3	7	3.6	1,497	13.2
Prior MH outcomes	No Prior MH Outcome	7,986	100	196	100	11,334	99.9
	Prior MH Outcome	2	0	0	0	6	0.1%

Note. Intelligence specialists include USAF Specialty Codes 1N1 and 1N0; Sensor Operators include USAF Specialty Code 1U0; Aircraft Armament includes USAF Specialty Code 2W1.

Table B2

Demographic and Military Characteristics of United States Air Force Specialty Code Groups, 1 January 2006 – 31 December 2010, Aircrew Operations, Healthcare, Mission Support

		United States Air Force Specialty Code Groups					
		Aircrew Operations		Healthcare		Mission Support	
		No.	%	No.	%	No.	%
Total		14,713	100	34,211	100	10,968	100
Sex	Male	12,852	87.4	17,173	49.9	5,471	49.9
	Female	1,861	12.6	17,038	50.1	5,497	50.1
Age	17-24	8,078	54.9	18,837	55.1	3,631	33.1
	25-29	2,413	16.4	6,620	19.4	2,233	20.4
	30-34	1,575	10.7	3,513	10.3	1,563	14.3
	35-39	1,489	10.1	2,793	8.2	1,840	16.8
	40+	1,158	7.9	2,448	7.2	1,701	15.5
Race/ethnicity	White Non-Hispanic	12,153	82.6	20,304	59.3	5,327	48.6
	Black Non-Hispanic	1,070	7.3	7,728	22.6	3,689	33.6
	Hispanic	554	3.8	2,240	6.5	887	8.1
	Asian/Pacific Islander	414	2.8	2,167	6.3	483	4.4
	Other	522	3.5	1,772	5.2	582	5.3
Marital Status	Single	8,219	55.9	16,987	49.7	3,466	31.6
	Married	5,847	39.7	14,992	43.8	6,311	57.5
	Divorced	639	4.3	2,204	6.4	1,163	10.6
	Other	8	0.1	28	0.1	28	0.3
Education level	High School Grad, Equiv, or less	3,917	26.6	9,514	27.8	1,728	15.8
	Some College, no Degree	8,003	54.4	18,658	54.5	5,979	54.5
	Two-year Degree	2,002	13.6	4,312	12.6	2,175	19.8

	Bachelors Degree, Graduate Work	745	5.1	1,557	4.6	911	8.3
	Graduate Degree, Doctorate, or Professional Degree	46	0.3	170	0.5	175	1.6
No. of Deployments	0	6,116	41.6	24,354	71.2	7,648	69.7
	1	3,062	20.8	7,756	22.7	2,764	25.2
	2	2,317	15.7	1,666	4.9	507	4.6
	3+	3,218	21.9	435	1.3	49	0.4
Military rank grouped	Amn-SrA	8,773	59.6	20,828	60.9	3,712	33.8
	SSgt-TSgt	4,316	29.3	10,735	31.4	5,293	48.3
	MSgt-CMSgt	1,624	11	2,648	7.7	1,963	17.9
Time in Service Grouped	<6 years	9,259	62.9	21,796	63.7	4,216	38.4
	6-10 years	1,722	11.7	5,238	15.3	2,135	19.5
	11-15 years	1,445	9.8	2,869	8.4	1,442	13.1
	16+ years	2,287	15.5	4,308	12.6	3,175	28.9
Prior MH outcomes	No Prior MH Outcome	14,709	100	34,191	99.9	10,963	100
	Prior MH Outcome	4	0	20	0.1	5	0

Note. Aircrew Operations include USAF Specialty Codes 1AX; Healthcare includes USAF Specialty Codes 4BX, 4CX, 4DX, 4EX, 4HX, 4JX, 4MX, 4NX, 4PX, 4RX, 4TX, 4VX, and 4YX; Mission Support includes USAF Specialty Codes 3SX.

Table B3

Demographic and Military Characteristics of United States Air Force Specialty Code Groups, 1 January 2006 – 31 December 2010, Other and Intel-Sensor Cross Trainees

		United States Air Force Specialty Groups			
		Other		Intel/Sensor Cross trainees	
		No.	%	No.	%
Total		327,917	100	229	100
Sex	Male	272,378	83.1	205	89.5
	Female	55,539	16.9	24	10.5
Age	17-24	193,019	58.9	162	70.7
	25-29	56,133	17.1	47	20.5
	30-34	28,987	8.8	14	6.1
	35-39	27,066	8.3	6	2.6
	40+	22,712	6.9	0	0
Race/ethnicity	White Non-Hispanic	234,672	71.6	179	78.2
	Black Non-Hispanic	51,912	15.8	20	8.7
	Hispanic	16,211	4.9	14	6.1
	Asian/Pacific Islander	12,384	3.8	8	3.5
	Other	12,738	3.9	8	3.5
Marital Status	Single	176,418	53.8	143	62.4
	Married	137,020	41.8	82	35.8
	Divorced	14,231	4.3	3	1.3
	Other	248	.1	1	.4
Education level	High School Grad, Equiv, or less	104,323	32.8	89	38.9
	Some College, no Degree	177,878	54.2	115	50.2
	Two-year Degree	33,613	10.3	17	7.4

	Bachelors Degree, Graduate Work	10,624	3.2	7	3.1
	Graduate Degree, Doctorate, or Professional Degree	1,479	.5	1	.4
No. of Deployments	0	192,677	58.8	131	57.2
	1	83,987	25.6	79	34.5
	2	36,351	11.1	14	6.1
	3+	14,902	4.5	5	2.2
Military rank grouped	Amn-SrA	208,759	63.7	181	79.0
	SSgt-TSgt	90,972	27.7	46	20.1
	MSgt-CMSgt	28,186	8.6	2	.9
Time in Service Grouped	<6 years	219,032	66.8	191	83.4
	6-10 years	40,572	12.4	26	11.4
	11-15 years	24,681	7.5	10	4.4
	16+ years	43,632	13.3	2	.9
Prior MH outcomes	No Prior MH Outcome	327,741	99.9	229	100
	Prior MH Outcome	176	.1	0	0

Note. Other includes all unique USAF Specialty Codes not otherwise listed in Table C1 and Table C2; Intel/Sensor Cross Trainees includes individuals who were categorized as both 1N0 or 1N1, as well as 1U0 within the period of study.