SLEEP DISTURBANCE FOLLOWING SEPTEMBER 11: RESULTS OF A NATIONWIDE LONGITUDINAL STUDY

by

Elaine Thomas Bailey

A Dissertation Submitted to the Faculty of the

DEPARTMENT OF PSYCHOLOGY

In Partial Fulfillment of the Requirements
For the Degree of

DOCTOR OF PHILOSOPHY

In the Graduate College

THE UNIVERSITY OF ARIZONA

2006

THE UNIVERSITY OF ARIZONA
GRADUATE COLLEGE

As members of the Dissertation Committee, we certify that we have read the dissertation prepared by Elaine Thomas Bailey
entitled Sleep Disturbance Following September 11:
Results of a Nationwide Longitudinal Study
and recommend that it be accepted as fulfilling the dissertation requirement for the Degree of Doctor of Philosophy

_____ Date: March 29, 2006
Richard R. Bootzin, Ph.D.

_____ Date: March 29, 2006
Alfred W. Kaszniak, Ph.D.

_____ Date: March 29, 2006
Varda Shoham, Ph.D.

_____ Date: March 29, 2006
Harold S. Arkowitz, Ph.D.

_____ Date: March 29, 2006
Anne M. Herring, Ph.D.

Final approval and acceptance of this dissertation is contingent upon the candidate's submission of the final copies of the dissertation to the Graduate College.

I hereby certify that I have read this dissertation prepared under my direction and recommend that it be accepted as fulfilling the dissertation requirement.

_____ Date: March 29, 2006
Dissertation Director: Richard R. Bootzin, Ph.D.

STATEMENT BY AUTHOR

This dissertation has been submitted in partial fulfillment of requirements for an advanced degree at the University of Arizona and is deposited in the University Library to be made available to borrowers under rules of the Library.

Brief quotations from this dissertation are allowable without special permission, provided that accurate acknowledgement of source is made. Requests for permission for extended quotations from or reproductions of this manuscript in whole or in part may be granted by the head of the major department of the Dean of the Graduate College when in his or her judgment the proposed use of the material is in the interests of scholarship. In all other instances, however, permissions must by obtained from the author.

SIGNED: Elaine T. Bailey

ACKNOWLEDGEMENTS

This dissertation would not have been possible without the generosity of Roxane Cohen Silver and Alison Holman at the University of California, Irvine. In sharing their data, time, and wisdom, they have helped me to learn a great deal not only about the nature of psychological reactions to trauma, but about the practice of doing science. For this, I am very grateful. Likewise, I am grateful to my committee members, Richard Bootzin, Al Kaszniak, Varda Shoham, Hal Arkowitz, and Anne Herring, whose guidance saw me through the long and often arduous process of proposing, completing, and defending my dissertation.

It is difficult for me to put into words how thankful I am for the mentorship of Dick Bootzin. As my advisor over these past 7 years, he has helped me through many hurdles on the way to becoming a scientist, clinician, and teacher. In the process of completing this dissertation, he put in countless hours with me, wading through the data and wrestling with ideas about how to best tackle the most interesting questions. In this project and throughout my graduate career, Dick has helped me to gain confidence in my skills as a psychologist. More than that, he has been a supportive figure as I have negotiated many of life's challenges: adjusting to graduate school and a new city located thousands of miles away from my family, learning more about my own strengths and weaknesses as a professional, and starting a family of my own. I appreciate not only his knowledge, but his humor and his humanity. I am glad to forever be a part of his academic family.

I have been fortunate to share this lineage with a remarkable group of people, my fellow sleep lab members and affiliates: Willoughby Britton, Keith Fridel, Brant Hasler, Leisha Smith, Jen Cousins, Jenne Breslin, and Tricia Haynes. Whether directly or indirectly, each one has contributed to my success as a graduate student, and for that, I am indebted to them all. This past year, I have led a double life as graduate student and psychology intern. My co-workers in the Psychiatry Department have been extremely supportive, especially in the last months and weeks leading up to my defense. Thank you to my fellow interns as well as Anne Herring (my internship training director) and Maryruth Farrell (the internship's administrative support) for their patience and understanding during my most sleep-deprived days. Though I cannot mention them all by name, I could not have survived these past years had it not been for my fellow graduate students. I will always treasure these friendships, bolstered as they are by the shared understating of the strange experience that is graduate school.

My parents' unwavering support has allowed me to accomplish many things, including this graduate degree. As I reflect on how much my own family has meant to me in completing this work, my thoughts turn to the families of the September 11th victims. As much as the terrorist attacks had a profound effect on me and so many other Americans, I will never be able to fully understand the impact that they had on those who lost loved ones on that clear September morning. I can only send them my compassion and acknowledge that while conducting this research has been a fascinating academic exercise for me, it is one that I wish had never been made possible.

DEDICATION

I once wrote that graduate school was like running a marathon. Well, here I am, just now crossing the finish line after a 7-year race. I am dedicating this dissertation to those who helped me the most along the way: my husband, Reid, and my daughter, Julia. They have seen me through endless periods of procrastination punctuated by bouts of caffeine-fueled work during which only the inconveniencies of having to eat and sleep kept me from writing 24 hours a day. I missed my family during those long hours, but they were there - Reid was there, working right alongside me, shouldering the burden of home life that I was forced to neglect during my most frantic days. For that reason, this dissertation is just as much his as it is mine.

It belongs to Julia, too. While her friends' mothers were toting them around to parks and storytime, she had to share hers with a computer screen and a pile of papers. From her perspective, she might think that I love these things more than her. So, to her I say, as proud as I am to finally earn my Ph.D., my greatest pride will always be in you.

Reid, Julia, the rest of my family, my professors, and my friends have all made the long road of my graduate career one that was well worth traveling. Now that I am finally reaching the end of my run, aching and exhausted, but still managing to shuffle one foot in front of the other, I look back at the experience and think

… given the choice, I would do it all over again.

TABLE OF CONTENTS

TABLE OF CONTENTS - *Continued*

TABLE OF CONTENTS - *Continued*

LIST OF FIGURES

LIST OF FIGURES - *Continued*

LIST OF TABLES

LIST OF TABLES - *Continued*

LIST OF TABLES - *Continued*

ABSTRACT

The terrorist attacks of September 11, 2001, provided a unique, though unfortunate, opportunity to study Americans' sleep reactions to a traumatic event. Questionnaires were distributed electronically to a web-based panel whose demographic distribution closely matched current U.S. census counts. Prior to 9/11/01, participants reported whether they had ever been diagnosed with anxiety, depression, or insomnia. Two weeks following the terrorist attacks, they completed an acute stress questionnaire (SASRQ) which included questions about 9/11-related difficulty falling or staying asleep and nightmares. They later completed a posttraumatic stress symptom questionnaire at two time points: 2 months and 6 months post-9/11. This instrument, the IES-R, included questions about 9/11-related difficulty falling asleep, difficulty staying asleep, and dreams. A total of 782 adults (50.4% male; mean age = 49.6 years) responded.

Two weeks following the terrorist attacks, 23% of the sample reported having 9/11-related difficulty falling or staying asleep; 9% reported 9/11-related nightmares. Two months following the attacks, 27% reported having at least some difficulty falling asleep related to 9/11, 33% reported having difficulty staying asleep, and 17% reported having 9/11-related dreams. When assessed again at 6 months post-9/11, levels of these three sleep issues dropped significantly to 14%, 15%, and 8%, respectively. Females reported higher levels of 9/11-related sleep difficulties than males both at 2 weeks and 2 months after the attacks. By 6 months post-9/11, this sex difference had all but disappeared. Older respondents were slightly less likely than younger ones to report nightmares 2 weeks post-9/11 and dreams 2 months post-9/11. Those with pre-9/11

diagnoses of anxiety, depression, and insomnia generally had higher rates of 9/11-related sleep difficulties at all time points assessed.

When tested with a hierarchical regression model, difficulty falling or staying asleep at 2 weeks post-9/11 significantly predicted posttraumatic stress symptoms experienced 6 months (but not 2 months) following the attacks. This was true even when taking into account the contribution of pre-existing psychiatric diagnoses and non-sleep-related acute stress symptoms. These findings raise the possibility that the experience of disturbed sleep soon after a trauma directly contributes to the eventual development and exacerbation of posttraumatic stress symptoms.

INTRODUCTION

On September 11, 2001, the United States of America suffered the largest terrorist attack in its history. Thousands of people died on that day as a result of the terrorism, thousands more witnessed these events unfold in person, while millions watched on TV. The psychological impact of this tragedy on people throughout the United States was felt immediately and is still being felt today. Experiencing a trauma has many sequelae, but disrupted sleep is perhaps the most common reaction to a distressing event (e.g. Green, 1993). The aim of this project is to understand more about the immediate and lasting effects of the 9/11 attacks on the sleep and dreaming of a nationally representative sample of Americans. In so doing, we hope to learn more about the nature of sleep as it pertains to trauma, and to elucidate its contribution to the development of posttraumatic stress reactions.

Psychological reactions to trauma

People are known to experience a variety of psychological symptoms in response to trauma. In some severe cases, individuals may develop acute stress disorder (ASD), and if the symptoms continue to persist, posttraumatic stress disorder (PTSD). ASD and PTSD are both marked by re-experiencing of the traumatic event through flashbacks or dreams, avoidance behavior, and increased arousal, often marked by difficulty sleeping (American Psychiatric Association, 2000). The main difference between the diagnostic criteria of these two diagnoses is the duration of symptoms; PTSD requires the

disturbance to have lasted for at least 1 month, while ASD describes the symptoms experienced in the first weeks following a trauma.

Psychological reactions to September 11

In the years following September 11, 2001, a great deal of research has emerged documenting the effects of the attacks on various outcome measures, particularly those related to stress (either acute or posttraumatic). Much of this research has found that a large number of Americans experienced significant psychiatric distress in the wake of the 9/11. For example, a nationally representative survey of U.S. residents found that up to 44% of adults reported a sizable stress reaction in the days immediately following September 11, 2001 (Schuster et al., 2001). Previous analyses of the data that will be used in the current study (Silver, Holman, McIntosh, Poulin, & Gil-Rivas, 2002) revealed that 2 weeks following the attacks, 12% of a nationally representative sample reported acute stress symptoms.

Rates of subjectively-measured distress appeared to diminish over time. Two months following 9/11, the Silver et al. (2002) study found that 17% of the sample reported 9/11-related posttraumatic stress symptoms; 6 months following the attacks, this number dropped to 5.8%. Likewise, the group that reported a 44% initial stress rate found that by 2 months following the attacks, this number had dropped to 21% (Stein et al., 2004). Comparing responses gathered in the days immediately following 9/11 to those gathered 2 months later, 16% of respondents reported persistent distress. Higher rates of persistent distress in reaction to 9/11 were reported by females and those of non-white race (Stein et al., 2004). Silver et al. (2002) also found that female sex, along with

a preexisting (pre-9/11) diagnosis of anxiety or depression and more direct exposure to the attacks, were associated with higher levels of posttraumatic stress symptoms.

Some studies have focused on the response of certain subgroups to the events of 9/11. For example, a telephone survey conducted in October and November of 2001 found a PTSD rate of 7.5% and a depression rate of 9.7% among adults living on Manhattan (Galea et al., 2002). These same authors found the PTSD rate to be even higher, 20%, for those living closest to the World Trade Center (i.e. south of Canal Street). In this study, Hispanic ethnicity, two or more prior stressors, a panic attack during or soon after the attacks, and loss of possessions due to the attacks significantly predicted PTSD levels. A study conducted 1 to 2 months following the attacks found a PTSD prevalence rate of 11.4% among those living in the New York Metropolitan area, while rates were lower in Washington, DC (2.7%), other metropolitan areas (3.6%) and the remainder of the country (4.0%) (Schlenger et al., 2002).

PTSD symptoms were recorded in a sample of American expatriates living in Brussels (Speckhard, 2003). In the first week following the attacks, 10% displayed symptoms of acute stress disorder such as heightened arousal, derealization, re-experiencing the event, difficulty working, and avoidance. For most of this sample, however, these symptoms subsided with time. A study focusing Hispanic immigrants in the Miami area found that of the 110 immigrants surveyed, 14% reported PTSD symptoms (Pantin, Schwartz, Prado, Feaster, & Szapocznik, 2003). A large majority of this population had experienced previous exposure to war (70%) and natural disasters (84%). These experiences were significantly related to the development of 9/11-related

PTSD symptoms. A telephone survey of Connecticut residents revealed that sleep difficulties, close relationship with a victim, increased smoking and drinking, and receipt of informal help were predictive of formal help seeking following September 11 (Adams, Ford, & Dailey, 2004).

Although many community surveys have documented significant distress in response to 9/11, objective evidence has been harder to find. For example, some had anticipated that a national tragedy such as the 9/11 attacks would have exacerbated or rekindled PTSD symptoms in survivors of past traumatic situations. However, there was no increase in the use of mental health services offered by the Department of Veterans Affairs by PTSD patients in the 6 months following 9/11 (Rosenheck & Fontana, 2003). In Manhattan, psychiatric medication use increased only slightly following 9/11, though the increase from 8.9% to 11.6% was statistically significant (Boscarino, Galea, Ahern, & Resnick, 2003).

Sleep and trauma

Difficulties with sleep onset, sleep maintenance, and nightmares are among the most commonly-reported responses to trauma (Harvey, Jones, & Schmidt, 2003). Subjective sleep difficulties have been described following industrial accidents, severe earthquakes, hurricanes, floods, car accidents, wars, sea catastrophes, and rape (Lavie, 2001). Among those who have experienced trauma, insomnia and sleep disordered breathing are often comorbid with affective and behavioral problems including depression and substance abuse (Caldwell & Redeker, 2005). For most, sleep

disturbances following trauma are transient. For others, however, these symptoms persist for months or even years, usually in the form of ASD or PTSD (Lavie, 2001).

Sleep disturbances are one of the hallmarks of PTSD. According to the *DSM-IV-TR* definition, this disorder is associated with two main sleep symptoms: 1) "difficulty falling or staying asleep," and 2) "recurrent distressing dreams of the event." (American Psychiatric Association, 2000). The poor sleep resulting from sleep-onset insomnia and frequent awakenings may make the trauma survivor prone to increased sensitivity and reactivity to memories of the trauma, leaving that person unable to adequately cope with their traumatic experience (Rothbaum & Mellman, 2001). The experience of nightmares may likewise impair one's ability to cope with trauma. Some have theorized that changes to REM sleep (the sleep state most associated with dreams of a narrative nature) may disrupt the brain's ability to transfer memory fragments stored as episodic memory in the hippocampus to semantic memory in the neocortex (Caldwell & Redeker, 2005). Without this process of memory consolidation working properly, the PTSD patient may be left to continually re-experience past traumas.

Prior to the 9/11 attacks, the bombing of the Federal building in Oklahoma City had been the largest terrorist attack in the U.S. Six months after the tragedy, a large number of Oklahoma City survivors reported sleep-related symptoms including insomnia (70%) and nightmares (50%) (North et al., 1999). In their 1992 study, Wood, Bootzin, Rosenhan, Nolen-Hoesksema, and Jourden found that university students in the San Francisco Bay area had nearly twice the frequency of nightmares following the an intense 1989 earthquake than university students in Tucson. Another study of dreams following

a natural disaster, Hurricane Andrew, found that dreams about the hurricane (trauma-replicating dreams) were less common than other dream types, but were reported exclusively by subjects who also met criteria for a diagnosis of PTSD (David & Mellman, 1997).

While PTSD patients experience more sleep disturbances and nightmares than others when measured by subjective means (Harvey et al., 2003), objective evidence of sleep disturbances in PTSD is harder to find. For instance, monitoring of Israelis' sleep during ballistic missile attacks revealed that both children and adults awakened to alarms preceding missile attacks, but fell quickly back asleep (Lavie, 2001). Objective measures in this study failed to reveal evidence of insomnia while subjective reports found substantial levels. Furthermore, laboratory studies that compared the sleep of PTSD patients 2 years post-trauma with normal controls found that although some patients did in fact have disturbed sleep, many others had sleep comparable to that of normal controls (Lavie, 2001).

Woodward, Friedman, Bliwise (1996) likewise failed to find significant differences in objective measures of sleep between PTSD patients and normal controls. A study of young adults in Michigan found no increase in sleep disturbances as measured polysomnography in those with PTSD diagnoses compared to those without (Breslau et al., 2004). The PTSD group did, however, show more frequent brief arousals from rapid eye movement (REM) sleep. The authors hypothesized that the subjective sleep complaints so often associated with PTSD may stem, in part, from amplified perceptions of these brief REM arousals (Breslau et al., 2004). One year following their collision,

those survivors of motor vehicle accidents who met criteria for PTSD reported significantly poorer sleep than either non-PTSD collision survivors or controls who had undergone elective surgery (Klein, Koren, Arnon, & Lavie, 2003). However, as with the other studies, objective actigraphy data failed to corroborate these subjective sleep complaints (Klein et al., 2003). The authors argued that these results, found in the absence of active psychiatric symptoms at the time the trauma occurred, support the findings that the issue at hand in PTSD is altered sleep *perception* rather than altered sleep itself.

Harvey & Bryant (1998) found that when assessed within 1 month of a trauma, the lack of sleep disturbance and nightmares strongly predicted the lack of later ASD, while the presence of these symptoms only moderately predicted the later development of ASD. Furthermore, Koren, Arnon, Lavie, & Klein (2002) found that sleep complaints reported at 1 week post-trauma were not predictive of PTSD, but sleep complaints at 1 month predicted PTSD at 12 months. Taken together, these results suggest that the experience of sleep disturbances and nightmares within the first days and weeks following a trauma are not necessarily indicative of later disorders. Many people may have sleep problems, but will not go on to develop ASD or PTSD. On the other hand, those that do not experience sleep disturbances following trauma can be fairly confident that they will not develop ASD or PTSD.

PTSD and the exposure criterion

Since ancient times, writers have recorded the lasting effects of horrifying events including war, natural disasters, sexual assault, and accidents on the human psyche

(Lasiuk & Hegadoren, 2006). In this country, combat-related difficulties were noticed in veterans from the Civil War and World War I, and especially in World War II (Scrignar, 1999). Posttraumatic stress disorder (PTSD) was first officially recognized by the American Psychiatric Association in 1980 when it published the third edition of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM-III*). Originally, the stressor event was defined as, "existence of a recognizable stressor that would evoke significant symptoms of distress in almost everyone." One could argue that terrorist events such as those that occurred on September 11, 2001, would fit such a description.

In the current version of the *Diagnostic and Statistical Manual of Mental Disorders*, *DSM-IV-TR* (American Psychiatric Association, 2000), the stressor criterion requires that two requirements be met, 1) "The person experienced, witnessed, or was confronted with an event or events that involved actual or threatened death or serious injury, or a threat to the physical integrity of self or others," and 2) "The person's response involved intense fear, helplessness, or horror." Suggesting that watching the 9/11 attacks on television fulfills this stressor criterion is more difficult with this updated, narrower definition. However, one could argue that through intense media exposure, many people did witness the events, albeit not in person. In fact, while only 2% of a nationally-representative sample reported direct exposure to the terrorist attacks, 60% of this sample reported watching the attacks occur live on television. Less than 1% reported watching no TV coverage in the week after 9/11. This means that nearly all Americans were exposed to some media coverage of the events (Silver et al., 2002). Such media exposure often included pictures of the planes crashing into the World Trade Center, the

towers falling, even humans plummeting to their death from the tops of the buildings, all images of a very distressing nature.

Regardless of actual exposure, the nature of the terrorist attacks were such that all Americans may have felt a direct "threat to the physical integrity of self or others," as required by the current PTSD diagnosis. Such is the nature of terror. Terrorism has been defined by the government as an intentional act whose purpose is to intimate a civilian population ("Executive Order 13224," 2001). Terrorists' motives are usually accomplished through means that elicit fear and stress in many others than just in those directly exposed to the act (Combs, 1997). Stein et al. (2004) described terrorism as, "essentially a psychological attack on a society's social capital," thus making terrorism fundamentally distinct from other large-scale traumas. In fact, traumas inflicted by some humans upon others appear to be associated with higher levels of severe psychological distress such as PTSD than are natural disasters (Norris, Byrne, Diaz, & Kaniasty, 2002). As the terrorists likely desired, fear was abundant across the United States in the aftermath of 9/11. Even without direct exposure to the attacks on New York City and Washington, DC, people across the country were frightened for their own personal safety.

Some may still argue that watching the attacks occur on TV or over the Internet still do not allow a person experiencing other symptoms of PTSD to meet *DSM-IV-TR* criteria. However, incidents like these are increasingly bringing this exposure criterion into question, so much so that some are considering revising the definition of PTSD to be more symptom-based in the next edition of the *DSM* (Friedman & Karam, 2005).

Sleep reactions to September 11

In 2001, the National Sleep Foundation (NSF) conducted its yearly *Sleep in America* poll between October 1 and November 18, thus allowing them to include questions related to September 11 (National Sleep Foundation, 2003). The telephone survey, executed by WB&A Market Research, included 933 adults and was estimated to have a margin of error of 3.1%.

Nearly half of those polled (47%) reported that their sleep was fair or poor on most of the nights following 9/11, while only 23% reported their sleep as very good or excellent. This represents a change from past NSF polls in which 27% of Americans rated their sleep as fair or poor on most nights and 40% rated their sleep as very good or excellent. While previous (pre-9/11) NSF polls have found no sex difference in sleep quality, a higher percentage of women than men (54% and 40%, respectively) reported poor sleep quality following 9/11. Likewise, no regional differences in sleep quality were reported prior to 9/11. Following the attacks, however, those polled in the Northeast (31%) were actually more likely to report their sleep as being very good or excellent compared to those in the South (21%) or the Midwest (15%), though this difference was not statistically significant.

Following the 9/11 attacks, over two thirds of those polled (69%) reported at least one symptom of insomnia. Symptoms reported included difficulty falling asleep (44% versus pre-9/11 rates of 25%), frequent nighttime awakenings (49% versus pre-9/11 rates of 36%), early morning awakenings (39% versus pre-9/11 rates of 24%), and waking up feeling unrefreshed (50% versus 40%). Additionally, 71% of respondents cited stress as

a major cause of their sleep difficulties. Fear (32%), depression (31%), and bad dreams (23%) were also reported as instigators of insomnia.

Present study

The study described here attempted to elaborate on the question of how 9/11 affected Americans' sleep. This was done using a nationally-representative data set collected by researchers at the University of California, Irvine. Data on stress reactions including sleep disturbances were gathered via online questionnaires at several points following the terrorist attacks: 2 weeks, 2 months, and 6 months post-9/11.

These data provided several advantages over past studies of trauma as well as other 9/11 studies. First, the nature of longitudinal data such as these permit inferences regarding the direction of causality, conclusions that are impossible with cross-sectional data. One of the greatest strengths of these data is the ability to control for pre-existing mental health conditions. This allowed us to determine the unique contribution of sleep issues above and beyond the influence of psychiatric disorders (which have a strong influence on sleep). In addition, this study included early data collection. Other studies were able to gather data within months following this attacks; this study included data gathered days afterwards. Finally, this study included a large sample size drawn from a nationally representative pool, allowing its findings to be more easily generalized to a larger population (i.e. Americans as a whole).

To begin with, this study investigated the overall experience of sleep difficulties in the wake of 9/11. Given the pre-existing data on sleep reactions to trauma in general, as well as Americans' psychological reactions to 9/11, we hypothesized that the current

data would show high levels of sleep disturbances, particularly at the time points closer to the attacks themselves. We also sought to describe the change in sleep symptoms over time and to determine if they attenuated, as expected, as more time passed after 9/11. These data allowed for the investigation of the contribution of participants' characteristics such as their sex, age, race, distance for the World Trade Center, and pre-existing psychiatric diagnoses to post-9/11 sleep difficulties.

Because females have a proclivity for experiencing both sleep difficulties and posttraumatic stress symptoms, we hypothesized that they would show higher levels of 9/11-related sleep difficulties than males. Increasing age is associated with insomnia (Ancoli-Israel, 2000), so it we expected that it would likewise be associated with higher levels of 9/11-related sleep difficulties. Regarding the effect of race and ethnicity, one study found that Hispanics living on Manhattan had a higher rate of 9/11-related PTSD than did other Manhattanites (Galea et al., 2002), and others found that non-white race (Stein et al., 2004) and Hispanic ethnicity (Galea et al., 2002) are associated with higher rates of 9/11-related stress. As such, we would expect to see higher rates of 9/11-related sleep disturbances in these populations. Several studies have found regional differences in 9/11-related stress (Galea et al., 2002; Schlenger et al., 2002). We therefore expected to see similar distance-based differences in our study.

People with psychiatric diagnoses appear to be vulnerable to developing sleep disturbances (Taylor, Lichstein, Durrence, Reidel, & Bush, 2005). Furthermore, we already know from previous analyses of this data set that it revealed significant amounts of posttraumatic stress symptoms following 9/11, and that pre-existing psychiatric

diagnoses were associated with higher levels of posttraumatic stress symptoms (Silver et al., 2002). In addition, PTSD is associated with subjectively-reported sleep disturbances (Harvey et al., 2003). Knowing these facts, we hypothesized that participants with pre-existing psychiatric diagnoses would demonstrate higher levels of sleep disturbances after a trauma such as 9/11.

One of the most interesting aspects of this data set is its ability to investigate how early sleep disturbances may impact the later development of posttraumatic stress symptoms. Research suggests that sleep disturbance may be an early predictor of other psychiatric disorders such as depression (Breslau, Roth, Rosenthal, & Andreski, 1996). Will that be the case with posttraumatic stress, or will high levels of overall distress experienced in the aftermath of the 9/11 wash out the predictive ability of sleep disturbance? Given the wide-ranging effects of sleep on both mental and physical health and well-being, we hypothesized that early sleep disruption would have some unique contribution to the development of later posttraumatic stress symptoms.

METHODS

Analyses focused on sleep-related questions that were part of a larger data set collected following 9/11 by a group of researchers led by Roxane Cohen Silver, Ph.D., at the University of California, Irvine. This team gathered their information using the services of Knowledge Networks (KN), a web-based survey company which collected data from a nationwide sample of over 60,000 households. The KN survey panel was selected using stratified random-digit-dialed telephone sampling. This technique allowed for a known non-zero probability of selection for every telephone-owning US household. KN used poststratification weighting to match their panel distribution to current US census benchmarks for sex, age, race, ethnicity, education, and geographic region.

As part of the KN panel, members received TV-based equipment to access the Internet (WebTV). In return, they were required to complete three to four brief (10-15 minute) online surveys every month. All responses were confidential and the surveys were password-protected. Panel members were notified by email when a new survey was available for completion and could access the survey at their convenience, at any time of day or night. Surveys could only be completed once by each panel member and maintenance of Internet access was never contingent upon the completion of any one particular survey.

Participants

A total of 782 respondents completed surveys at all time points relevant to the present analyses (Waves 0, 1, 2, and 3; see Table 1 for description). Of this sample,

50.4% (n = 394) were male, 49.6% (n = 388) female. The mean age was 48.6 (sd = 16.3) and ranged from 18 to 101 years. Ethnicity of the sample was as follows: 73% Caucasian, 10% Hispanic, 8% African-American, 7% Other, 2% unknown.

Survey Distribution

Data were collected in several waves, both before and after the 9/11 terror attacks. Wave 0 represents the demographic and psychiatric data gathered between June 17, 2000 and September 4, 2001. Wave 1 occurred shortly after the terror attacks of September 11, 2001, when questionnaires were sent to a random sample of 3496 KN participants. Completed surveys were returned between September 20 and October 4, 2001 by 78% (n = 2729) of those contacted. Of those who responded, 75% returned their surveys in the first few days following 9/11 (9-14 days after the attacks). In Wave 2, a random sample of 1069 Wave 1 completers were sent surveys 2 months following 9/11 (November 10 – December 3, 2001). Response rate for Wave 2 was 87% (n = 933). Six months after 9/11 (March 16 – April 11, 2002), Wave 3 surveys were sent to the 860 available Wave 2 completers, generating a response rate of 92% (n = 787). See Table 1 for a summary of this information.

Table 1. *Dates, Response Rates, Questions, and Response Options for the Waves of Data Collection*

<table>
<tr><td>Wave 0: Pre-9/11</td><td colspan="2">Dates of survey completion: June 17, 2000 - Sept 4, 2001</td></tr>
<tr><td colspan="3">Questions:
Has the respondent ever been diagnosed with the following psychiatric disorders?
- Anxiety
- Depression
- Insomnia/Chronic Sleep Loss

Response Options:
0: No
1: Self-diagnosed only (not confirmed by a doctor)
2: Doctor-confirmed or diagnosed</td></tr>
<tr><td>Wave 1: 2 weeks post-9/11</td><td colspan="2">Dates of survey completion: Sept 20 – Oct 4, 2001</td></tr>
<tr><td># sent surveys: 3496</td><td># respondents: 2729</td><td>response rate: 78%</td></tr>
<tr><td colspan="3">Questions:
SASRQ (measure of acute stress symptoms)
- 9/11-related difficulty falling or staying asleep
- 9/11-related nightmares

Response Options:
0: Did not experience
1: Experienced</td></tr>
<tr><td>Wave 2: 2 months post-9/11</td><td colspan="2">Dates of survey completion: Nov 10 – Dec 3, 2001</td></tr>
<tr><td># sent surveys: 1069</td><td># respondents: 933</td><td>response rate: 87%</td></tr>
<tr><td colspan="3">Questions:
IES-R (measure of posttraumatic stress symptoms experienced in the past week)
- 9/11-related difficulty falling asleep
- 9/11-related difficulty staying asleep
- 9/11-related dreams

Response Options:
0: Not at all
1: A little bit
2: Moderately
3: Quite a bit
4: Extremely</td></tr>
<tr><td>Wave 3: 6 months post-9/11</td><td colspan="2">Dates of survey completion: March 16 - April 11, 2002</td></tr>
<tr><td># sent surveys: 860</td><td># respondents: 787</td><td>response rate: 92%</td></tr>
<tr><td colspan="3">Questions & Response Options:
Same as Wave 2</td></tr>
</table>

Survey Content

In Wave 0, respondents reported demographic information such as age, sex, and race, in addition to answering three separate questions about whether they had ever been diagnosed with anxiety, depression, and insomnia. They indicated whether this was a self-diagnosis only, or if the diagnosis had been made or confirmed by a medical professional.

Wave 1 respondents completed a modified version of the Stanford Acute Stress Reaction Questionnaire (SASRQ) as a method of assessing early acute stress symptoms (Cardena, Koopman, Classen, Waelde, & Spiegel, 2000). The SASRQ is often used to evaluate acute stress disorder (ASD) within 1 month on an event. Items were adapted to a 6.5-grade Kincaid reading level. Questions were prefaced by the following statement:

> The following questions measure the different ways people sometimes experience stress in relation to disasters like the recent terrorist attacks. Some people experience a lot of these reactions, and others very few of them. We're interested in whether you experienced each of these feelings since the terrorist attack on the World Trade Center and the Pentagon.

Respondents responded if they "experienced" or "did not experience" acute stress symptoms that were directly related to 9/11. The SASRQ contained two questions specific to sleep: "I had difficulty falling or staying asleep," and, "I had nightmares about the recent disaster."

Both Wave 2 and Wave 3 questionnaires included a measure of posttraumatic stress, the Impact of Events Scale – Revised (IES-R) (Weiss & Marmar, 1997). Respondents described the level to which they had experienced 22 different 9/11-related posttraumatic stress symptoms. They were asked, "With respect to the attacks of

September 11th, during the past week, including today, how much were you distressed or bothered by these difficulties?" The IES-R included three sleep-related items: "I had trouble falling asleep," "I had trouble staying asleep," and, "I had dreams about them." Participants responded using a 5-point scale ranging from "0: Not at all" to "4: Extremely". Table 1 includes a summary of survey content at each Wave.

Research Questions & Data Analyses

The following analyses addressed the research questions outlined as follows:

A. How many participants experienced 9/11-related sleep difficulties?

Simple frequencies of response were reported for each sleep-related question at Waves 1, 2, and 3.

B. Did participants experience a significant change in their sleep responses to September 11th over time (2 months following the attacks versus 6 months following the attacks)?

Participants completed the IES-R both at Wave 2 and Wave 3, allowing for comparison across waves. Due to the non-normal distribution of the dependent variables, non-parametric statistics were used. In order to compare data from Wave 2 to Wave 3, Wilcoxon signed-rank tests were performed for the three sleep-related IES-R items (difficulty falling asleep, difficulty staying asleep, dreams).

C. How did factors such as sex, age, race, distance from the World Trade Center, and pre-existing psychiatric diagnoses impact participants' sleep response to 9/11?

Sex

In order to determine the existence of sex differences, chi square analyses were used to compare Wave 1 sleep experiences between males and females. Additionally, Mann-Whitney U tests were performed to compare differences between males' and females' sleep responses to the three sleep-related IES-R items both at 2 months and 6 months post-9/11. Wilcoxon signed-rank tests compared females' sleep responses at Wave 2 to females' sleep responses at Wave 3, and likewise for males' Wave 2 and Wave 3 sleep responses. Finally, Mann-Whitney U tests compared the change scores (Wave 3 – Wave 2) between females and males for 9/11-related difficulty falling asleep, difficulty staying asleep, and dreams.

Age

Non-parametric correlations (Spearman's rho) were used to determine the effect of age on 9/11-related sleep issues.

Race and ethnicity

Race and ethnicity was recorded in the data set as falling into one of four possible categories: White, non-Hispanic; Black, non-Hispanic, other non-Hispanic, and Hispanic. Chi square analyses were used to determine differences between categories of race and the experience (or not) of 9/11-related sleep issues at Wave 1. The Kruskal-

Wallis H test was used to determine the effect of race/ethnicity on the level 9/11-related sleep disturbances experiences at Wave 2 and Wave 3.

Distance from the World Trade Center

Azimuth distances to the World Trade Center were calculated by KN based on participants' Zipcodes. Non-parametric correlations (Spearman's rho) were used to determine the effect of this distance on 9/11-related sleep issues.

Pre-existing psychiatric diagnoses

Simple frequencies of pre-existing psychiatric diagnoses were reported, followed by nonparametric correlations between the different diagnoses in order to determine comorbidity (whether participants having one psychiatric diagnosis were more likely to have another).

Chi square analyses investigated the moderating effects of pre-existing psychiatric diagnoses on 9/11-related difficulty falling and staying asleep and 9/11-related nightmares as measured at Wave 1. The analyses of pre-existing psychiatric diagnoses' effect on sleep variables at Wave 2 and Wave 3 paralleled those conducted for sex. That is, first Mann-Whitney U tests compared the responses of those with and without diagnoses both at Wave 2 and Wave 3. Then, for each diagnosis level, Wilcoxon signed-rank tests compared the response levels between Wave 2 and Wave 3. Finally, Mann-Whitney U tests compared the difference scores (Wave 3 – Wave 2) between the different diagnosis levels.

Self- versus professionally-diagnosed comparison

Prior to 9/11, participants reported whether or not they were diagnosed with any of three psychiatric diagnoses: anxiety, depression, or insomnia. More specifically, they reported if they received no diagnosis (level 0), were self-diagnosed only (level 1), or if their diagnosis was made or confirmed by a professional (level 2). Planned orthogonal comparisons were used to determine differences between these three separate levels. First, those with and without diagnoses (level 0 versus levels 1 and 2 combined) were compared using the analyses described earlier. Then, in a follow-up analysis, those who were self-diagnosed only were compared to those who reported that their diagnosis had been made or confirmed by a professional (level 1 versus level 2).

"Combined psychiatric" variable

As an additional test of the effect of pre-existing psychiatric diagnoses on later sleep difficulties, an additional variable was created representing an overall level of psychiatric distress. On this "combined psychiatric" variable, participants were divided into three groups: level 2, those who had at least one professionally-diagnosed psychiatric issue (of anxiety, depression, or insomnia); level 1, those who had at least one self-diagnosed psychiatric issue (but none professionally-confirmed); and level 0, those who did not have any psychiatric diagnoses. In order to be counted in this last category, participants had to have given a valid response of "No diagnosis" (level 0) to all three psychiatric variables (anxiety, depression, and insomnia). Those with missing data on any three of the diagnoses were considered to have missing data on the "combined psychiatric" variable. Analyses were conducted as described previously using this

"combined psychiatric" variable in the same manner as the three individual psychiatric variables.

D. Are sleep difficulties related to acute and posttraumatic stress symptoms on the same measurement occasion?

Nonparametric correlations using Spearman's rho compared levels of Wave 1 difficulty falling or staying asleep and nightmares to mean acute stress as measured by the SASRQ. Because these two sleep-related questions were taken from the SASRQ and are therefore represented in the overall SASRQ mean, they were compared to the SASRQ mean with the "difficulty falling or staying asleep" and "nightmares" questions removed. Likewise, nonparametric correlations compared Wave 2 9/11-related sleep disturbances (difficulty falling asleep, difficulty staying asleep, dreams) to the overall measure of posttraumatic stress (IES-R), from which they were drawn. As with the Wave 1 sleep variables, they were compared to a modified IES-R mean that excluded the sleep variables. Likewise, the three Wave 3 sleep disturbance items were correlated with the Wave 3 IES-R mean (without sleep variables).

E. Did initial sleep difficulties predict the development of later posttraumatic stress symptoms over and above pre-existing psychiatric diagnoses (anxiety, depression, and insomnia)?

<u>Wave 1 sleep variables predicting Wave 2 and Wave 3 posttraumatic stress symptoms</u>

A hierarchical regression model was created to test the effects of initial sleep difficulties (those experienced 2 weeks post-9/11) on posttraumatic stress symptoms reported at 2 months and 6 months post-9/11. Independent variables were entered into the model in blocks as follows in Table 2:

Table 2. *Order of Independent Variables Entered Into Hierarchical Regression Model Predicting the Effect of Sleep Difficulties Experienced 2 Weeks Post-9/11 on Later Posttraumatic Stress Symptoms*

Block 1: Demographics - Sex - Age
Block 2: Pre-existing psychiatric diagnoses (none v. self- or professionally-diagnosed) - Anxiety - Depression - Insomnia
Block 3: Wave 1 (2 weeks post-9/11) acute stress symptoms - SASRQ mean excluding sleep variables (nightmares, difficulty falling or staying asleep)
Block 4: Wave 1 (2 weeks post-9/11) nightmares - 9/11-related nightmares (from the SASRQ)
Block 5: Wave 1 (2 weeks post-9/11) difficulty falling or staying asleep - 9/11-related difficulty falling or staying asleep (from the SASRQ)

Analyses tested the independent variables' ability to predict two different dependent variables (DVs): the mean of IES-R items excluding the three sleep-related variables (difficulty falling asleep, difficulty staying asleep) at Wave 2 (2 months post-9/11), and the mean of IES-R items excluding the three sleep-related variables at Wave 3 (6 months post-9/11). Sleep variables in the outcome measures were excluded as a more stringent test of the initial sleep variables' ability to predict later posttraumatic stress symptoms. That is, rather than test whether sleep problems at one point predict sleep problems at a later point, excluding the sleep variables from IES-R mean ensures that the sleep variables are predicting posttraumatic stress, rather than simply like predicting like.

Wave 2 sleep variables predicting Wave 3 posttraumatic stress symptoms

An additional hierarchical regression model was created to evaluate the ability of sleep issues experienced 2 months post-9/11 to predict non-sleep-related posttraumatic

stress symptoms 6 months post-9/11. Table 3 summarizes the entry order of the independent variables.

Table 3. *Order of Independent Variables Entered Into Hierarchical Regression Model Predicting the Effect of Sleep Difficulties Experienced 2 Months Post-9/11 on Later Posttraumatic Stress Symptoms*

Block 1: Demographics - Sex - Age
Block 2: Pre-existing psychiatric diagnoses (none v. self- or professionally-diagnosed) - Anxiety - Depression - Insomnia
Block 3: Wave 1 (2 weeks post-9/11) acute stress symptoms - SASRQ mean
Block 4: Wave 2 (2 months post-9/11) posttraumatic stress symptoms - Wave 2 IES-R mean excluding sleep variables (difficulty falling asleep, difficulty staying asleep, dreams)
Block 5: Wave 2 (2 months post-9/11) dreams - 9/11-related dreams (from the IES-R)
Block 6: Wave 2 (2 months post-9/11) difficulty falling asleep - 9/11-related difficulty falling asleep (from the IES-R)
Block 7: Wave 2 (2 months post-9/11) difficulty staying asleep - 9/11-related difficulty staying asleep (from the IES-R)

9/11-related difficulty staying asleep was selected as the last variable because more people had difficulty staying asleep in relation to 9/11 than they did difficulty falling asleep or 9/11-related dreams (see Results). In addition, the results from the Wave 1 sleep variables suggested that difficulty falling or staying asleep may have some predictive effect on later posttraumatic stress symptoms, while 9/11-related dreams did not.

Outlier exclusion

In regression, outliers can sometimes unduly influence the results. As a means for correcting for possible outlier influence, Cook's distances were calculated for all participants for the dependent variable. Some suggest excluding any values with a Cook's D of 1 or greater. However, others have proposed different methods for detecting influential outliers. For example, Fox (1991) suggested excluding values with Cook's distances of greater than 4/(n-k-1) where n is the number of cases and k is the number of independent variables in an analysis. Following this advice, follow-up analyses paralleling each of the regression analyses described earlier were conducted excluding participants' values whose Cook's distance fell above this latter parameter.

RESULTS

Research Questions

A. How many participants experienced 9/11-related sleep difficulties?

Two weeks following September 11, 2001, participants completed the SASRQ as part of Wave 1 of data collection. On this measures, 23% of the sample (n = 183) reported having difficulty falling or staying asleep related to the terror attacks; 9% (n = 68) reported having 9/11-related nightmares. Two months and 6 months following 9/11, participants completed the IES-R as part of Waves 2 and 3 of data collection, respectively. They answered questions regarding the amount of sleep-related issues (difficulty falling asleep, difficulty staying asleep, dreams) that they had experienced related to 9/11 in the past week. Table 4 summarizes the frequencies of their responses.

Table 4. *Frequencies of Response to Sleep Items on the IES-R (Waves 2 & 3)*

Level of sleep issue experienced regarding 9/11	Difficulty Falling Asleep		Difficulty Staying Asleep		Dreams	
	Wave 2	Wave 3	Wave 2	Wave 3	Wave 2	Wave 3
0: Not at all	573	672	527	659	645	715
1: A little bit	110	76	148	81	79	46
2: Moderately	55	20	57	26	43	15
3: Quite a bit	37	10	40	11	8	3
4: Extremely	6	3	8	3	3	0
(Did not respond)	1	1	2	2	4	3

B. Did participants experience a significant change in their sleep responses to September 11th over time (2 months following the attacks versus 6 months following the attacks)?

Change in response rates from Wave 2 (2 months post-9/11) to Wave 3 (6 months post-9/11) to the three 9/11-related sleep issues was determined using the Wilcoxon signed-rank test. Results of these comparisons are summarized in Table 5.

Table 5. *Wilcoxon Signed-Rank Comparison of Wave 2 and Wave 3 Levels of 9/11-related Sleep Issues*

	Difficulty Falling Asleep	Difficulty Staying Asleep	Dreams
Z	-8.08	-9.71	-6.39
Sig. (2-tailed)	<0.001	<0.001	<0.001

The response rates for all three 9/11-related sleep issues changed significantly over time such that participants were reporting lower levels of distress 6 months post-9/11 (Wave 3), than 2 months post 9/11 (Wave 2; $p<0.001$ for all comparisons). *Figure 1* represents the difference scores for Wave 3 versus Wave 2 for the three 9/11-related sleep variables.

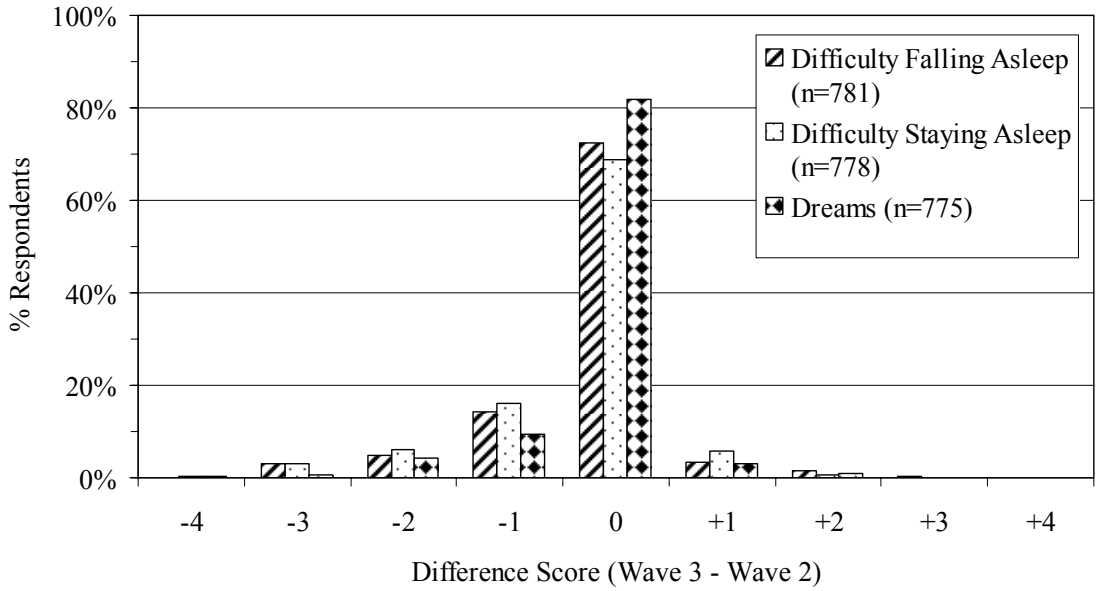

Figure 1. Percentage of respondents whose change in response from Wave 2 to Wave 3 produced the same difference scores (-4 to +4).

The changes in response level percentages from Wave 2 to Wave 3 are represented graphically in *Figure 2*, *Figure 3*, and *Figure 4* for 9/11-related difficulty falling asleep, 9/11-related difficulty staying asleep, and 9/11-related dreams, respectively. Only the data from participants who responded to the particular sleep item at both Waves 2 and 3 are included. The figures indicate percentages for those who did not experience the sleep issue ("0: Not at all") as well as a combined percentage of those who reported that they experienced any level of the sleep issue ("1: A little bit" through "4: Extremely").

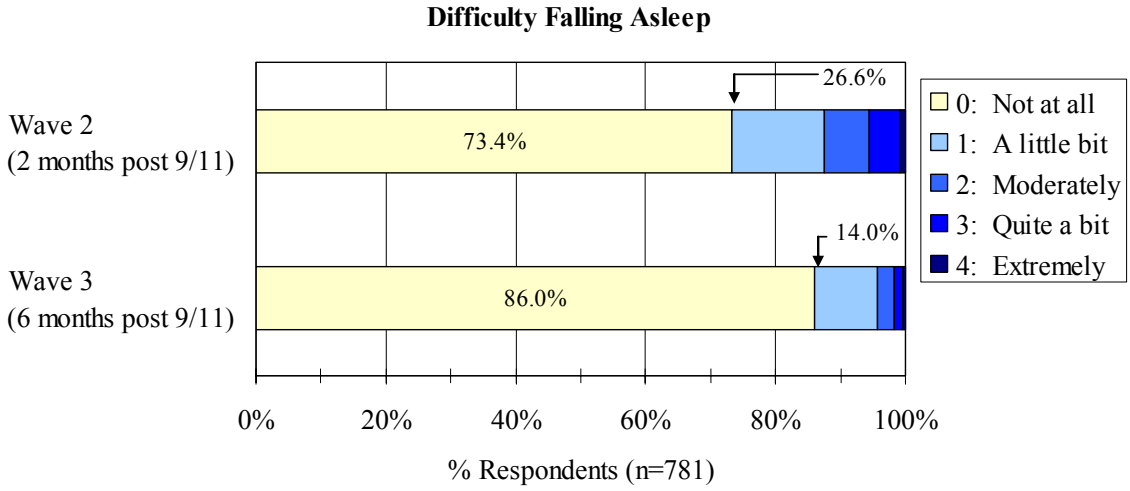

Figure 2. Percentage response rates of 9/11-related difficulty falling asleep at Wave 2 (2 months post-9/11) and Wave 3 (6 months post-9/11).

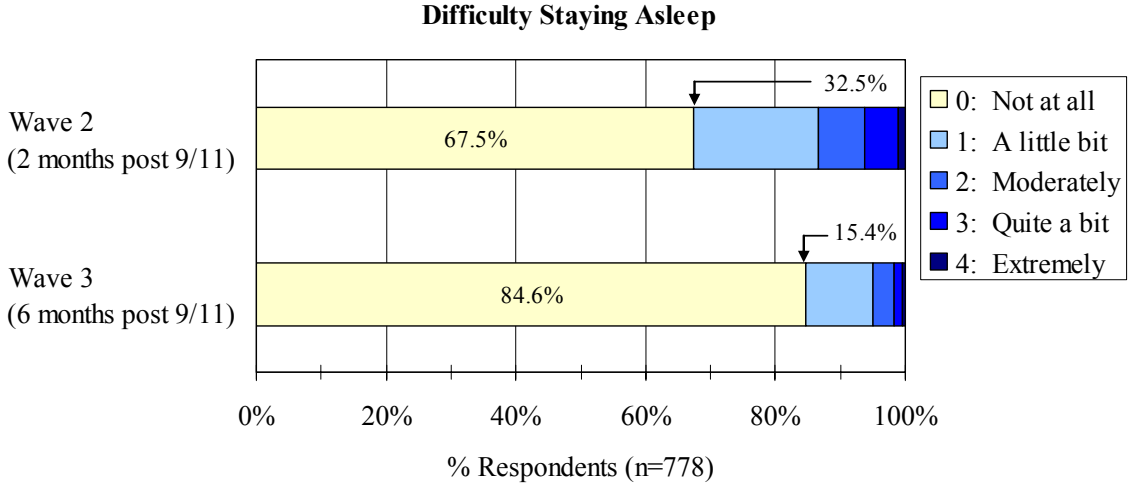

Figure 3. Percentage response rates of 9/11-related difficulty staying asleep at Wave 2 (2 months post-9/11) and Wave 3 (6 months post-9/11).

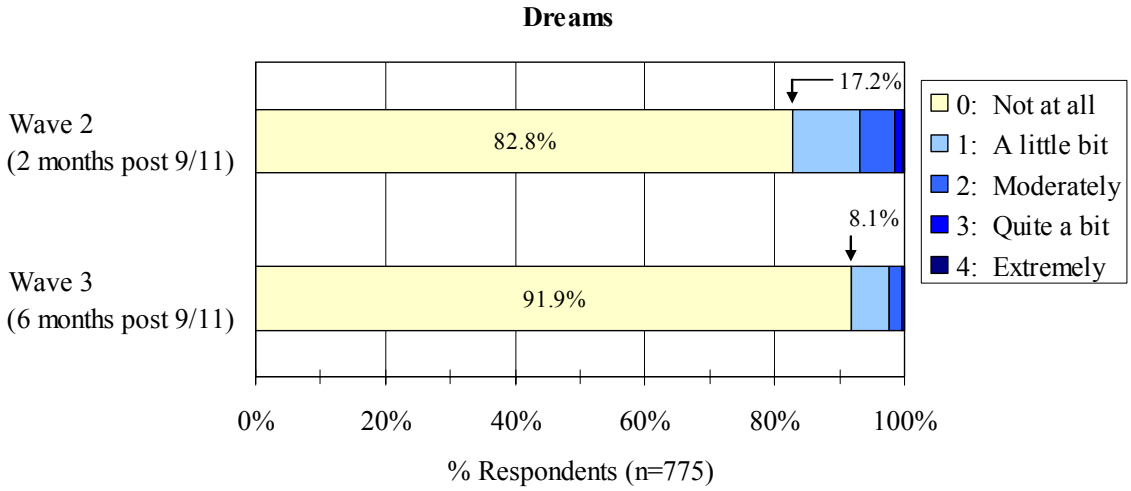

Figure 4. Percentage response rates of 9/11-related dreams at Wave 2 (2 months post-9/11) and Wave 3 (6 months post-9/11).

C. How did factors such as sex, age, race, distance from the World Trade Center, and pre-existing psychiatric diagnoses impact participants' sleep response to 9/11?

Sex

Chi-square analyses comparing frequencies of females' and males' responses to Wave 1 SASRQ sleep-related questions were significant for both variables: 9/11-related difficulty falling or staying asleep, χ^2 (1, $n_{females} = 388$, $n_{males} = 394$) = 26.0, $p < 0.01$; 9/11-related nightmares, χ^2 (1, $n_{females} = 388$, $n_{males} = 394$) = 8.2, $p < 0.01$. *Figure 5* shows the frequencies of females and males who responded that they experienced 9/11-related difficulty falling asleep and 9/11-related nightmares 2 weeks following the terrorist attacks.

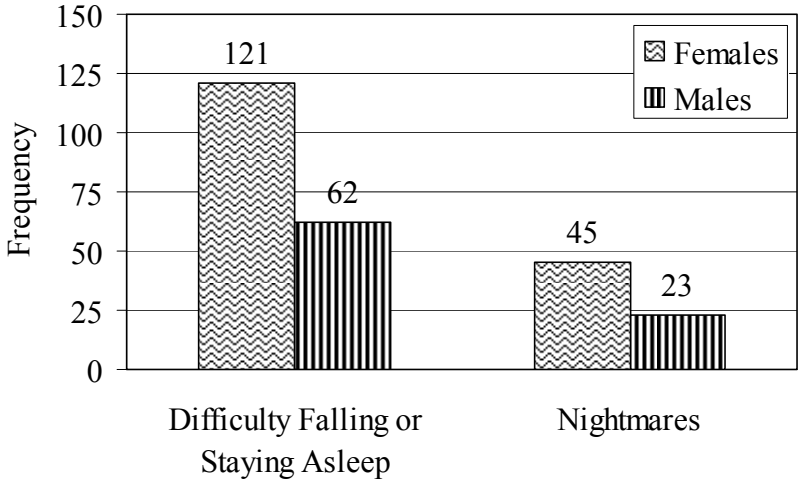

Figure 5. Frequency of respondents reporting that they experienced 9/11-related sleep issues at Wave 1 (2 weeks post-9/11; $n_{females} = 388$, $n_{males} = 394$).

Separate Mann-Whitney U tests compared the responses of females to males at Wave 2 and at Wave 3 (see Table 6). Significant differences existed between the sexes at Wave 2 (2 months post -9/11) for all three 9/11-related sleep issues: difficulty falling asleep ($Z = -4.52$, $p < 0.001$), difficulty staying asleep ($Z = -3.87$, $p < 0.001$), and dreams ($Z = -2.50$, $p = 0.012$). By Wave 3 (6 months post-9/11), females and males differed significantly only in their levels of 9/11-related difficulty staying asleep ($Z = -2.13$, $p = 0.033$).

Table 6. *Mann-Whitney U Tests Comparing the Responses of Females Versus Males*

	Difficulty Falling Asleep		Difficulty Staying Asleep		Dreams	
	Wave 2	Wave 3	Wave 2	Wave 3	Wave 2	Wave 3
Z	-4.52	-1.04	-3.87	-2.13	-2.50	-0.19
Sig. (2-tailed)	<0.001	0.299	<0.001	0.033	0.012	0.850

Wilcoxon signed-rank tests were performed to compare the change in each sex's responses from Wave 2 to Wave 3 (see Table 7). Both females' and males' responses

changed significantly between Wave 2 and Wave 3 for all three sleep items ($p < 0.001$ for all comparisons except males' responses to 9/11-related dreams, $p = 0.001$).

Table 7. *Wilcoxon Signed-Rank Comparison of Responses at Wave 2 (2 months post-9/11) Versus Wave 3 (6 months post-9/11)*

	Difficulty Falling Asleep		Difficulty Staying Asleep		Dreams	
	Females	Males	Females	Males	Females	Males
Z	-7.09	-3.93	-7.83	-5.72	-5.40	-3.46
Sig. (2-tailed)	<0.001	<0.001	<0.001	<0.001	<0.001	0.001

In order to determine if the rate of change of response levels differed between the sexes, difference scores (Wave 3 response – Wave 2 response) were calculated for females and males separately (see *Figure 6*, *Figure 7*, and *Figure 8*). Mann-Whitney U tests confirmed that these difference scores varied significantly between females and males for all three 9/11-related sleep issues: difficulty falling asleep ($Z = -3.81$, $p < 0.001$), difficulty staying asleep ($Z = -2.71$, $p = 0.007$), and dreams ($Z = -2.07$, $p = 0.039$).

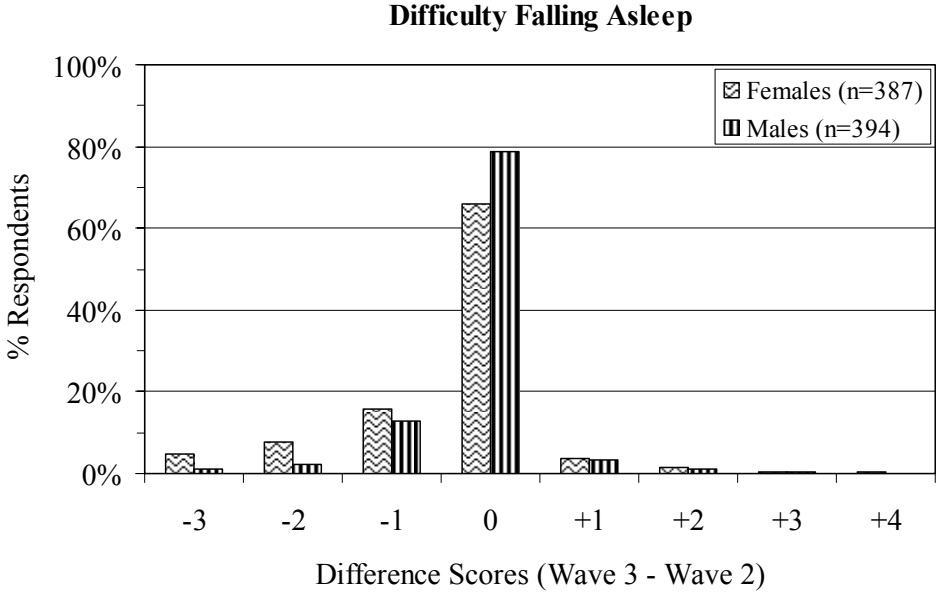

Figure 6. Percentage of respondents whose change in response from Wave 2 to Wave 3 produced the same difference scores (-3 to +4) for 9/11-related difficulty falling asleep.

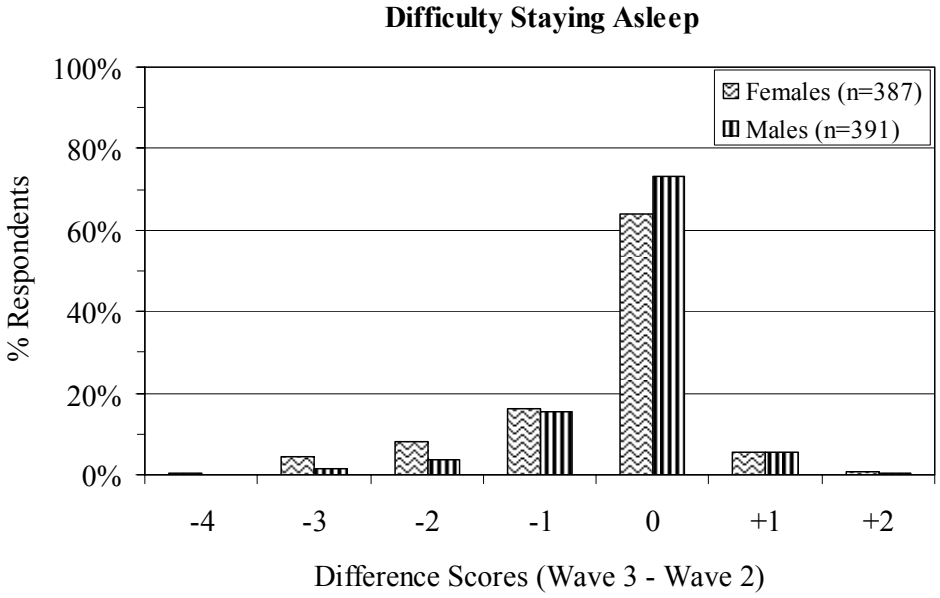

Figure 7. Percentage of respondents whose change in response from Wave 2 to Wave 3 produced the same difference scores (-4 to +2) for 9/11-related difficulty staying asleep.

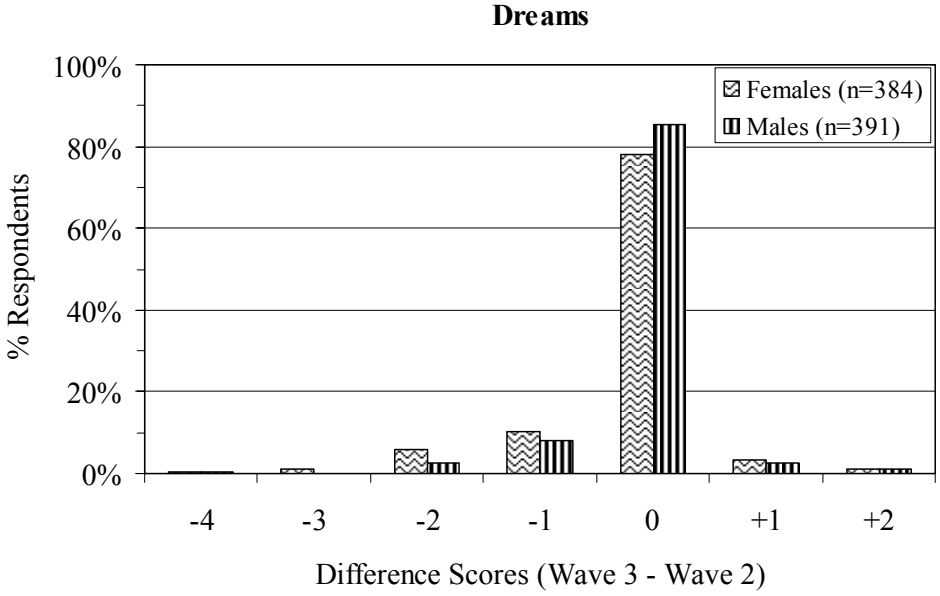

Figure 8. Percentage of respondents whose change in response from Wave 2 to Wave 3 produced the same difference scores (-4 to +2) for 9/11-related dreams.

Figure 9, *Figure 10*, and *Figure 11* represent the mean responses for females and males at Wave 2 (2 months post 9/11) and Wave 3 (6 months post-9/11) to the three 9/11-related sleep IES-R items. They are included for illustrative purposes only, as the analyses conducted to determine the moderating effects of sex are necessarily non-parametric due to the non-normal distribution of the dependent variables. However, repeated-measures ANOVAs were performed as secondary analyses in order to confirm the primary analyses and to support the data represented in the figures. Findings were similar to those found by the non-parametric analyses: sex had a main effect on both 9/11-related difficulty falling asleep and difficulty staying asleep ($p < 0.001$ for each). The time by sex interaction was significant for all the sleep variables: difficulty falling asleep ($p < 0.001$), difficulty staying asleep ($p < 0.001$), and dreams ($p = 0.016$). The Appendix contains a summary of these parametric analyses.

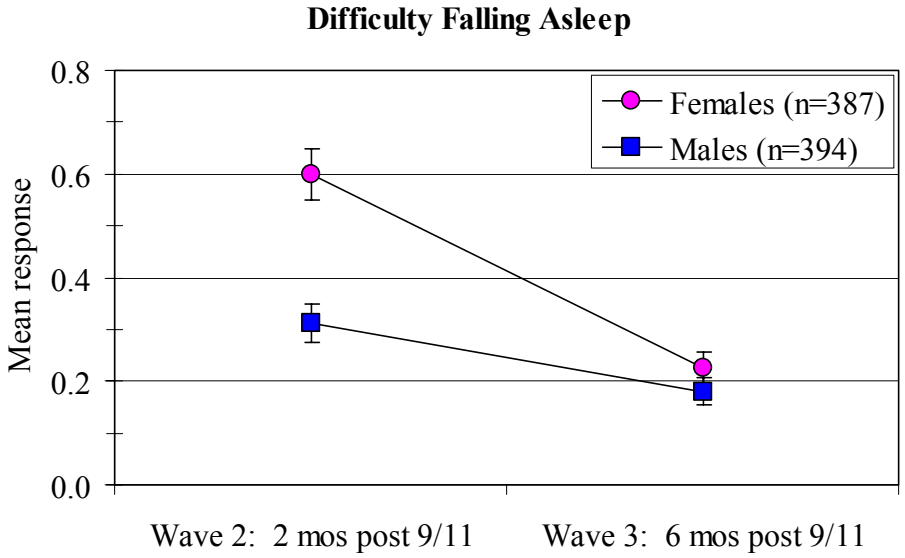

Figure 9. Mean responses of females and males to IES-R item regarding 9/11-related difficulty falling asleep at Wave 2 and Wave 3.

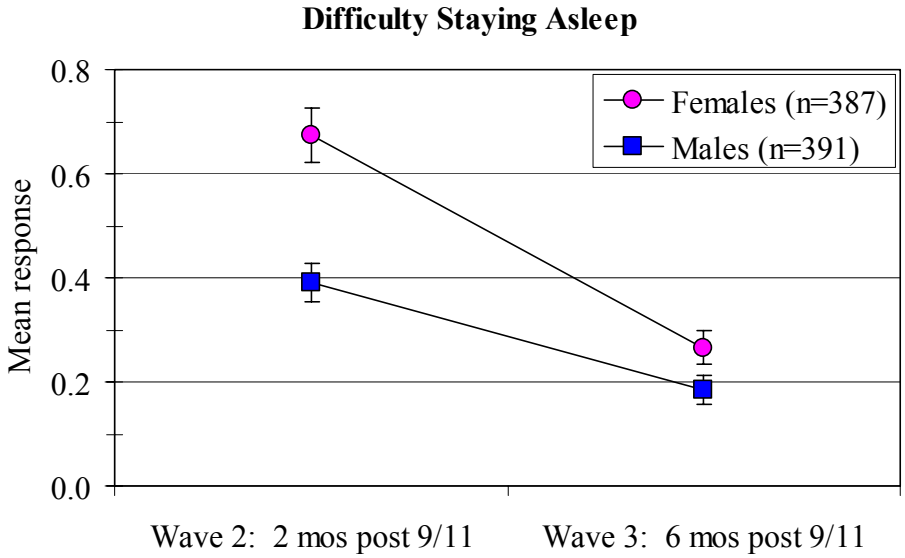

Figure 10. Mean responses of females and males to IES-R item regarding 9/11-related difficulty staying asleep at Wave 2 and Wave 3.

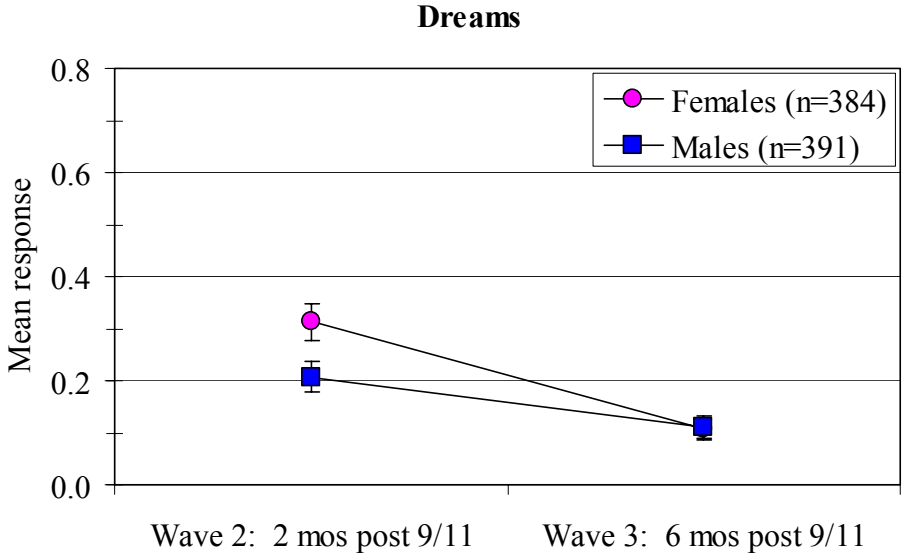

Figure 11. Mean responses of females and males to IES-R item regarding 9/11-related dreams at Wave 2 and Wave 3.

Age

At Wave 1 (2 weeks post-9/11), 9/11-related nightmares were significantly negatively correlated with age: $r_s(781) = -0.16$, $p < 0.001$. To a lesser extent, 9/11-related dreams were significantly negatively correlated with age at Wave 2 (2 months post-9/11): $r_s(777) = -0.08$, $p = 0.021$. These negative correlations are represented graphically in *Figure 12* and *Figure 13*.

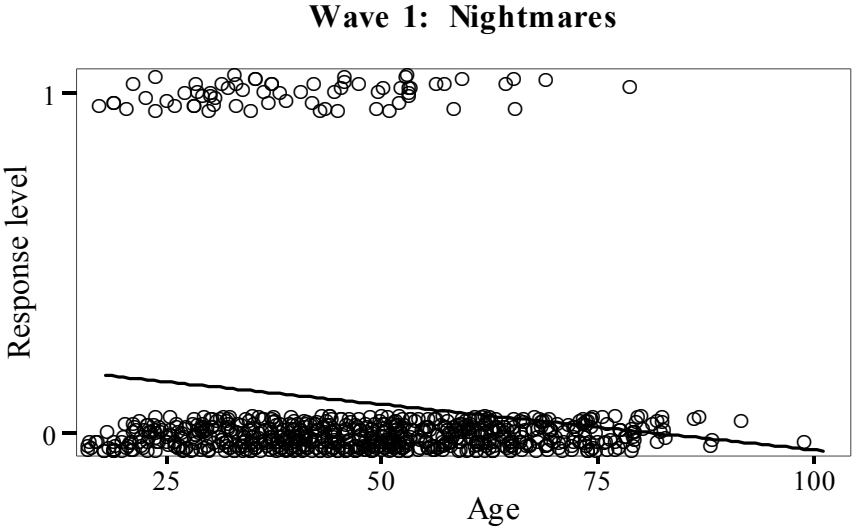

Figure 12. Scatterplot with regression line (r_s = -0.16, $p < 0.0001$) showing negative relationship between age and 9/11-related nightmares at Wave 1 (2 weeks post-9/11). Points are jittered so that all observations can be seen.

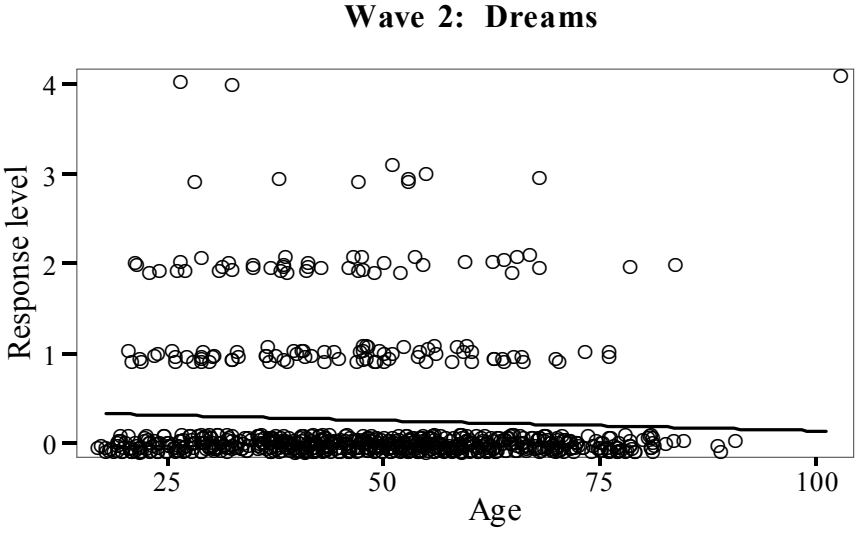

Figure 13. Scatterplot with regression line (r_s = -.08, $p = 0.021$) showing negative relationship between age and 9/11-related dreams at Wave 2 (2 months post-9/11). Points are jittered so that all observations can be seen.

Race and ethnicity

Chi square comparisons of differences between racial/ethnic categories were not significant for either Wave 1 sleep variable: 9/11-related difficulty falling or staying asleep, χ^2 (3, $n_{White} = 570$, $n_{Hispanic} = 80$, $n_{Black} = 61$, $n_{other} = 54$) = 0.7, $p > 0.05$; 9/11-related nightmares, χ^2 (3, $n_{White} = 570$, $n_{Hispanic} = 80$, $n_{Black} = 61$, $n_{other} = 54$) = 2.1, $p > 0.05$. Similarly, Kruskal-Wallis H tests failed to reveal any significant differences in 9/11-related sleep symptoms between those in different race/ethnic categories. This was true both at Wave 2 (2 months post-9/11) and Wave 3 (6 months post-9/11). Table 8 provides a summary of the Kruskal-Wallis test statistics.

Table 8. *Kruskal-Wallis H Tests Comparing Differences Between Categories of Race/Ethnicity in the Experience of 9/11-related Sleep Issues at Wave 2 (2 Months Post-9/11) and Wave 3 (6 Months Post-9/11)*

	Difficulty Falling Asleep		Difficulty Staying Asleep		Dreams	
	Wave 2	Wave 3	Wave 2	Wave 3	Wave 2	Wave 3
χ^2	0.65	1.91	0.23	2.86	3.29	3.57
df	3	3	3	3	3	3
Significance	0.886	0.590	0.973	0.414	0.350	0.312

Distance from the World Trade Center

Non-parametric correlations failed to reveal any significant relationship between azimuth distance to the World Trade Center and reporting of 9/11-related sleep issues at Wave 1 (2 weeks post-9/11), Wave 2 (2 months post-9/11), and Wave 3 (3 months post-9/11). Results of these correlations are summarized in Table 9 (Wave 1 variables) and Table 10 (Wave 2 and Wave 3 variables).

Table 9. *Nonparametric Correlations Between Azimuth Distance to the World Trade Center and Wave 1 (2 Weeks Post-9/11) Sleep Variables*

	Difficulty Falling or Staying Asleep	Nightmares
Spearman's rho	-0.035	0.031
Sig. (2-tailed)	0.334	0.388
N	*782*	*782*

Table 10. *Nonparametric Correlations Between Azimuth Distance to the World Trade Center and Wave 2 (6 Months Post-9/11) and Wave 3 (6 Months Post-9/11) Sleep Variables*

	Difficulty Falling Asleep		Difficulty Staying Asleep		Dreams	
	Wave 2	Wave 3	Wave 2	Wave 3	Wave 2	Wave 3
Spearman's rho	-0.022	0	-0.021	-0.006	-0.031	0.012
Sig. (2-tailed)	0.532	0.923	0.557	0.868	0.382	0.735
N	*781*	*781*	*780*	*780*	*778*	*779*

Pre-existing psychiatric diagnoses

In order to address the moderating effects of pre-existing psychiatric diagnoses on 9/11-related sleep disturbances, first the percentages of participants reporting different psychiatric diagnoses prior to 9/11 were calculated (see Table 11). For all categories of pre-existing psychiatric diagnoses, more participants reported that their diagnoses had been made or confirmed by a professional than self-diagnosed only.

Table 11. *Frequencies of Pre-existing Psychiatric Diagnoses*

	Anxiety	Depression	Insomnia	"Combined Psychiatric"
Self-diagnosed only	1.9%	7.2%	5.6%	9.8%
Doctor-diagnosed or confirmed	7.4%	13.7%	8.1%	19.1%
Total (self & doctor-diagnosed)	9.3%	20.8%	13.7%	28.9%

Nonparametric correlations between the pre-existing diagnoses were all highly significant ($p < 0.001$ for all comparisons). The relationship between anxiety and

depression had a medium effect size ($r_s(682) = 0.418$), as did the relationship between anxiety and insomnia ($r_s(631) = 0.340$) and between depression and insomnia ($r_s(635) = 0.313$).

Wave 1 (2 weeks post-9/11)

Chi square analyses comparing 9/11-related nightmares and 9/11-related difficulty falling or staying asleep between those with and without pre-existing psychiatric diagnoses (anxiety, depression, insomnia, and "combined psychiatric") were significant for all analyses with the exception of the effect of insomnia on 9/11-related nightmares (see Table 12 for a summary of these results).

Table 12. *Chi Square Analyses Comparing Frequencies of 9/11-related Sleep Issues Experienced at Wave 1 (2 Weeks Post-9/11) by Pre-existing Psychiatric Diagnoses*

Difficulty Falling or Staying Asleep	Anxiety	Depression	Insomnia	Combined Psychiatric
χ^2	13.0	14.7	15.4	17.6
$N_{\text{no diangosis}}$	611	525	572	424
$N_{\text{any diagnosis (self or professional)}}$	73	163	107	226
Significance	<0.01	<0.01	<0.01	<0.01

Nightmares	Anxiety	Depression	Insomnia	Combined Psychiatric
χ^2	4.6	5.5	3.1	5.4
$N_{\text{no diangosis}}$	611	525	572	424
$N_{\text{any diagnosis (self or professional)}}$	73	163	107	226
Significance	<0.05	<0.05	n/s	<0.05

A second, follow-up set of analyses was conducted to determine whether there was a difference in response rates depending on the type of diagnosis, either self- or professionally-made, that a participant received. Once again, chi square analyses were

conducted. In this case, only two significant differences were found: those with self- versus professionally-diagnosed anxiety diagnoses reported different rates of nightmares 2 weeks post-9/11, χ^2 (1, n_{self} = 15, $n_{professional}$ = 58) = 4.9, $p < 0.05$. Those with self- versus professionally-diagnosed disorders on the "combined psychiatric" variable reported different rates of nightmares as well, χ^2 (1, n_{self} = 77, $n_{professional}$ = 149) = 4.3, $p < 0.05$.

In order to illustrate these differences between those with psychiatric diagnoses and those without, the mean response rates for each group is represented in *Figure 14* (difficulty falling or staying asleep) and *Figure 15* (nightmares). The statistic that would normally be used to test the difference in means is an independent-samples t-test, which is not appropriate for these data, given the non-normal distribution of the dependent variables. However, they were performed as secondary analyses to confirm the findings (and to support the graphed means). The results exactly paralleled the chi square findings: significant differences remained significant and no new significant differences surfaced. See the Appendix for a summary of the t-test results.

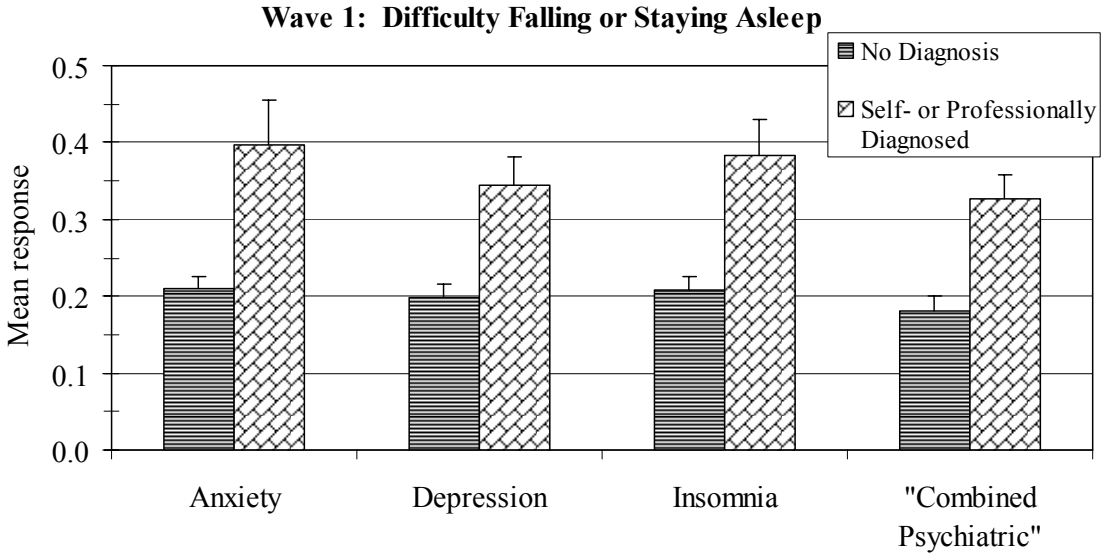

Figure 14. Comparison of mean 9/11-related difficulty falling or staying asleep experienced at Wave 1 (2 weeks post-9/11) experienced by participants with versus without pre-existing psychiatric diagnoses.

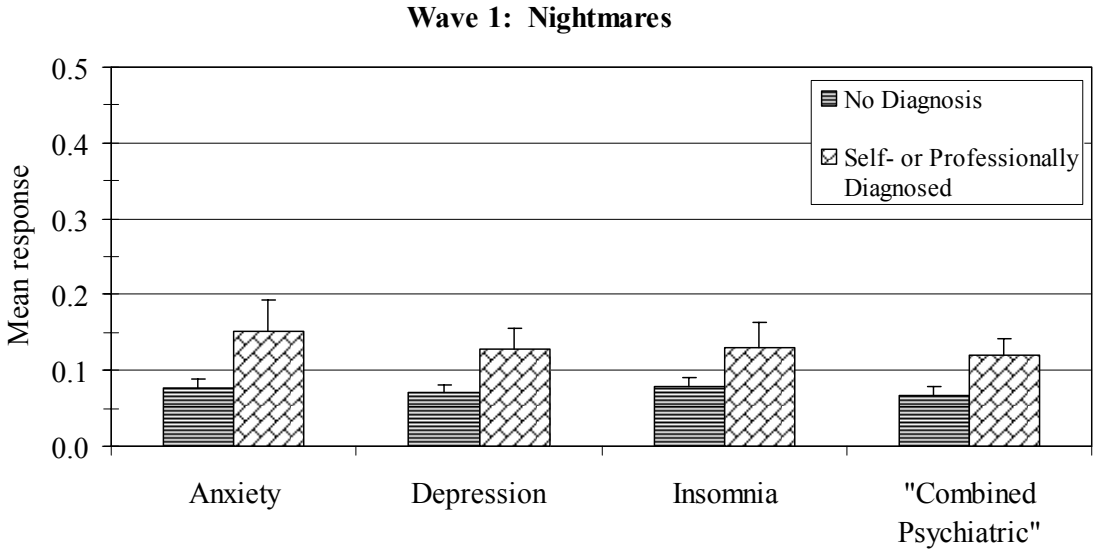

Figure 15. Comparison of mean 9/11-related nightmares experienced at Wave 1 (2 weeks post-9/11) experienced by participants with versus without pre-existing psychiatric diagnoses.

Wave 2 (2 months post-9/11) and Wave 3 (3 months post-9/11)

Mann-Whitney U tests were performed in order to compare the sleep response of those with and without pre-existing psychiatric diagnoses at Wave 2 and Wave 3 separately. All analyses were significant with three exceptions. Those with and without pre-existing depression diagnoses did not differ in their level of 9/11-related dreams at Wave 3 (6 months post-9/11). Likewise, those with and without any psychiatric diagnoses (the "combined psychiatric" variable) did not differ in their level of 9/11-related dreams at either Wave 2 (2 months post-9/11) or Wave 3 (6 months post-9/11). See Table 13 and Table 14 for a summary of these analyses.

Table 13. *Mann-Whitney U Tests Comparing the Sleep Responses of Respondents With and Without Pre-Existing Psychiatric Diagnoses at Wave 2 (2 months post-9/11)*

Difficulty Falling Asleep	Anxiety	Depression	Insomnia	Combined Psychiatric
Z	-3.99	-4.19	-4.69	-4.90
Sig. (2-tailed)	<0.001	<0.001	<0.001	<0.001

Difficulty Staying Asleep	Anxiety	Depression	Insomnia	Combined Psychiatric
Z	-3.10	-2.40	-4.84	-3.19
Sig. (2-tailed)	0.002	0.016	<0.001	0.001

Dreams	Anxiety	Depression	Insomnia	Combined Psychiatric
Z	-3.85	-2.97	-2.50	-1.74
Sig. (2-tailed)	<0.001	0.003	0.013	0.082

Table 14. *Mann-Whitney U Tests Comparing the Sleep Responses of Respondents With and Without Pre-Existing Psychiatric Diagnoses at Wave 3 (6 months post-9/11)*

Difficulty Falling Asleep	Anxiety	Depression	Insomnia	Combined Psychiatric
Z	-4.18	-4.00	-4.53	-3.36
Sig. (2-tailed)	<0.001	<0.001	<0.001	<0.001

Difficulty Staying Asleep	Anxiety	Depression	Insomnia	Combined Psychiatric
Z	-4.08	-2.57	-4.63	-2.98
Sig. (2-tailed)	<0.001	0.010	<0.001	0.003

Dreams	Anxiety	Depression	Insomnia	Combined Psychiatric
Z	-3.08	-1.32	-2.35	-0.96
Sig. (2-tailed)	0.002	0.186	0.019	0.336

Wilcoxon signed-rank tests compared the change in each diagnosis level (either those with diagnoses or those without) from Wave 2 to Wave 3. All analyses were significant (see Table 15 and Table 16 for summary).

Table 15. *Wilcoxon Signed-Rank Comparison of Wave 2 and Wave 3 Levels of 9/11-related Sleep Issues for Respondents with No Pre-existing Diagnoses*

Difficulty Falling Asleep	Anxiety	Depression	Insomnia	Combined Psychiatric
Z	-7.67	-6.56	-6.84	-4.94
Sig. (2-tailed)	<0.001	<0.001	<0.001	<0.001

Difficulty Staying Asleep	Anxiety	Depression	Insomnia	Combined Psychiatric
Z	-8.59	-7.78	-8.17	-6.87
Sig. (2-tailed)	<0.001	<0.001	<0.001	<0.001

Dreams	Anxiety	Depression	Insomnia	Combined Psychiatric
Z	-5.49	-4.50	-5.33	-4.26
Sig. (2-tailed)	<0.001	<0.001	<0.001	<0.001

Table 16. *Wilcoxon Signed-Rank Comparison of Wave 2 and Wave 3 Levels of 9/11-related Sleep Issues for Respondents with Pre-existing Diagnoses*

Difficulty Falling Asleep	Anxiety	Depression	Insomnia	Combined Psychiatric
Z	-2.29	-4.32	-3.22	-5.27
Sig. (2-tailed)	0.022	<0.001	0.001	<0.001

Difficulty Staying Asleep	Anxiety	Depression	Insomnia	Combined Psychiatric
Z	-3.02	-4.73	-3.54	-5.42
Sig. (2-tailed)	0.003	<0.001	<0.001	<0.001

Dreams	Anxiety	Depression	Insomnia	Combined Psychiatric
Z	-2.98	-4.44	-2.72	-4.36
Sig. (2-tailed)	0.003	<0.001	0.007	<0.001

Additional Mann-Whitney U tests were performed on the difference scores of Wave 3 – Wave 2 responses to determine if there was a difference in rate of change between those with and without pre-existing psychiatric diagnoses. Results were significant for pre-existing depression on 9/11-related difficulty falling asleep ($Z = -1.98$, $p = 0.048$) and 9/11-related dreams ($Z = -2.26$, $p = 0.024$). Those with and without pre-existing insomnia diagnoses also changed differently between Wave 2 and Wave 3 in their level of 9/11-related difficulty falling asleep ($Z = -2.03$, $p = 0.042$). Finally, having any pre-existing psychiatric diagnosis versus having none (the "combined psychiatric" variable) was significantly related to the level of change in 9/11-related difficulty falling asleep over time. See Table 17 for a summary of these analyses.

Table 17. *Mann-Whitney U Tests Comparing the Difference Scores (Wave 3 Response - Wave 2 Response) of Those With Versus Those Without Pre-existing Psychiatric Diagnoses*

Difficulty Falling Asleep	Anxiety	Depression	Insomnia	Combined Psychiatric
Z	-0.88	-1.98	-2.03	-3.30
Sig. (2-tailed)	0.379	0.048	0.042	<0.001

Difficulty Staying Asleep	Anxiety	Depression	Insomnia	Combined Psychiatric
Z	-0.72	-0.56	-0.86	-0.92
Sig. (2-tailed)	0.474	0.573	0.390	0.357

Dreams	Anxiety	Depression	Insomnia	Combined Psychiatric
Z	-1.72	-2.26	-0.54	-1.17
Sig. (2-tailed)	0.086	0.024	0.587	0.241

As with the Wave 1 data, a second, follow-up set of analyses was conducted to determine whether there was a difference in response rates depending on the type of diagnosis, either self- or professionally-made, that a participant received. Mann-Whitney U Tests comparing the response rates of those whose diagnoses were self-made versus those whose diagnoses were confirmed by a professional failed to reveal any significant differences.

Mean response rates are used to graphically represent the difference in response rates between those with and without pre-existing psychiatric diagnoses (see *Figure 16* through *Figure 27*). Although the assumption of normal, interval data is violated, repeated measures ANOVAs were run to as a means of supporting these figures and to confirm the nonparametric statistics reported earlier. A summary of these analyses may be found in the Appendix.

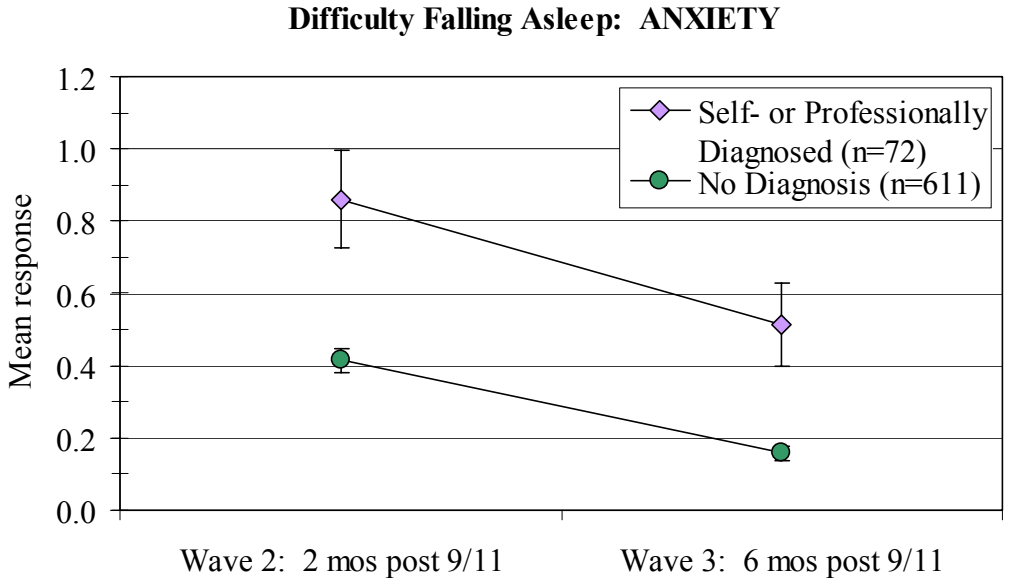

Figure 16. Comparison of mean 9/11-related difficulty falling asleep for those with and without pre-existing anxiety diagnoses.

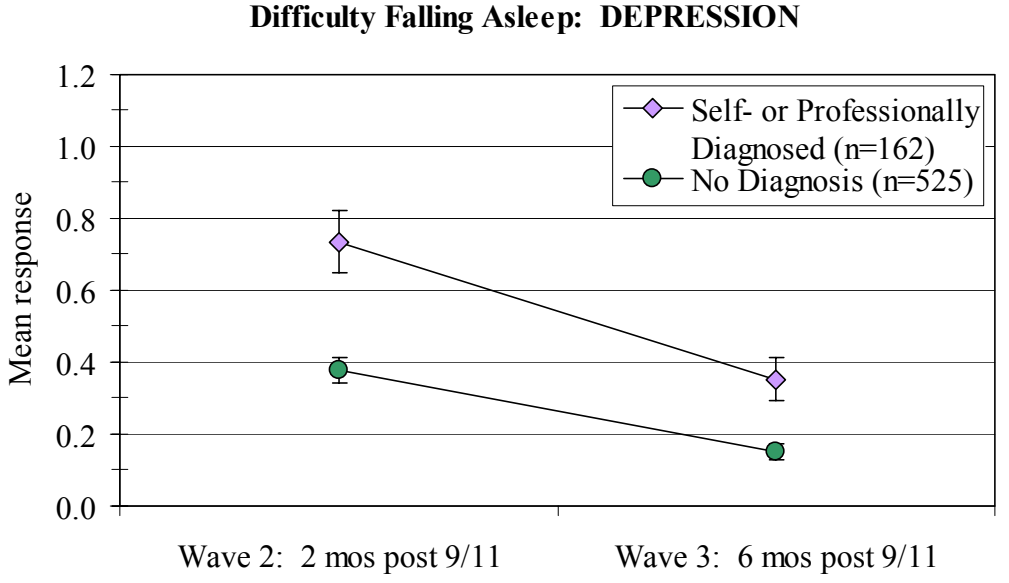

Figure 17. Comparison of mean 9/11-related difficulty falling asleep for those with and without pre-existing depression diagnoses.

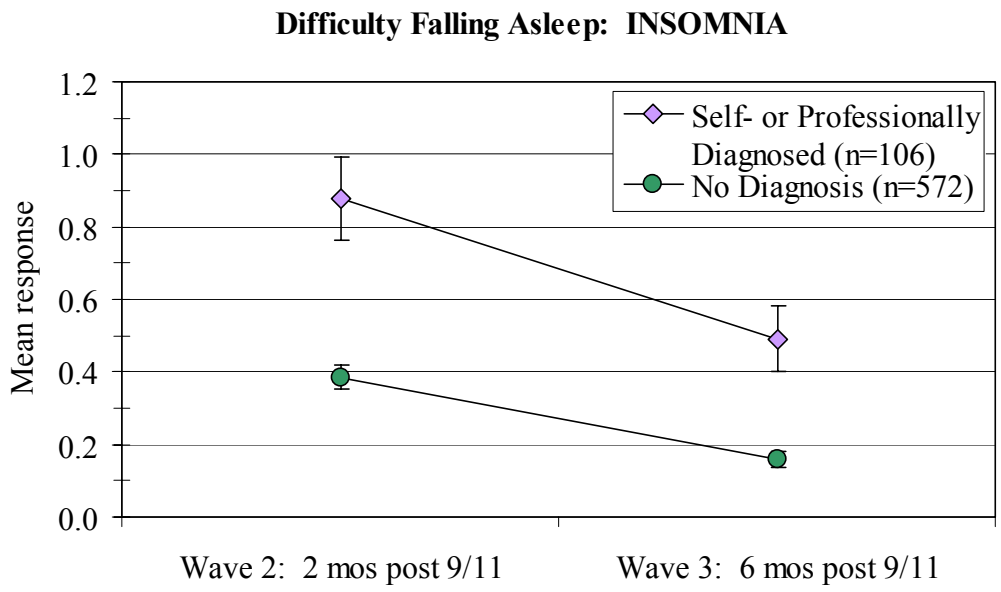

Figure 18. Comparison of mean 9/11-related difficulty falling asleep for those with and without pre-existing insomnia diagnoses.

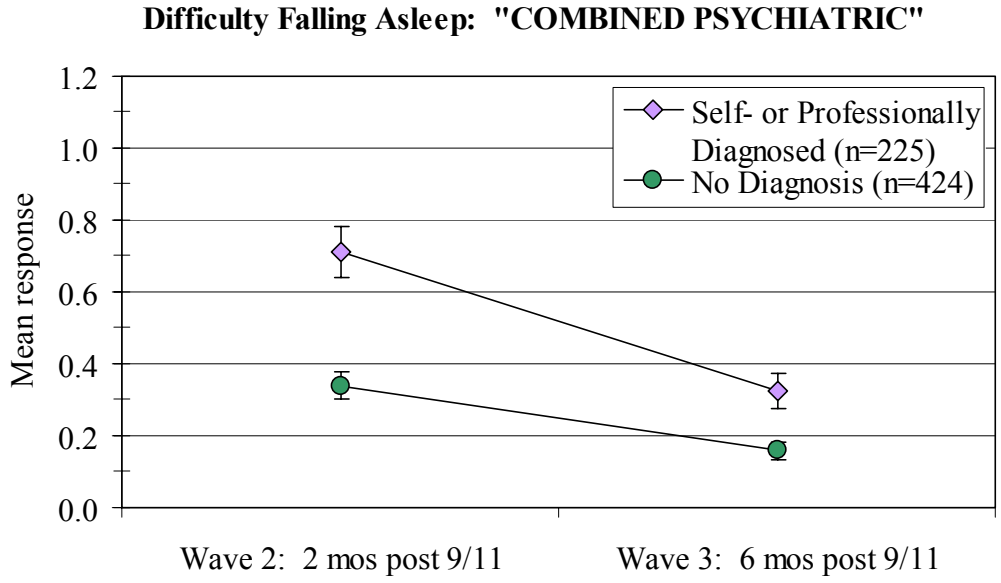

Figure 19. Comparison of mean 9/11-related difficulty falling asleep for those with and without pre-existing "combined psychiatric" diagnoses.

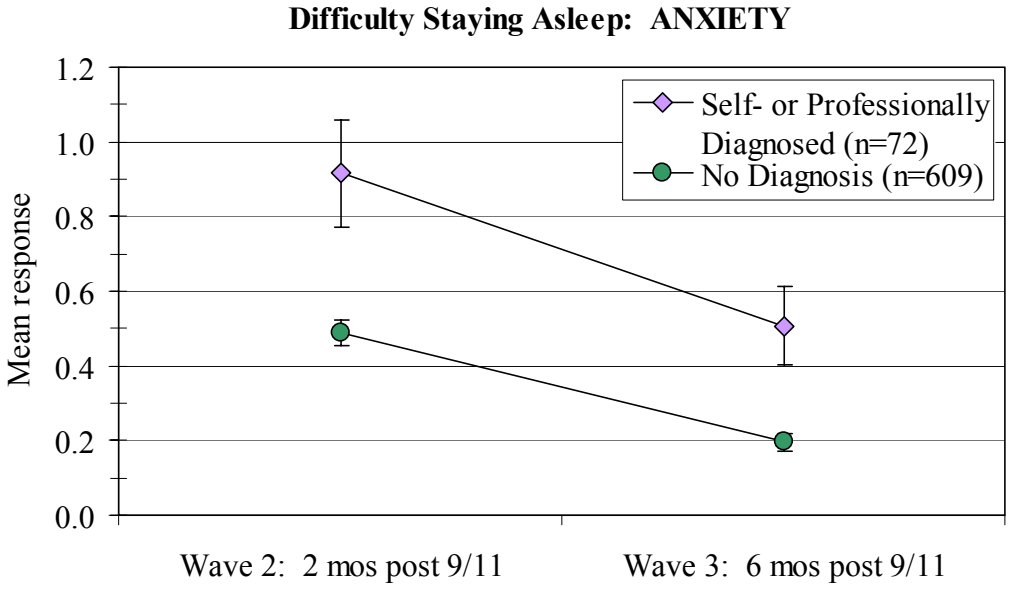

Figure 20. Comparison of mean 9/11-related difficulty staying asleep for those with and without pre-existing anxiety diagnoses.

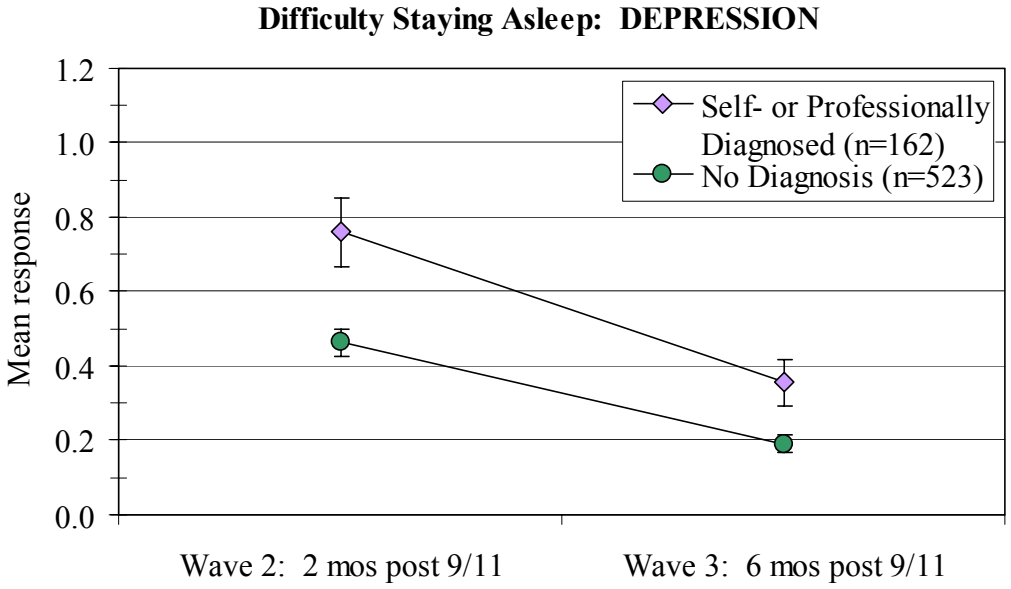

Figure 21. Comparison of mean 9/11-related difficulty staying asleep for those with and without pre-existing depression diagnoses.

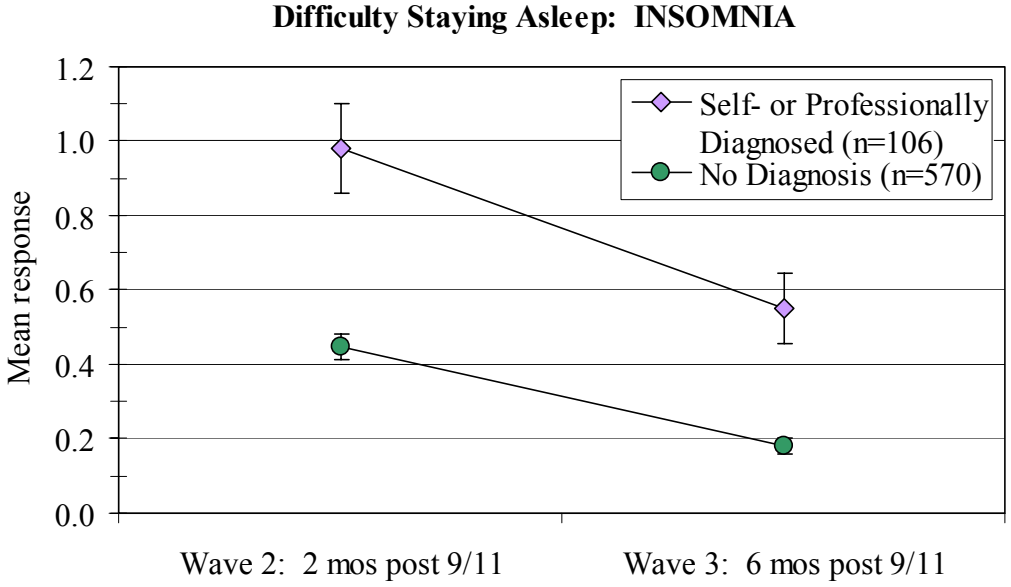

Figure 22. Comparison of mean 9/11-related difficulty staying asleep for those with and without pre-existing insomnia diagnoses.

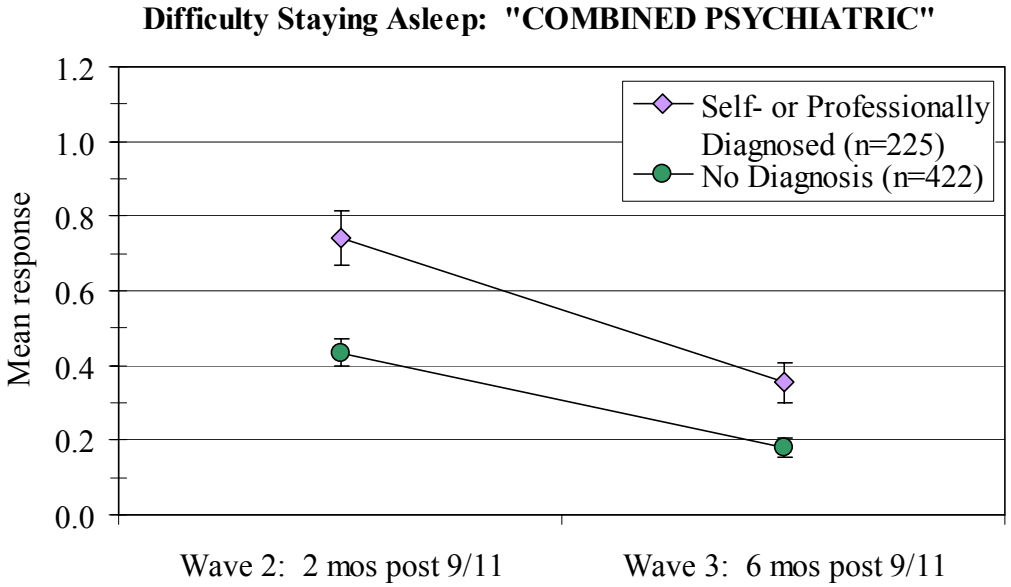

Figure 23. Comparison of mean 9/11-related difficulty staying asleep for those with and without pre-existing "combined psychiatric" diagnoses.

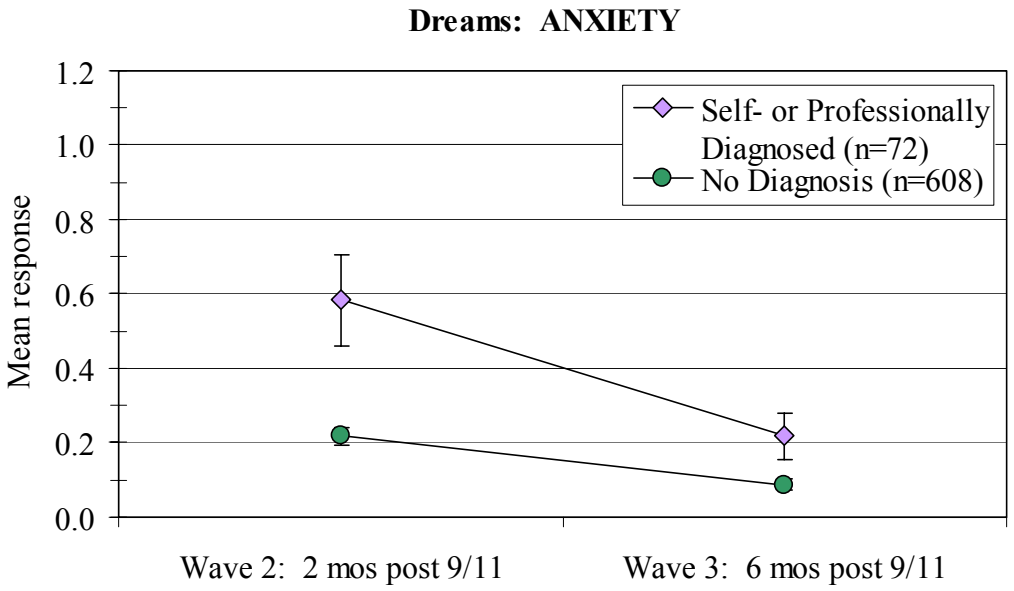

Figure 24. Comparison of mean 9/11-related dreams for those with and without pre-existing anxiety diagnoses.

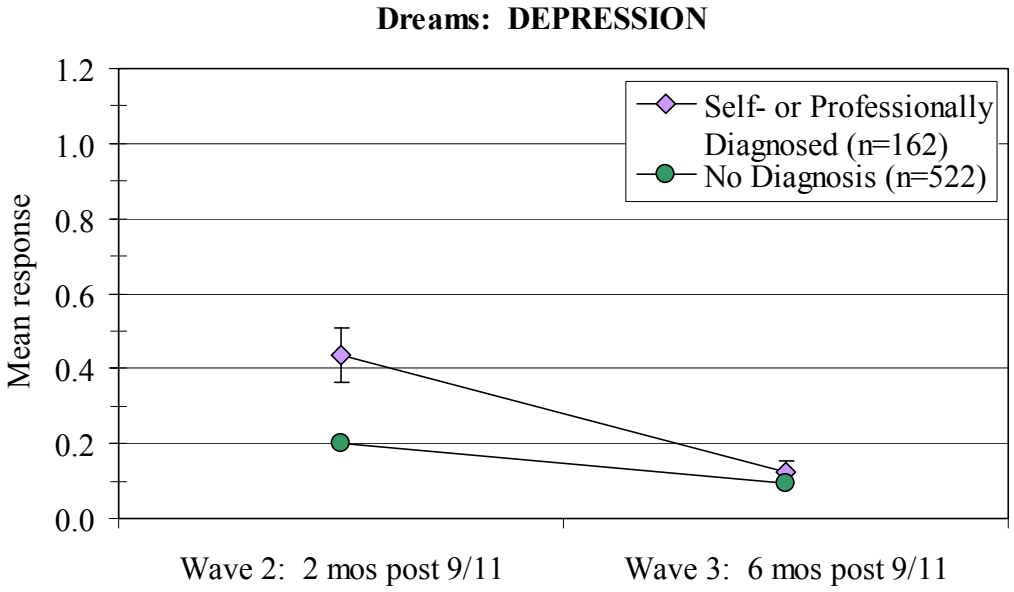

Figure 25. Comparison of mean 9/11-related dreams for those with and without pre-existing depression diagnoses.

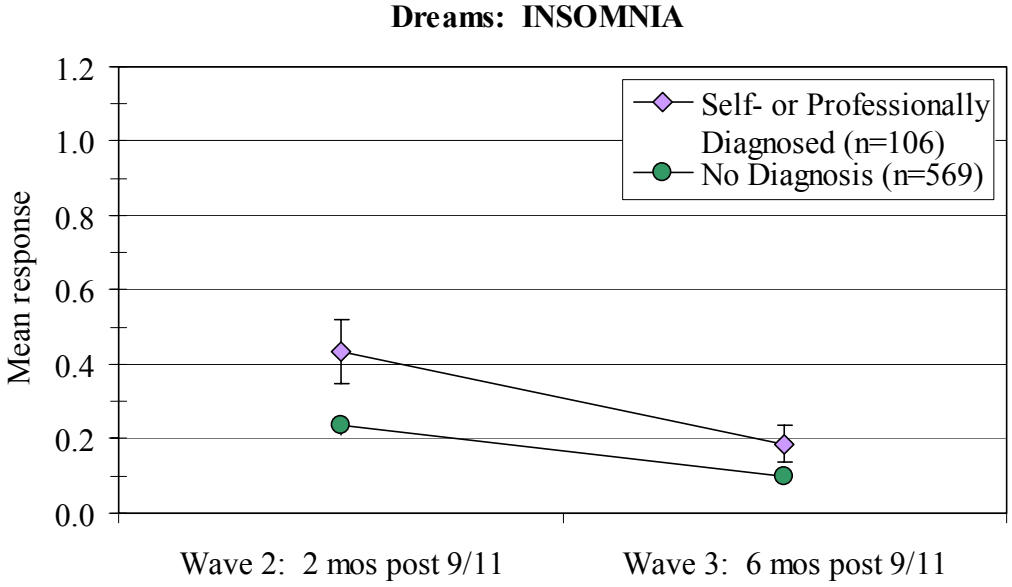

Figure 26. Comparison of mean 9/11-related dreams for those with and without pre-existing insomnia diagnoses.

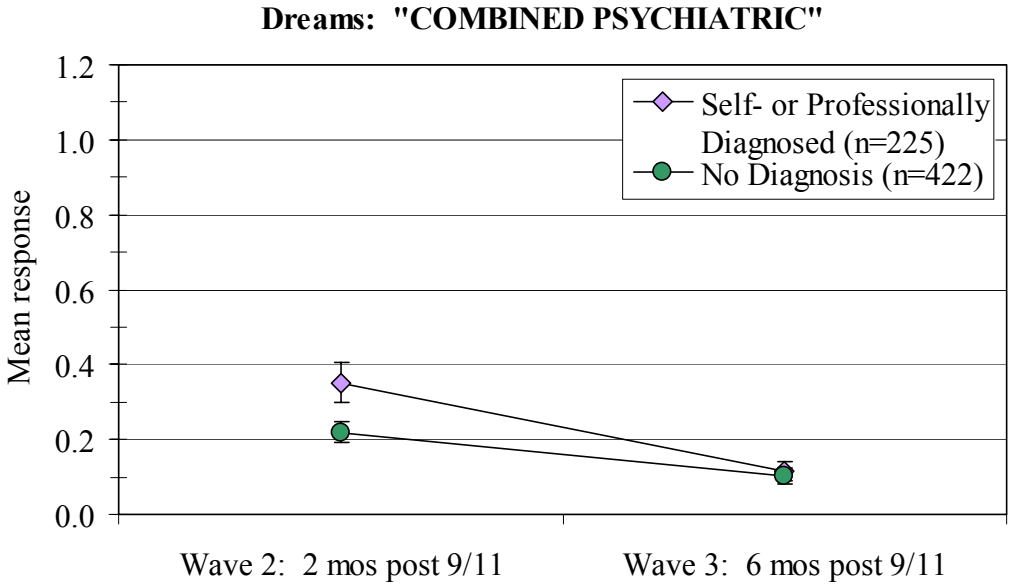

Figure 27. Comparison of mean 9/11-related dreams for those with and without pre-existing "combined psychiatric" diagnoses.

D. Are sleep difficulties related to acute and posttraumatic stress symptoms on the same measurement occasion?

Using nonparametric correlations, Wave 1 sleep variables were both found to be significantly related to acute stress as measured by the SASRQ mean without sleep variables. The correlation between difficulty falling or staying asleep and acute stress symptoms had a medium effect size ($r_s(782) = 0.422$, $p < 0.001$). The correlation between nightmares and acute stress symptoms, while highly significant, had a small effect size ($r_s(782) = 0.275$, $p < 0.001$). The relationship between the two sleep variables themselves (difficulty falling or staying asleep and nightmares) was highly significant ($p < 0.001$) and had a medium effect size ($r_s(782) = 0.323$).

Nonparametric correlations using Spearman's rho were also used to compare sleep variables collected at 2 months post-9/11 (9/11-related difficulty falling asleep, difficulty staying asleep, dreams) to the overall level of posttraumatic stress reported at the same time point (Wave 2 IES-R mean with sleep variables excluded). Correlations between all variable pairs were highly significant ($p < 0.001$). Difficulty falling asleep and difficulty staying asleep each showed a large effect size in their relationship to overall posttraumatic stress symptoms ($r_s(781) = 0.561$ and $r_s(780) = 0.587$, respectively). The correlation between 9/11-related dreams and overall posttraumatic stress symptoms had a medium effect size ($r_s(778) = 0.413$). See Table 18 for a summary of these results.

Table 18. *Nonparametric Correlations Between Variables Collected at Wave 2 (2 Months Post-9/11)*

		Wave 2: Falling Asleep	Wave 2: Staying Asleep	Wave 2: Dreams	Wave 2: IES-R mean (no sleep)
Wave 2: Falling Asleep	Spearman's rho	1	0.781	0.401	0.561
	Sig. (2-tailed)	.	<0.001	<0.001	<0.001
	N	*781*	*780*	*777*	*781*
Wave 2: Staying Asleep	Spearman's rho		1	0.367	0.587
	Sig. (2-tailed)		.	<0.001	<0.001
	N		*780*	*776*	*780*
Wave 2: Dreams	Spearman's rho			1	0.413
	Sig. (2-tailed)			.	<0.001
	N			*778*	*778*
Wave 2: IES-R mean (no sleep)	Spearman's rho				1
	Sig. (2-tailed)				.
	N				*782*

Likewise, correlations were calculated between these same variables at Wave 3 (6 months post-9/11). Once again, correlations between all variable pairs were highly significant ($p < 0.001$). Similar to the Wave 2 results, difficulty falling asleep and difficulty staying asleep measured at Wave 3 showed a large effect size in their relationship to the Wave 3 IES-R mean with the sleep variables excluded ($r_s(780) = 0.503$ and $r_s(779) = 0.502$, respectively). The correlation between dreams and overall posttraumatic stress symptoms had a medium effect size $r_s(779) = 0.376$. See Table 19 for a summary of these results.

Table 19. *Nonparametric Correlations Between Variables Collected at Wave 3 (6 Months Post-9/11)*

		Wave 3: Falling Asleep	Wave 3: Staying Asleep	Wave 3: Dreams	Wave 3: IES-R mean (no sleep)
Wave 3: Falling Asleep	Spearman's rho	1	0.739	0.508	0.503
	Sig. (2-tailed)	.	<0.001	<0.001	<0.001
	N	*781*	*779*	*778*	*780*
Wave 3: Staying Asleep	Spearman's rho		1	0.476	0.502
	Sig. (2-tailed)		.	<0.001	<0.001
	N		*780*	*777*	*779*
Wave 3: Dreams	Spearman's rho			1	0.376
	Sig. (2-tailed)			.	<0.001
	N			*779*	*779*
Wave 3: IES-R mean (no sleep)	Spearman's rho				1
	Sig. (2-tailed)				.
	N				*781*

E. Did initial sleep difficulties predict the development of later posttraumatic stress symptoms over and above pre-existing psychiatric diagnoses (anxiety, depression, and insomnia)?

Wave 1 sleep variables predicting Wave 2 and Wave 3 posttraumatic stress symptoms

The first regression tested the model outlined in Table 2 against the dependent variable, Wave 2 IES-R mean (with sleep items excluded). In the final iteration of this first analysis, only two independent variables significantly predicted variance in the sleep-item-less Wave 2 IES-R mean: age ($\beta = 0.133$, $p < 0.001$) and Wave 1 SASRQ mean (with sleep variables excluded; $\beta = 0.445$, $p < 0.001$). A summary of the model coefficients for this and the following regression analyses may be found in the Appendix.

As a means for correcting for outliers, a follow-up analysis was conducted excluding data from participants whose Cook's D fell outside of a certain parameter. As

discussed in the Methods section, some have suggested excluding all cases whose Cook's D fall above 1. In this instance, all Cook's Ds were substantially lower than 1 (the maximum was 0.047). The threshold for exclusion based on an alternate method of determination, 4/(n-k-1), was $D = 0.006441$. Therefore, the follow-up analysis was conducted using only data from participants whose Cook's D fell below this number. Results of this follow-up analysis revealed a similar outcome as the original: in the final model, only age ($\beta = 0.157$, $p < 0.001$) and Wave 1 SASRQ mean (with sleep variables excluded; $\beta = 0.518$, $p < 0.001$) were significant.

Yet another analysis of the Table 2 model predicted the Wave 3 IES-R mean (less the three sleep-related variables). As with the previous analyses, age ($\beta = 0.171$, $p < 0.001$) and Wave 1 SASRQ mean (with sleep variables excluded; $\beta = 0.315$, $p < 0.001$) significantly predicted the dependent variable. However, this time difficulty falling or staying asleep at Wave 1 (2 weeks post-9/11) also made a significant, unique contribution to the variance in the DV ($\beta = 0.122$, $p = 0.004$). Excluding variables with a Cook's distance of greater than 4/(n-k-1) ($D > 0.006452$) resulted in the addition of sex as a significant predictor ($\beta = 0.092$, $p = 0.016$). As with the main analysis, age ($\beta = 0.221$, $p < 0.001$), Wave 1 SASRQ mean (with sleep variables excluded; $\beta = 0.353$, $p < 0.001$), and Wave 1 difficulty falling or staying asleep ($\beta = 0.115$, $p = 0.005$) also significantly predicted the DV variance.

In summary: age and SASRQ mean (with sleep variables excluded) significantly predicted mean IES-R (with sleep variables excluded) both at Wave 2 (2 months post-9/11) and Wave 3 (6 months post-9/11), regardless of outlier inclusion or exclusion.

Wave 1 difficulty falling or staying asleep added a unique contribution to the prediction of the posttraumatic stress symptoms measured 6 months post-9/11 (Wave 3 IES-R mean without sleep variables), but not at 2 months post-9/11. This was true regardless of outlier inclusion or exclusion. Sex, on the other hand, only made a unique contribution to the prediction of 6-month posttraumatic stress symptoms when outliers were excluded.

Wave 2 sleep variables predicting Wave 3 posttraumatic stress symptoms

The hierarchical regression model described in Table 3 was created in order to test the predictive ability of sleep disturbances reported 2 months following 9/11 on posttraumatic stress symptoms reported 6 months following 9/11. Using the Wave 3 IES-R mean (with sleep variables excluded) as the DV, age ($\beta = 0.112$, $p = 0.001$), SASRQ mean ($\beta = 0.122$, $p = 0.002$), and Wave 2 IES-R mean (excluding sleep items; $\beta = 0.479$, $p < 0.001$) significantly predicted some of the DV variance. These three variables were also significant when Cook's D outliers ($D > 0.006515$) were excluded: age, $\beta = 0.101$, $p = 0.002$; SASRQ mean, $\beta = 0.119$, $p = 0.002$; and Wave 2 IES-R mean (excluding sleep items), $\beta = 0.489$, $p < 0.001$. In addition, pre-existing anxiety ($\beta = 0.069$, $p = 0.047$) was also a significant predictor.

In summary, no Wave 2 sleep items significantly predicted posttraumatic stress symptoms at Wave 3. The significant predictive abilities on Wave 3 posttraumatic stress symptoms of age, acute stress symptoms measured at Wave 1 (SASRQ mean), and posttraumatic stress symptoms measures at Wave 2 (IES-R mean) were robust to changes in outlier inclusion or exclusion. Anxiety predicted a significant amount of variance only when outliers were excluded.

DISCUSSION

Research Questions

A. How many participants experienced 9/11-related sleep difficulties?

The level of 9/11-related difficulty falling or staying asleep reported by this sample in the 2 weeks following the terrorist attacks (23%) was lower than numbers reported in the NSF (2003) poll. In the latter case, 44% of participants in a phone survey reported that in the days immediately following 9/11, they experienced difficulty falling asleep; 39% reported that they experienced problems with waking up too early and not falling back asleep. Similarly, the current study found that 9% of respondents reported experiencing 9/11-related nightmares 2 weeks following the terrorist attacks, while in the NSF study, 23% of respondents reported that they had difficulty sleeping due to "bad dreams."

Several things could account for the difference in percentages of symptoms reported by the two different samples. For example, the questionnaire in the present study asked specifically about sleep disturbances related to 9/11, while the NSF study simply asked participants if they experienced sleep difficulties in the nights immediately after 9/11. Previous NSF polls found that prior to 9/11, 25% of survey respondents reported difficulty falling asleep on an ordinary night (National Sleep Foundation, 2003). The higher percentage of 9/11-related sleep difficulties reported in the NSF poll compared to the current study appears to reflect the additive effect of specifically 9/11-related difficulties to this baseline rate of trouble sleeping.

Regardless of the exact numbers, it is clear that a large percentage of Americans reported some sleep difficulties in the days immediately following 9/11. This finding certainly has a great deal of face validity; it makes sense that people would have difficulty sleeping during the uncertain time that followed the unexpected and unprecedented attacks that occurred on September 11, 2001. In addition, a wealth of research has documented subjective sleep difficulties following other traumatic events (e.g. Lavie, 2001; North et al., 1999; Wood et al., 1992).

Two months following the attacks, nearly 1 out of 3 participants reported that they had experienced at least "a little bit" of difficulty staying asleep related to 9/11. Over 1/4 of participants reported at least "a little bit" of 9/11-related difficulty falling asleep. Dreams related to 9/11 were experienced at least "a little bit" by 17% of the respondents. While it is true that the majority of respondents reported experiencing no 9/11-related sleep disturbances, these numbers suggest that substantial amounts of the population were still experiencing disturbed sleep 2 months after the attacks. This is not surprising given the climate in the United States at the time of the surveys. The threat of terrorism was kept alive in the public consciousness through increased airport security and other new screening measures at public facilities. Furthermore, the anthrax-mail scare continued to be a concern during the Wave 2 data collection period (November 10 – December 3, 2001).

At first glance, the higher percentages of respondents reporting any difficulty falling asleep, difficulty staying asleep, and dreams at Wave 2 (2 months post-9/11) than at Wave 1 (2 weeks post-9/11) appear to suggest that 9/11-related sleep disturbances had

increased rather than decreased over time. However, these two measures cannot be compared directly. First of all, they come from different scales. The Wave 1 question asked about difficulty falling and staying asleep in combination; at Wave 2 these two sleep difficulties were split into separate questions. Wave 1 asked respondents to report about 9/11-related nightmares as opposed to dreams (as was asked in Wave 2). The term "dreams" is a more general, inclusive one and may have allowed more people to respond in the affirmative.

Perhaps the more important distinction, however, between the two waves is the difference in response options. Wave 1 participants were asked a dichotomous question: did they experience or not experience a certain symptom. At Wave 2, participants were given a choice of five different response levels (0: "Not at all" to 4: "Extremely"). It is likely that many participants who answered "1: A little bit", or even "2: Moderately" would have chosen to report that they did not experience a particular symptom, had they been forced to make dichotomous choice such as in Wave 1. In fact, looking at respondents who answered that they experienced a symptom at least "2: Moderately" or more at Wave 2 (2 months post-9/11), the percentages drop to from 27% to 12.5% for difficulty falling asleep, from 33% to 13.5% for difficulty staying asleep, and from 17% to 7% for dreams.

B. Did participants experience a significant change in their sleep responses to September 11th over time (2 months following the attacks versus 6 months following the attacks)?

While it is not possible to quantitatively compare responses between Wave 1 and Wave 2, such a comparison was made possible between Wave 2 and Wave 3 because the

same questionnaire (IES-R) was used in both waves. Analysis of the responses between these two time points (2 months post-9/11 and 6 months post-9/11, respectively), showed a highly significant change for all three 9/11-related sleep variables. Levels of difficulty falling asleep, difficulty staying asleep, and dreams all dropped over time. That is, fewer people reported "Extremely" experiencing symptoms 6 months following the attacks than they did at 2 months following the attacks (the same was true for all response levels).

Individual difference scores between Wave 2 and Wave 3 indicated that many people did not change their level of distress over time, a finding most likely influenced by the fact that the majority of people at both time points reported no distress. However, of those that did change, most did so in a negative (less symptomatic) direction.

C. How did factors such as sex, age, race, distance from the World Trade Center, and pre-existing psychiatric diagnoses impact participants' sleep response to 9/11?

Sex

Compared to males, females consistently reported higher levels of 9/11-related sleep difficulties both at Wave 1 (2 weeks post-9/11) and Wave 2 (2 months post-9/11). These findings align with other studies of both 9/11-related distress and trauma-related sleep disturbances. The NSF poll (2003), which, like the present study, focused on 9/11-related sleeping difficulties, found that more women than men reported poor sleep quality after the terrorist attacks.

Because it assessed sleeping difficulty at multiple time points with the same measure, this study was able to determine if sex moderated the change in response over time. It did. While both males' and females' levels of 9/11-related sleep difficulties

decreased over time, women did so at a faster rate than men. In fact, by Wave 3 (6 months post-9/11), no difference existed between the sexes on difficulty falling asleep and difficulty staying asleep; the difference between males and females for dreaming was small, though statistically significant. Thus, it appears that whatever difference exists between men and women in their experience of trauma-related sleep difficulties disappears with the passage of time.

There are many reasons that could account for females' higher levels of sleep-related difficulties at time points closely following September 11. First of all, women tend to have higher levels of insomnia than men (Taylor et al., 2005). In addition, females have nearly twice the overall lifetime prevalence of PTSD than males (Nemeroff et al., 2005). Even when exposed to the same trauma, women are more likely than men to develop posttraumatic symptoms (Nemeroff et al., 2005). Some have postulated that men and women have a different physical reaction to trauma. For example, researchers have found that a certain polymorphism in a serotonin transporter promoter affects females macaque monkey's reaction to stress, but not males (Barr et al., 2004). The authors of this study postulated that women with this genotype may become more distressed in the face of adversity than women without the polymorphism or men. Others have speculated that fluctuating hormones may put women at greater risk of developing psychiatric problems such as insomnia and depression (Taylor et al., 2005).

A differential reporting bias constitutes another possible contributing factor to the difference in 9/11-related sleep reaction between males and females. Women may feel more comfortable or otherwise be more likely to endorse items than men. Given the

same perception of sleep disturbance, a woman might consider that it affects her "moderately," while a man might find it to be just "a little bit" disturbing. While such differences in reporting may exist between any two individuals regardless of sex, it may happen that overall, women have a lower threshold for reporting disturbances than men. This reporting bias, if it exists, may have to do with the social expectation for males to "tough it out". However, the fact that this was an anonymous Internet survey argues against that fact. Whatever the cause, the data are consistently clear across the three different sleep variables: women experienced significantly higher levels of difficulty falling asleep, difficulty staying asleep, and 9/11-related dreams both at 2 weeks post-9/11 and at 2 months post-9/11. By the time 6 months had passed since the attacks, their sleep difficulties had diminished to the point that they were the same, or nearly the same, as those experienced by men.

Age

Age did not appear to have a strong effect on any of the sleep variables. It did, however, have a weak, though significant effect on the experience of 9/11-related nightmares experienced 2 weeks following 9/11. Its relationship was even weaker (though still significant) with 9/11-related dreams experienced 2 months post-9/11. In both cases, older age was associated with fewer dreams/nightmares. This finding parallels past research which has suggested that nightmares decrease with age (Salvio, Wood, Schwartz, & Eichling, 1992; Wood, Bootzin, Quan, & Klink, 1993). While the one question does not specifically ask about nightmares, it is conceivable that 9/11-related dreams would be considered nightmares by many. The fact that no age-related

influence was detected 6 months post-9/11 may be due to the low numbers of people experiencing 9/11-related dreams at that time.

Race and ethnicity

Unlike the results of some other studies (e.g. Galea et al., 2002), there did not appear to be a systematic difference in response to 9/11-related sleep difficulties based on race or ethnicity.

Distance from the World Trade Center

Azimuth distance from the World Trade Center was not significantly correlated with any of the 9/11-related sleep issues. Given the regional differences found in other studies (Galea et al., 2002; Schlenger et al., 2002), it is likely that differences in 9/11-related sleep difficulties existed that were not detected by the azimuth distance variable. There could be several reasons for this. First of all, New York City was not the only site of terrorism on 9/11; the Pentagon in Washington, DC, was also struck, and a fourth plane crashed in rural Pennsylvania. Those in the metropolitan Washington, DC, area, for example, may have experienced just as much distress as New York City residents, though their azimuth distance to the World Trade Center was much higher.

In addition, it seems plausible that those in urban areas may have felt themselves to be more vulnerable to subsequent terrorist attack, and therefore experienced higher levels of acute and posttraumatic stress symptoms, including difficulty falling asleep, staying asleep, and 9/11-related dreams. Such an urban/rural distinction is not detected in the azimuth distance measure.

Pre-existing psychiatric diagnoses

Overall, rates of psychiatric diagnoses in this sample were slightly different from other published data. For example, in a rigorous study involving face-to-face structured diagnostic interviews, lifetime prevalence rates for anxiety were 28.8% (National Comorbidity Study Replication, NCS-R) (Kessler et al., 2005). The current study found that only 9.3% of participants reported that they had ever been diagnosed (either by themselves or a professional) with anxiety. On the other hand, the NCS-R found a lifetime prevalence of 16.6% for major depressive disorder, 20.8% for any mood disorder. In the current study, 20.8% of the participants reported that at some point in their lives, they had been self- or professionally-diagnosed with depression. These numbers, while slightly different in what they are reportedly measuring (major depressive disorder alone or mood disorders in general) are remarkably close. The lower rate of anxiety found in the present study may be accounted for by the self-report nature of the data. An individual who may not consider him- or herself to be anxious may very well meet diagnostic criteria if they were to be subjected to a face-to-face structured interview such as that used in the NCS-R study.

Prevalence rates of insomnia vary depending on the methodology of the study used to collect them. Some estimate the prevalence of insomnia to be between 9% to 12% (Taylor et al., 2005). The *DSM-IV-TR*, however, reports that the 1-year prevalence may be as high as 30% to 45% for adults (American Psychiatric Association, 2000). The rate of insomnia found in this study, 13.7% total, is closer to the prevalence estimates found by Taylor et al. (2005).

While these current data may be limited by their self-reported nature, they can still be useful in determining the contribution of pre-existing psychiatric diagnoses on the later experience of 9/11-related sleep issues. Their particular strength is in the fact that they were collected prior to 9/11, and thus not subject to retrospective influence (at least when it comes to the intervening event of the terrorist attacks themselves). At all waves, participants reporting psychiatric diagnoses experienced higher levels of 9/11-related sleep difficulties.

Those with insomnia diagnoses might be expected to report increased sleep difficulties following 9/11 due to their already-demonstrated susceptibility to sleep disturbances. It is likewise not surprising to find a strong association between anxiety and depression diagnoses and the experience of post-9/11 sleep difficulties. There is a high level of comorbidity between insomnia, depression, and anxiety. This is true both in the literature (e.g. Taylor et al., 2005), as well as the current data set (all three diagnoses were significantly correlated). This suggests that some common factors may be at work to cause all three.

In addition, these three psychiatric difficulties may feed each other. That is, the experience of insomnia may impair a person's emotional capabilities, thus making him or her more susceptible to develop anxiety and depression. Furthermore, the experience of having these disorders may make it difficult to sleep. In any case, it is clear that subjects who experienced pre-9/11 psychiatric diagnoses may have been more vulnerable to experiencing post-9/11 sleep disturbances than other people.

With two small exceptions (self versus professionally-diagnosed "combined psychiatric" and self- versus professionally-diagnosed anxiety's effect on Wave 1 nightmares), there were no significant differences in the level of 9/11-related sleep issues between those whose diagnosis was professionally-made and those who had only made the diagnosis themselves. Thus, it appears that for this self-report data, the report that any diagnosis was made is a more relevant piece of information than is the source of that diagnosis.

The rate of change between Wave 2 and Wave 3 was not affected by pre-existing psychiatric diagnosis for most variables. All subjects dropped significantly in their reported levels of 9/11-related sleep issues from 2 months post-9/11 to 6 months post-9/11, regardless of psychiatric diagnosis. However, those with a history of depression diagnoses did appear to decline more rapidly than those without in their level of 9/11-related difficulty falling asleep and 9/11-related dreams. Likewise, those with a history of insomnia diagnoses as well as those with at least one psychiatric diagnosis ("combined psychiatric") declined more rapidly over time on 9/11-related difficulty falling asleep than did those without.

This more rapid attenuation of symptoms by certain groups parallels the manner in which females were found to return to levels similar to males over time. Thus, in these cases, it appears that the exacerbating influence of the pre-existing diagnosis decreases as more time after the trauma passes. The fact that this decrease was not seen in more of the variable combinations may reflect three things: 1) This was a very small effect and therefore difficult to detect. 2) Because it is a small effect, it may take more time to show

its influence. If participants had been measured using the same instrument at 1 year following 9/11, perhaps other variable combinations would have demonstrated a differential change over time based on pre-existing psychiatric diagnoses. 3) A preexisting-psychiatric diagnosis affects the level of response rather than the pattern. That is, for the most part, people with pre-existing psychiatric diagnoses have higher levels of sleep difficulties related to 9/11 regardless of the time point assessed (as was seen for most analyses). This might simply reflect their predisposition to experience or notice (report) sleep difficulties more than others, rather than having an exaggerated response that attenuates over time (as was seen in females versus males).

D. Are sleep difficulties related to acute and posttraumatic stress symptoms on the same measurement occasion?

Two weeks following the 9/11 attacks, sleep difficulties as reported in a measure of acute stress, the SASRQ, were significantly related to the overall level of acute stress. Similarly, 2 months following 9/11, the three sleep variables from a measure of posttraumatic stress, the IES-R, were significantly related to the overall level of posttraumatic stress as assessed at the same occasion. In other words, sleep problems appear to arise at the same time as other symptoms of distress. Based on the levels of correlation, difficulty falling and/or staying asleep are somewhat more related to overall level of acute or posttraumatic stress than are dreams or nightmares.

E. Did initial sleep difficulties predict the development of later posttraumatic stress symptoms over and above pre-existing psychiatric diagnoses (anxiety, depression, and insomnia)?

Sleep difficulties measured 2 weeks following the 9/11 attacks did not contribute any unique predictive ability on posttraumatic stress symptoms experienced 2 months post-9/11. However, difficulty falling or staying asleep reported 2 weeks following 9/11 did predict the development of posttraumatic stress symptoms experienced 6 months following that attacks. This was true even when taking into account pre-existing psychiatric diagnoses as well as the effects of sex, age, and other acute stress symptoms experienced 2 weeks post-9/11. This effect, while small, was significant.

Why would immediate sleep difficulties predict posttraumatic symptoms at 6 months post-9/11, but not 2 months after the attacks? Many more people experienced posttraumatic stress symptoms closer to the attacks than as time went on (Silver et al., 2002). The experience of posttraumatic stress 2 months following the attacks was so common that it could also be considered a "normal" reaction to the distressing events of September 11. In this way, perhaps initial sleeping difficulty did not predict this "normal" reaction. On the other hand, because the levels of posttraumatic stress symptoms had subsided for many people by 6 months following the attacks, initial difficulty sleeping may have been indicative of a longer-term struggle with posttraumatic stress symptoms. Stated another way, the experience of initial sleeping difficulties may have shown a vulnerability to persistent posttraumatic stress symptoms. These analyses controlled for the influence of pre-existing sleeping difficulties (i.e. insomnia). Those who were more vulnerable to sleep problems would have been more likely to report

insomnia diagnoses, and therefore, this would have been controlled for in the analysis. The fact that initial sleep difficulties were associated with later posttraumatic stress symptoms suggests that they made a unique contribution to the experience of later distress. Granted, this was a small contribution, but significant nonetheless.

The ability to sleep well in the days immediately following a trauma such as 9/11 may give one some additional resources to cope with a difficult situation. Being more well-rested may have allowed people to engage more fully in their normal coping mechanisms such as meaningful relationships with family and friends, helping activities, or even exercise. On the other hand, good sleep may have played a more fundamental role in preventing later posttraumatic stress through its role in memory consolidation (Caldwell & Redeker, 2005).

Methodological limitations

Any methodology includes a certain number of trade-offs. While this study permitted for large numbers of Americans to be surveyed, the disadvantage is that it included only self-reported data with no means of objective corroboration. As discussed earlier, subjective complaints of trauma-related sleep disturbances are often uncorroborated when examined objectively. Furthermore, the data gathered on sleep is gross in nature. Participants are only asked to endorse broad statements such as having had, "difficulty falling asleep or staying asleep." Regardless of these limitations, this data set provided a rich opportunity to learn more about the nature of sleep reactions following trauma.

Summary

Overall, many Americans experienced disrupted sleep following the terrorist attacks of September 11, 2001. For example, 2 months following 9/11, up to one third of those surveyed were still experiencing at least some difficulties staying asleep as a result of the terrorism. The level of sleep disruptions attenuated over time, although the percentage of people still experiencing 9/11-related sleep difficulties 6 months after the attacks was non-trivial (14% reported difficulty falling asleep, 15% reported difficulty staying asleep, and 8% reported having dreams about the attacks).

Sex had a strong effect on these reactions, with women reporting higher levels of sleep disturbance than men both 2 weeks and 2 months following 9/11. By the time 6 months had passed since the attacks, this sex difference had all but disappeared. Age did not have any influence on how much people experienced difficulty falling and/or staying asleep at any of the time points assessed. It did, however, have a small negative effect on the reporting of nightmares 2 weeks post-9/11 and dreams 2 months post-9/11. Neither race/ethnicity nor azimuth distance had any effect on the 9/11-related sleep variables assessed in this data set.

Initial sleep disruption (difficulty falling or staying asleep 2 weeks post-9/11) predicted a small, but significant, amount of posttraumatic stress symptoms measured 6 months following the terrorist attacks. Therefore, sleep disruption and trauma-related dreaming may have a small effect on the development of later posttraumatic stress symptoms, but only in those individuals struggling with a more persistent stress reaction.

APPENDIX

Table 20. *Repeated Measures ANOVA Comparing the Effect of Sex and Time (Wave 2 to Wave 3) on 9/11-related Sleep Issues*

Difficulty Falling Asleep	Type III Sums of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Between subjects						
Gender	10.8	1	10.8	14.5	<0.001	0.018
Error (Ss w/in grps)	577.3	779	0.7			
Within subjects						
Time	25.1	1	25.1	73.4	<0.001	0.086
Time x Gender	5.7	1	5.7	16.8	<0.001	0.021
Error (Time x Ss within groups)	265.9	779	0.3			

Difficulty Staying Asleep	Type III Sums of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Between subjects						
Gender	13.0	1	13.0	15.6	<0.001	0.020
Error (Ss w/in grps)	645.6	776	0.8			
Within subjects						
Time	36.8	1	36.8	107.9	<0.001	0.122
Time x Gender	3.9	1	3.9	11.5	<0.001	0.015
Error (Time x Ss within groups)	264.9	776	0.3			

Dreams	Type III Sums of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Between subjects						
Gender	1.0	1	1.0	2.7	0.100	0.003
Error (Ss w/in grps)	288.1	773	0.4			
Within subjects						
Time	8.9	1	8.9	45.3	<0.001	0.055
Time x Gender	1.1	1	1.1	5.8	0.016	0.007
Error (Time x Ss within groups)	151.5	773	0.2			

Table 21. *Independent Samples T-tests Comparing the Effect of Psychiatric Diagnosis on Level of 9/11-related Difficulty Falling or Staying Asleep Experienced at Wave 1 (2 Weeks Post-9/11)*

Anxiety	Mean	Std. Error Mean	t	df	Sig. (2-tailed)	Effect Size
No diagnosis	0.209	0.016	-3.64	682	0.000	-0.65
Self- or Professionally-diagnosed	0.397	0.058				

Depression	Mean	Std. Error Mean	t	df	Sig. (2-tailed)	Effect Size
No diagnosis	0.198	0.017	-3.88	686	0.000	-0.53
Self- or Professionally-diagnosed	0.344	0.037				

Insomnia	Mean	Std. Error Mean	t	df	Sig. (2-tailed)	Effect Size
No diagnosis	0.208	0.017	-3.96	677	0.000	-0.61
Self- or Professionally-diagnosed	0.383	0.047				

"Combined Psychiatric"	Mean	Std. Error Mean	t	df	Sig. (2-tailed)	Effect Size
No diagnosis	0.182	0.019	-4.24	648	0.000	-0.56
Self- or Professionally-diagnosed	0.327	0.031				

Table 22. *Independent Samples T-tests Comparing the Effect of Psychiatric Diagnosis on Level of 9/11-related Nightmares Experienced at Wave 1 (2 Weeks Post-9/11)*

Anxiety	Mean	Std. Error Mean	t	df	Sig. (2-tailed)	Effect Size
No diagnosis	0.077	0.011	-2.14	682	0.033	-0.52
Self- or Professionally-diagnosed	0.151	0.042				

Depression	Mean	Std. Error Mean	t	df	Sig. (2-tailed)	Effect Size
No diagnosis	0.070	0.011	-2.35	686	0.019	-0.46
Self- or Professionally-diagnosed	0.129	0.026				

Insomnia	Mean	Std. Error Mean	t	df	Sig. (2-tailed)	Effect Size
No diagnosis	0.079	0.011	-1.76	677	0.079	-0.39
Self- or Professionally-diagnosed	0.131	0.033				

"Combined Psychiatric"	Mean	Std. Error Mean	t	df	Sig. (2-tailed)	Effect Size
No diagnosis	0.066	0.012	-2.34	648	0.020	-0.45
Self- or Professionally-diagnosed	0.119	0.022				

Table 23. *Repeated Measures ANOVA Comparing the Effect of Pre-Existing Anxiety and Time (Wave 2 to Wave 3) on 9/11-related Sleep Issues*

Difficulty Falling Asleep	Type III Sums of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Between subjects						
Anxiety	22.1	2	11.0	15.4	<0.001	0.043
Error (Ss within groups)	487.9	680	0.7			
Within subjects						
Time	5.1	1	5.1	14.7	<0.001	0.021
Time x Anxiety	0.3	2	0.1	0.4	0.676	n/a
Error (Time x Ss within groups)	237.2	680	0.3			

Difficulty Staying Asleep	Type III Sums of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Between subjects						
Anxiety	17.9	2	8.9	10.7	<0.001	0.031
Error (Ss within groups)	568.1	677	0.8			
Within subjects						
Time	5.3	1	5.3	14.9	<0.001	0.022
Time x Anxiety	1.6	2	0.8	2.3	0.100	0.007
Error (Time x Ss within groups)	240.1	677	0.4			

Dreams	Type III Sums of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Between subjects						
Anxiety	8.2	2	4.1	11.2	<0.001	0.032
Error (Ss within groups)	248.7	675	0.4			
Within subjects						
Time	3.6	1	3.6	18.1	<0.001	0.026
Time x Anxiety	1.7	2	0.9	4.4	0.013	0.013
Error (Time x Ss within groups)	134.3	675	0.2			

Table 24. *Repeated Measures ANOVA Comparing the Effect of Pre-Existing Depression and Time (Wave 2 to Wave 3) on 9/11-related Sleep Issues*

Difficulty Falling Asleep	Type III Sums of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Between subjects						
Depression	19.5	2	9.8	13.5	<0.001	0.038
Error (Ss within groups)	493.6	684	0.7			
Within subjects						
Time	17.3	1	17.3	49.9	<0.001	0.068
Time x Depression	1.5	2	0.8	2.2	0.109	n/a
Error (Time x Ss within groups)	237.1	684	0.3			

Difficulty Staying Asleep	Type III Sums of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Between subjects						
Depression	12.3	2	6.2	7.2	<0.001	0.021
Error (Ss within groups)	582.7	681	0.9			
Within subjects						
Time	20.4	1	20.4	58.1	<0.001	0.079
Time x Depression	1.4	2	0.7	2.0	0.138	n/a
Error (Time x Ss within groups)	239.6	681	0.4			

Dreams	Type III Sums of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Between subjects						
Depression	4.6	2	2.3	6.2	0.002	0.018
Error (Ss within groups)	252.8	679	0.4			
Within subjects						
Time	10.3	1	10.3	52.4	<0.001	0.072
Time x Depression	2.9	2	1.4	7.3	<0.001	0.021
Error (Time x Ss within groups)	133.6	679	0.2			

Table 25. *Repeated Measures ANOVA Comparing the Effect of Pre-Existing Insomnia and Time (Wave 2 to Wave 3) on 9/11-related Sleep Issues*

Difficulty Falling Asleep	Type III Sums of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Between subjects						
Insomnia	30.4	2	15.2	20.9	<0.001	0.058
Error (Ss within groups)	491.3	675	0.7			
Within subjects						
Time	12.9	1	12.9	37.0	<0.001	0.052
Time x Insomnia	1.5	2	0.7	2.1	0.123	n/a
Error (Time x Ss within groups)	236.2	675	0.3			

Difficulty Staying Asleep	Type III Sums of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Between subjects						
Insomnia	34.6	2	17.3	21.1	<0.001	0.059
Error (Ss within groups)	551.4	672	0.8			
Within subjects						
Time	16.6	1	16.6	48.1	<0.001	0.067
Time x Insomnia	1.6	2	0.8	2.3	0.102	n/a
Error (Time x Ss within groups)	232.0	672	0.3			

Dreams	Type III Sums of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Between subjects						
Insomnia	3.9	2	2.0	5.0	0.007	0.015
Error (Ss within groups)	261.2	669	0.4			
Within subjects						
Time	5.3	1	5.3	25.0	<0.001	0.036
Time x Insomnia	0.7	2	0.4	1.7	0.176	n/a
Error (Time x Ss within groups)	140.6	669	0.2			

Table 26. *Repeated Measures ANOVA Comparing the Effect of Pre-Existing Psychiatric Diagnoses ("Combined Psychiatric") and Time (Wave 2 to Wave 3) on 9/11-related Sleep*

Difficulty Falling Asleep	Type III Sums of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Between subjects						
"Combined Psych"	22.4	2	11.2	14.9	<0.001	0.044
Error (Ss within groups)	485.7	646	0.8			
Within subjects						
Time	20.4	1	20.4	55.9	<0.001	0.080
Time x "ComPsych"	3.1	2	1.5	4.2	0.015	0.013
Error (Time x Ss within groups)	236.2	646	0.4			

Difficulty Staying Asleep	Type III Sums of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Between subjects						
"Combined Psych"	17.5	2	8.8	10.1	<0.001	0.031
Error (Ss within groups)	555.9	643	0.9			
Within subjects						
Time	23.5	1	23.5	65.9	<0.001	0.093
Time x "ComPsych"	1.8	2	0.9	2.6	0.077	0.008
Error (Time x Ss within groups)	229.8	643	0.4			

Dreams	Type III Sums of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Between subjects						
"Combined Psych"	2.3	2	1.1	2.9	0.055	0.009
Error (Ss within groups)	250.9	641	0.4			
Within subjects						
Time	8.2	1	8.2	39.8	<0.001	0.058
Time x "ComPsych"	1.0	2	0.5	2.5	0.081	0.008
Error (Time x Ss within groups)	132.2	641	0.2			

Table 27. *Hierarchical Regression Coefficients for Wave 1 Sleep Variables Predicting Wave 2 Posttraumatic Stress Symptoms (Outliers Included)*

		Unstandardized Coef.		Std. Coef.		
		B	Std. Error	Beta	t	Sig.
Block 1	(Constant)	0.459	0.080		5.736	0.000
	Sex	0.213	0.049	0.171	4.353	0.000
	Age	0.003	0.001	0.085	2.158	0.031
Blocks 1&2	(Constant)	0.397	0.081		4.924	0.000
	Sex	0.180	0.049	0.144	3.655	0.000
	Age	0.004	0.001	0.093	2.388	0.017
	Anxiety	0.084	0.089	0.041	0.936	0.350
	Depression	0.130	0.065	0.089	2.009	0.045
	Insomnia	0.146	0.071	0.086	2.047	0.041
Blocks 1-3	(Constant)	-1.437	0.159		-9.017	0.000
	Sex	0.060	0.045	0.048	1.331	0.184
	Age	0.005	0.001	0.131	3.767	0.000
	Anxiety	-0.064	0.080	-0.032	-0.804	0.422
	Depression	0.070	0.058	0.047	1.207	0.228
	Insomnia	0.130	0.063	0.077	2.051	0.041
	SASRQ mean*	1.560	0.121	0.471	12.890	0.000
Blocks 1-4	(Constant)	-1.411	0.162		-8.738	0.000
	Sex	0.059	0.045	0.047	1.322	0.187
	Age	0.005	0.001	0.136	3.868	0.000
	Anxiety	-0.065	0.080	-0.032	-0.805	0.421
	Depression	0.069	0.058	0.047	1.192	0.234
	Insomnia	0.128	0.063	0.075	2.013	0.045
	SASRQ mean*	1.526	0.126	0.460	12.109	0.000
	Nightmares	0.080	0.082	0.036	0.980	0.327
Blocks 1-5	(Constant)	-1.357	0.169		-8.005	0.000
	Sex	0.055	0.045	0.044	1.214	0.225
	Age	0.005	0.001	0.133	3.794	0.000
	Anxiety	-0.064	0.080	-0.032	-0.797	0.426
	Depression	0.067	0.058	0.046	1.166	0.244
	Insomnia	0.120	0.064	0.071	1.884	0.060
	SASRQ mean*	1.476	0.134	0.445	10.977	0.000
	Nightmares	0.060	0.084	0.027	0.714	0.476
	Diff. falling/ staying asleep	0.063	0.060	0.043	1.063	0.288

Table 28. *Hierarchical Regression Coefficients for Wave 1 Sleep Variables Predicting Wave 2 Posttraumatic Stress Symptoms (Outliers Excluded)*

		Unstandardized Coef.		Std. Coef.		
		B	Std. Error	Beta	t	Sig.
Block 1	(Constant)	0.119	0.047		2.531	0.012
	Sex	0.150	0.028	0.219	5.325	0.000
	Age	0.002	0.001	0.113	2.755	0.006
Blocks 1&2	(Constant)	0.084	0.047		1.779	0.076
	Sex	0.134	0.028	0.196	4.797	0.000
	Age	0.003	0.001	0.125	3.078	0.002
	Anxiety	0.147	0.055	0.119	2.683	0.008
	Depression	0.098	0.037	0.116	2.612	0.009
	Insomnia	-0.016	0.043	-0.016	-0.377	0.706
Blocks 1-3	(Constant)	-0.851	0.102		-8.354	0.000
	Sex	0.067	0.026	0.098	2.538	0.011
	Age	0.003	0.001	0.163	4.360	0.000
	Anxiety	0.090	0.051	0.073	1.786	0.075
	Depression	0.057	0.035	0.067	1.633	0.103
	Insomnia	-0.026	0.039	-0.026	-0.661	0.509
	SASRQ mean*	0.805	0.079	0.402	10.135	0.000
Blocks 1-4	(Constant)	-0.356	0.091		-3.895	0.000
	Sex	0.040	0.022	0.058	1.780	0.076
	Age	0.002	0.001	0.092	2.891	0.004
	Anxiety	0.086	0.042	0.070	2.038	0.042
	Depression	0.049	0.029	0.058	1.685	0.093
	Insomnia	-0.030	0.033	-0.030	-0.921	0.358
	SASRQ mean*	0.275	0.075	0.137	3.654	0.000
	Nightmares	0.349	0.023	0.554	15.266	0.000
Blocks 1-5	(Constant)	-0.351	0.091		-3.845	0.000
	Sex	0.039	0.022	0.057	1.756	0.080
	Age	0.002	0.001	0.101	3.139	0.002
	Anxiety	0.082	0.042	0.067	1.934	0.054
	Depression	0.048	0.029	0.058	1.664	0.097
	Insomnia	-0.031	0.033	-0.031	-0.950	0.342
	SASRQ mean*	0.265	0.075	0.132	3.524	0.000
	Nightmares	0.333	0.025	0.529	13.543	0.000
	Diff. falling/ staying asleep	0.039	0.023	0.061	1.725	0.085

Table 29. *Hierarchical Regression Coefficients for Wave 1 Sleep Variables Predicting Wave 3 Posttraumatic Stress Symptoms (Outliers Included)*

		Unstandardized Coef.		Std. Coef.		
		B	Std. Error	Beta	t	Sig.
Block 1	(Constant)	0.459	0.080		5.736	0.000
	Sex	0.213	0.049	0.171	4.353	0.000
	Age	0.003	0.001	0.085	2.158	0.031
Blocks 1&2	(Constant)	0.397	0.081		4.924	0.000
	Sex	0.180	0.049	0.144	3.655	0.000
	Age	0.004	0.001	0.093	2.388	0.017
	Anxiety	0.084	0.089	0.041	0.936	0.350
	Depression	0.130	0.065	0.089	2.009	0.045
	Insomnia	0.146	0.071	0.086	2.047	0.041
Blocks 1-3	(Constant)	-1.437	0.159		-9.017	0.000
	Sex	0.060	0.045	0.048	1.331	0.184
	Age	0.005	0.001	0.131	3.767	0.000
	Anxiety	-0.064	0.080	-0.032	-0.804	0.422
	Depression	0.070	0.058	0.047	1.207	0.228
	Insomnia	0.130	0.063	0.077	2.051	0.041
	SASRQ mean*	1.560	0.121	0.471	12.890	0.000
Blocks 1-4	(Constant)	-1.411	0.162		-8.738	0.000
	Sex	0.059	0.045	0.047	1.322	0.187
	Age	0.005	0.001	0.136	3.868	0.000
	Anxiety	-0.065	0.080	-0.032	-0.805	0.421
	Depression	0.069	0.058	0.047	1.192	0.234
	Insomnia	0.128	0.063	0.075	2.013	0.045
	SASRQ mean*	1.526	0.126	0.460	12.109	0.000
	Nightmares	0.080	0.082	0.036	0.980	0.327
Blocks 1-5	(Constant)	-1.357	0.169		-8.005	0.000
	Sex	0.055	0.045	0.044	1.214	0.225
	Age	0.005	0.001	0.133	3.794	0.000
	Anxiety	-0.064	0.080	-0.032	-0.797	0.426
	Depression	0.067	0.058	0.046	1.166	0.244
	Insomnia	0.120	0.064	0.071	1.884	0.060
	SASRQ mean*	1.476	0.134	0.445	10.977	0.000
	Nightmares	0.060	0.084	0.027	0.714	0.476
	Diff. falling/ staying asleep	0.063	0.060	0.043	1.063	0.288

Table 30. *Hierarchical Regression Coefficients for Wave 1 Sleep Variables Predicting Wave 3 Posttraumatic Stress Symptoms (Outliers Excluded)*

		Unstandardized Coef.		Std. Coef.		
		B	Std. Error	Beta	t	Sig.
Block 1	(Constant)	0.119	0.047		2.531	0.012
	Sex	0.150	0.028	0.219	5.325	0.000
	Age	0.002	0.001	0.113	2.755	0.006
Blocks 1&2	(Constant)	0.084	0.047		1.779	0.076
	Sex	0.134	0.028	0.196	4.797	0.000
	Age	0.003	0.001	0.125	3.078	0.002
	Anxiety	0.147	0.055	0.119	2.683	0.008
	Depression	0.098	0.037	0.116	2.612	0.009
	Insomnia	-0.016	0.043	-0.016	-0.377	0.706
Blocks 1-3	(Constant)	-0.851	0.102		-8.354	0.000
	Sex	0.067	0.026	0.098	2.538	0.011
	Age	0.003	0.001	0.163	4.360	0.000
	Anxiety	0.090	0.051	0.073	1.786	0.075
	Depression	0.057	0.035	0.067	1.633	0.103
	Insomnia	-0.026	0.039	-0.026	-0.661	0.509
	SASRQ mean*	0.805	0.079	0.402	10.135	0.000
Blocks 1-4	(Constant)	-0.356	0.091		-3.895	0.000
	Sex	0.040	0.022	0.058	1.780	0.076
	Age	0.002	0.001	0.092	2.891	0.004
	Anxiety	0.086	0.042	0.070	2.038	0.042
	Depression	0.049	0.029	0.058	1.685	0.093
	Insomnia	-0.030	0.033	-0.030	-0.921	0.358
	SASRQ mean*	0.275	0.075	0.137	3.654	0.000
	Nightmares	0.349	0.023	0.554	15.266	0.000
Blocks 1-5	(Constant)	-0.351	0.091		-3.845	0.000
	Sex	0.039	0.022	0.057	1.756	0.080
	Age	0.002	0.001	0.101	3.139	0.002
	Anxiety	0.082	0.042	0.067	1.934	0.054
	Depression	0.048	0.029	0.058	1.664	0.097
	Insomnia	-0.031	0.033	-0.031	-0.950	0.342
	SASRQ mean*	0.265	0.075	0.132	3.524	0.000
	Nightmares	0.333	0.025	0.529	13.543	0.000
	Diff. falling/ staying asleep	0.039	0.023	0.061	1.725	0.085

Table 31. *Hierarchical Regression Coefficients for Wave 2 Sleep Variables Predicting Wave 3 Posttraumatic Stress Symptoms (Outliers Included)*

		Unstandardized Coef.		Std. Coef.		
		B	Std. Error	Beta	t	Sig.
Block 1	(Constant)	0.459	0.080		5.736	0.000
	Sex	0.213	0.049	0.171	4.353	0.000
	Age	0.003	0.001	0.085	2.158	0.031
Blocks 1&2	(Constant)	0.397	0.081		4.924	0.000
	Sex	0.180	0.049	0.144	3.655	0.000
	Age	0.004	0.001	0.093	2.388	0.017
	Anxiety	0.084	0.089	0.041	0.936	0.350
	Depression	0.130	0.065	0.089	2.009	0.045
	Insomnia	0.146	0.071	0.086	2.047	0.041
Blocks 1-3	(Constant)	-1.437	0.159		-9.017	0.000
	Sex	0.060	0.045	0.048	1.331	0.184
	Age	0.005	0.001	0.131	3.767	0.000
	Anxiety	-0.064	0.080	-0.032	-0.804	0.422
	Depression	0.070	0.058	0.047	1.207	0.228
	Insomnia	0.130	0.063	0.077	2.051	0.041
	SASRQ mean	1.560	0.121	0.471	12.890	0.000
Blocks 1-4	(Constant)	-1.411	0.162		-8.738	0.000
	Sex	0.059	0.045	0.047	1.322	0.187
	Age	0.005	0.001	0.136	3.868	0.000
	Anxiety	-0.065	0.080	-0.032	-0.805	0.421
	Depression	0.069	0.058	0.047	1.192	0.234
	Insomnia	0.128	0.063	0.075	2.013	0.045
	SASRQ mean	1.526	0.126	0.460	12.109	0.000
	Wave 2 IES-R mean*	0.080	0.082	0.036	0.980	0.327
Blocks 1-5	(Constant)	-1.357	0.169		-8.005	0.000
	Sex	0.055	0.045	0.044	1.214	0.225
	Age	0.005	0.001	0.133	3.794	0.000
	Anxiety	-0.064	0.080	-0.032	-0.797	0.426
	Depression	0.067	0.058	0.046	1.166	0.244
	Insomnia	0.120	0.064	0.071	1.884	0.060
	SASRQ mean	1.476	0.134	0.445	10.977	0.000
	Wave 2 IES-R mean*	0.060	0.084	0.027	0.714	0.476
	Dreams	0.063	0.060	0.043	1.063	0.288

		Unstandardized Coef.		Std. Coef.		
		B	Std. Error	Beta	t	Sig.
Blocks 1-6	(Constant)	-0.450	0.123		-3.645	0.000
	Sex	-0.002	0.032	-0.002	-0.050	0.960
	Age	0.003	0.001	0.113	3.456	0.001
	Anxiety	0.031	0.057	0.020	0.533	0.594
	Depression	0.013	0.041	0.012	0.324	0.746
	Insomnia	0.018	0.045	0.014	0.403	0.687
	SASRQ mean	0.322	0.099	0.125	3.234	0.001
	Wave 2 IES-R mean*	0.376	0.035	0.485	10.704	0.000
	Dreams	0.021	0.028	0.029	0.750	0.454
	Difficulty falling asleep	0.018	0.023	0.033	0.762	0.446
Blocks 1-7	(Constant)	-0.443	0.124		-3.583	0.000
	Sex	-0.001	0.032	-0.001	-0.045	0.964
	Age	0.003	0.001	0.112	3.451	0.001
	Anxiety	0.032	0.057	0.020	0.557	0.578
	Depression	0.015	0.041	0.013	0.357	0.721
	Insomnia	0.015	0.046	0.011	0.324	0.746
	SASRQ mean	0.316	0.100	0.122	3.163	0.002
	Wave 2 IES-R mean*	0.371	0.036	0.479	10.395	0.000
	Dreams	0.018	0.028	0.025	0.651	0.515
	Difficulty falling asleep	0.002	0.030	0.004	0.079	0.937
	Difficulty staying asleep	0.023	0.029	0.044	0.795	0.427

Table 32. *Hierarchical Regression Coefficients for Wave 2 Sleep Variables Predicting Wave 3 Posttraumatic Stress Symptoms (Outliers Excluded)*

		Unstandardized Coef.		Std. Coef.		
		B	Std. Error	Beta	t	Sig.
Block 1	(Constant)	0.119	0.047		2.531	0.012
	Sex	0.150	0.028	0.219	5.325	0.000
	Age	0.002	0.001	0.113	2.755	0.006
Blocks 1&2	(Constant)	0.084	0.047		1.779	0.076
	Sex	0.134	0.028	0.196	4.797	0.000
	Age	0.003	0.001	0.125	3.078	0.002
	Anxiety	0.147	0.055	0.119	2.683	0.008
	Depression	0.098	0.037	0.116	2.612	0.009
	Insomnia	-0.016	0.043	-0.016	-0.377	0.706
Blocks 1-3	(Constant)	-0.851	0.102		-8.354	0.000
	Sex	0.067	0.026	0.098	2.538	0.011
	Age	0.003	0.001	0.163	4.360	0.000
	Anxiety	0.090	0.051	0.073	1.786	0.075
	Depression	0.057	0.035	0.067	1.633	0.103
	Insomnia	-0.026	0.039	-0.026	-0.661	0.509
	SASRQ mean	0.805	0.079	0.402	10.135	0.000
Blocks 1-4	(Constant)	-0.356	0.091		-3.895	0.000
	Sex	0.040	0.022	0.058	1.780	0.076
	Age	0.002	0.001	0.092	2.891	0.004
	Anxiety	0.086	0.042	0.070	2.038	0.042
	Depression	0.049	0.029	0.058	1.685	0.093
	Insomnia	-0.030	0.033	-0.030	-0.921	0.358
	SASRQ mean	0.275	0.075	0.137	3.654	0.000
	Wave 2 IES-R mean*	0.349	0.023	0.554	15.266	0.000
Blocks 1-5	(Constant)	-0.351	0.091		-3.845	0.000
	Sex	0.039	0.022	0.057	1.756	0.080
	Age	0.002	0.001	0.101	3.139	0.002
	Anxiety	0.082	0.042	0.067	1.934	0.054
	Depression	0.048	0.029	0.058	1.664	0.097
	Insomnia	-0.031	0.033	-0.031	-0.950	0.342
	SASRQ mean	0.265	0.075	0.132	3.524	0.000
	Wave 2 IES-R mean*	0.333	0.025	0.529	13.543	0.000
	Dreams	0.039	0.023	0.061	1.725	0.085

		Unstandardized Coef.		Std. Coef.		
		B	Std. Error	Beta	t	Sig.
Blocks 1-6	(Constant)	-0.316	0.092		-3.425	0.001
	Sex	0.037	0.022	0.054	1.665	0.097
	Age	0.002	0.001	0.101	3.148	0.002
	Anxiety	0.084	0.042	0.068	1.985	0.048
	Depression	0.044	0.029	0.053	1.533	0.126
	Insomnia	-0.040	0.033	-0.039	-1.198	0.231
	SASRQ mean	0.239	0.076	0.120	3.164	0.002
	Wave 2 IES-R mean*	0.308	0.027	0.490	11.549	0.000
	Dreams	0.028	0.023	0.045	1.237	0.216
	Difficulty falling asleep	0.042	0.018	0.093	2.324	0.020
Blocks 1-7	(Constant)	-0.315	0.092		-3.409	0.001
	Sex	0.037	0.022	0.054	1.664	0.097
	Age	0.002	0.001	0.101	3.148	0.002
	Anxiety	0.084	0.042	0.069	1.989	0.047
	Depression	0.045	0.029	0.053	1.536	0.125
	Insomnia	-0.040	0.033	-0.040	-1.208	0.228
	SASRQ mean	0.239	0.076	0.119	3.142	0.002
	Wave 2 IES-R mean*	0.308	0.027	0.489	11.408	0.000
	Dreams	0.028	0.023	0.044	1.192	0.234
	Difficulty falling asleep	0.039	0.024	0.087	1.670	0.096
	Difficulty staying asleep	0.004	0.023	0.009	0.174	0.862

*with sleep variables excluded

REFERENCES

Adams, M. L., Ford, J. D., & Dailey, W. F. (2004). Predictors of help seeking among Connecticut adults after September 11, 2001. *American Journal of Public Health, 94*(9), 1596-1602.

American Psychiatric Association. (1980). *Diagnostic and statistical manual of mental disorders* (3rd ed.). Washington, DC: Author.

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th, text rev. ed.). Washington, DC: Author.

Ancoli-Israel, S. (2000). Insomnia in the elderly: A review for the primary care practitioners. *Sleep, 23*, S23-S30.

Barr, C. S., Newman, T. K., Schwandt, M., Shannon, C., Dvoskin, R. L., Lindell, S. G., et al. (2004). Sexual dichotomy of an interaction between early adversity and the serotonin transporter gene promoter variant in rhesus macaques. *Proceedings of the National Academy of Sciences of the United States of America, 101*(33), 12358-12363.

Boscarino, J. A., Galea, S., Ahern, J., & Resnick, H. (2003). Psychiatric medication use among Manhattan residents following the World Trade Center disaster. *Journal of Traumatic Stress, 16*(3), 301-306.

Breslau, N., Roth, T., Burduvali, E., Kapke, A., Schultz, L., & Roehrs, T. (2004). Sleep in lifetime posttraumatic stress disorder. *Archives of General Psychiatry, 61*, 508-516.

Breslau, N., Roth, T., Rosenthal, L., & Andreski, P. (1996). Sleep disturbance and psychiatric disorders: A longitudinal epidemiological study of young adults. *Biological Psychiatry, 39*(6), 411-418.

Caldwell, B. A., & Redeker, N. (2005). Sleep and trauma: A review. *Issues in Mental Health Nursing, 26*, 721-738.

Cardena, E., Koopman, C., Classen, C., Waelde, L. C., & Spiegel, D. (2000). Psychometric properties of the Stanford Acute Stress Reaction Questionnaire (SASRQ): A valid and reliable measure of acute stress. *Journal of Traumatic Stress, 13*(4), 719-734.

Combs, C. C. (1997). *Terrorism in the Twenty-first Century*. Upper Saddle River, NJ: Prentice Hall.

David, D., & Mellman, T. A. (1997). Dreams following Hurricane Andrew. *Dreaming, 7*(3), 209-214.

Executive Order 13224. (2001). *Blocking property and prohibiting transactions with persons who commit, threaten to commit, or support terrorism*.

Fox, J. (1991). *Regression diagnostics*. Newbury Park: Sage.

Friedman, M., & Karam, E. (2005). *Stress-induced and fear circuity disorders*. Retrieved March 21, 2006, from http://dsm5.org/conference7.cfm

Galea, S., Ahern, J., Resnick, H., Kilpatrick, D., Bucuvalas, M., Gold, J., et al. (2002). Psychological sequelae of the September 11 terrorist attacks in New York City. *New England Journal of Medicine, 346*(13), 982-987.

Green, B. (1993). Disasters and posttraumatic stress disorder. In J. R. T. Davidson & E. B. Foa (Eds.), *Posttraumatic stress disorder: DSM-IV and beyond*. Washington, DC: American Psychiatric Press.

Harvey, A. G., & Bryant, R. A. (1998). The relationship between acute stress disorder and posttraumatic stress disorder: a prospective evaluation of motor vehicle accident survivors. *Journal of Consulting and Clinical Psychology, 66*, 507-512.

Harvey, A. G., Jones, C., & Schmidt, D. A. (2003). Sleep and posttraumatic stress disorder: a review. *Clinical Psychology Review, 23*, 377-407.

Kessler, R. C., Berglund, P., Demler, O., Jin, R., Merikangas, K. R., & Walters, E. E. (2005). Lifetime prevalance and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. *Archives of General Psychiatry, 62*, 593-602.

Klein, E., Koren, D., Arnon, I., & Lavie, P. (2003). Sleep complaints are not corroborated by objective sleep measures in post-traumatic stress disorder: A 1-year prospective study in survivors of motor vehicle crashes. *Journal of Sleep Research, 12*, 35-41.

Koren, D., Arnon, I., Lavie, P., & Klein, E. (2002). Sleep complaints as early predictors of posttraumatic stress disorder: a 1-year prospective study of injured survivors of motor vehicle accidents. *American Journal of Psychiatry, 159*(5), 855-857.

Lasiuk, G. C., & Hegadoren, K. M. (2006). Posttraumatic stress disorder part I: Historical development of the concept. *Perspectives in Psychiatric Care, 42*(1), 13-20.

Lavie, P. (2001). Sleep disturbances in the wake of traumatic events. *New England Journal of Medicine, 345*(25), 1825-1832.

National Sleep Foundation. (2003). *National Sleep Foundation 2002 Sleep in America poll results relating to September 11*. Retrieved November 3, 2003, from www.sleepfoundation.org/PressArchives/911poll.cfm

Nemeroff, C. B., Bremmer, J. D., Foa, E. B., Mayberg, H. S., North, C. S., & Stein, M. B. (2005). Posttraumatic stress disorder: A state-of-the-science review. *Journal of Psychiatric Research, 40*, 1-21.

Norris, F. H., Byrne, C. M., Diaz, E., & Kaniasty, K. (2002). *The range, magnitude, and duration of effects of natural and human-caused disasters: A review of the empirical literature*. Retrieved March 17, 2006, from www.ncptsd.va.gov/facts/disasters

North, C. S., Nixon, S. J., Shariat, S., Mallonee, S., McMillen, J. C., L.Spitznagel, E., et al. (1999). Psychiatric disorders among survivors of the Oklahoma City bombing. *Journal of the American Medical Association, 282*(8), 755-762.

Pantin, H. M., Schwartz, S. J., Prado, G., Feaster, D. J., & Szapocznik, J. (2003). Posttraumatic stress disorder symptoms in Hispanic immigrants after the September 11th attacks: Severity and relationship to previous traumatic exposure. *Hispanic Journal of Behavioral Sciences, 25*(1), 56-72.

Rosenheck, R., & Fontana, A. (2003). Use of mental health services by veterans with PTSD after terrorist attacks of September 11. *American Journal of Psychiatry, 160*, 1684-1690.

Rothbaum, B. O., & Mellman, T. A. (2001). Dreams and exposure therapy in PTSD. *Journal of Traumatic Stress, 14*(3), 481-490.

Salvio, M. A., Wood, J. M., Schwartz, J., & Eichling, P. S. (1992). Nightmare prevalence in the healthy elderly. *Psychology and Aging, 7*, 324-325.

Schlenger, W. E., Caddell, J. M., Ebert, L., Jordan, B. K., Rourke, K. M., Wilson, D., et al. (2002). Psychological reactions to terrorist attacks: Findings from the national study Americans' reactions to September 11. *Journal of the American Medical Association, 288*(5), 581-588.

Schuster, M. A., Stein, B. D., Jaycox, L. H., Collins, R. L., Marshall, G. N., Elliott, M. N., et al. (2001). A national survey of stress reactions after the September 11, 2001, terrorist attacks. *New England Journal of Medicine, 345*(20), 1507-1512.

Scrignar, C. B. (1999). PTSD, the traumatic principle and lawsuits. *Psychiatric Times*, 52-55.

Silver, R. C., Holman, E. A., McIntosh, D. N., Poulin, M., & Gil-Rivas, V. (2002). Nationwide longitudinal study of psychological responses to September 11. *Journal of the American Medical Association, 288*(10), 1235-1244.

Speckhard, A. (2003). Acute stress disorder in diplomats, military, and civilian Americans living abroad following the September 11 terrorist attacks on America. *Professional Psychology: Research and Practice, 34*(2), 151-158.

Stein, B. D., Elliott, M. N., Jaycox, L. H., Collins, R. L., Berry, S. H., Klein, D. J., et al. (2004). A national longitudinal study of the psychological consequences of the September 11, 2001 terrorist attacks: Reactions, impairment, and help-seeking. *Psychiatry, 67*(2), 105-117.

Taylor, D. J., Lichstein, K. L., Durrence, H. H., Reidel, B. W., & Bush, A. J. (2005). Epidemiology of insomnia, depression, and anxiety. *Sleep, 28*(11), 1457-1464.

Weiss, D. S., & Marmar, C. R. (1997). The Impact of Events Scale - revised. In J. P. Wilson & T. M. Keane (Eds.), *Assessing psychological trauma and PTSD* (pp. 399-411). New York: Guilford.

Wood, J. M., Bootzin, R. R., Quan, S. F., & Klink, M. E. (1993). Prevalence of nightmares among patients with asthma and chronic obstructive airways disease. *Dreaming, 3*, 231-241.

Wood, J. M., Bootzin, R. R., Rosenhan, D., Nolen-Hoeksema, S., & Jourden, F. (1992). Effects of the 1989 San Francisco earthquake on frequency and content of nightmares. *Journal of Abnormal Psychology, 101*(2), 219-224.

Woodward, S. H., Friedman, M. J., & Bliwise, D. L. (1996). Sleep and depression in combat-related PTSD inpatients. *Biological Psychiatry, 39*, 182-192.