

COMBAT DEPLOYMENT AND MENTAL HEALTH
IN MILITARY DEPENDENTS

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ABSTRACT

ALYSSA J. MANSFIELD: Combat Deployment and Mental Health in Military Dependents
(Under the direction of Jay S. Kaufman)

Operations in Iraq and Afghanistan have involved the frequent and extended deployment of U.S. military personnel, many of whom are married, have children, or both. The effect of deployment on mental health problems in military spouses and children is largely unstudied. Research is needed to inform assessment and allocation of military mental health resources. This study characterized outpatient mental health diagnoses among the family members of U.S. military personnel associated with deployment in support of Operations Iraqi Freedom (OIF) and Enduring Freedom (OEF). The risk and rate of mental health diagnoses associated with prolonged (≥ 7 months) OIF and OEF deployment between January 1, 2003 and December 31, 2006 were compared using electronic medical record data for spouses ($n=267,126$) and dependent children ($n=348,012$) of active duty U.S. Army personnel. After adjusting for sociodemographic characteristics and the family member's mental health history, the excess of mental health cases attributable to longer spousal deployment was 34.7 per thousand (95% CI: 29.7–39.6). It was greater for disorders of depression (22.7 cases; 95% CI: 18.4–29.9), sleep (15.8 cases; 95% CI: 12.9–18.6), stress (15.2 cases; 95% CI: 11.7–18.8), and anxiety (13.2 cases; 95% CI: 9.8–16.6), with diagnosis rates 11 to 24 percent higher for these same conditions. Excess mental health cases among children attributable to prolonged parental deployment were 14.1 per thousand (95% CI: 10.6–17.6), and were greater for depression (3.6 cases; 95% CI: 1.6–5.6), stress (9.0 cases;

95% CI: 6.5–11.5), and pediatric behavioral disorders (4.7 cases; 95% CI: 2.9–6.4), with diagnosis rates 12 to 39 percent higher for these same conditions, as well as bipolar disorder. Excess cases and rates varied for male and female children, and by military installation for all family members. This is the first large-scale study examining the effects of deployment on mental health problems in military families. Findings indicate prolonged periods of deployment are associated with increased occurrence and rates of mental health diagnoses, and have relevance for informing prevention efforts and service provision at locations with substantial troop deployment.

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DEDICATION

This dissertation, in its entirety, is dedicated to the men and women who serve in all branches of the United States Armed Forces, and to the family members they leave behind during deployment.

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LIST OF ABBREVIATIONS

AFHSC	Armed Forces Health Surveillance Center
AMSA	Army Medical Surveillance Activity
DMDC	Defense Manpower Data Center
DMSS	Defense Medical Surveillance System
DoD	Department of Defense
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders, 4 th Ed.
HIPAA	Health Insurance Portability and Accountability Act
ICD-9	International Classification of Diseases, 9 th Revision
IRB	Institutional Review Board
OEF	Operation Enduring Freedom
OIF	Operation Iraqi Freedom
SADR	Standard Ambulatory Data Record
SIDR	Standard Inpatient Data Record
TED	TRICARE Enrolled Dependent
USUHS	Uniformed Services University of the Health Sciences
ZINB	Zero-inflated negative binomial
ZIP	Zero-inflated Poisson

I. LITERATURE REVIEW

A. Conceptual Framework

The goal of integrating stress and coping research with aspects of military life is to allow for the parceling out of influences at the individual and social levels. In doing so, one can more readily elucidate the effects unique to this population and environment. Previous research has shown that mental health disorders are more common among deployed military personnel than non-deployed military personnel, and suggests that psychological trauma can extend to those who support military personnel yet who are not involved in direct combat, and are, therefore, less exposed.¹ This research hypothesized that the same relationship holds true among the family members of deployed military personnel. Specifically, it was expected that psychological stress is greater among dependents of military service members with greater time spent deployed for current operations compared to dependents of non-operationally deployed personnel, and that this stress, if not properly and adequately treated, can lead to relationship, school/work, and health problems. Because this research utilized electronic medical surveillance data collected continuously over time, data could be linked to the military member's deployment status over time, and used to examine the relationship between cumulative deployment and medical visits for mental health purposes.

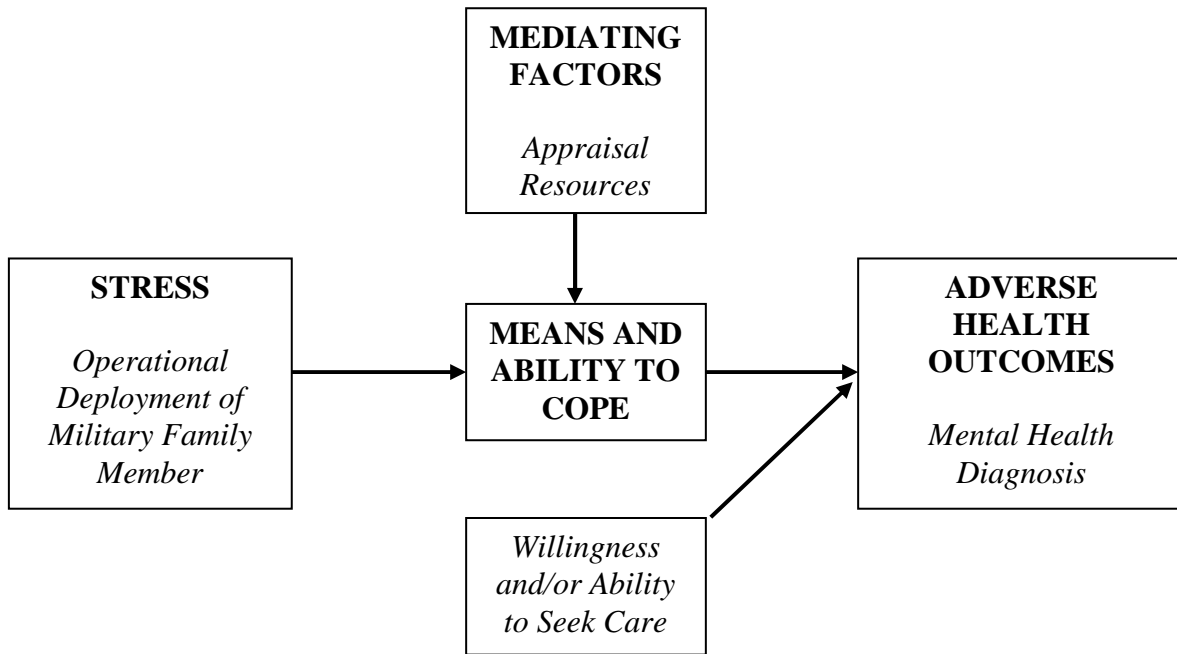
Although operational deployment may be related to increased symptoms and treatment for mental health disorders among military dependents, it is unclear if the deployment per se provokes pathological levels of symptoms or maladaptive behavior in otherwise healthy adults and children. As such, it was further hypothesized that the resulting stress would manifest as

mental health disorders including, but not limited to, substance abuse, sleep disorders, and mood disorders which can be assessed, in part, using medical surveillance data to quantify medical diagnosis and treatment.

The current work employed linear risk and negative binomial regression modeling to examine several demographic and social factors in relation to deployment and mental health outcomes. It was hypothesized that the type of mental health outcome would be dependent upon various demographic factors. As previous research on the psychological effects of deployment indicates a certain emotional vulnerability to mental health disorders among those with a prior mental health diagnosis,¹ this research included diagnostic evidence of mental health history. For this reason, it was also expected that past mental health history would modify the relationship between deployment status and mental health outcomes, as well as predict the type of mental health outcome observed during the study period.

The conceptual model employed in the current research views adverse health outcomes, including mental health outcomes, as resulting from exposure to increased levels of stress (see Figure 1.1). A stress and coping mechanism, specifically, the ability to cope with this stress, or lack thereof, is hypothesized to influence the occurrence and severity of adverse health outcomes and is believed to be mediated by the individual's appraisal of the stressor, available social and cultural resources, as well as willingness or ability to seek care. The stress and coping mechanism suggested by this conceptual model was not tested or substantially explored in this dissertation, but offers plausible insight into how a stressor, in this case, prolonged operational deployment, could affect mental health outcomes in family members of the deployed personnel.²

Figure 1.1: Conceptual model



B. Public Health Significance

Besides the federal government's civilian sector, the military is the largest single employer in the United States, maintaining a workforce of over two million as of the end of May 2004.³ Since 1990 the number of U.S. military service members deployed for war and peacekeeping operations has been at an all-time high. Following the events of September 11, 2001, over 10,000 military personnel were deployed to Afghanistan in support of Operation Enduring Freedom (OEF). Shortly after, in early 2003, over 150,000 military personnel were deployed to Iraq and surrounding areas in support of Operation Iraqi Freedom (OIF). In the years since the initial deployment, troop levels in support of these operations have fluctuated between 120,000 and 160,000. As of June 2008, the Army had over 117,000 troops deployed in and around Iraq in support of OIF and over 21,000 troops deployed in and around Afghanistan in support of OEF.⁴ Both operations have been associated with some of the longest combat deployments for American troops since the Vietnam War era. Because these deployments

involve married military personnel with families, the medical and mental health communities have a tremendous need to comprehend their effects on the military family.

Following several murders at Fort Bragg committed by military personnel following their extended deployment to Afghanistan, the armed services began taking a more active approach toward mental health care support for service members. While this addresses a portion of the problem, the current deployment of large numbers of U.S. troops and the continued activation of national guardsmen and reservists affect a large population of family members who remain in the United States. There are about 1.1 million active duty service members in the U.S. military⁴ and roughly the same number of reservists and guardsmen, the majority of whom have dependents. Because almost all military personnel eventually leave the armed services and receive at least a portion of medical care for themselves and their dependents outside of the military, untreated mental health problems in this population can eventually become a widespread public health issue.

The Department of Defense has invested considerable resources to prepare service members and their families for the challenges and changes brought on by family separation, yet the current deployment of U.S. military personnel to Iraq and Afghanistan brings added challenges to families due to the more volatile nature of the situation, longer periods of deployment, unique characteristics of these conflicts (such as improvised explosive devices or IEDs), and in many cases, multiple deployments to the region. Although there is a vast body of literature on family separation, there are few attempts to merge insights from military and civilian research. Focusing on the spouses and children of military personnel and the unique stress of deployment is a novel approach to research in the epidemiology of mental health disorders.

Currently, the effect of combat deployment on the mental health of family members is largely unknown. To better understand the psychological effects on military families, a large-scale study covering a period of time sufficient to observe the effects of deployment-related stress is required. Consideration of, and adjustment for, confounding and modifying factors must be thorough, as other factors may be associated with both deployment and obtaining a mental health diagnosis. Finally, measurement of deployment and diagnosis must be both valid and reliable if results are to be generalized to other military families.

The current study attempted to elucidate the association between prolonged operational deployment and the mental health among the dependents who are left behind. It also attempted to identify certain subgroups whose members may experience disorders to a disproportionate extent. Secondary preventive interventions suggested by this study may consist of pre-deployment programs for children and spouses at greater risk for problems upon deployment of a military family member, as well as support programs during the actual deployment period. In addition, tertiary prevention programs can be implemented for situations when children appear at school, or family members present to a medical clinic, with stress-related symptoms or behavioral or emotional disorders. Overall, this work has relevance for informing early prevention interventions for those at greater risk of developing mental health disorders among military families in and around the period of deployment.

C. Critical Review of Literature

1. Military Deployment and Stress

The frequent or extended deployment of military units leads to increased stress, anxiety, and depression among both military personnel⁵⁻⁷ and the family members they leave behind.⁸⁻¹¹ The type of warfare currently taking place in Iraq and Afghanistan is very different from that of

more recent conflicts involving the United States. Combat undertaken during the first Persian Gulf War in the early 1990s was won with relative ease in a limited ground engagement and with relatively few U.S. casualties. In contrast, operations in Iraq and Afghanistan have involved the first sustained ground combat since the Vietnam War, followed by a period of insurgent attacks that claim U.S. lives on a nearly daily basis. In the same number of months, nearly six times as many hostile deaths occurred from Operation Iraqi Freedom than occurred during Operations Desert Shield and Desert Storm in the first Persian Gulf War (August 1990-September 1991) combined.^{12, 13} The proximal psychological effects of this type of combat upon service members are not well understood. Though recent studies suggest significant mental health problems among a large proportion of soldiers and marines returning from Iraq and Afghanistan,^{6, 14-17} this early assessment is thought to underestimate the actual magnitude of the problem.¹⁸

The psychosocial burden on families of deployed military personnel is even less well understood, and perhaps more unique compared to previous deployments given current conditions of service. Besides the added fear for the safety of loved ones, spouses of military personnel with children currently deployed to combat areas may face the challenges of coping as a single parent, as well as potential marital strain due to deployment-induced separation. Several studies examining the effects of deployment on spousal relationships have shown mixed results. One study found a decline in marital satisfaction during the deployment period, but no long-term effects and no measurable effect on marital stability or quality.¹¹ Another study showed an increase in divorce rates following deployment, but only for female soldiers.⁸ The authors also reported a drop in employment rates among military spouses during deployment, but only for wives of male soldiers. Because previous research in this area is limited to short

deployment periods (i.e., 6 months or less) or limited combat operations (e.g., Operation Desert Storm), it is difficult to generalize to the current military deployment situation facing the United States.

In summary, the hypothesized increase in levels of acute and long-term stress among military family members surrounding the deployment period is a viable mechanism for the development of mental health problems. The existing literature suggests a pathway by which maladaptive coping strategies may initiate or exacerbate the experience of psychological distress, ultimately leading to the development of clinical mental health outcomes. Research examining the effects of stress and coping separately in children and adults supports these hypotheses. However, literature in this area is sparse and demonstrates a need for further investigation since previous studies may not be applicable to the current conflicts.

2. Stress and Coping Among Adults

Numerous studies in nonmilitary populations have found an association between the occurrence of stressful life events and the subsequent onset or recurrence of psychopathology, mainly relating to depression,¹⁹⁻²² substance use and abuse,²³⁻²⁶ and bipolar disorder.^{27, 28} Mood and sleep disorders may be viewed as examples of *internalization* of stress, whereas substance use and physical or emotional abuse would be considered examples of *externalization* of stress. Whether internalizing or externalizing, mitigation of stress is the ultimate goal. Although both stress and depressive symptoms can explain a portion of the variance in each other, some stressors are clearly the consequence of depressive symptoms, while others appear to exhibit a causal influence,²² as in the effect of deployment-induced separation on stress levels within a military family. Further, the impact of stressful life events has been observed to be greatest in the period shortly after the event occurs, and for those events which are independent of an

individual's behavior.¹⁹ Consistent with these findings, spouses of military personnel deployed during Operation Desert Storm experienced marked increases in depression compared with spouses of non-deployed personnel when assessed both prior to and during the deployment of their military partners.¹⁰

Civilian studies have also reported that individuals exposed to stress are more likely to abuse alcohol and other drugs or undergo relapse if a history of such abuse exists.^{23, 25, 26} Substance use is theorized to regulate the negative affect often associated with stressful life events, thus serving as a coping mechanism.²⁹ In particular, stressful life events have been more strongly associated with alcohol use among men compared to women, and more strongly associated with psychotherapeutic drug use among women than men.²⁴ In contrast, these authors found no association between stressful life events and illicit drug use in men or women, suggesting that illicit drugs may be used for more recreational purposes than for affect regulation.²⁴

Data on bipolar disorder have been inconsistent, with some studies suggesting that stressful life events play a role in the onset of new episodes,^{27, 28} and others failing to support such findings.³⁰ The limited research on depression, and no available data on newly diagnosed or recurring substance use, bipolar disorder, psychosomatic illness, or psychosis relating to families of deployed military personnel, represent a knowledge gap in this population.

3. Stress and Coping Among Children and Adolescents

Major life events and daily struggles have been shown to predict future emotional and behavioral functioning in both children and adolescents.^{31, 32} Similar to adults, the effect of stress on children and adolescents often depends upon the nature and degree of the stressful event, as well as the chosen coping strategies. Long-term parental absence can be detrimental

and traumatic for children, especially if, from the child's perspective, the separation involves a sense of danger, or if the child is not adequately prepared.

Research suggests that U.S. children fear the death of a parent above any other event.³³ Children in military families view war as a threat to the security and stability of their families and caretakers.³⁴ The mere threat of war and a parent's potential harm has been shown sufficient to induce anxiety, emotional problems, and negative coping strategies among children with active duty and reserve military parents,³⁵ as has an actual military-induced parental separation.³⁶ Even after accounting for the effects of rank and child's age, deployment status has been associated with depression and negative affect in children with military parents.¹⁰ Furthermore, increased self-reported levels of depression are greatest among children when the non-deployed caretaking parent also reports increased depression, suggesting the stress levels of the parent and child are related and may need to be both studied and treated on a family rather than individual level.⁶

Civilian studies show that among adolescents, major life stress has been associated with depression,^{37, 38} substance use and abuse,³⁸ emotional and behavioral problems,³⁸ delinquent activity,³⁸ and poor academic performance.³⁸ Although previous research has suggested a higher prevalence of psychopathology among children and adolescents in military families compared to the civilian population,³⁹ studies are extremely sparse and inconsistent with a more recent community survey of military children and their parents which found levels of psychopathology at or below levels observed in civilian children.⁴⁰ Despite these findings, and because such studies are limited by the use of self-report data, small samples, and cross-section designs, or were conducted during peacetime, results may not generalize to children of military personnel deployed in support of combat operations.

The occurrence of stressful life events and subsequent onset of psychological distress in both children and adults is well established in the literature. Previous research has shown that in both civilian and military populations, the effects of stress can manifest as mood disorders, substance use, and relationship and behavioral problems, as well as declines in academic and job performance. Such outcomes have been observed following military-induced separation, yet remain severely understudied in large military populations during periods of long and/or frequent deployment to combat areas. In recent years, the United States military has deployed its forces to areas of high volatility and instability. In turn, as U.S. troops face greater dangers overseas, the need to anticipate the psychological consequences for family members left behind and offer timely intervention where needed is imperative.

II. STATEMENT OF SPECIFIC AIMS

A. Specific Aims

Although frequent or extended deployment of military personnel has been associated with increased stress, anxiety, and depression among both military personnel⁵⁻⁷ and their families,⁸⁻¹¹ the bulk of existing research centers around peacetime deployments. The influence of military deployment for combat operations on the development or exacerbation of mental health disorders among military personnel has only just begun to receive increased attention. Though recent and ongoing studies suggest significant mental health problems among many soldiers and marines returning from combat operations in Iraq and Afghanistan,⁶ such evidence is thought to underestimate the magnitude of the problem.¹⁸

Still, even less is known about how combat deployment and the resulting family separation and stress affect the mental health of military family members who remain back home. Previous studies have linked reduced marital satisfaction¹¹ and increased divorce rates with short, peacetime deployment periods,⁸ and increased depression among spouses of deployed versus non-deployed military personnel during short, combat operation periods.¹⁰ Though quite sparse, the few studies examining children's responses indicate both potential³⁵ and actual deployment³⁶ of a parent are each sufficient to induce anxiety, depression and negative affect within children in military families. Although these studies used peacetime deployment periods, these findings suggest the effects of longer and more frequent combat deployments would yield similar, if not more severe, responses in children.

In terms of specific reactions, stressful life events have been associated with subsequent onset or recurrence of depression,¹⁹⁻²² substance abuse,²³⁻²⁶ and bipolar disorder^{27, 28} among adults, and depression,^{37, 38} substance abuse,³⁸ and other emotional problems³⁸ among children and adolescents. Of these, only depression was examined within the context of military families during deployment, and only in a handful of studies. This highlights the need to understand the role of deployment on specific types of psychopathology within families of military personnel.

This research estimated the association between operational deployment of active duty U.S. Army personnel and assignment of mental health diagnoses among the medical care-seeking spouses and children of these military personnel by conducting analyses of existing U.S. Department of Defense (DoD) medical surveillance data.

Specific aims of this study were to:

1. Estimate the association between prolonged (i.e., 7 months or more) operational deployment of an immediate family member and being diagnosed with a mental health problem among family members of U.S. Army active duty personnel.
2. Assess the extent to which this association is modified by a range of covariates, including age, gender, race/ethnicity, mental health history, the military member's rank, and time in service.
3. Evaluate this association separately for various specific categories of mental health diagnoses: Alcohol; Anxiety; Bipolar; Delirium, Dementia, & Other Cognitive Disorders; Depression; Dissociative; Drug; Impulse Control; Pediatric Behavioral Disorders; Personality; Psychotic; Sleep; Somatoform/Factitious; and Stress.
4. Evaluate this association separately for spouses and for children of U.S. Army active duty personnel.

The primary means by which the data were examined used binary measures of deployment and diagnosis for each medical visit (mental health diagnosis vs. non-mental health diagnosis) and linear risk regression models to calculate the risk difference. In addition, negative binomial regression modeling was employed using a binary diagnostic outcome for each medical visit (mental health diagnosis vs. non-mental health diagnosis) and assessing if the rate of mental health diagnoses varied as a function of deployment time and selected covariates.

B. Hypotheses and Rationale

Hypotheses and rationales for each aim of the proposed study are:

Aim 1: It was hypothesized that the risk and rate of medical visits yielding a mental health diagnosis versus a non-mental health diagnosis would be greater among the immediate family members of military personnel who were operationally deployed for more time between 2003 and 2006 as compared to dependents of military personnel who were not operationally deployed or deployed for less time during the same period. Preliminary data found a small effect when deployment was assessed at the military installation level. This was expected to increase with deployment status assessed at the family level.

Aim 2: It was hypothesized that the risk and rate of mental health diagnoses attributable to longer deployment (aim 1) would be modified by age, gender, race/ethnicity, mental health history, the military member's rank, and time in service. Prior studies support variation in mental health diagnoses based upon age, gender, race/ethnicity, and mental health history. The military member's rank and time in service were expected to be positively associated with age. As such, they were expected to modify the association in aim 1, though they were not expected to yield substantial effect measure modification.

Aim 3: If the association described in aim 1 was detected, it was expected to vary across various specific categories of mental health diagnoses. Existing literature within military families has been extremely limited, but when combined with prior studies in the general population, suggests the categories of alcohol, anxiety, bipolar, depression, drug, and stress may yield stronger associations compared to other categories in the current study.

Aim 4: If the associations stated in Aims 1-3 were present, it was expected they would vary between the spouses and children of military personnel. Prior studies support variation in mental health diagnoses based upon age and gender. Females are more likely to seek treatment for and be diagnosed with certain types of mental health disorders.^{41,42} In addition, the median age of onset varies by type of disorder, with anxiety and impulse-control typically emerging in childhood and substance use and mood disorders typically emerging in early adulthood.⁴³ Military spouses are both older and with a higher proportion of females relative to children of military personnel. To help elucidate important differences in deployment and a mental health diagnosis between these groups, data on spouses and children were analyzed and reported separately in the current research.

III. RESEARCH DESIGN AND METHODS

A. Study Overview

This study used a retrospective cohort design. Participants were chosen based on exposure and not outcome, namely, whether or not their family likely included a military member deployed for combat operations between January 1, 2003, and December 31, 2006.

B. Study Design

1. Subject Identification and Selection

a. Study Population

The population under investigation comprised spouses and children of active duty U.S. Army personnel who obtained outpatient medical care from either a) a treatment facility located on a U.S. military installation, or b) utilized military medical insurance for an outpatient medical visit at a healthcare facility outside of a U.S. military installation. Because the outcome under investigation related to the diagnosis and treatment of mental health disorders, some of which may not be clinically relevant or reliably diagnosed within certain age groups, children who had not yet achieved an age at which a clinical diagnosis is usually or reliably made were excluded from the data analysis. Specifically, all medical visits for any children four and younger were excluded, and children whose weighted mean age over the four-year study period was less than five years were also excluded. Additionally, a maximum age of 22 years was established for children based upon two eligibility rules under

TRICARE, the health care program serving active duty military personnel and their families.⁴⁴ First, unmarried biological and adopted children are eligible for coverage up to age 21 unless they are full-time college students, in which case their eligibility continues until their 23rd birthday or the end of that school year, whichever comes first. As it was impossible to determine student status for children in the current study, it was assumed that children over 21 years were indeed eligible to receive coverage through the military medical system. Second, since only under extremely special circumstances (e.g., severe disability) are children of active duty personnel eligible for medical care after their 23rd birthday, children older than 23 represent a unique medical cohort whose study was not the purpose of the current analysis. The minimum age for spouses was set at 18 years and a maximum age of 48 years was selected. This age ceiling was imposed based upon several factors: 1) Examination of the age by months deployed distribution for the study period indicated a sharp drop-off in deployment for spouses aged 45 years and older; 2) Although the mandatory age of retirement for U.S. Army personnel is 62 years (increased in 2006 from age 55 or 60, based on rank),^{45, 46} most retire well before this age.⁴⁷ Based on these two factors, and under the assumption that a spouse's age is similar to the military sponsor, spouses with a mean age for the study period greater than 48 years were excluded from further analysis.

The current study utilized a four-year subset of all outpatient medical encounters between January 1, 2003 and December 31, 2006 for the spouse and all dependent children of non-retired, active duty U. S. Army personnel. Table 3.1 presents characteristics of all U.S. Army active duty personnel during the study period. The total analysis sample included over 12 million outpatient medical encounters for 267,126 spouses and 348,012 children.

Table 3.1. Characteristics of all active duty Army personnel, 2003-6

	2003	2004	2005	2006	Average
Total Active Duty personnel	493,563	494,291	488,579	502,790	494,806
Commissioned Officer (%)	14	14	14	14	14
Warrant (%)	2	2	3	3	2
Enlisted (%)	84	84	83	84	84
Race/ethnicity (%)					
White	59	60	61	62	61
Black	24	23	22	21	22
Hispanic	10	10	11	11	10
Asian	4	4	4	4	4
Other	3	3	3	3	3
Married (%)					
Officer	67	66	68	68	67
Warrant	83	82	83	82	82
Enlisted	49	48	51	52	50
TOTAL	52	51	54	55	53
Dual military marriages ¹ (%)					
Officer	10	10	10	9	10
Warrant	6	7	7	6	7
Enlisted	11	10	9	9	10
TOTAL	10	10	9	9	10
Have children (%)					
Officer	53	52	nd	nd	53
Warrant	76	76	nd	nd	76
Enlisted	45	44	nd	nd	45
TOTAL	47	46	nd	nd	47
Single with children (%)					
Officer	4	5	4	4	4
Warrant	7	7	7	7	7
Enlisted	8	8	7	7	8
TOTAL	8	8	7	7	7
Total Spouses ²	257,684	254,011	262,463	275,016	262,294
Total Children	469,069	459,634	457,645	473,176	464,881

Source: Army Demographic Profiles, FY 2003-6⁴⁸⁻⁵¹

Note: All percentages rounded to the nearest whole number

nd = No data reported

¹Percent of all marriages

²Does not include non-married, former spouses of military personnel still eligible for care and captured in spouse data (i.e., married to their former service member spouses for 10+ years)

b. Selection Criteria

The population of interest in the current study was military personnel and their immediate family members. For this reason, only beneficiary data for spouses and children, no other beneficiaries, were included. The dependents of military personnel in the Reserve and National Guard components do not generally receive military medical benefits until the military member is called up to active duty. Without presumption that outpatient mental health care would be received at a military medical facility and/or utilizing military medical insurance, assessment of mental health care prior to and during the study period could not be conducted with any certainty for these dependents. The likely association between a mental health history and a mental health diagnosis during the study period is too large to ignore. For this reason, several inclusion criteria were applied. First, the data set included only beneficiaries of active duty military members, as well as variables for the military member to assess both time in the active component and time in overall service. Beneficiaries whose military member was in active duty service for a period of time less than five years as of January 1, 2007 were excluded. Five years was chosen to exclude families of Army personnel who joined the military during the four-year study period, and included an additional year prior to the study period to capture any mental health visits occurring through the military medical system. As previously mentioned, reliable assessment of mental health history is crucial to the current study. Finally, due to difficulties in obtaining permission for tri-service (i.e., Army, Air Force, Navy/Marines) data, only data for U.S. Army personnel and their families are included.

2. Data Sources

This research examined the relationship between operational deployment of a military family member and mental health diagnoses among military dependents after controlling for individual covariates. This involved combining several types of data: 1) military dependent medical and demographic data for visits occurring at a military medical treatment facility, 2) data for outpatient medical visits occurring outside of a military medical facility but utilizing military insurance (termed *purchased care*), 3) deployment and personnel data for the military member. Each of the data sources, any major strengths or limitations of each, if applicable, and pertinent details of data acquisition are discussed below.

a. Military Dependent Medical and Demographic Data

Medical data for this study were previously collected for medical surveillance and epidemiologic analysis in accordance with DoD Directive 6490.2, dated 21 Oct 2004 and DoD Instruction 6490.3, dated 7 Aug 1997. The outpatient medical visit data originate from the Standard Ambulatory Data Record (SADR) and inpatient medical visit data originate from the Standard Inpatient Data Record (SIDR). Both are mandatory collection and reporting systems for all medical visits taking place at military medical facilities. The data are stored in the Defense Medical Surveillance System (DMSS). DMSS is the DoD's premier epidemiological database, which contains longitudinal demographic, service, deployment, immunization, and medical event data for U.S. military service members and their eligible dependents. The DMSS is maintained by the Armed Forces Health Surveillance Center (AFHSC, formerly the Army Medical Surveillance Activity [AMSA]), U.S. Army Center for Health Promotion and Preventive Medicine.

b. Purchased Care Outpatient Medical Data

Data for military beneficiaries' outpatient medical care utilization outside of a military medical treatment facility, but using the military's medical insurance system (TRICARE) represent a separate data feed into DMSS. TRICARE Enrolled Dependent (TED) data contain complete billing code information and were considered up-to-date through the end of the study period (Dec. 31, 2006) at the time data for this research were compiled (December 2007). Combined, SADR and TED data comprised the outpatient medical data for this study.

c. Military Member Deployment and Personnel Data

The DMSS contains information from the Defense Manpower Data Center (DMDC) deployment rosters, personnel rosters, and gain/loss rosters. The DMDC Contingency Tracking System deployment roster data, which has been previously proven to be very accurate in determining service members that have deployed to OIF/OEF, has been incorporated into DMSS and is used to answer questions from the Assistant Secretary of Defense (Health Affairs) on a weekly basis. The study variables concerning the military member's rank, time in service, time in active duty component, and deployment status for each outpatient visit are derived from the DMDC records.

3. Study Measures

The preceding section described the sources of data for the current research. This section describes how the exposure, outcome, and covariate measures were constructed for the existing data.

a. Classification of Exposure: Deployment

i. Exposure of Interest: Combat Deployment

Deployment status of the military family member constituted the exposure data for this research. The particular exposure of interest in this study was deployment to or around Iraq or Afghanistan in support of Operations Iraqi Freedom (OIF) or Enduring Freedom (OEF), respectively, with time spent in each operation counted separately in the data file for each operation. Deployment was measured as the number of months deployed during the four-year study period 2003-2006 and included a set of nominal indicator variables assessing to which operation(s) the military member was deployed during that time.

ii. Exposure Duration

As mentioned above, family member deployment status was measured by matching personnel data on the military family member and DoD deployment data during the study period (January 1, 2003 through December 31, 2006). Deployment was assessed as the total number of months deployed for this four-year period in combination with the aforementioned nominal categorical variables for operation(s).

b. Classification of Outcome: Mental Health Diagnosis

Mental health diagnosis was the outcome of interest for the current research and was defined as having at least one mental health-related International Classification of Diseases, 9th Revision (ICD-9) code out of four possible ICD-9 codes for a given outpatient medical visit. Mental health diagnosis was further classified into one of 14 categories based on ICD-9 coding (see Table 3.2) in order to assess the type of mental health outcome among the study population. See Appendix A for a list of specific ICD-9 codes by category. To increase the

specificity of a mental health diagnosis code for a current mental health diagnosis, all mental health full and partial remission ICD-9 codes were excluded in assigning mental health diagnoses during the study period. See Appendix B for a list of excluded codes.

c. Assessment of Potential Study Biases

As DoD deployment records were used for individual level exposure, exposure misclassification was theoretically possible, though believed to be unlikely. Outcome misclassification was more likely 1) based on inclusion of only care-seeking individuals, 2) based on incorrect coding of diagnosis and treatment, and 3) based on selection and/or omission of specific ICD-9 codes for mental health outcome classification. In this study, decreased sensitivity but increased specificity in outcome classification was a major determinant for diagnosis inclusion/exclusion. In doing so, a tradeoff between sensitivity and specificity in outcome classification was unavoidable considering some mental health diagnoses involve conditions that are not commonly brought on or exacerbated by environmental stress. Potential selection bias may have resulted from the study assumption that all persons experiencing mental health issues sought medical care, yet could not be assessed practically in the current retrospective cohort study. Diagnostic bias also may have been present since medical professionals were not blinded to the deployment status of the patient's military family member. Plans for future assessment of these potential biases through sensitivity analyses are discussed in greater detail in the Conclusion section.

d. Assessment of Potential Confounding and Effect Measure Modification

The assessment of potential confounding and effect measure modification in this research was limited to the variables included as part of the SADR outpatient medical record,

variables that could be constructed from these data, and available fields from the other DoD data sources. Table 3.2 presents all study variables, their definition, and their form in the original analysis data set.

Table 3.2. List of variables including covariates for assessment of confounding and effect measure modification.

FIELDS FOR DEPENDENT FAMILY MEMBER		
ID/DEMOGRAPHIC VARIABLES		
Name	Definition	Form
Pseudo ID	Pseudo 'SSN', random 9 digits, same family has same pseudo ID	Continuous
Family Member Prefix Code	Identifies child vs. spouse and order (1 st , 2 nd , etc.), with pseudo ID creates a unique ID for each individual	Continuous
Sex	Gender of family member	Categorical Male Female
Age	Age at time of medical encounter	Continuous
Race/Ethnicity	Self-identified race/ethnicity of family member	Categorical Asian/Pacific Islander Black Hispanic Amer. Indian/Alaska Native Other White Unknown
MEDICAL ENCOUNTER VARIABLES --- STUDY PERIOD (1/1/03 – 12/31/06)		
Name	Definition	Form
Encounter Date	Date of medical encounter	Continuous (SAS date)
Clinic Code	Unique identifier for each medical clinic	Categorical
ICD9-1, ICD9-2, ICD9-3, ICD9-4	Primary, secondary, tertiary, and quaternary diagnostic codes for each encounter, as ordered by provider	Continuous
Location (Installation)	Military installation where care was received; if purchased care visit, location (city, state or region) where care was received (as defined by DoD)	Categorical

Purchased Care Encounter	Was medical visit a purchased care encounter using military medical insurance off-base	Dichotomous No Yes
MEDICAL HISTORY VARIABLES --- 3 YEARS BEFORE STUDY PERIOD (1/1/00 – 12/31/02)		
Annual Outpatient Mental Health Encounters*	Number of outpatient visits in each of 14 mental health categories for each of the 3 calendar years prior to the study period (2000, 2001, 2002)	Continuous for each of the following categories [†] 1. Alcohol 2. Anxiety 3. Bipolar 4. Delirium, Dementia, & Other Cognitive Disorders 5. Depression 6. Dissociative 7. Drug 8. Impulse Control 9. Pediatric Behavioral Disorders 10. Personality 11. Psychotic 12. Sleep 13. Somatoform/Factitious 14. Stress
Annual Usage of Military Medical System	Presence of any inpatient and outpatient visits for each of the 3 calendar years prior to the study period (2000, 2001, 2002)	Dichotomous Yes No
FIELDS FOR MILITARY MEMBER		
Rank	Rank of the military member as of 1/1/07 or last record	Dichotomous Officer Enlisted
Deployment Status	Time military member spent (in days) deployed for each operation (OIF and OEF) by calendar year for study period (2003, 2004, 2005, 2006)	Continuous (8 variables)
Time in Military Service	Total number of days member was in the military as of 1/1/07	Continuous
Time in Active Duty	Total number of days member was in active duty as of 1/1/07	Continuous

*If a single outpatient visit between JAN 1, 2000 and DEC 31, 2002, yielded more than one type of mental health ICD-9 code, each code would count towards the total in its respective category for that calendar year.

[†]See Appendix for a list of ICD-9 codes and descriptions by mental health category

For family members, age, gender, race/ethnicity, mental health history, and relationship to the military service member, and for military members, rank, and time in the military were examined as the main covariates within this study. The outcome is known to vary in the general population by race/ethnicity and gender with the same effect measure modification examined here.⁴² Age was also considered as a likely effect measure modifier. It was decided a priori that history of mental health outpatient visits for the three years prior to the study period would be included to control for previous mental health history based on preliminary data analyses. Family member type identifies the patient's relationship to the military member (i.e., "child" or "spouse") and acted as an effect measure modifier in preliminary analyses. Although this is related to age, "child" does not stop at 18-years old and "spouse" can also be any age based on state laws. Rank of the military member was examined for confounding and effect measure modification in the current data as it may have been associated with an increased likelihood of deployment, as well as an increased risk of injury or death, which may increase acute stress in family members.

For assessment of confounding, a change-in-estimate of 10 percent or greater was used in comparing effect measures. Preliminary analyses confirmed the likelihood of obtaining extremely low p-values for the Breslow-Day test of homogeneity simply due to large sample size. For this reason, comparison of stratum-specific measures of effect and their confidence intervals were used to assess effect measure modification. Similarly, due to the large sample size, confidence intervals rather than p values were used to indicate meaningful differences for all analyses.⁵²

4. Data Analyses

a. Quality Control

This research did not involve original data collection. The DMSS data do not likely suffer from significant errors or inconsistencies in the data at the point of collection and entry.

b. Review of Study Hypotheses

The primary outcome for this research was a mental health diagnosis. The study hypotheses arising from each of the three research questions, evaluated separately for spouses and for children, were as follows:

Research Question 1: What is the association between prolonged (i.e., 7 months or more) operational deployment of an immediate family member and being diagnosed with a mental health problem among family members of U.S. Army active duty personnel? **Study Hypothesis 1:** It was hypothesized that the risk and rate of medical visits yielding a mental health diagnosis versus a non-mental health diagnosis would be greater among the immediate family members of military personnel who were operationally deployed for more time between 2003 and 2006 as compared to dependents of military personnel who were not operationally deployed or deployed for less time during the same period.

Research Question 2: To what extent is the association between mental health diagnosis and deployment for combat operations modified by a range of covariates, including age, gender, race/ethnicity, mental health history, the military member's rank, time in service, and time in active duty? **Study Hypothesis 2:** It was hypothesized that the risk and rate of mental health diagnose attributable to longer deployment (aim 1) would be modified by age, gender, race/ethnicity, mental health history, the military member's rank, and time in service. Prior studies support variation in mental health diagnoses based upon age, gender,

race/ethnicity, and mental health history. The military member's rank and time in service were expected to be positively associated with age. As such, they were expected to modify the association in aim 1, though they were not expected to yield substantial effect measure modification.

Research Question 3: Are there observed differences in the types of mental health diagnoses among immediate family members of military personnel based upon the military member's current combat deployment status? **Study Hypothesis 3:** If the association described in aim 1 was detected, it was expected to vary across various specific categories of mental health diagnoses. Existing literature within military families has been extremely limited, but when combined with prior studies in the general population, suggests the categories of alcohol, anxiety, bipolar, depression, drug, and stress may yield stronger associations compared to other categories in the current study.

Research Question 4: Does the association between prolonged (i.e., 7 months or more) operational deployment of an immediate family member and being diagnosed with a mental health problem vary between the spouses and children of U.S. Army active duty personnel? **Study Hypothesis 4:** If the associations stated in Aims 1-3 were present, it was expected they would vary between the spouses and children of military personnel. Prior studies support variation in mental health diagnoses based upon age and gender. Females are more likely to seek treatment for and be diagnosed with certain types of mental health disorders.^{41,42} In addition, the median age of onset varies by type of disorder, with anxiety and impulse-control typically emerging in childhood and substance use and mood disorders typically emerging in early adulthood.⁴³ Compared to children in military families, military spouses are both older and more likely to be female. To help elucidate important differences

in deployment and a mental health diagnosis between these groups, data on spouses and children were analyzed and reported separately in the current study

c. Statistical Analyses

The statistical analysis resulted from the study's specific aims and research questions. The procedures general to all three study hypotheses are addressed first. The specific analyses for each research question follow the general discussion.

i. Descriptive Analyses

The data analysis began by examining the distributions of key variables to assess normality, linearity, the nature of the continuous variables and the distribution of the categorical variables. As the data fields used in this analysis are mandatory for each electronic medical record, missing data were not expected, or expected to be appreciable, as confirmed in the analysis of preliminary data.

ii. Crude Associations

Deployment of 7 or more months for OIF/OEF was compared to deployment for less than 7 months (including no deployment), and mental health was examined both in terms of any mental health diagnosis, as well as in terms of category-specific diagnoses (see Table 3.2). These relationships and all data analyses were assessed using linear risk and negative binomial regression models in the SAS Version 9.2.⁵³

iii. Multivariate Analyses

Linear risk models were used to produce risk difference effect measures, representing the additional risk of having a mental health diagnosis attributable to having a military member

operationally deployed 7 or more months (the median number of months deployed for spouses and children) compared to operational deployment of less than 7 months or no deployment. Although Poisson regression is typically used to model count response data, its distribution assumes equality of the mean and variance.⁵⁴ The large majority of family members did not have a mental health diagnosis during the study period. Consequently, the variance exceeded the mean resulting in overdispersion. Negative binomial regression is a standard method used to model overdispersed Poisson data. Examination of various models (i.e., Poisson, zero-inflated Poisson (ZIP), negative binomial, zero-inflated negative binomial (ZINB)) in both spouses and children confirmed that a negative binomial model best fit the data after adjusting for necessary covariates (see Figures 3.1 and 3.1). Negative binomial regression models were used to produce count ratio effect measures, representing the relative number of mental health diagnoses among individuals with a military member operationally deployed 7 or more months versus 7 or fewer months.

Figure 3.1: Regression model choice for modeling rate of mental health visits in spouses.

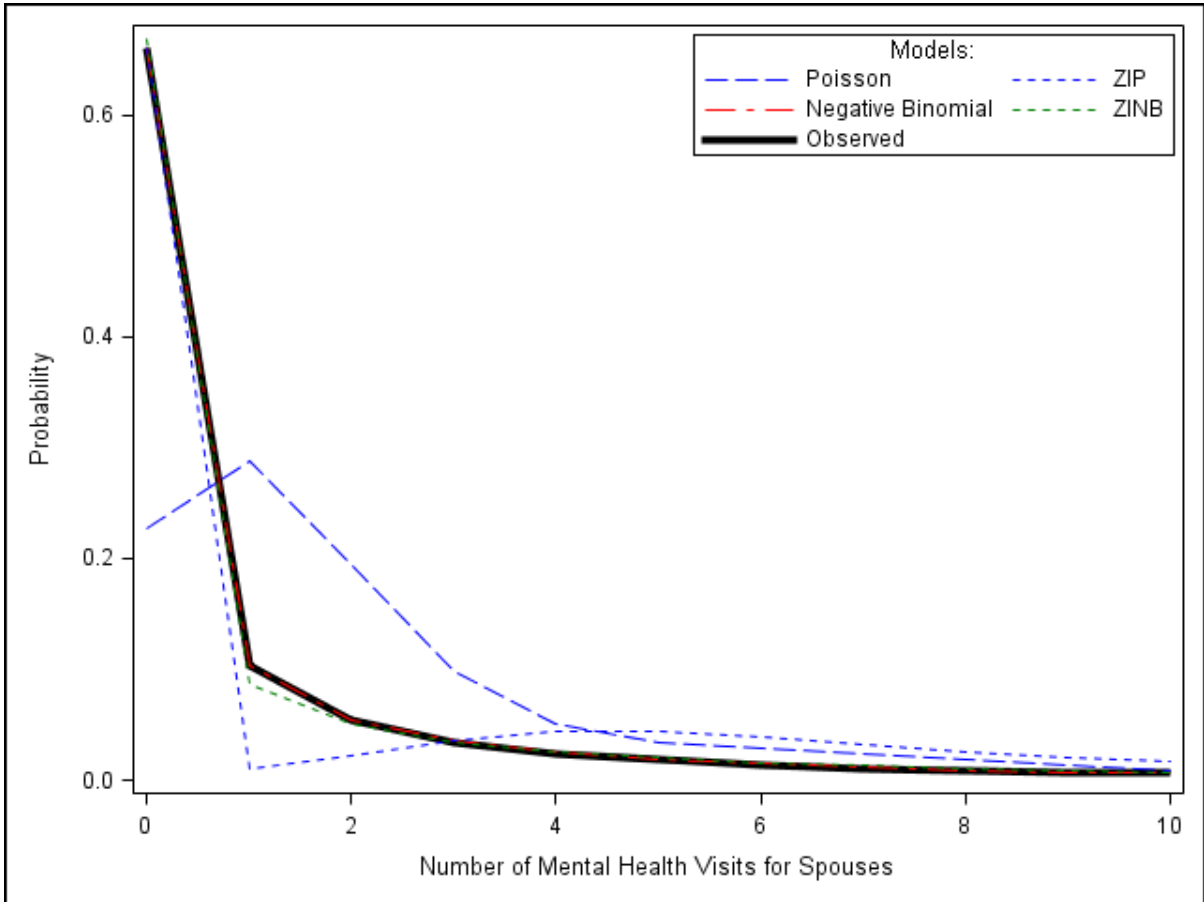
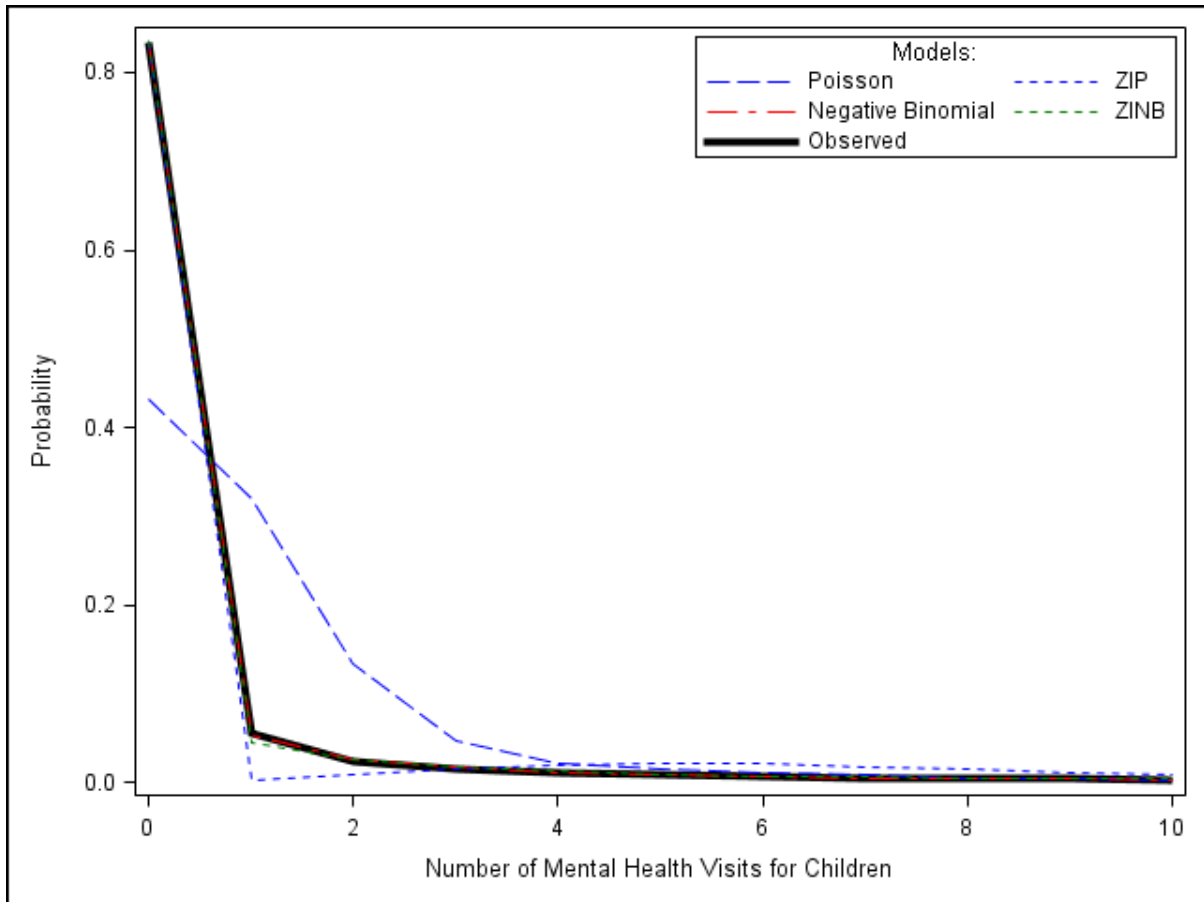


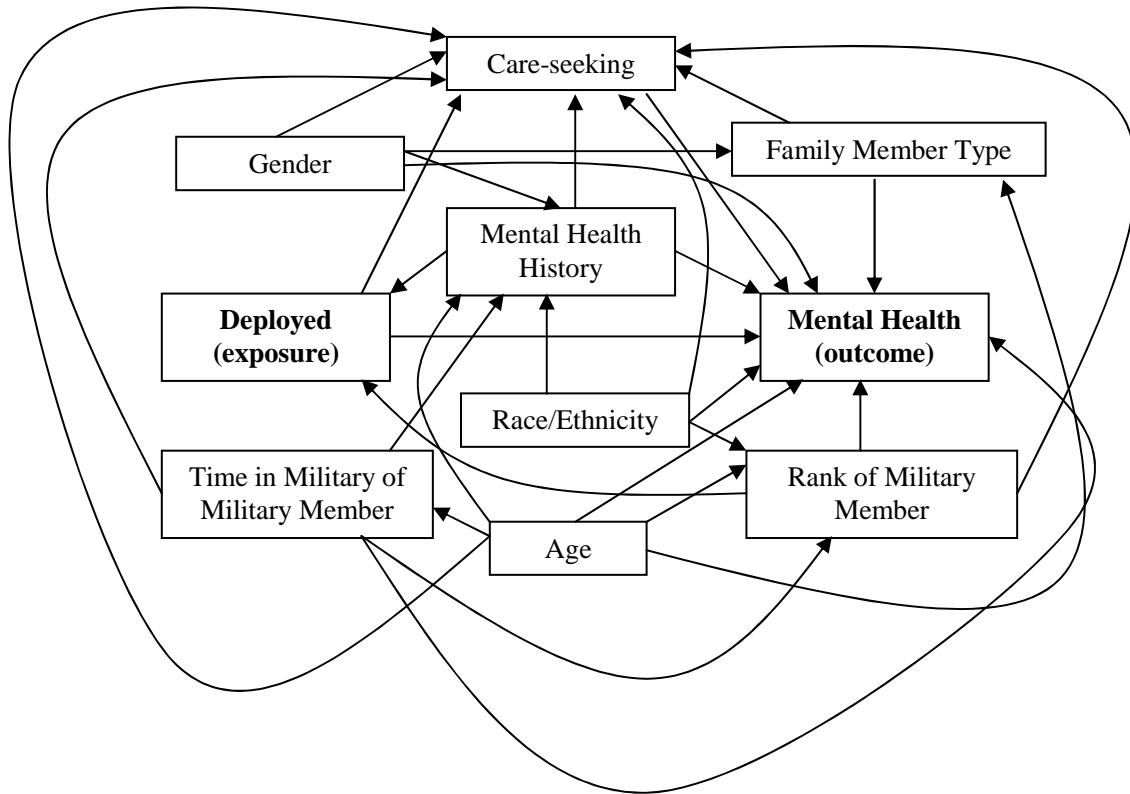
Figure 3.2: Regression model choice for modeling rate of mental health visits in children.



For aforementioned reasons, the relationship between deployment and a mental health diagnosis was examined separately for children and spouses of military personnel in the current study. To assess potential non-independence as a result of children clustered within families, risk difference models were assessed for robustness using generalized estimating equations. The size of the children’s data set (i.e., 348,012 children within 176,932 families) and unique individual- and family-specific identification codes allow for this type of analysis. As negative binomial models can be overdispersed and used to model correlated data, regardless of the cause, these models were not examined for any effects of clustering.⁵⁴

Model building and testing were conducted to identify variables that confounded, or modified this relationship. A change in estimate of 10 percent or greater indicated confounding and marked a covariate it for inclusion in the final model.⁵⁵ Confounding between variables can be represented using a directed acyclic graph (DAG).⁵⁶ Based on the DAG for this research and presented in Figure 3.3, the following variables were identified and explored as potential confounders of the deployment-mental health relationship: Gender, Age, Family Member Type, Mental Health History, Race/Ethnicity, Rank of Military Member, Time in Military of Military Member, and Care-seeking. With the exception of Care-seeking, each of these variables appeared in multiple unblocked backdoor paths, and as such, was included in the full model and assessed individually for potential confounding using the aforementioned change-in-estimate criterion. It should be noted that Care-seeking acts as a collider in the DAG for all backdoor paths except where it is followed immediately by the outcome. However, this research conditioned on care-seeking by including only persons who sought medical care during the study period. This can create a correlation between the exposure and the outcome for any variables (measured or unmeasured) affecting both care-seeking and the exposure. This selection bias was a known limitation of the data and is discussed in greater detail in the Results and Conclusion sections of this document.

Figure 3.3: Directed acyclic graph (DAG) for the association of deployment with a mental health diagnosis.



d. Study Size and Power Analysis

Because data were already collected and the study size was large and predetermined, there was no a priori selection of alpha and beta. Even so, the extremely large sample size in this study suggested that hypothesis testing would not be as useful since many tests would come out significant simply due to sample size. Instead, the focus for data analysis was placed on estimation of effect measures and comparison of confidence intervals rather than on traditional alpha and beta values used in hypothesis testing. The follow-up period in this study was four years. Because these data are electronic medical surveillance data, include the *only or most likely* sites of medical care acquisition for all study participants, and because

participants do not enroll *per se*, loss to follow-up was expected to be negligible. Based upon preliminary data which measured deployment at a more macro (i.e., installation) level, roughly 5% of medical services were for mental health reasons in both exposure populations. This was expected to vary once deployment was estimated at the individual level, as well as vary when more recent data (i.e., since the January-July 2003 preliminary data period) were included in the analysis. Specifically, the assessment of deployment at a finer level of analysis (i.e., family) was expected to result in greater observed variation in mental health diagnoses between the exposed and unexposed groups.

5. Human Subjects

The proposed research received approval by the Institutional Review Board (IRB) of the UNC-Chapel Hill School of Public Health (Public Health IRB #04-2335, approved AUG 2004 and subsequently renewed 2005), and was exempted from IRB oversight (AUG 2006). Approval was also granted by the IRB of the Uniformed Services University of the Health Sciences (USUHS, IRB #HU88LC), which also exempted the proposed research from IRB oversight (SEP 2007).

These data are a subset of surveillance data maintained by the Department of Defense (DoD) for active duty military and their dependents, if eligible for medical care through the military, and housed at the AFHSC. The data are de-identified, but are not part of a public use data set. The data are only accessible a) by individuals working for or through the U.S. Department of Defense, and/or b) by formal request to obtain the data in hard copy for analysis. A data request was provided to the AFHSC to obtain these data for the proposed analysis. Because the AFHSC is not a covered entity, HIPAA does not apply.

Data elements for this research are listed in the Study Measures section above. The data do not contain personal identifiers, and instead, records are linked using a pseudo-social security number. The link file(s) containing name and/or the actual social security number (SSN) of the individual, as well as the algorithm used to create the pseudo-SSN, are maintained by the AFHSC and were stripped of these fields before being transferred for the purpose of this research. The data set did not contain variables such as name, ID number (SSN or other government ID), address, or date of birth, or any of these variables for the military member associated with the dependent's data record. Although some demographic information was included with the data set, the total number of medical visits, even broken down by point of care, would make it impossible to identify an individual using only the information within the limited data set.

a. Inclusion of Women and Minority Groups

This research made no attempt to exclude or limit the number of women or minority groups either in the acquisition of data. As a result, it was expected that the percentages of each, respectively, would reflect the gender and minority distribution within the U.S. military dependent community.

b. Inclusion of Children

Children of military personnel were one group targeted by the current research to determine the effect of a parent's deployment on the child's mental and emotional well-being. Therefore, no exclusion of children in the acquisition of data occurred. Because the outcome under investigation relates to the diagnosis and treatment of mental health disorders, some of which may not be clinically relevant for certain age groups, children who had not yet

achieved an age at which a reliable clinical diagnosis can be made were eventually excluded from the data analysis.

c. Exclusion of Potentially Identifiable Racial/Ethnic Groups

Although the de-identification and large volume of data (i.e., over 12 million records) in this study made it extremely unlikely that any individual could be identified, the small number of subjects expected for certain ethnic groups raised some concern. Specifically, using a combination of demographic variable within a given military installation for the small number of individuals likely to be classified as American Indian/Alaska Native or Native Hawaiian or other Pacific Islander could make identification possible. In the end, the race/ethnicity variable was excluded from analyses due to a large percentage of missing data for both spouses and children, thus eliminating the need to exclude certain ethnic groups from analysis.

IV. RESULTS

A. Paper 1: Mental Health Diagnoses in Spouses of Military Personnel Deployed in Support of Operation Iraqi Freedom and Operation Enduring Freedom

1. Introduction

Mental health research involving warfare of the past generation indicates that frequent or extended deployment of military units leads to increased stress, anxiety, and depression among military personnel¹⁻³ and their family members.⁴⁻⁷ However, current warfare in Iraq and Afghanistan differs greatly from that of recent conflicts involving the United States. Combat undertaken during the first Persian Gulf War ended quickly and with relatively few U.S. casualties. In contrast, current operations have involved the first sustained ground combat since the Vietnam War, followed by a period of insurgent attacks that regularly claim U.S. lives. In the same number of months, nearly six times as many hostile deaths occurred from Operation Iraqi Freedom than occurred during Operations Desert Shield and Desert Storm in the first Persian Gulf War (August 1990-September 1991) combined.^{8,9}

Recent studies report significant mental health problems among a large proportion of service members returning from Iraq and Afghanistan.^{2, 10, 11} The psychosocial burden on families of deployed military personnel is less well understood, and perhaps not comparable to previous deployments given current conditions of service. Besides added fear for loved ones' safety, spouses of deployed personnel may face the challenges of maintaining a household,

coping as a single parent, and potential marital strain due to deployment-induced separation of uncertain duration. Studies examining the effects of deployment on spouses have shown increased rates of marital dissatisfaction, unemployment, divorce, and declining emotional health.^{4, 7, 12} However, previous research is often limited to short deployment periods (i.e., 6 months or less)⁷ or limited combat operations (e.g., Operation Desert Storm),^{4, 5, 7} making generalization to current operations difficult. Furthermore, existing studies have involved small samples, low survey response rates, and lack of medical data leaving gaps in understanding the effects of combat deployment on mental health in military spouses.

Increased levels of acute and long-term stress among military family members surrounding the deployment period is a potential mechanism for development of mental health problems. The association between stressful life events and the subsequent onset or recurrence of psychopathology, including depression,¹³⁻¹⁶ substance use and abuse,¹⁷⁻²⁰ and bipolar disorder^{21, 22} is well documented, though understudied in military families.

We estimated the association between operational deployment and mental health diagnoses among spouses of U.S. Army active duty personnel. We hypothesized that the risk and rate of medical visits yielding a mental health diagnosis would be greater among spouses of military personnel with more time spent in operational deployment between 2003 and 2006. Additionally, we expected these relationships to vary across specific categories of mental health disorders and to be modified by demographic and military variables, as well as by spousal mental health history.

2. Methods

a. Participants

We examined electronic medical record data for all outpatient medical visits occurring between January 1, 2003 and December 31, 2006 among spouses of non-retired, active duty U.S. Army personnel aged 18-48 years who either a) obtained outpatient medical care from a treatment facility located on a U.S. military installation, or b) utilized military medical insurance for an outpatient medical visit at a non-military healthcare facility. We imposed an age ceiling of 48 years based upon several factors. First, the distribution of age by months deployed for the study period indicated a sharp drop-off in sponsor deployment for spouses aged 45 years and older. Second, although the mandatory age of retirement for U.S. Army personnel is 62 years, increased in 2006 from age 55 or 60 depending on rank,²³²⁴ most retire or leave the service well before this age.²⁵ Third, we assumed that spousal age is similar to the military sponsor.

We excluded spouses of Reserve and National Guard personnel as their beneficiaries do not generally receive military medical benefits until the sponsor is called up to active duty. Further, we included only spouses whose military members were in active duty service for a period of time greater than or equal to five years as of January 1, 2007. Five years was required to exclude families of personnel who joined the military during the four-year study period, and included an additional year immediately prior to the study to establish a recent mental health history.

b. Data Sources and Measures

Outpatient medical visit data originated from the Standard Ambulatory Data Record (SADR) and TRICARE Enrolled Dependent (TED) data. SADR is a mandatory collection and reporting system for all outpatient medical visits at military medical facilities with data stored in the Defense Medical Surveillance System (DMSS) and maintained by the Armed Forces Health Surveillance Center. TED data feed into the DMSS and contain complete billing code information for medical care received outside of a military medical treatment facility, but using the military's medical insurance system. The DMSS also contains information on military sponsors from the Defense Manpower Data Center's (DMDC) deployment, personnel, and gain/loss rosters. Military member's rank, total time in service and active duty as of January 1, 2007, and total number of months deployed for Operations Iraqi Freedom (OIF) or Enduring Freedom (OEF) from January 1, 2003 through December 31, 2006, were derived from DMDC records.

c. Mental Health Diagnosis

A mental health diagnosis was defined as having at least one mental health-related International Classification of Diseases, 9th Revision (ICD-9) code out of four possible codes for a given outpatient medical visit, and was classified into one of 14 categories^{*}: Alcohol; Anxiety; Bipolar; Delirium, Dementia, & Other Cognitive Disorders; Depression; Dissociative; Drug; Impulse Control; Pediatric Behavioral Disorders[†]; Personality; Psychotic; Sleep; Somatoform/Factitious; and Stress. To increase sensitivity and specificity of a mental health diagnosis code for a current mental health diagnosis, we excluded codes for mental health

^{*} See appendix C for ICD-9 codes by category

[†] Though commonly diagnosed in childhood and adolescence, this category includes diagnoses also given to individuals aged 18 years and older (e.g., conduct disorder).

conditions in full and partial remission given during the study period. Mental health history was determined using these same 14 categories for diagnoses occurring between January 1, 2000 and December 31, 2002, and included remission codes.

d. Data Analysis

We used linear risk and negative binomial regression models to obtain risk difference and rate ratio effect measures, respectively, attributable to deployment in support of OIF or OEF and based on median months of deployment. We conducted model building and testing to identify variables that confounded or modified this relationship. A change-in-estimate of 10 percent or greater indicated confounding.²⁶ Main covariates included age, gender, mental health history, preferred installation, and military member's rank and time in service. We decided a priori to include outpatient mental health diagnoses for the three years prior to the study period in all models to control for mental health history. Specifically, 15 dichotomous variables were created to indicate the presence or absence of any outpatient diagnosis for each of the 14 categories and overall. Due to the large sample size, we used confidence intervals rather than p values to indicate meaningful differences.²⁷ All data analyses were conducted using SAS software Version 9.2 (SAS Institute, Cary, NC).

This study was reviewed and exempted from the Institutional Review Boards of the University of North Carolina-Chapel Hill School of Public Health (UNC Public Health IRB #04-2335, exempted August 2006), and the Uniformed Services University of the Health Sciences (USUHS IRB #HU88LC; exempted September 2007).

3. Results

The sample included 6,823,281 outpatient visits for 267,126 spouses, of whom 33.9 percent had at least one mental health diagnosis during the study period. One in five diagnoses was for depression (21.5 percent), with anxiety (12.3 percent), stress (12.2 percent) and sleep (7.8 percent) disorders also commonly diagnosed (Table 5.1). The majority of military sponsors deployed during this time, either supporting OIF only (54.6 percent), OEF only (6.6 percent), or both operations (6.8 percent). The remaining service members (32.0 percent) did not deploy for any operations. Individuals with and without a mental health diagnosis were of similar age, sponsor years in military and active duty, and mean months of OEF deployment. Compared to individuals without a mental health diagnosis, individuals with a mental health diagnosis were more likely to be female, non-Hispanic White, and have more outpatient visits for any reason. Spouses of personnel who were enlisted or deployed for more months to OIF were also more likely to have a mental health diagnosis (Table 5.1). Characteristics of the military sponsor were similar when specific categories of diagnoses for their spouses were compared, with the exception of rank, which showed greater variability by category. For spouses with at least one mental health diagnosis, age did not vary by category. However, differences were observed for total outpatient visits and gender. Data on race or ethnicity were missing for over half (53.5 percent) of participants. Although there was no evidence of confounding (e.g., mean months deployed \approx 11.5 for all racial/ethnic groups), race/ethnicity was excluded from data analysis given the extent of missing data.

We created a binary deployment measure to facilitate modeling based upon the median total months deployed from 2003-6 for military sponsors (7 months) and used this measure for all regression analyses. Besides mental health history, age, gender, and operation

emerged as likely confounders of the spousal deployment-mental health diagnosis relationship and were included in all models. Risk difference results are expressed as the number of excess cases of mental health diagnoses among spouses, attributable to deployment of 7 months or more from 2003 to 2006, per thousand personnel deployed. After adjustment, the number of excess cases for any mental health diagnosis was 34.7 (95 percent confidence interval (CI): 29.7 – 39.6). Among specific categories, the greatest effects were observed for disorders of depression (22.7 excess cases; 95 percent CI: 18.4 – 26.9), sleep (15.8 excess cases; 95 percent CI: 12.9 – 18.6), stress (15.2 excess cases; 95 percent CI: 11.7 – 18.8), and anxiety (13.2 excess cases; 95 percent CI: 9.8 – 16.6) (Table 5.2). Though smaller in comparison, excess cases were also observed for diagnoses of alcohol (1.8 excess cases; 95 percent CI: 0.7 – 2.8), drug (2.0 excess cases; 95 percent CI: 1.0 – 3.1), personality (1.6 excess cases; 95 percent CI: 0.6 – 2.7), psychotic (1.8 excess cases; 95 percent CI: 0.7 – 2.9), and bipolar disorders (2.2 excess cases; 95 percent CI: 0.8 – 3.7).

The rate of mental health diagnoses followed a pattern similar to attributable risk. Compared to fewer months or no deployment, the rates of diagnoses associated with 7 or more months deployment were 11 to 24 percent higher for depression (rate ratio (RR) = 1.13, 95 percent CI: 1.09 – 1.17), sleep (RR = 1.24, 95 percent CI: 1.18 – 1.30), stress (RR = 1.12, 95 percent CI: 1.07 – 1.17), and anxiety (RR = 1.11, 95 percent CI: 1.07 – 1.17). Though less precise, rates were 22 percent higher for drug (RR = 1.22, 95 percent CI: 1.04 – 1.43) and personality (RR = 1.22, 95 percent CI: 1.04 – 1.44) disorders, and 56 percent higher for pediatric behavioral disorders (RR = 1.56, 95 percent CI: 1.09 – 2.23). The rate of mental health diagnoses for all categories combined was 13 percent higher (RR = 1.13, 95 percent

CI: 1.10 – 1.16) when periods of longer versus shorter or no deployment were compared (Table 5.2).

A test of the deployment \times installation product interaction term in the adjusted models was conducted to determine if the effect of deployment on mental health diagnosis was constant across Army installations. Results indicated heterogeneity of the risk difference (chi-square = 146.30, df = 19, Wald $p < .0001$) and rate ratio (chi-square = 125.57, df = 19, Wald $p < .0001$) based upon the installation where spouses received most of their outpatient care during the study period (hereafter “preferred installation”). Consequently, we examined the relationship between deployment and any mental health visit separately for the top 20 preferred installations, representing roughly two-thirds of spouses (Table 5.3). Though more than half of these installations showed excess mental health diagnoses associated with longer deployment, results were not constant across locations. More excess cases were found for installations deploying a larger percentage of their troops to Iraq and Afghanistan. These included Forts Campbell (69.3 excess cases; 95 percent CI: 47.3 – 91.3), Stewart (62.4 excess cases; 95 percent CI: 37.2 – 87.6), Carson (55.3 excess cases; 95 percent CI: 29.4 – 81.2), Polk (53.3 excess cases; 95 percent CI: 15.5 – 91.0), and Benning (50.6 excess cases; 95 percent CI: 21.8 – 79.4). In contrast, we did not observe excess cases of mental health diagnoses attributable to deployment for large catchment areas, but with fewer deployed personnel relative to the local troop strength (e.g., Washington D.C., Landstuhl/KMC).

Differences in diagnosis rates for these 20 installations showed similar results (Table 5.3). With the exception of Fort Campbell (RR = 1.11, 95 percent CI: 0.99 – 1.24), the rates of mental health diagnoses associated with more versus less time deployed were 18 to 39 percent higher at Forts Stewart (RR = 1.39, 95 percent CI: 1.21 – 1.60), Carson (RR = 1.38,

95 percent CI: 1.20 – 1.58), Polk (RR = 1.37, 95 percent CI: 1.13 – 1.65), Benning (RR = 1.25, 95 percent CI: 1.06 – 1.47), and Hood (RR = 1.18, 95 percent CI: 1.05 – 1.32).

Although excess mental health diagnoses associated with longer deployment was more modest at Fort Bragg (38.3 excess cases; 95 percent CI: 22.1 – 54.4) relative to other bases deploying large numbers of troops, the mental health diagnosis rates among spouses were more disparate between deployment groups (RR = 1.23, 95 percent CI: 1.13 – 1.35) at this installation.

4. Discussion

We examined mental health diagnoses among spouses of active duty Army soldiers in conjunction with deployment supporting Operations Iraqi Freedom and Enduring Freedom. To our knowledge, this is the first large-scale investigation of mental health problems in military families relating to the current conflicts in Iraq and Afghanistan. Our findings indicate that after controlling for individual and sponsor characteristics, prolonged periods of spousal deployment for these operations are associated with an increased risk of mental health diagnoses and more visits for mental health diagnoses over time (Table 5.2). This was most apparent for depression, anxiety, stress and sleep disorders, but was also observed for substance use/abuse, bipolar, personality, and psychotic disorders. That increased risks and rates were absent for disorders that would not be expected to vary with deployment (e.g., delirium, dementia and other cognitive disorders), particularly given the power to detect such differences with a very large sample, lends additional support to our findings. Overall, our data suggest that the mental health effects of current operations are extending beyond service members and into their immediate families.

Differences in psychiatric diagnoses observed between military installations seem to be associated with the number of personnel deployed rather than installation size. Larger installations have more and larger medical treatment and specialty care facilities since they are responsible for serving a larger population. In turn, they will see and treat more patients for mental health problems relative to facilities serving smaller military communities. Extended and multiple troop deployments for OIF and OEF have included over 20,000 soldiers with the 101st Airborne Division (Fort Campbell), 19,000 soldiers with the 3rd Infantry Division (housed between Forts Stewart and Benning), 35,000 soldiers with the 4th Infantry or 1st Cavalry Divisions (both at Fort Hood), 5,200 soldiers with the 3rd Armored Cavalry Regiment (Fort Carson), and thousands more from the 10th Mountain Division (Fort Drum), the 82nd Airborne Division (Fort Bragg), and the 2nd Armored Cavalry Regiment (Fort Polk). That both the risk and rate of diagnoses were higher at these installations, from which personnel deployed more frequently or in greater numbers, and not necessarily installations treating more active duty army spouses, supports our general finding that deployment is a contributing factor to mental health problems among spouses.

Our research has several strengths. Medical care received through the military health system comes at little or no cost to dependents of active duty personnel. As such, access to medical care is fairly equalized among the study population and makes cost an unlikely barrier to care-seeking in this population. Further, we included outpatient medical visits where military medical insurance was used outside of a military installation, thus making it unlikely we missed an appreciable amount of data on family members who sought care somewhere other than a military medical facility. Additionally, our sample is quite large and

captures a substantial proportion of the nearly 300,000 active duty army spouses in the target population,²⁸ facilitating statistical inference and generalizability.

Our use of administrative data was essential to obtain the high volume of records, but meant that measures of mental health were in the form of diagnostic codes. This relied upon assumptions of coding validity and reliability, in general, and the use of codes by medical professionals, specifically. Reliance upon these codes may represent an insensitive method of ascertaining current and past mental health status in this study. A potential diagnostic bias may also be present since medical professionals would not necessarily be blinded to the deployment status of the service member. Neither issue could be addressed given our retrospective design. Spouses with good jobs who utilize employer medical benefits may represent unmeasured diagnoses in our research. While likely to be higher functioning, it is unlikely effects of their utilization would vary with deployment. Though race and ethnicity did not appear to confound the relationship between deployment and mental health, the amount of missing data precluded a thorough analysis of its effects. Previous research has reported racial and ethnic differences in attitudes towards seeking care for mental health services.²⁹ Future work should determine if this finding is supported in military populations.

Lack of information on service members represents another limitation. Data on injury and death of personnel during the study period were not included, yet could greatly impact spousal mental health. We also did not include details on the mental health of the military member, which could impact a spouse's knowledge and attitudes about psychiatric conditions and treatment. Partners of military members dealing with mental health problems may be more attuned to symptoms, aware of resources and willing to seek professional help. However, the stigma associated with seeking care for mental health concerns has been well

documented within military personnel.^{2, 30} Spouses may share these concerns about stigmatization and avoid seeing a medical professional, in which case our results would underestimate mental health problems in the military beneficiary population. As such, the true attributable risk of mental health disorders is unknown as the data include only persons seeking medical care during the study period. Similarly, it is possible that an individual was prescribed medication to treat the symptoms of a mental health problem, but was not assigned a corresponding mental health diagnostic code for that particular encounter. As we did not include prescription data, these individuals would not be counted as having a mental health diagnosis. Still, such occurrences would underestimate the true incidence of mental health problems in the study population, and, as they are not expected to occur differentially by deployment status of the military member, are unlikely to have had an appreciable effect on our results.

The exclusion of spouses whose sponsor had been in the military less than 5 years as of January 1, 2007, spouses of Reserve and Guard personnel, and spouses of personnel from other service branches limits the generalizability of our findings. Without presumption that outpatient mental health care would be received through the military medical system, assessment of mental health care prior to and during the study period could not be conducted with any certainty for these individuals. Though controlling for mental health history dictated their exclusion, family members new to military life or deployment are an important group whose experiences are worthy of research attention, and whose outcomes may differ markedly from those in the current work.

Our findings have important public health implications. The 34.7 excess cases of any mental health diagnosis attributable to deployment per thousand deployed personnel

translates into 4,837 excess mental health diagnoses among spouses of 139,399 personnel deployed for 7 months or more between 2003 and 2006 in this study. Because the majority of active duty army personnel are married,²⁸ and they and their families will eventually receive care outside of the military medical system, both the short- and long-term impact of these findings should be considered in the planning of programs and allocation of mental health resources within the military community. Currently, military leaders go to great lengths to offer services and support to families of deployed personnel. Such action has likely mitigated the effect of deployment on the mental health of family members given the length and hazards associated with current operations. Greater attention is being paid to the mental health of returning soldiers.³¹⁻³³ Our findings support increased efforts aimed at family members, specifically on military installations deploying greater numbers of troops. Future studies similar to ours should be conducted among Navy, Marine Corps, and Air Force spouses to better characterize the effects of deployment on family member mental health in all service branches. Further, additional studies are needed to assess mental health using survey and clinical interview data, either apart or in tandem with medical surveillance data, and should include spouses of both active duty and Guard/Reserve personnel.

Table 5.1. Characteristics based on any diagnosis, no diagnosis, and specific types of mental health diagnoses

<i>Any Diagnosis 2003-6</i>	<u><i>Spousal Characteristics</i></u>				<u><i>Military Member Characteristics</i></u>				
	<i>N (%) individuals with diagnosis</i>	<i>Mean (SD) Age, years</i>	<i>% Male</i>	<i>Mean (SD) Outpatient Visits</i>	<i>Mean (SD) Years in Military</i>	<i>Mean (SD) Years Active Duty</i>	<i>% Officer</i>	<i>Mean (SD) OEF Months</i>	<i>Mean (SD) OIF Months</i>
Alcohol	2,873 (1.1)	31.6 (7.1)	12.0	47.8 (47.1)	12.3 (5.2)	11.7 (5.2)	13.6	1.1 (3.4)	7.9 (7.5)
Anxiety	32,907 (12.3)	32.4 (6.6)	1.6	48.0 (41.7)	13.4 (5.1)	12.7 (5.1)	21.6	1.2 (3.5)	7.6 (7.3)
Bipolar	6,059 (2.3)	31.5 (6.5)	2.3	61.8 (52.8)	12.6 (5.0)	11.9 (5.0)	15.8	1.2 (3.6)	7.5 (7.4)
Delirium, Dementia & Other Cognitive	1,585 (0.6)	33.2 (6.6)	3.2	70.6 (65.1)	13.7 (5.1)	13.0 (5.2)	21.5	1.2 (3.5)	7.2 (7.2)
Depression	57,543 (21.5)	32.0 (6.6)	1.9	44.1 (38.5)	13.2 (5.1)	12.4 (5.1)	20.3	1.2 (3.5)	7.6 (7.4)
Dissociative	122 (0.0)	33.7 (6.7)	1.6	92.2 (87.9)	14.0 (4.8)	13.3 (5.1)	17.2	0.7 (2.4)	6.4 (7.9)
Drug	2,723 (1.0)	31.8 (6.9)	7.3	70.6 (70.1)	12.6 (5.1)	11.9 (5.1)	11.9	1.1 (3.5)	8.0 (7.5)
Impulse Control	331 (0.1)	32.2 (6.6)	9.1	67.5 (67.2)	12.7 (5.1)	11.9 (5.1)	16.0	1.2 (3.5)	7.2 (7.5)
Pediatric Behavioral	403 (0.2)	31.6 (6.5)	3.7	54.2 (47.5)	12.7 (5.2)	12.2 (5.1)	15.6	1.2 (3.5)	7.1 (7.4)
Personality	2,846 (1.1)	31.1 (6.5)	2.1	69.3 (57.8)	12.4 (5.0)	11.7 (5.0)	16.0	1.1 (3.3)	7.9 (7.6)
Psychotic	3,204 (1.2)	32.4 (6.6)	2.7	61.8 (58.0)	13.3 (5.2)	12.6 (5.2)	18.8	1.1 (3.3)	7.5 (7.4)
Sleep	20,914 (7.8)	33.3 (6.7)	4.0	51.4 (45.2)	13.8 (5.1)	13.1 (5.2)	20.2	1.1 (3.4)	7.8 (7.5)
Somatoform, Factitious	642 (0.2)	33.0 (6.8)	2.8	74.4 (68.2)	13.7 (5.1)	12.9 (5.2)	21.3	1.1 (3.8)	7.9 (7.6)
Stress	32,480 (12.2)	32.0 (6.5)	2.5	48.1 (41.8)	13.2 (5.1)	12.5 (5.1)	20.3	1.2 (3.5)	7.7 (7.4)
Composite									
Any Diagnosis	90,599 (33.9)	32.2 (6.7)	2.9	40.4 (35.8)	13.3 (5.1)	12.6 (5.2)	20.8	1.2 (3.5)	7.5 (7.4)
No Diagnosis	176,527 (66.1)	32.2 (6.9)	5.8	17.9 (18.8)	13.3 (5.2)	12.7 (5.3)	23.5	1.0 (3.3)	6.6 (7.2)
Total Sample	267,126 (100)	32.2 (6.8)	4.8	25.5 (28.0)	13.3 (5.2)	12.7 (5.3)	22.6	1.1 (3.4)	6.9 (7.3)

SD denotes standard deviation

Table 5.2. Adjusted number of excess cases of mental health diagnoses per 1000 spouses attributable to deployment of their service member partners and adjusted rate ratios for association between deployment and number of mental health visits among spouses, by diagnostic category

Category	Number of excess cases per thousand (95% CI)	RR (95% CI)
Alcohol	1.8 (0.7 – 2.8)	1.13 (0.95 – 1.33)
Anxiety	13.2 (9.8 – 16.6)	1.11 (1.07 – 1.17)
Bipolar	2.2 (0.8 – 3.7)	1.08 (0.95 – 1.22)
Delirium, Dementia, or other Cognitive Disorder	0.4 (-0.4 – 1.2)	1.01 (0.84 – 1.22)
Depression	22.7 (18.4 – 29.9)	1.13 (1.09 – 1.17)
Dissociative*		1.32 (0.52 – 3.31)
Drug	2.0 (1.0 – 3.1)	1.22 (1.04 – 1.43)
Impulse Control	0.1 (-0.3 – 0.4)	1.04 (0.64 – 1.70)
Pediatric Behavioral Disorder	0.5 (0.1 – 0.9)	1.56 (1.09 – 2.23)
Personality	1.6 (0.6 – 2.7)	1.22 (1.04 – 1.44)
Psychotic	1.8 (0.7 – 2.9)	1.06 (0.92 – 1.24)
Sleep	15.8 (12.9 – 18.6)	1.24 (1.18 – 1.30)
Somatoform/Factitious	0.2 (-0.3 – 0.7)	0.96 (0.72 – 1.28)
Stress	15.2 (11.7 – 18.8)	1.12 (1.07 – 1.17)
Any Mental Health Diagnosis	34.7 (29.7 – 39.6)	1.13 (1.10 – 1.16)

*Linear risk regression model unstable. Analysis based upon n=267,078; 48 observations excluded due to missing values for gender; RR denotes rate ratio, CI confidence interval. Linear risk and negative binomial regression models adjusted for age, gender, operation, and history of diagnosis within each diagnostic category 2000-2. Comparison based upon personnel deployed 7 or more months versus personnel deployed 0 to < 7 months from 2003-6.

Table 5.3. Adjusted number of excess cases of any mental health diagnosis per 1000 spouses attributable to deployment of their service member partners and adjusted rate ratios for association between deployment and number of mental health visits among spouses, by preferred installation.

Installation	N*	Number of excess cases per thousand (95% CI)	RR (95% CI)
Ft. Bragg Catchment	21,854	38.3 (22.1 – 54.4)	1.23 (1.13 – 1.35)
Ft. Hood	18,481	46.4 (26.3 – 66.5)	1.18 (1.05 – 1.32)
Ft. Campbell	13,940	69.3 (47.3 – 91.3)	1.11 (0.99 – 1.24)
Washington DC Catchment	13,680	10.3 (-15.8 – 36.3)	0.89 (0.75 – 1.05)
Ft. Lewis	12,026	42.1 (16.5 – 67.6)	1.14 (1.00 – 1.29)
Ft. Carson/Colo Spgs Catchment	10,264	55.3 (29.4 – 81.2)	1.38 (1.20 – 1.58)
Ft. Stewart Catchment	9,776	62.4 (37.2 – 87.6)	1.39 (1.21 – 1.60)
Ft. Benning	7,611	50.6 (21.8 – 79.4)	1.25 (1.06 – 1.47)
Landstuhl/KMC Catchment	7,536	12.9 (-16.3 – 42.1)	1.10 (0.92 – 1.32)
Heidelberg Catchment	7,089	23.1 (-5.9 – 52.1)	0.97 (0.82 – 1.15)
Ft. Sill	6,555	34.7 (3.7 – 65.8)	1.12 (0.96 – 1.30)
Ft. Bliss Catchment	6,446	-4.1 (-32.3 – 24.2)	0.93 (0.79 – 1.09)
Ft. Riley	5,645	36.8 (4.2 – 69.4)	1.19 (1.01 – 1.40)
Ft. Drum	5,620	45.8 (9.1 – 82.5)	1.03 (0.85 – 1.24)
San Antonio Catchment	5,452	-13.6 (-53.6 – 26.5)	1.20 (0.96 – 1.51)
Ft. Gordon Catchment	5,435	36.6 (0.7 – 72.4)	0.96 (0.77 – 1.19)
Ft. Shafter	5,263	-4.2 (-40.5 – 32.1)	0.94 (0.76 – 1.15)
Ft. Knox	4,752	51.0 (8.9 – 93.1)	1.11 (0.90 – 1.36)
Ft. Polk	4,441	53.3 (15.5 – 91.0)	1.37 (1.13 – 1.65)
Vilseck Catchment	3,764	24.7 (-14.8 – 64.3)	1.16 (0.91 – 1.48)

*Number of spouses in analysis data set with given preferred installation. Preferred installation is where individual received most outpatient care 2003-6 and only top 20 preferred installations were examined, representing ~ 66% of 267,126 spouses. RR denotes rate ratio, CI confidence interval, Colo Spgs Colorado Springs, KMC Kaiserslautern Military Community. Linear risk and negative binomial regression models adjusted for age, gender, operation, and history of any mental health diagnosis 2000-2. Comparison based upon personnel deployed 7 or more months versus personnel deployed 0 to < 7 months from 2003-6.

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B. Paper 2: The Effects of Operational Deployment on Mental Health Diagnoses among Children of Military Personnel

1. Introduction

Current operations in Iraq and Afghanistan have involved the frequent and extended deployment of U.S. military personnel, prompting greater attention to the mental health needs of returning soldiers.¹⁻³ However, major life events such as long-term parental absence are also traumatic for children, and often predict future emotional and behavioral functioning in children of all ages.^{4,5} The psychosocial burden of parental deployment on children of military personnel remains poorly understood and largely unstudied.

U.S. children fear the death of a parent above any other event,⁶ and children in military families view war as a threat to the security and stability of their caretakers.⁷ Even the possibility of war and a parent's potential harm has been shown sufficient to induce psychological distress among children with military parents,⁸ as has actual military-induced parental separation.⁹ After accounting for the effects of rank and child's age, deployment status during Operation Desert Storm was associated with depression and negative affect in children with military parents.¹⁰ Research focusing on psychopathology and behavioral problems in military children during current operations (i.e., Operations Iraqi Freedom [OIF] and Enduring Freedom [OEF]) is sparse, yet points to increased stress and behavioral problems associated with parental deployment.^{11,12} Although some have suggested a higher baseline prevalence of psychopathology exists among children in military versus nonmilitary families due to stresses of military life (e.g., frequent relocation, deployment),¹³ others have found no differences.¹⁴ Because existing studies on children focusing on the effects of parental deployment are limited

by the use of self-report data, small samples, and cross-sectional design, or were conducted during peacetime, results may not generalize well to children of military personnel deployed in support of current operations.

The United States military has often deployed its forces to areas of high volatility and instability. As U.S. troops face a dynamic and evolving set of threats (such as an increasingly sophisticated array of roadside explosive devices), the need to anticipate the psychological consequences for their children and offer timely intervention becomes increasingly important. The purpose of this study was to examine the association between operational deployment and mental health diagnoses among children of U.S. Army active duty personnel. We hypothesized that the risk and rate of mental health diagnoses would be greater among children of military personnel who had spent more time on operational deployment in support of Operations Iraqi Freedom (OIF) and Enduring Freedom (OEF) between 2003 and 2006. In addition, these relationships were expected to vary across specific categories of mental health disorders and to be modified by demographic and military variables, as well as by children's mental health history.

2. Methods

a. Study Participants

We examined electronic medical record data for all outpatient medical visits occurring between January 1, 2003 and December 31, 2006 among children of non-retired, active duty U.S. Army personnel who obtained outpatient medical care from either a) a treatment facility located on a U.S. military installation, or b) utilized military medical insurance for a medical visit outside of a U.S. military installation. Because some mental health disorders may not be clinically relevant for certain age groups, children who had not

yet achieved an age at which a clinical diagnosis is usually made were excluded from analysis. Specifically, all medical visits for any children four and younger were excluded, as were children whose mean age over the four-year study period was less than five years. Additionally, a maximum age of 22 years was established for children based upon two eligibility rules under TRICARE, the health care program serving military personnel and their families.¹⁵ First, unmarried biological and adopted children are eligible for coverage up to age 21 unless they are full-time college students, in which case their eligibility continues until their 23rd birthday or the end of that school year, whichever comes first. As it was impossible to determine student status for children in the current study, we assumed that children over 21 years were eligible to receive coverage through the military medical system. Second, since only under extremely special circumstances (e.g., severe disability) are children of active duty personnel eligible for medical care after their 23rd birthday, covered children older than 23 years represent a unique medical cohort whose study was not the purpose of the current analysis.

We excluded children of Reserve and National Guard personnel as their beneficiaries do not generally receive military medical benefits until the service member is called up to active duty. Further, we included only children whose military sponsor had been in active duty service for at least five years as of January 1, 2007. This was required to exclude children of Army personnel who joined the military during the four-year study period, and included an additional year immediately prior to the study to establish a recent mental health history. Furthermore, our study is limited to children of Army personnel due to difficulties in obtaining data from other service branches.

b. Data Sources

Outpatient medical visit data was obtained from two sources: 1) the Standard Ambulatory Data Record (SADR), and 2) the TRICARE Enrolled Dependent (TED) data. SADR is a mandatory collection and reporting system for all outpatient medical visits at military medical facilities with data stored in the Defense Medical Surveillance System (DMSS) and maintained by the Armed Forces Health Surveillance Center (AFHSC), U.S. Army Center for Health Promotion and Preventive Medicine. TED is also a DMSS data feed and contains complete billing code information for medical care received outside of a military medical treatment facility that is reimbursed under the military's medical insurance system.

The DMSS also provided personnel information on military deployments at the individual level using the Defense Manpower Data Center's (DMDC) deployment, personnel, and gain/loss rosters. Military member's rank, total time in service and active duty as of January 1, 2007, and total number of months deployed for Operations Iraqi Freedom (OIF) or Enduring Freedom (OEF) from January 1, 2003 through December 31, 2006, were derived from the DMDC records.

c. Mental Health Diagnosis

A mental health diagnosis was defined as having at least one mental health-related International Classification of Diseases, 9th Revision (ICD-9) code out of four possible codes for a given outpatient medical visit, and was classified into one of 14 categories:[‡] Alcohol; Anxiety; Bipolar; Delirium, Dementia, & Other Cognitive Disorders; Depression; Dissociative; Drug; Impulse Control; Pediatric Behavioral Disorders; Personality; Psychotic; Sleep;

[‡] See appendix C for ICD-9 codes by category

Somatoform/Factitious; and Stress. To increase the specificity of a mental health diagnosis code for a current mental health diagnosis, codes for mental health conditions in full and partial remission were excluded for visits during the study period. Mental health history was determined using these same 14 categories for diagnoses occurring between January 1, 2000 and December 31, 2002, and included remission codes.

d. Data Analysis

Linear risk¹⁶ and negative binomial¹⁷ regression models were used to obtain risk difference and rate ratio effect measures, respectively, for the effect of deployment in support of OIF or OEF and based on median months of deployment. To assess potential non-independence as a result of children clustered within families, we examined the robustness of linear risk regression model estimates using generalized estimating equations (GEE). The size of the children's data set (i.e., 348,012 children within 176,932 families) and unique individual- and family-specific identification codes allow for this type of analysis. As negative binomial models can be overdispersed and used to model correlated data regardless of the cause, these models were not examined for any effects of clustering.¹⁷ Model building and testing were conducted to identify variables that confounded or modified this relationship. A change-in-estimate of 10 percent or greater indicated confounding.¹⁸ Age, gender, mental health history, preferred installation, and military member's rank and time in the military were examined as the main covariates. All outpatient mental health diagnoses for the three years prior to the study period were included in all models to control for mental health history. Specifically, 15 dichotomous variables were created to indicate the presence or absence of any outpatient diagnosis for each of the 14 categories and overall. Confidence intervals rather than p values were used to determine which differences were most

meaningful.¹⁹ All data analyses were conducted using SAS software Version 9.2 (SAS Institute, Cary, NC).

This study was reviewed and exempted from the Institutional Review Boards of the University of North Carolina-Chapel Hill School of Public Health (UNC Public Health IRB #04-2335, exempted August 2006), and the Uniformed Services University of the Health Sciences (USUHS IRB #HU88LC; exempted September 2007).

3. Results

The sample included 4,899,621 outpatient medical encounters for 348,012 children, of whom 16.6 percent had at least one mental health diagnosis during the study period. The most common diagnoses were for disorders of stress (7.1%), depression (5.9%), pediatric behavioral issues (4.4%), anxiety (2.8%), and sleep (2.3%; Table 5.4). Most military parents deployed during this time were in support of OIF only (50.7%), OEF only (6.0%), or both operations (5.4%). The remaining service members (37.9%) did not deploy for any operations. Military parents of children with and without a mental health diagnosis were of similar years in military and active duty, and mean months of OEF deployment. Children with a mental health diagnosis were slightly older, more likely to be male, and had over twice the number of outpatient visits for any reason compared to children without a mental health diagnosis. Children of personnel who were enlisted or deployed for more time to OIF were also more likely to have a mental health diagnosis, though only slightly (Table 5.4).

Characteristics of the military parent were similar when specific categories of diagnoses for their children were compared, with the exception of rank and mean months OIF deployment, which showed greater variability by category. Children with diagnoses for alcohol, drug, depression, and personality disorders were older when only children with at

least one mental health diagnosis were considered. Differences were also observed for total outpatient visits and gender. Data on race or ethnicity were missing for most (71.8%) children. There was no evidence of confounding by race/ethnicity (e.g., mean months deployed \approx 7 months for all racial/ethnic groups) and it was excluded from further data analysis given the extent of missing data

We created a dichotomous deployment measure to facilitate modeling based upon the median total months deployed (7 months) from 2003-6 for military parents and used this measure for all regression analyses. Mental health history, age, gender, and operation (i.e., OEF, OIF, or both) emerged as likely confounders of the deployment-child mental health diagnosis relationship and were included in all models. As GEE and non-GEE confidence limits were similar and did not suggest an effect of clustering by family, all analyses were conducted using generalized linear models with maximum likelihood estimates of variance. Risk difference results are expressed as the number of excess cases of mental health diagnoses among children, attributable to deployment of 7 months or more from 2003 to 2006, per thousand personnel deployed. For comparison, overall and gender-specific results are presented.

The unadjusted number of excess cases per 1000 exposures for any mental health diagnosis was 23.0 (95 percent confidence interval (CI): 20.5 – 25.5) and, after adjustment, was 14.1 (95 percent CI: 10.6 – 17.6). Among specific categories, the largest deployment effects were observed for disorders of stress, pediatric behavioral problems, and depression (Table 5.5). Excess cases for any mental health diagnosis were higher among male children than females. Among males, effects were similar for stress and pediatric behavioral disorders, whereas among females the effect of deployment for stress disorders was roughly

three times greater than those for pediatric behavioral problems. Excess cases of depression were observed for males, but not for females.

Similar to risk, diagnosis rates associated with prolonged deployment were 12 to 39 percent higher. Deployments effects were observed for stress, pediatric behavioral, and depressive disorders when compared to fewer months or no deployment. Additionally, rates of diagnoses for bipolar disorder were 39 percent higher among all children. When male and female children were examined separately, trends in diagnosis rates were similar for bipolar, pediatric behavioral, and stress disorders. Male children experienced a 45 percent higher diagnosis rate for depression, while females experienced a 28 percent higher diagnosis rate for psychotic disorders. The rate of mental health diagnoses for all categories combined was 12 percent higher for all children (15 percent higher among males, 10 percent higher among females) when periods of longer versus shorter or no deployment were compared (Table 5.5).

A test of the deployment \times installation product interaction term in the adjusted models indicated heterogeneity of the risk difference (chi-square = 121.76, df = 19, Wald $p < .0001$) and rate ratio (chi-square = 107.76, df = 19, Wald $p < .0001$) based upon the installation where children received most of their outpatient care during the study period (i.e. “preferred installation”). We examined the relationship between deployment and any mental health visit separately for the top 20 preferred installations, representing roughly two-thirds of children (Table 5.6). Results were not constant across installations. Excess cases for any mental health diagnosis overall and for both genders were observed at Fort Campbell, and nearly double for males compared to females (39.1 vs. 23.0 excess cases, respectively). Diagnosis rates at Fort Campbell associated with longer deployment were 30 percent higher among all children and 41 percent higher among males. For all children, excess cases were

also found at Forts Riley, Carson, Stewart, Hood, and Bragg, and diagnosis rates were 23 to 48 percent higher at Forts Hood, Sill, and Drum. We observed some variation by gender, with females at Forts Hood and Riley and males at Forts Carson, Stewart, Drum, and Leonard Wood showing increased risks and rates for mental health diagnoses associated with prolonged deployment. Notably, we observed effects with less precision or magnitude at locations with larger catchment areas, but with fewer deployed personnel relative to the local troop strength (e.g., Washington D.C., Heidelberg, Landstuhl/KMC).

4. Discussion

This is the first large-scale investigation of mental health problems among children in military families relating to current operations in Iraq and Afghanistan. After controlling for child and military parent characteristics, we found prolonged periods of parental operational deployment were associated with an increased risk and rate of mental health diagnoses between 2003 and 2006. This was most apparent for stress, and pediatric behavioral disorders among all children, for depression among males, and for bipolar disorder among females. Lack of any effect for disorders not expected to be associated with deployment (e.g., delirium, dementia and other cognitive disorders) lends further support to our findings, while the absence of effects for alcohol and drug disorders reflects the young nature of our sample.

Similar to data from military spouses (see Chapter 5, Section A), the heterogeneity of the deployment effect by installation may be associated with the number of personnel deployed at each installation. Prolonged deployment appears to be taking a mental health toll on children at Fort Campbell, from which over 20,000 soldiers with the 101st Airborne Division have deployed multiple times for operations since 2003. Extended and multiple troop deployments for OIF and OEF also included 19,000 soldiers with the 3rd Infantry

Division (housed between Forts Stewart and Benning), 35,000 soldiers with the 4th Infantry or 1st Cavalry Divisions (both at Fort Hood), 5,200 soldiers with the 3rd Armored Cavalry Regiment (Fort Carson), and thousands more from the 10th Mountain Division (Fort Drum), the 82nd Airborne Division (Fort Bragg), and the 1st Brigade Combat Team (Fort Riley). These represent installations where we observed both excess cases and rates for mental health diagnoses. In contrast, we did not find increased mental health diagnoses at several installations treating large numbers of children of active duty personnel, but from which personnel deployed in much fewer numbers, for shorter duration, or with less frequency. Together, these findings suggest that prolonged or multiple deployments of active duty personnel may contribute to mental health problems among their children.

Medical care for children of active duty personnel and received through the military comes at little or no direct financial cost to the parents, making cost an unlikely barrier to care-seeking in this study. We also included data for outpatient medical visits where military medical insurance was used in the civilian medical system, thus making it unlikely we missed an appreciable amount of data on children who received their care outside of a military medical facility. Our sample includes over two-thirds of the roughly 493,000 children of active duty Army personnel.²⁰

Our use of administrative data included assumptions about the validity, reliability, and use of diagnostic codes in the medical system. Reliance upon these codes to ascertain current and past mental health status is not a perfectly sensitive or specific method of classification. In general, medical professionals may be reluctant to assign mental health diagnoses, resulting in underreporting of our outcome. This likely occurred in both deployment groups, but if failure to assign a diagnosis was based on the belief that an

individual was reacting to a stressful event, this may have introduced a misclassification bias. Since medical care professionals were not necessarily blinded to the deployment status of the military parent, a potential diagnostic bias may also be present. Our retrospective study design precluded assessment of these potential biases, and these issues warrant further attention in future studies.

Data on the mental health status, injury, or death of personnel during the study period were not included, nor was the mental health status of the child's caretaker during deployment of their military parent, yet any of these could greatly impact a child's mental health. Children become attuned to the psychological state of their parents, and studies suggest that stress levels of parents and children are related.⁶ If children in our study developed psychological disorders through internalization of their caretakers' stress, this would only underscore the importance of comprehending the far-reaching effects of deployment on military families. Nonmilitary or nondeployed parents dealing with their own mental health problems may be more or less attuned to symptoms in themselves and in their children, affecting their willingness to seek professional help. Additional research is needed on this matter, perhaps studying parents and children concurrently or examining families rather than individuals. It is possible medication was prescribed to treat the symptoms of a mental health problem without assigning a corresponding diagnostic code. Though we did not include prescription data, such occurrences would underestimate the true incidence of mental health problems in the study population, and, as they are not expected to occur differentially by deployment status of the military member, are unlikely to have had an appreciable effect on our results.

Controlling for mental health history meant including only children of active duty personnel in the military 5 or more years as of January 1, 2007. In addition, data were only

available for children of Army personnel. This limits the generalizability of our findings, recognizing that children new to military life or parental deployment, or with parents in other service branches may have markedly different experiences from our study. We also excluded very young children. Others have shown parental deployment is associated with increased behavioral symptoms in children younger than 5 years as reported by their caretakers.¹² We relied upon diagnostic evidence of psychological distress. However, the complexity of diagnosis and assessment with young children and the current availability of many different diagnostic manuals make it very difficult to reliably use diagnostic codes.²¹ Roughly seven percent of active duty Army personnel are single parents and 8.7 percent of all active duty marriages are between dual-military partners.²⁰ Our data likely include children from these families, yet they could not be identified for subgroup analysis in this study. Considering these children is an important direction for future research.

The 14.1 excess cases of any mental health diagnosis attributable to longer deployment per thousand deployed personnel translates into nearly 2,000 excess mental health diagnoses among children of 139,399 personnel deployed for 7 months or more between 2003 and 2006 in this study. The majority of personnel have children who will eventually receive care outside of the military medical system.²⁰ Thus, the prevention and treatment of mental health problems associated with deployment has broad public health relevance. Family Readiness Groups and other installation-level support programs to families of deployed personnel are a first step in addressing the mental health needs of children associated with current operations. Our findings support increasing targeted programs, specifically on military installations deploying greater numbers of troops. Future studies should include all service branches, and children of Guard and Reserve personnel.

Table 5.4. Characteristics of children with any diagnosis, no diagnosis, and specific types of mental health diagnoses

<i>Diagnosis</i>	<u>Child Characteristics</u>				<u>Military Member Characteristics</u>				
	N (%) individuals with diagnosis	Mean (SD) Age, years	% Male	Mean (SD) Outpatient Visits	Mean (SD) Years in Military	Mean (SD) Years in Active Duty	% Officer	Mean (SD) OEF Months	Mean (SD) OIF Months
Alcohol	1,336 (0.4)	16.6 (3.1)	55.7	30.6 (34.2)	17.6 (4.0)	16.9 (4.35)	28.6	1.0 (3.6)	5.7 (7.0)
Anxiety	9,863 (2.8)	12.6 (4.3)	48.8	36.4 (35.3)	16.4 (4.3)	15.6 (4.6)	29.9	0.9 (3.1)	6.4 (7.2)
Bipolar	4,176 (1.2)	13.0 (4.0)	57.1	47.8 (38.3)	15.7 (4.5)	14.8 (4.8)	20.8	0.8 (2.8)	7.0 (7.4)
Delirium, Dementia & Other Cognitive	761 (0.2)	12.2 (4.1)	56.4	56.8 (59.1)	16.0 (4.4)	15.4 (4.6)	25.5	0.9 (3.2)	6.7 (7.4)
Depression	20,494 (5.9)	13.7 (3.8)	47.7	32.8 (31.1)	16.4 (4.2)	15.7 (4.6)	24.5	0.9 (3.0)	6.5 (7.3)
Dissociative	53 (0.0)	12.6 (3.9)	49.1	52.4 (45.1)	16.6 (3.9)	15.8 (4.5)	32.1	0.7 (3.2)	5.9 (7.0)
Drug	1,989 (0.6)	16.4 (2.8)	62.8	32.1 (33.3)	17.4 (3.8)	16.8 (4.3)	25.7	0.9 (3.2)	5.8 (7.0)
Impulse Control	1,405 (0.4)	12.0 (3.8)	66.9	44.4 (37.3)	15.7 (4.4)	14.9 (4.6)	20.0	0.9 (3.1)	6.9 (7.5)
Pediatric Behavioral	15,321 (4.4)	10.9 (3.7)	67.1	33.2 (30.2)	15.0 (4.6)	14.2 (4.8)	18.6	0.9 (3.0)	7.2 (7.3)
Personality	1,213 (0.3)	14.0 (4.0)	47.8	48.4 (46.0)	16.6 (4.3)	15.8 (4.6)	23.4	0.9 (3.1)	6.5 (7.2)
Psychotic	5,502 (1.6)	11.6 (4.1)	66.7	44.6 (40.0)	15.7 (4.4)	14.9 (4.7)	26.0	0.9 (3.1)	6.6 (7.3)
Sleep	7,833 (2.3)	10.7 (4.4)	55.0	33.1 (36.1)	15.3 (4.6)	14.6 (4.7)	23.2	0.9 (3.1)	6.8 (7.2)
Somatoform/Factitious	263 (0.1)	12.5 (4.3)	39.9	40.0 (39.0)	16.3 (4.3)	15.4 (4.6)	25.1	0.8 (2.8)	6.3 (7.0)
Stress	24,648 (7.1)	11.7 (4.0)	51.3	29.7 (28.6)	15.6 (4.5)	14.8 (4.8)	22.6	0.9 (3.2)	7.0 (7.3)
Composite									
Any Diagnosis	57,736 (16.6)	12.0 (4.2)	53.9	27.7 (27.7)	15.7 (4.5)	14.9 (4.7)	23.3	0.9 (3.1)	6.7 (7.2)
No Diagnosis	290,276 (83.4)	11.4 (4.4)	49.1	11.4 (13.1)	15.7 (4.6)	15.0 (4.8)	24.3	0.9 (3.1)	6.1 (7.1)
Total Sample	348,012 (100)	11.5 (4.4)	49.9	14.1 (17.5)	15.7 (4.5)	15.0 (4.8)	24.1	0.9 (3.1)	6.2 (7.1)

SD denotes standard deviation

Table 5.5. Adjusted number of excess cases of mental health diagnoses per 1000 children attributable to longer deployment of their service member parents and adjusted rate ratios for association between deployment and number of mental health visits among children, by diagnostic category and gender

Category	Total (n = 346,505)		Female Children (n = 172,748)		Male Children (n = 173,757)	
	Number of excess cases per thousand (95% CI)	RR (95% CI)	Number of excess cases per thousand (95% CI)	RR (95% CI)	Number of excess cases per thousand (95% CI)	RR (95% CI)
Alcohol	*	1.07 (0.86 – 1.33)	*	0.96 (0.70 – 1.31)	0.1 (-0.5 – 0.6)	1.21 (0.89 – 1.63)
Anxiety	1.1 (-0.5 – 2.6)	1.06 (0.97 – 1.16)	0.7 (-1.5 – 2.9)	1.08 (0.95 – 1.22)	1.3 (-0.9 – 3.5)	1.05 (0.92 – 1.20)
Bipolar	0.9 (-0.0 – 1.9)	1.39 (1.19 – 1.63)	1.1 (-0.1 – 2.2)	1.34 (1.06 – 1.71)	0.6 (-0.9 – 2.0)	1.37 (1.11 – 1.69)
Delirium, Dementia, or other Cognitive Disorder	0.3 (-0.2 – 0.7)	0.84 (0.62 – 1.12)	0.3 (-0.2 – 0.9)	1.26 (0.81 – 1.96)	0.1 (-0.6 – 0.8)	0.62 (0.41 – 0.94)
Depression	3.6 (1.6 – 5.6)	1.12 (1.05 – 1.20)	2.7 (-0.1 – 5.5)	0.99 (0.91 – 1.08)	4.3 (1.4 – 7.2)	1.45 (1.39 – 1.51)
Dissociative	-0.0 (-0.1 – 0.1)	0.91 (0.25 – 3.25)	*	0.56 (0.07 – 4.21)	*	0.63 (0.08 – 4.99)
Drug	0.1 (-0.3 – 0.4)	1.01 (0.84 – 1.23)	-0.0 (-0.6 – 0.5)	0.97 (0.71 – 1.32)	0.2 (-0.4 – 0.8)	1.06 (0.83 – 1.36)
Impulse Control	0.2 (-0.4 – 0.7)	1.02 (0.80 – 1.31)	0.2 (-0.4 – 0.9)	1.20 (0.77 – 1.87)	0.1 (-0.9 – 1.1)	0.86 (0.64 – 1.16)
Pediatric Behavioral Disorder	4.7 (2.9 – 6.4)	1.25 (1.17 – 1.35)	2.8 (0.7 – 5.0)	1.27 (1.12 – 1.44)	9.3 (6.3 – 12.3)	1.24 (1.13 – 1.35)
Personality	0.8 (0.3 – 1.3)	1.17 (0.92 – 1.47)	0.7 (0.0 – 1.3)	1.23 (0.88 – 1.72)	0.9 (0.1 – 1.6)	1.16 (0.84 – 1.60)
Psychotic	0.9 (-0.2 – 2.0)	1.06 (0.93 – 1.21)	1.0 (-0.3 – 2.3)	1.28 (1.02 – 1.59)	0.2 (-1.7 – 2.1)	0.93 (0.79 – 1.09)
Sleep	0.7 (-0.7 – 2.2)	0.98 (0.90 – 1.07)	1.0 (-1.0 – 2.9)	0.94 (0.83 – 1.06)	0.5 (-1.7 – 2.6)	1.03 (0.92 – 1.15)
Somatoform/Factitious	0.0 (-0.2 – 0.3)	1.45 (0.89 – 2.36)	-0.1 (-0.5 – 0.4)	1.11 (0.61 – 2.02)	0.1 (-0.2 – 0.4)	2.13 (0.93 – 4.87)
Stress	9.0 (6.5 – 11.5)	1.12 (1.06 – 1.18)	8.3 (4.9 – 11.8)	1.14 (1.05 – 1.23)	9.6 (6.0 – 13.1)	1.11 (1.02 – 1.20)
Any Mental Health Diagnosis	14.1 (10.6 – 17.6)	1.12 (1.08 – 1.16)	11.9 (7.2 – 16.7)	1.10 (1.03 – 1.16)	16.2 (11.0 – 21.3)	1.15 (1.09 – 1.21)

*Linear risk regression model unstable. Analysis based upon n=346,505; 1,507 observations excluded due to missing values for gender; RR denotes rate ratio, CI confidence interval. Linear risk and negative binomial regression models adjusted for age, gender (except for analyses by gender), operation, and history of diagnosis within each diagnostic category 2000-2. Comparison based upon personnel deployed 7 or more months versus personnel deployed 0 to < 7 months from 2003-6.

Table 5.6. Adjusted number of excess cases of any mental health diagnosis per 1000 children attributable to longer deployment of their service member parents and adjusted rate ratios for association between deployment and number of mental health visits among children, by preferred installation and gender

Installation	N*	Total			Female Children			Male Children		
		Number of excess cases per thousand (95% CI)	RR (95% CI)		Number of excess cases per thousand (95% CI)	RR (95% CI)		Number of excess cases per thousand (95% CI)	RR (95% CI)	
Ft. Bragg Catchment	24,779	15.5 (3.7 – 27.4)	1.02 (0.89 – 1.17)		15.1 (-1.2 – 31.3)	1.03 (0.84 – 1.27)		15.1 (-2.1 – 32.2)	0.99 (0.82 – 1.20)	
Ft. Hood	22,527	19.5 (3.9 – 35.0)	1.23 (1.07 – 1.41)		28.3 (7.4 – 49.1)	1.29 (1.04 – 1.60)		7.7 (-15.1 – 30.5)	1.17 (0.97 – 1.41)	
Washington DC Catchment	20,085	-0.3 (-18.0 – 17.4)	0.92 (0.76 – 1.13)		2.4 (-21.4 – 26.2)	0.92 (0.69 – 1.23)		-4.1 (-30.3 – 22.0)	0.88 (0.67 – 1.17)	
Ft. Campbell	16,492	31.2 (16.5 – 45.9)	1.30 (1.09 – 1.56)		23.0 (2.7 – 43.3)	1.22 (0.93 – 1.59)		39.1 (18.1 – 60.2)	1.41 (1.10 – 1.81)	
Ft. Lewis	13,256	19.6 (-1.1 – 40.4)	1.01 (0.84 – 1.21)		23.6 (-4.8 – 52.0)	1.21 (0.93 – 1.58)		14.8 (-15.2 – 44.8)	0.89 (0.69 – 1.15)	
Ft. Carson/Colo Spgs Catchment	11,131	33.0 (12.4 – 53.6)	1.21 (0.99 – 1.47)		15.2 (-13.6 – 44.0)	0.88 (0.66 – 1.17)		45.3 (16.4 – 74.2)	1.50 (1.15 – 1.96)	
Ft. Stewart Catchment	12,076	25.1 (8.2 – 41.9)	1.17 (0.96 – 1.42)		21.5 (-1.8 – 44.7)	1.13 (0.84 – 1.51)		27.0 (2.6 – 51.3)	1.32 (1.01 – 1.72)	
Ft. Benning	9,891	5.1 (-15.0 – 25.2)	1.14 (0.89 – 1.46)		0.7 (-26.0 – 27.5)	1.20 (0.81 – 1.80)		11.4 (-18.8 – 41.5)	1.13 (0.83 – 1.54)	
Heidelberg Catchment	8,769	-5.2 (-25.2 – 14.9)	0.84 (0.65 – 1.07)		-7.3 (-33.2 – 18.7)	0.86 (0.59 – 1.27)		-7.5 (-37.9 – 22.8)	0.76 (0.55 – 1.06)	
Ft. Gordon Catchment	8,763	-4.1 (-25.2 – 17.0)	0.86 (0.64 – 1.14)		-7.6 (-36.8 – 21.5)	0.90 (0.60 – 1.36)		3.3 (-27.4 – 34.0)	0.84 (0.56 – 1.25)	
Landstuhl/KMC Catchment	8,754	-11.0 (-30.7 – 8.7)	0.99 (0.75 – 1.30)		-27.6 (-54.3 – 0.8)	0.83 (0.55 – 1.26)		10.1 (-18.1 – 38.4)	1.26 (0.88 – 1.23)	
Ft. Bliss Catchment	8,336	-15.6 (-36.0 – 4.9)	0.93 (0.74 – 1.16)		-18.4 (-46.0 – 9.2)	0.85 (0.60 – 1.20)		-11.6 (-41.8 – 18.6)	1.04 (0.77 – 1.40)	
San Antonio Catchment	8,072	-2.5 (-31.1 – 26.1)	1.09 (0.84 – 1.41)		-1.6 (-41.3 – 38.1)	1.16 (0.80 – 1.70)		-1.3 (-42.5 – 39.8)	1.07 (0.75 – 1.53)	
Ft. Sill	7,888	10.5 (-13.4 – 34.4)	1.34 (1.06 – 1.69)		3.9 (-30.2 – 37.9)	1.30 (0.92 – 1.84)		14.8 (-18.8 – 48.5)	1.31 (0.96 – 1.80)	
Ft. Knox	6,759	5.4 (-24.7 – 35.4)	0.86 (0.66 – 1.13)		28.7 (-11.1 – 68.4)	1.14 (0.75 – 1.73)		-19.0 (-63.5 – 25.4)	0.73 (0.51 – 1.04)	
Ft. Riley	6,227	41.1 (17.4 – 64.8)	1.23 (0.95 – 1.59)		47.2 (15.5 – 79.0)	1.40 (0.95 – 2.08)		32.1 (-2.9 – 67.1)	1.08 (0.77 – 1.53)	
Ft. Drum	5,903	4.8 (-22.4 – 32.1)	1.48 (1.06 – 2.07)		2.6 (-33.3 – 38.5)	1.28 (0.78 – 2.09)		3.1 (-37.4 – 43.6)	1.71 (1.08 – 2.70)	
Ft. Leonard Wood	5,362	7.9 (-22.1 – 38.0)	1.28 (0.91 – 1.79)		7.7 (-34.9 – 50.3)	1.05 (0.63 – 1.77)		10.1 (-32.5 – 52.8)	1.65 (1.05 – 2.59)	
Schofield Barracks (Hawaii) Area	5,227	-1.2 (-27.7 – 25.3)	0.85 (0.62 – 1.17)		-14.3 (-50.3 – 21.8)	0.62 (0.38 – 1.01)		13.8 (-25.3 – 52.9)	1.27 (0.84 – 1.94)	
Ft. Polk	5,075	7.0 (-20.5 – 34.6)	1.01 (0.75 – 1.37)		-20.2 (-59.0 – 18.5)	0.81 (0.52 – 1.26)		32.1 (-6.2 – 70.4)	1.26 (0.84 – 1.90)	

*Total number of children in analysis data set with given preferred installation. Preferred installation is where individual received most outpatient care 2003-6 and only top 20 preferred installations were examined, representing ~ 67% of 348,012 children. RR denotes rate ratio, CI confidence interval, Colo Spgs Colorado Springs, KMC Kaiserslautern Military Community. Linear risk and negative binomial regression models adjusted for age, gender (except for analyses by gender), operation, and history of any mental health diagnosis 2000-2. Comparison based upon personnel deployed 7 or more months versus personnel deployed 0 to < 7 months from 2003-6.

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V. CONCLUSIONS

A. Recapitulation of Overall Study Aims, Findings, and Degree to Which the Goals of the Doctoral Research Have Been Met

The specific aims of this study were to 1) estimate the association between prolonged operational deployment of an immediate family member and being diagnosed with a mental health problem among family members of U.S. Army active duty personnel; 2) assess the extent to which this association is modified by a range of covariates; 3) evaluate this association separately for various specific categories of mental health diagnoses; and 4) evaluate this association separately for spouses and for children of U.S. Army active duty personnel.

Findings indicate that after controlling for the family member's age, gender, and mental health history, and the military member's operation(s) of deployment, prolonged periods of deployment for these operations are associated with an increased risk of mental health diagnoses and more visits for mental health diagnoses over time for both spouses and children of U.S. Active Duty Army personnel between 2003 and 2006. Among spouses, this was most apparent for depression, anxiety, stress and sleep disorders, but was also observed for substance use/abuse, bipolar, personality, and psychotic disorders. Among children, this was most apparent for stress and pediatric behavioral disorders among all children, for depression among males, and for bipolar disorder among females. That increased risks and rates were absent for disorders that would not be expected to vary with deployment (e.g., delirium, dementia and other cognitive disorders), particularly given the power to detect such differences with a very large sample, lends additional support to these findings. The absence

of effects for alcohol and drug disorders among children likely reflects the young nature of the children's sample. Overall, these findings suggest that the mental health effects of current operations are extending beyond service members and into their immediate families.

For both spouses and children, the heterogeneity of the deployment effect by installation may be associated with the number of personnel deployed at each installation. Larger installations have more and larger medical treatment and specialty care facilities since they are responsible for serving a larger population. In turn, they will see and treat more patients for mental health problems relative to facilities serving smaller military communities. Extended and multiple troop deployments for OIF and OEF have included over 20,000 soldiers with the 101st Airborne Division (Fort Campbell), 19,000 soldiers with the 3rd Infantry Division (housed between Forts Stewart and Benning), 35,000 soldiers with the 4th Infantry or 1st Cavalry Divisions (both at Fort Hood), 5,200 soldiers with the 3rd Armored Cavalry Regiment (Fort Carson), and thousands more from the 10th Mountain Division (Fort Drum), the 82nd Airborne Division (Fort Bragg), the 2nd Armored Cavalry Regiment (Fort Polk), and the 1st Brigade Combat Team (Fort Riley). These represent installations where excess cases and rates for mental health diagnoses were observed for spouses, children, or both. In contrast, increased mental health diagnoses were not observed at several installations treating large numbers of dependents of active duty personnel, but from which personnel deployed in much fewer numbers, for shorter duration, or with less frequency. Together, these findings suggest that prolonged or multiple deployments of active duty personnel may contribute to mental health problems among their family members.

Overall, the findings from this research have important public health implications. The 34.7 (spouses) and 14.1 (children) excess cases of any mental health diagnosis

attributable to longer deployment per thousand deployed personnel translates into 4,837 excess mental health diagnoses among spouses and nearly 2,000 excess mental health diagnoses among children of 139,399 personnel deployed for 7 months or more between 2003 and 2006 in this study. The majority of personnel have dependents who will eventually receive care outside of the military medical system.⁵⁷ Thus, the prevention and treatment of mental health problems associated with deployment has broad public health relevance. Family Readiness Groups and other installation-level support programs to families of deployed personnel are a first step in addressing the mental health needs of children associated with current operations. These findings support increasing targeted programs, specifically on military installations deploying greater numbers of troops. Future studies should also include all service branches, and children of Guard and Reserve personnel.

This research set out to quantify the mental health effects of deployment on family members of military personnel using epidemiological methods to adjust for appropriate covariates and including examination of a range of mental health diagnoses. To that end, the goals of the doctoral research have been achieved. Although this research uncovered potential study biases and illuminated areas which remain understudied, it is the first known large-scale investigation of mental health problems in military families relating to the current conflicts in Iraq and Afghanistan. As such, it paves the way for future research on this topic.

B. Strengths

This research has several strengths. Because the medical care received at military medical treatment facilities comes at little or no direct financial cost to military dependents, family members generally receive most, if not all, of their medical care in one location, yet are allowed to receive care at any military medical facility. This equalizes the access to

medical care among the study population and makes cost an unlikely barrier to care-seeking among military families. Further, by including outpatient medical visits where military medical insurance was used outside of a military installation, it is unlikely that an appreciable amount of data on family members who sought care somewhere other than a military medical facility was missed. Additionally, the analysis sample is quite large (i.e., nearly 12 million records for 267,126 spouses and 348,012 children) and captures a substantial proportion of the nearly 300,000 active duty army spouses and over two-thirds of the roughly 493,000 children of active duty Army personnel in the target population,⁵⁷ facilitating statistical inference and generalizability.

C. Limitations

Use of administrative data was essential to obtain the high volume of records for this research, but meant that measures of mental health were in the form of diagnostic codes. This relied upon assumptions of coding validity and reliability, in general, and the use of codes by medical professionals, specifically. Reliance upon these codes may represent an insensitive method of ascertaining current and past mental health status in this study. In general, medical professionals may be reluctant to assign mental health diagnoses, resulting in underreporting of our outcome. This likely occurred in both deployment groups, but if failure to assign a diagnosis was based on the belief that an individual was reacting to a stressful event, this may have introduced a misclassification bias. Since medical care professionals were not necessarily blinded to the deployment status of the military member, a potential diagnostic bias may also be present. Our retrospective study design precluded assessment of these potential biases, and these issues warrant further attention in future studies. Spouses with good jobs who utilize employer medical benefits may represent unmeasured diagnoses in our

research. While likely to be higher functioning, it is unlikely effects of their utilization would vary with deployment. Though race and ethnicity did not appear to confound the relationship between deployment and mental health, the amount of missing data precluded a thorough analysis of its effects. Previous research has reported racial and ethnic differences in attitudes towards seeking care for mental health services.⁵⁸ Future work should determine if this finding is supported in military populations.

Lack of information on service members represents another limitation. Data on injury and death of personnel during the study period were not included, yet could greatly impact spousal or children's mental health. Details on the mental health of the military member were also not available, which could impact a spouse's knowledge and attitudes about psychiatric conditions and treatment. Partners of military members dealing with mental health problems may be more attuned to symptoms, aware of resources and willing to seek professional help. However, the stigma associated with seeking care for mental health concerns has been well documented within military personnel.^{6, 59} Spouses may share these concerns about stigmatization and avoid seeing a medical professional, in which case our results would underestimate mental health problems in the military beneficiary population. As such, the true attributable risk of mental health disorders is unknown as the data include only persons seeking medical care during the study period. Similarly, it is possible that an individual was prescribed medication to treat the symptoms of a mental health problem, but was not assigned a corresponding mental health diagnostic code for that particular encounter. As we did not include prescription data, these individuals would not be counted as having a mental health diagnosis. Still, such occurrences would underestimate the true incidence of mental health problems in the study population, and, as they are not expected to occur differentially

by deployment status of the military member, are unlikely to have had an appreciable effect on the results.

Data on the mental health status of the child's caretaker during deployment of their military parent were also not included, yet could greatly impact a child's mental health. Children become attuned to the psychological state of their parents, and studies suggest that stress levels of parents and children are related.³³ If children in the current study developed psychological disorders through internalization of their caretakers' stress, this would only underscore the importance of comprehending the far-reaching effects of deployment on military families. Nonmilitary or nondeployed parents dealing with their own mental health problems may be more or less attuned to symptoms in themselves and in their children, affecting their willingness to seek professional help. Additional research is needed on this matter, perhaps studying parents and children concurrently or examining family units rather than individuals.

The exclusion of family members whose sponsor had been in the military less than 5 years as of January 1, 2007, and of dependents of Reserve and Guard personnel, limits the generalizability of research findings. Without presumption that outpatient mental health care would be received through the military medical system, assessment of mental health care prior to and during the study period could not be conducted with any certainty for these individuals. Though controlling for mental health history dictated their exclusion, family members new to military life or deployment are an important group whose experiences are worthy of research attention, and whose outcomes may differ markedly from those in the current work. Very young children were also excluded. Others have shown parental deployment is associated with increased behavioral symptoms in children younger than 5 years as reported by their caretakers.⁶⁰ The current research relied upon diagnostic evidence

of psychological distress. However, the complexity of diagnosis and assessment with young children and the current availability of many different diagnostic manuals make it quite difficult to reliably use diagnostic codes.⁶¹ Currently, roughly seven percent of active duty Army personnel are single parents and 8.7 percent of all active duty marriages are between dual-military partners.⁵⁷ Study data likely include children from these families, yet they could not be identified for subgroup analysis in this study. Considering these children is an important direction for future research.

D. Future Directions

As discussed above, future research will need to address several limitations of the current study. Although race/ethnicity did not appear to confound the study results presented here, the amount of missing data suggests it was not measured reliably in the SADR data. Therefore, a careful examination of more reliably measured race and ethnicity variable as a potential confounder is needed. Although detailed estimates were not presented here, mental health history acted as the largest confounder of the relationship between deployment and a mental health diagnosis during the study period. As such, limiting analyses to incident mental health diagnoses only (i.e., those without any mental health history) may further elucidate the findings presented here and can be done using the existing data set. The current study based a mental health outcome on only clinical diagnoses as assigned by medical professionals, thus perhaps missing prescription data as a measure of mental health symptoms, and the more personal and qualitative side of mental health effects resulting from deployment of a military family member. A more complete picture of these effects would be gained by incorporating prescription, survey, and clinical interview data, either separately or in tandem with the electronic medical surveillance data used here.

Additional research should also include important groups who were excluded in the current work. As previously mentioned, spouses and children of Guard/Reserve personnel represent an important population whose experiences may differ markedly from those of Active Duty dependents. In addition, family members of all military branches need to be examined. Research on the spouses and children of Marines is particularly important given that, along with the Army, the Marine Corps has deployed the largest number and percentage of personnel for OIF and OEF. The effects of deployment on very young children (< 5 years old), children on single military parents, and children in dual-military parent families also need to be considered in future studies.

Persons experiencing medical problems, specifically mental health-related issues, may avoid seeing a medical professional or may not discuss these problems with their primary care provider. Additionally, providers may have withheld a mental health diagnosis if they believed a family member was reacting to the stress of their loved one's deployment. If these scenarios occurred, results from this research may underestimate mental health problems in the military population. As such, the true attributable risk of mental health disorders cannot be known as the data include only persons seeking medical care during the study period, and the outcome was assigned by a medical professional rather than the family members themselves. By testing various assumptions about the proportion of individuals in the target population within each exposure group who sought medical care and applying correction factors to the analyses, sensitivity analyses can be used to gauge the effects of this potential outcome misclassification on parameter estimates and overall study results.⁶² Recent trends indicate that Americans are becoming more willing to seek professional treatment for mental health problems and talk with a professional about their personal

troubles.⁶³ Despite these trends and improvements in mental health diagnosis and treatment, many individuals still do not obtain adequate care for psychological conditions. The National Comorbidity Survey-Replication (NCS-R), a nationally representative face-to-face study of mental health diagnosis and treatment among U.S. adults, found that only 41.1% of individuals diagnosed with Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (*DSM-IV*)⁶⁴ disorders in the previous 12 months received treatment.⁴² Lack of health insurance, low income, and rural residence were among the factors associated with low mental health service utilization. Studies of this type and magnitude have not been conducted among military families. These barriers should be minimal within military families due to the provision of health insurance to active duty personnel and their families, no-to-low cost medical care, and the availability of services both inside and outside of the military medical community. Still, a sensitivity analysis can help affirm the robustness of study results to outcome misclassification resulting from these and other reasons an individual may fail to seek care.

For those who did seek care, false-negatives rather than false-positives are of concern in this study as it seems much more likely that a medical professional could have missed a mental health diagnosis in an individual with mental health problems (e.g., if the individual did not discuss these symptoms) than assign a mental health diagnosis to an individual who did not truly have one. Similarly, decreased sensitivity but increased specificity in outcome classification was a major determinant for diagnosis inclusion/exclusion in this study. In doing so, a tradeoff between sensitivity and specificity in outcome classification is unavoidable considering some mental health diagnoses involve conditions that are not commonly brought on or exacerbated by environmental stress. Considerable effort was

involved in determining inclusion and exclusion criteria for mental health ICD-9 codes, particularly those whose etiology was increasingly less likely to be related to the exposure of interest. Because all ICD-9 codes were retained in the original data set regardless of mental health status, a sensitivity analysis can be used to gauge the effect of inclusion and exclusion of ICD-9 codes that have a lower sensitivity for stress-related mental health outcomes. In addition, assumptions about providers' assignment of mental health diagnoses knowing that an immediate family member was deployed can be assessed for differential outcome misclassification. From the sensitivity analyses, a correction factor can be applied to test for robustness of effect estimates in the presence of these biases. Both specific sensitivity analyses are planned for the future.

The prevention and treatment of mental health problems associated with deployment has broad public health relevance. Because the majority of active duty army personnel are married or have children,⁵⁷ and they and their families will eventually receive care outside of the military medical system, both the short- and long-term impact of these findings should be considered in the planning of programs and allocation of mental health resources within the military community. Currently, military leaders go to great lengths to offer services and support to families of deployed personnel. These Family Readiness Groups and other installation-level support programs to families of deployed personnel are a first step in addressing the mental health needs of children associated with current operations. Such action has likely mitigated the effect of deployment on the mental health of family members given the length and hazards associated with current operations. Greater attention is being paid to the mental health of returning soldiers.¹⁵⁻¹⁷ However, this large-scale study, the first to examine the effects of deployment in support of OIF and OEF on mental health problems in

military families, indicate that the effects of prolonged periods of deployment are extending beyond the military members to their spouses and children as well. These findings have relevance for informing prevention efforts and service provision, particularly at locations with substantial troop deployment. Such efforts may consist of pre-deployment programs for children and spouses at greater risk for problems upon deployment of a military family member, as well as support programs during the actual deployment period. In addition, tertiary prevention programs can be implemented for situations when children appear at school, or family members present to a medical clinic, with stress-related symptoms or behavioral or emotional disorders.

APPENDICES

Appendix A

ICD-9 Codes and Diagnoses by Mental Health Category

ALCOHOL	
ICD-9 CODE	DIAGNOSIS
291	Alcoholic psychoses
291.0	Delirium tremens
291.1	Alcohol amnestic syndrome
291.2	Alcoholic dementia NEC
291.3	Alcohol withdrawal hallucinosis
291.4	Alcohol intoxication, pathological
291.5	Alcoholic jealousy
291.8	Alcoholic psychosis NEC
291.81	Alcohol withdrawal
291.89	Other specified alcoholic psychosis
291.9	Alcoholic psychosis NOS
303.0	Intoxication, acute alcohol
303.00	Intox, acute alcoholic, unspc
303.01	Intox, acute alcoholic, continuous
303.02	Intox, acute alcoholic, episodic
303.9	Dependence, alcohol
303.90	Dpnd, alcohol NEC/NOS, unspecified
303.91	Dpnd, alcohol NEC/NOS, continuous
303.92	Dpnd, alcohol NEC/NOS, episodic
305.0	Abuse, alcohol
305.00	Abuse, alcohol, unspecified
305.01	Abuse, alcohol, continuous
305.02	Abuse, alcohol, episodic
ANXIETY	
300.0	Anxiety states
300.00	Anxiety state NOS
300.01	Panic disorder
300.02	Anxiety disorder, generalized
300.09	Anxiety state NEC
300.2	Disorders, phobic
300.20	Phobia NOS
300.21	Agoraphobia w/panic attacks
300.22	Agoraphobia w/o panic attacks
300.23	Phobia, social

300.29	Phobias, other isolated or simple
300.3	Disorders, obsessive-compulsive
BIPOLAR	
296.0	Manic disorder, single episode
296.00	Manic disorder, sngl epsd, unspc
296.01	Manic disorder, sngl epsd, mild
296.02	Manic disorder, sngl epsd, moderate
296.03	Manic disorder, sngl epsd, severe
296.04	Mnc dsord sng epsd svr w/psyct bhvr
296.1	Manic disorder, recurrent episode
296.10	Manic disorder, recurrent, unspc
296.11	Manic disorder, recurrent, mild
296.12	Manic disorder, recurrent, moderate
296.13	Manic disorder, recurrent, severe
296.14	Manic dsord, rcr, svr w/psyct behv
296.4	Bipolar affective disorder, manic
296.40	Bipolar afct dsord, manic, unspc
296.41	Bipolar afct dsord, manic, mild
296.42	Bipolar afct dsord, manic, moderate
296.43	Bipolar afct dsord, manic, severe
296.44	Bipolar afct dsord mnc svr w/psyct
296.5	Bipolar afctv disorder, depressed
296.50	Bplr afctv dsord, dprsd, unspc
296.51	Bplr afctv dsord, dprsd, mild
296.52	Bplr afctv dsord, dprsd, moderate
296.53	Bplr afctv dsord, dprsd, severe
296.54	Bplr afctv dsord dprsd svr w/psyct
296.6	Bipolar affective disorder, mixed
296.60	Bplr afctv dsord mixed, unspecified
296.61	Bplr afctv dsord mixed, mild
296.62	Bplr afctv dsord mixed, moderate
296.63	Bplr afctv dsord mixed, severe
296.64	Bplr afctv dsord mixed, svr w/psyct
296.7	Biplr afctv disorder mixed NOS
296.8	Manic-dprsv psychosis, oth & unspc
296.80	Manic-depressive psychosis NOS
296.81	M-D psycho, atypical manic disorder
296.82	M-D psycho, atypical dprsv disorder
296.89	Manic-depressive psychosis NEC
DELIRIUM, DEMENTIA AND OTHER COGNITIVE DISORDERS	
293.0	Delirium, acute
293.1	Delirium, subacute
293.8	Dsord, oth transient organic mental

293.81	Syndrome, organic delusional
293.82	Syndrome, organic hallucinosis
293.83	Syndrome, organic affective
293.84	Syndrome, organic anxiety
293.89	Dsord, transient organic mental NEC
293.9	Dsord, transient organic mental NOS
294	Psychotic conditions, other organic
294.0	Syndrome, amnestic
294.1	Dementia in other diseases
294.8	Syndrome, organic brain NEC
294.9	Syndrome, organic brain NOS
DEPRESSION	
296.2	Depressive dsord, major, snl epsd
296.20	Dprsv dsord, major snl epsd unspc
296.21	Dprsv dsord, major snl epsd, mild
296.22	Dprsv dsord, major snl epsd, mod
296.23	Dprsv dsord, major snl epsd, svr
296.24	Dprsv dsord, mjr snl svr w/psyc
296.3	Dprsv dsord, major recurrent epsd
296.30	Dprsv dsord, major rcr, unspc
296.31	Dprsv dsord, major recurrent, mild
296.32	Dprsv dsord, major recurrent, mod
296.33	Dprsv dsord, major rcr, severe
296.34	Dprsv dsord, mjr rcr svr psyc behv
300.4	Depression, neurotic
309.0	Reaction, brief depressive
309.1	Reaction, prolonged depressive
309.2	React, adjustment w/emntl disturb
311	Disorder, depressive NEC
DISSOCIATIVE	
300.12	Amnesia, psychogenic
300.13	Fugue, psychogenic
300.14	Multiple personality
300.15	Dissociative reaction NOS
300.6	Syndrome, depersonalization
DRUG	
292.0	Withdrawal syndrome, drug
292.1	Paranoid/hlucnt state, drug-induced
292.11	Paranoid state, drug-induced
292.12	Hallucinosis, drug-induced
292.2	Intoxication, pathological drug
292.8	Dsord, oth spec drug-induced mental

292.81	Delirium, drug-induced
292.82	Dementia, drug-induced
292.83	Syndrome, amnestic, drug-induced
292.84	Syndrome, depressive, drug-induced
292.89	Disorder, drug-induced mental NEC
292.9	Disorder, drug-induced mental NOS
304.0	Dependence, opioid type
304.00	Dependence, opioid, unspecified
304.01	Dependence, opioid, continuous
304.02	Dependence, opioid, episodic
304.1	Dependence, barbiturate/sedative
304.10	Dpdn, barb/sed, unspec
304.11	Dpdn, barb/sed, continuous
304.12	Dpdn, barb/sed, episodic
304.2	Dependence, cocaine
304.20	Dependence, cocaine, unspecified
304.21	Dependence, cocaine, continuous
304.22	Dependence, cocaine, episodic
304.3	Dependence, cannabis
304.30	Dependence, cannabis, unspecified
304.31	Dependence, cannabis, continuous
304.32	Dependence, cannabis, episodic
304.4	Dependence, amphetamine
304.40	Dependence, amphetamine, unspc
304.41	Dependence, amphetamine, continuous
304.42	Dependence, amphetamine, episodic
304.5	Dependence, hallucinogen
304.50	Dependence, hallucinogen, unspc
304.51	Dependence, hallucinogen, cntns
304.52	Dependence, hallucinogen, episodic
304.6	Dependence, unspecified drug
304.60	Dependence, drug NEC, unspecified
304.61	Dependence, drug NEC, continuous
304.62	Dependence, drug NEC, episodic
304.7	Dpdn, opioid cmb w/other drug
304.70	Dpdn, opioid cmb w/oth drug, unspc
304.71	Dpdn, opioid cmb w/oth drug, cntns
304.72	Dpdn, opioid cmb w/oth drug, epsd
304.8	Dpdn, combined drug w/o opioid
304.80	Dpdn, cmb drug w/o opioid, unspc
304.81	Dpdn, cmb drug w/o opioid, cntns
304.82	Dpdn, cmb drug w/o opioid, epsd
304.9	Dependence, drug NOS
304.90	Dependence, drug NOS, unspecified
304.91	Dependence, drug NOS, continuous

304.92	Dependence, drug NOS, episodic
305.2	Abuse, cannabis
305.20	Abuse, cannabis, unspecified
305.21	Abuse, cannabis, continuous
305.22	Abuse, cannabis, episodic
305.3	Abuse, hallucinogen
305.30	Abuse, hallucinogen, unspecified
305.31	Abuse, hallucinogen, continuous
305.32	Abuse, hallucinogen, episodic
305.4	Abuse, barbiturate/sedative
305.40	Abuse, barb/sed, unspecified
305.41	Abuse, barb/sed, continuous
305.42	Abuse, barb/sed, episodic
305.5	Abuse, opioid
305.50	Abuse, opioid, unspecified
305.51	Abuse, opioid, continuous
305.52	Abuse, opioid, episodic
305.6	Abuse, cocaine
305.60	Abuse, cocaine, unspecified
305.61	Abuse, cocaine, continuous
305.62	Abuse, cocaine, episodic
305.7	Abuse, amphetamine
305.70	Abuse, amphetamine, unspecified
305.71	Abuse, amphetamine, continuous
305.72	Abuse, amphetamine, episodic
305.8	Abuse, antidepressant
305.80	Abuse, antidepressant, unspecified
305.81	Abuse, antidepressant, continuous
305.82	Abuse, antidepressant, episodic
305.9	Abuse, other/mixed/unspecified drug
305.90	Abuse, oth/mixed/unspc drug, unspc
305.91	Abuse, oth/mixed/unspc drug, cntns
305.92	Abuse, oth/mixed/unspc drug, epsd
IMPULSE CONTROL	
312.3	Disorders of impulse control NEC
312.30	Disorder of impulse control NOS
312.31	Gambling, pathological
312.32	Kleptomania
312.33	Pyromania
312.34	Disorder, intermittent explosive
312.35	Disorder, isolated explosive
312.39	Disorder of impulse control NEC
PEDIATRIC BEHAVIORAL DISORDERS	

312	Disturbance of conduct NEC
312.0	Dsord, undersocialized conduct, agr
312.00	Dsord, undrsc cndct, agr, unspc
312.01	Dsord, undrsc cndct, agr, mild
312.02	Dsord, undrsc cndct, agr, moderate
312.03	Dsord, undrsc cndct, agr, severe
312.1	Dsord, undersocialized cndct, unagr
312.10	Dsord, undrsc cndct, unagr, unspe
312.11	Dsord, undrsc cndct, unagr, mild
312.12	Dsord, undrsc cndct, unagr, mod
312.13	Dsord, undrsc cndct, unagr, severe
312.2	Disorder, socialized conduct
312.20	Disorder, social conduct, unspec
312.21	Disorder, social conduct, mild
312.22	Disorder, social conduct, moderate
312.23	Disorder, social conduct, severe
312.4	Disturbance, mixed conduct/emotions
312.8	Disturbance, conduct, other spec
312.81	Disorder, conduct, childhood onset
312.82	Disorder, conduct, adolescent onset
312.89	Disorder, conduct, other
312.9	Disturbance, conduct NOS
313	Disturb, emotions, chldhd/adols
313.0	Disorder, overanxious
313.1	Disorder, misery and unhappiness
313.2	Dsord, sensitivity/shyness/wthdrwl
313.21	Disorder, shyness, childhood
313.22	Disorder, introverted, childhood
313.23	Mutism, elective
313.3	Problems, relationship
313.8	Dsturb, oth/mxd emtnl, chldhd/adols
313.81	Disorder, oppositional
313.82	Disorder, identity
313.83	Dsord, academic underachievement
313.89	Dsturb, oth/mixed emtnl, chldhd NEC
313.9	Dsturb, oth/mixed emtnl, chldhd NOS
PERSONALITY	
301.0	Paranoid personality
301.1	Disorder, affective personality
301.10	Disorder, affective personality NOS
301.11	Disorder, chronic hypomanic prsnlty
301.12	Disorder, chrn depressive prsnlty
301.13	Disorder, cyclothymic personality
301.2	Disorder, schizoid personality

301.20	Disorder, schizoid personality NOS
301.21	Disorder, introverted personality
301.22	Disorder, schizotypal personality
301.3	Disorder, explosive personality
301.4	Disorder, compulsive personality
301.5	Disorder, histrionic personality
301.50	Disorder, histrionic prsnlty NOS
301.51	Dsord chrn fictious ill w/phys symp
301.59	Dsord, histrionic personality NEC
301.6	Disorder, dependent personality
301.7	Disorder, antisocial personality
301.8	Disoder, personality, other
301.81	Disorder, narcissistic personality
301.82	Disorder, avoidant personality
301.83	Disorder, borderline personality
301.84	Disorder, passive-aggr prsnlty
301.89	Disorder, personality NEC
301.9	Disorder, personality NOS
PSYCHOTIC	
295	Disorders, schizophrenic
295.0	Schizophrenia, simple
295.00	Schizophrenia, simple, unspecified
295.01	Schizophrenia, simple, subchronic
295.02	Schizophrenia, simple, chronic
295.03	Schizo, smpl sbchrn w/acute exacrb
295.04	Schizo, smpl chrn w/acute exacrb
295.1	Schizophrenia, disorganized
295.10	Schizophrenia, disorganized, unspc
295.11	Schizophrenia, dsorgn, subchronic
295.12	Schizophrenia, dsorgn, chronic
295.13	Schizo, dsorgn, sbchrn acute exacrb
295.14	Schizo, dsorgn, chrn w/acute exacrb
295.2	Schizophrenia, catatonic
295.20	Schizophrenia, catatonic, unspc
295.21	Schizo, catatonic, subchronic
295.22	Schizo, catatonic, chronic
295.23	Schizo ctatnc sbchrn w/acute exacrb
295.24	Schizo ctatnc chrn w/acute exacrb
295.3	Schizophrenia, paranoid
295.30	Schizophrenia, paranoid, unspc
295.31	Schizo, paranoid, subchronic
295.32	Schizo, paranoid, chronic
295.33	Schizo prnoid sbchrn w/acute exacrb
295.34	Schizo prnoid chrn w/acute exacrb

295.4	Schizophrenic episode, acute
295.40	Schizophrenic episode, acute unspc
295.41	Schizo episode, acute, subchronic
295.42	Schizo episode, acute, chronic
295.43	Schizo epsd acute sbchrn w/exacrb
295.44	Schizo epsd acute chrn w/exacrb
295.5	Schizophrenia, latent
295.50	Schizophrenia, latent, unspecified
295.51	Schizophrenia, latent, subchronic
295.52	Schizophrenia, latent, chronic
295.53	Schizo latent sbchrn w/acute exacrb
295.54	Schizo latent chrn w/acute exacrb
295.6	Schizophrenia, residual
295.60	Schizophrenia, residual, unspc
295.61	Schizophrenia, residual, subchronic
295.62	Schizophrenia, residual, chronic
295.63	Schizo, resid sbchrn w/acute exacrb
295.64	Schizo, resid chrn w/acute exacrb
295.7	Schizophrenia schizo-affective type
295.70	Schizo, schizo-afctv, unspc
295.71	Schizo schizo-afctv, sbchrn
295.72	Schizo schizo-afctv, chronic
295.73	Schizo-afctv, sbchrn w/acute exacrb
295.74	Schizo-afctv, chrn w/acute exacrb
295.8	Schizophrenia, other
295.80	Schizophrenia NEC, unspecified
295.81	Schizophrenia NEC, subchronic
295.82	Schizophrenia NEC, chronic
295.83	Schizo NEC, sbchrn w/acute exacrb
295.84	Schizo NEC, chronic w/acute exacrb
295.9	Schizophrenia NOS
295.90	Schizophrenia NOS, unspecified
295.91	Schizophrenia NOS, subchronic
295.92	Schizophrenia NOS, chronic
295.93	Schizo NOS, sbchrn w/acute exacrb
295.94	Schizo NOS, chronic w/acute exacrb
296.9	Affective psychosis, oth & unspc
296.90	Affective psychosis NOS
296.99	Affective psychosis NEC
297	Paranoid states (Delusional disord)
297.0	Paranoid state, simple
297.1	Paranoia
297.2	Paraphrenia
297.3	Paranoid disorder, shared
297.8	Paranoid states NEC

297.9	Paranoid state NOS
298	Nonorganic psychoses, other
298.0	Nonorganic psychosis, depressive
298.1	Nonorganic psychosis, excitative
298.2	Nonorgn psych, reactive confusion
298.3	Nonorgn psych, acute prnoid react
298.4	Nonorgn psych, psygnc prnoid psych
298.8	Nonorgan psych, reactive oth/unspc
298.9	Nonorganic psychosis NOS
299	Psychoses specific to childhood
299.1	Disintegrative psychosis
299.10	Disintegrative psychosis, active
299.11	Disintegrative psychosis, residual
299.8	Psychoses, early childhood, other
299.80	Psychosis, early chldhd NEC, active
299.81	Psychosis, early chldhd NEC, resid
299.9	Psychosis, early childhood, unspc
299.90	Psychosis, early chldhd NOS, active
299.91	Psychosis, early chldhd NOS, resid
SLEEP	
307.4	Disorders, nonorganic sleep
307.40	Disorder, nonorganic sleep NOS
307.41	Insomnia, transient
307.42	Insomnia, persistent
307.43	Hypersomnia, transient
307.44	Hypersomnia, persistent
307.45	Disruption, 24hr sleep/wake cycle
307.46	Somnambulism/night terrors
307.47	Dysfunction, sleep state NEC
307.48	Intrusion, repetitive sleep
307.49	Disorder, nonorganic sleep NEC
780.5	Disturbance, sleep
780.50	Disturbance, sleep NOS
780.51	Insomnia w/sleep apnea
780.52	Insomnia NEC
780.53	Hypersomnia w/sleep apnea
780.54	Hypersomnia NEC
780.55	Irregular sleep/wake rhythm NOS
780.56	Dysfunctions, sleep stage
780.57	Apnea, sleep NOS
780.59	Disturbances, sleep NEC
SOMATOFORM/FACTITIOUS	
300.1	Hysteria

300.10	Hysteria NOS
300.11	Conversion disorder
300.12	Amnesia, psychogenic
300.16	Illness, factitious w/symptoms
300.19	Illness, factitious NEC/NOS
300.7	Hypochondriasis
300.81	Disorder, somatization
300.82	Disorder, undiff somatoform
STRESS	
300.5	Neurasthenia
300.8	Disorders, other neurotic
300.89	Disorder, neurotic NEC
300.9	Disorder, neurotic NOS
306.0	Disord, psychogenic musculoskeletal
306.1	Disorder, psychogenic respiratory
306.2	Disord, psychogenic cardiovascular
306.3	Disorder, psychogenic skin
306.4	Disorder, psychogenic GI
306.5	Disorder, psychogenic genitourinary
306.50	Disorder, psychogenic GU NOS
306.51	Disorder, psychogenic vaginismus
306.52	Disorder, psychogenic dysmenorrhea
306.53	Disorder, psychogenic dysuria
306.59	Disorder, psychogenic GU NEC
306.6	Disorder, psychogenic endocrine
306.7	Disorder, psychogenic sensory
306.8	Disorder, psychogenic NEC
306.9	Disorder, psychogenic NOS
307.80	Pain, psychogenic NOS
307.81	Headache, tension
307.89	Pain, psychogenic NEC
307.9	Symptoms/syndromes NEC/NOS, special
308	Reaction, acute, to stress
308.0	React, acute stress w/emtnl disturb
308.1	React, acute stress w/cns/cs disturb
308.2	React, acute stress w/psychomotor
308.3	Reaction, acute stress NEC
308.4	React, acute stress w/mixed dsord
308.9	Reaction, acute stress, NOS
309.21	Disorder, separation anxiety
309.22	Disord, emncp, adlsnt/early adult
309.23	Inhibition, academic/work
309.24	Reaction, adjustment w/anxious mood
309.28	React, adjustment w/mixed emotion

309.29	Reaction, adjustment, emotional NEC
309.3	React, adjustment w/conduct disturb
309.4	React, adjustment w/mixed disturb
309.8	Reaction, adjustment, other
309.81	Disorder, prolonged psttraum stress
309.82	React, adjustment w/physical symp
309.83	Reaction, adjustment w/withdrawal
309.89	Reaction, adjustment NEC
309.9	Reaction, adjustment NOS

Appendix B

ICD-9 Remission Codes and Diagnoses Included for Mental Health History and

Excluded for Diagnosis During Study Period, by Mental Health Category

ALCOHOL	
ICD-9 CODE	DIAGNOSIS
303.03	Intox, acute alcoholic, in remission
303.93	Dpdn, alcohol NEC/NOS, in remission
305.03	Abuse, alcohol, in remission
ANXIETY	
BIPOLAR	
296.05	Manic dsord, sng epsd, prtl rmis
296.06	Manic dsord, sng epsd, full rmis
296.15	Manic disorder, rcr, partial rmis
296.16	Manic disorder, rcr, full remission
296.45	Bipolar afct dsord mnc, prtl rmis
296.46	Bipolar afct dsord mnc, full rmis
296.55	Bplr afctv dsord dprsd, prtl rmis
296.56	Bplr afctv dsord dprsd, full rmis
296.65	Bplr afctv dsord mixed, prtl rmis
296.66	Biplr afctv dsord mixed, full rmis
DELERIUM, DEMENTIA AND OTHER COGNITIVE DISORDERS	
DEPRESSION	
296.25	Dprsv dsord, mjr sngle, prtl rmis
296.26	Dprsv dsord, mjr sngle, full rmis
296.35	Dprsv dsord, mjr rcr, partial rmis
296.36	Dprsv dsord, mjr rcr, full rmis
DISSOCIATIVE	
DRUG	
304.03	Dependence, opioid, in remission
304.13	Dpdn, barb/sed, in remission
304.23	Dependence, cocaine, in remission
304.33	Dependence, cannabis, in remission
304.43	Dependence, amphetamine, in rmis
304.53	Dependence, hallucinogen, in rmis
304.63	Dependence, drug NEC, in remission

304.73	Dpdn, opioid cmb w/oth drug, rmis
304.83	Dpdn, cmb drug w/o opioid, in rmis
304.93	Dependence, drug NOS, in remission
305.23	Abuse, cannabis, remission
305.33	Abuse, hallucinogen, in remission
305.43	Abuse, barb/sed, in remission
305.53	Abuse, opioid, in remission
305.63	Abuse, cocaine, in remission
305.73	Abuse, amphetamine, in remission
305.83	Abuse, antidepressant, in remission
305.93	Abuse, oth/mixed/unspc drug, remis
IMPULSE CONTROL	
PEDIATRIC BEHAVIORAL DISORDERS	
PERSONALITY	
PSYCHOTIC	
295.05	Schizophrenia, simple, in remission
295.15	Schizophrenia, dsorgn, in remission
295.25	Schizo, catatonic, in remission
295.35	Schizo, paranoid, in remission
295.45	Schizo epsd acute, in remission
295.55	Schizo, latent, in remission
295.65	Schizo, residual, in remission
295.75	Schizo, schizo-afctv, in remission
295.85	Schizophrenia NEC, in remission
295.95	Schizophrenia NOS, in remission
SLEEP	
SOMATOFORM/FACTITIOUS	
STRESS	

Appendix C

ICD-9 Codes by Diagnostic Category, as Reported in Submitted Manuscripts

Alcohol: 291, 291.0 – 291.5, 291.8, 291.81, 291.89, 291.9, 303.0, 303.00 – 303.02, 303.9, 303.90 – 303.92, 305.0, 305.00 – 305.02

Also included for history ascertainment: 303.03, 303.93, 305.03

Anxiety: 300.0, 300.00 – 300.02, 300.09, 300.2, 300.20 – 300.23, 300.29, 300.3

Bipolar: 296.0, 296.00 – 296.04, 296.1, 296.10 – 296.14, 296.4, 296.40 – 296.44, 296.5, 296.50 – 296.54, 296.6, 296.60 – 296.64, 296.7, 296.8, 296.80 – 296.82, 296.89

Also included for history ascertainment: 296.05, 296.06, 296.15, 296.16, 296.45, 296.46, 296.55, 296.56, 296.65, 296.66

Delirium, Dementia or other Cognitive Disorder: 293.0, 293.1, 293.8, 293.81 – 293.84, 293.89, 293.9, 294, 294.0, 294.1, 294.8, 294.9

Depression: 296.2, 296.20 – 296.24, 296.3, 296.30 – 296.34, 300.4, 309.0 – 309.2, 311

Also included for history ascertainment: 296.25, 296.26, 296.35, 296.36

Dissociative: 300.12 – 300.15, 300.6

Drug: 292.0, 292.1, 292.11, 292.12, 292.2, 292.8, 292.81 – 292.84, 292.89, 292.9, 304.0, 304.00 – 304.02, 304.1, 304.10 – 304.12, 304.2, 304.20 – 304.22, 304.3, 304.30 – 304.32, 304.4, 304.40 – 304.42, 304.5, 304.50 – 304.52, 304.6, 304.60 – 304.62, 304.7, 304.70 – 304.72, 304.8, 304.80 – 304.82, 304.9, 304.90 – 304.92, 305.2, 305.20 – 305.22, 305.3, 305.30 – 305.32, 305.4, 305.40 – 305.42, 305.5, 305.50 – 305.52, 305.6, 305.60 – 305.62, 305.7, 305.70 – 305.72, 305.8, 305.80 – 305.82, 305.9, 305.90 – 305.92

*Also included for history ascertainment: 304.*3, 305.23 – 305.93*

Impulse Control: 312.3, 312.30 – 312.35, 312.39

Pediatric Behavioral Disorder: 312, 312.0, 312.00 – 312.03, 312.1, 312.10 – 312.13, 312.2, 312.20 – 312.23, 312.4, 312.8, 312.81, 312.82, 312.89, 312.9, 313, 313.0 – 313.2, 313.21 – 313.23, 313.3, 313.8, 313.81 – 313.83, 313.89, 313.9

Personality: 301.0, 301.1, 301.10 – 301.13, 301.2, 301.20 – 301.23, 301.3 – 301.5, 301.50, 301.51, 301.59, 301.6 – 301.8, 301.81 – 301.84, 301.89, 301.9

Psychotic: 295, 295.0, 295.00 – 295.04, 295.1, 295.10 – 295.14, 295.2, 295.20 – 295.24, 295.3, 295.30 – 295.34, 295.4, 295.40 – 295.44, 295.5, 295.50 – 295.54, 295.6, 295.60 – 295.64, 295.7, 295.70 – 295.74, 295.8, 295.80 – 295.84, 295.9, 295.90 – 295.94, 296.9, 296.90, 296.99, 297, 297.0 – 297.3, 297.8, 297.9, 298, 298.0 – 298.4, 298.8, 298.9, 299, 299.1, 299.10, 299.11, 299.8, 299.80, 299.81, 299.9, 299.90, 299.91

*Also included for history ascertainment: 295.*5*

Sleep: 307.4, 307.4*, 780.5, 780.50 – 780.57, 780.59

Somatoform/Factitious: 300.1, 300.10 – 300.12, 300.16, 300.19, 300.7, 300.81, 300.82

Stress: 300.5, 300.8, 300.89, 300.9, 306.0, 306.1 – 306.5, 306.50 – 306.53, 306.59, 306.6 – 306.9, 307.80, 307.81, 307.89, 307.9, 308, 308.0 – 308.4, 308.9, 309.21 – 309.24, 309.28, 309.29, 309.3, 309.4, 309.8, 309.81 – 309.83, 309.89, 309.9

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