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# TESTIMONY

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## Invisible Wounds of War

### *Quantifying the Societal Costs of Psychological and Cognitive Injuries*

CHRISTINE EIBNER

CT-309

June 2008

Testimony presented before the Joint Economic Committee on June 12, 2008

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**The RAND Corporation**

***Invisible Wounds of War: Quantifying the Societal Costs of Psychological  
and Cognitive Injuries<sup>2</sup>***

**Before the Joint Economic Committee**

**June 12, 2008**

Chairman Schumer, Vice Chair Maloney, Ranking Member Brownback, and distinguished members of the committee, thank you for inviting me to testify and to describe our analysis. It is an honor and pleasure to present this information.

My testimony will discuss the costs and consequences of PTSD, depression, and TBI among servicemembers returning from Operations Enduring Freedom and Iraqi Freedom, as well as several recommendations for better understanding and reducing these costs. These recommendations stem from a large study conducted at the RAND Corporation entitled *Invisible Wounds of War: Psychological and Cognitive Injuries, Their Consequences, and Services to Assist Recovery* (Tanielian and Jaycox [Eds.], 2008). I served on the management team for this report, and co-led the analysis of economic costs undertaken for the study.

**Background**

Since October 2001, approximately 1.64 million U.S. troops have deployed as part of Operation Enduring Freedom (OEF; Afghanistan) and Operation Iraqi Freedom (OIF; Iraq). The pace of deployments in these current conflicts is unprecedented in the history of the all-volunteer force (Belasco, 2007; Bruner, 2006). Not only is a higher proportion of the armed forces being deployed, but deployments have been longer, redeployment to combat has been common, and breaks between deployments have been infrequent (Hosek, Kavanagh, and Miller, 2006). At the same time, episodes of intense combat notwithstanding, these operations have employed smaller forces and have produced casualty rates of killed or wounded that are historically lower than in earlier prolonged wars, such as Vietnam and Korea. Advances in both medical technology and body armor mean that more servicemembers are surviving experiences that would have led to death in prior wars (Regan, 2004; Warden, 2006). However, casualties of a different kind are beginning to

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emerge—invisible wounds, such as mental health conditions and cognitive impairments resulting from deployment experiences.

The costs of these invisible wounds go beyond the immediate costs of mental health treatment. Adverse consequences that may arise from post-deployment mental and cognitive impairments include suicide, reduced physical health, increased engagement in unhealthy behaviors, substance abuse, unemployment, poor performance while at work, homelessness, marital strain, domestic violence, and poor parent-child relationships. The costs stemming from these consequences are substantial, and may include costs related to lost productivity, reduced quality of life, substance abuse treatment, and premature mortality.

To quantify these costs, RAND undertook an extensive review of the literature on the costs and consequences of post-traumatic stress disorder (PTSD), depression, and traumatic brain injury (TBI). Our analysis included the development and use of a micro-simulation model to estimate 2-year post-deployment costs associated with PTSD and depression for military servicemembers returning from OEF and OIF. The more limited literature on TBI led us to use a somewhat different approach to estimate the costs associated with TBI. Our analyses use a societal cost perspective, which considers costs that accrue to all members of U.S. society including government agencies (e.g., DoD and VA), servicemembers, their families, employers, private health insurers, taxpayers, and others.

In conducting the micro-simulation analysis for PTSD and depression, our analysis also estimated the costs and potential savings associated with different levels of medical care, including proven, evidence-based care, usual care, and no care. Because information on effective treatments for TBI is limited, we did not attempt to distinguish between evidence-based and usual care in the TBI analysis.

### **The Consequences of PTSD, Depression, and TBI**

The literature suggests that the three conditions we examined—PTSD, depression, and TBI—have wide ranging negative implications for those afflicted. Below, we summarize some of the key negative outcomes that have been linked to PTSD, depression, and TBI in prior studies. For a more thorough discussion of these issues, please see Tanielian and Jaycox [Eds.], 2008, Chapter Five.

**Suicide:** Depression, PTSD, and TBI all increase the risk for suicide, as shown by evidence from studies of both military and civilian populations. Psychological autopsy studies of civilian suicides have consistently shown that a large number of civilians who committed suicide had a probable

depressive disorder. One study showed that approximately 30 percent of veterans committing suicide within 1-year had a mental health disorder such as depression, as did approximately 40 percent of veterans attempting suicide. Although not as strongly associated with suicide as depression, PTSD is more strongly associated with suicidal thoughts and attempts than any other anxiety disorder and has also been linked to elevated rates of suicide among Vietnam veterans. Studies of civilian populations have consistently shown that persons with TBI have a higher risk of suicide than persons without TBI.

**Physical Health:** Depression, PTSD, and TBI have all been linked to increased morbidity. With respect to physical health, cardiovascular diseases are the most frequently studied morbidity outcome among persons with psychiatric disorders. Both PTSD and depression have been linked to higher rates of heart disease in military and civilian populations. Depression also affects conditions associated with aging, including osteoporosis, arthritis, Type 2 diabetes, certain cancers, periodontal disease, and frailty. In the long-term, individuals with TBI are at risk for developing Alzheimer's disease, Parkinson's disease, and other brain-related disorders.

**Health-compromising Behaviors:** The link between depression and PTSD and negative physical health outcomes may be partly explained by increases in health-risk behaviors that influence health outcomes. For example, research on civilian populations has shown a clear link between PTSD and depression and smoking, as well as a link between symptoms of depression and PTSD and sexual risk taking.

**Substance Abuse:** Rates of co-occurring substance use disorders with PTSD, depression, and TBI are common and are often associated with more-severe diagnostic symptoms and poorer treatment outcomes. Several studies have examined the relationship between mental disorders and alcohol and drug abuse. The results have varied, depending on the specific condition studied. Studies of Vietnam veterans showed that PTSD increases the risk of alcohol and substance abuse, while other studies of civilian populations have found that depression, by contrast, tends to be a consequence of substance abuse rather than a cause. Veterans with TBI were much more likely than other veterans to be discharged from the military for reasons associated with alcohol and drug use.

**Labor Market Outcomes:** PTSD, depression, and TBI all influence labor-market outcomes. Specifically, there is compelling evidence indicating that these conditions will affect servicemembers' return to employment, their productivity at work, and their future job prospects. Studies of Vietnam veterans have also found that those with a diagnosis of depression or PTSD had lower hourly wages than Vietnam veterans without a diagnosis. In civilian populations, TBI has been similarly linked to lower wages.

**Homelessness:** Few studies have examined the rates of homelessness among individuals with PTSD, depression, or TBI; rather, most studies have studied the prevalence of mental disorders among homeless individuals. Compared with non-homeless persons in the general population, homeless people have higher rates of mental disorder, including traumatic brain injury, and are more likely to experience a severe mental disorder. One study found that 75 percent of homeless individuals with PTSD had developed the condition prior to becoming homeless. However, evidence in this area is not strong, and the prevalence of mental disorders among homeless people may be overstated, possibly the consequence of studies relying on poor sampling methods or flawed assumptions.

**Marriage and Intimate Relationships:** The effects of post-combat mental and cognitive conditions inevitably extend beyond the afflicted servicemember. As servicemembers go through life, their impairments cannot fail to wear on those with whom they interact, and those closest to the servicemember are likely to be the most severely affected. Studies of Vietnam veterans, whose results parallel those among civilian populations, have linked PTSD and depression to difficulties maintaining intimate relationships, and these deficits account for a greatly increased risk of distressed relationships, intimate-partner violence, and divorce among those afflicted. Although there is relatively scant research on TBI and intimate partner relationships, several studies of the civilian population have linked TBI to difficulties resolving relationship conflict, aggression, and intimate partner violence.

**Child Outcomes:** In addition, the interpersonal deficits that interfere with emotional intimacy in the romantic relationships of servicemembers with these PTSD and depression may interfere with their interactions with their children. In particular, interviews with spouses of veterans from several conflicts (World War II, Korea, and Vietnam) have all revealed a higher rate of problems among children of veterans with symptoms of PTSD. Rates of academic problems, as well as rates of psychiatric treatment, were also higher in children of veterans with PTSD compared to children of veterans without PTSD. The implications of a parent's depression on children's outcomes has not been studied directly in military populations, but numerous studies of civilian populations have shown that the children of depressed parents are at far greater risk of behavioral problems and psychiatric diagnoses than children of non-depressed parents. The cross-generational effects of TBI have yet to be studied.

A limitation of the research summarized above is that virtually none of the studies we reviewed were randomized controlled trials, and thus may not be able to detect causal relationships between these disorders and subsequent adverse consequences such as homelessness, substance abuse, or relationship problems. Further, the majority of studies reviewed drew from data on Vietnam-era

veterans or from data on civilians. Nevertheless, these studies are important for understanding the range of co-morbidities and behavioral outcomes likely to be associated with PTSD, depression, and TBI, and this information is relevant for determining the required resources for treating servicemembers and veterans with these conditions. Effective treatments for PTSD, depression, and TBI exist (Tanielian and Jaycox [Eds.], 2008, Chapter 7), and can greatly improve functioning. With adequate treatment and support, some servicemembers may avoid negative outcomes altogether.

## **Two-Year Societal Costs of PTSD and Depression**

To understand the consequences of these conditions in economic terms, we developed a microsimulation model. Using data from the literature (which had limited information on specific populations and costs), we estimated the costs associated with mental health conditions (PTSD and major depression) for a hypothetical cohort of military personnel deployed to Afghanistan and Iraq.

We defined costs in terms of lost productivity, treatment, and suicide attempts and completions, and we estimated costs over a two-year period (see Tanielian and Jaycox [Eds.], 2008, Chapter Six). Other studies of the medical costs of the conflicts in Afghanistan and Iraq (Bilmes, 2007; CBO, 2007) have been able to analyze longer timeframes because they considered average costs per patient across a wide range of conditions and projected this number over time, adjusting for expected number of patients, inflation, and other factors. However, for this analysis, we focus specifically on the costs of PTSD and depression, and we considered the costs associated with different types of treatment and different patterns of co-morbidity, allowing for remission and relapse rates to be influenced by treatment type. The data available to conduct this type of detailed analysis for specific mental health conditions, however, did not support projecting costs beyond a 2 year time horizon.

For each condition, we generated two estimates—one that included the medical costs and the value of lives lost due to suicide, and one that excluded such costs. We were unable to estimate the costs associated with homelessness, domestic violence, family strain, and substance abuse because reliable data are not available to create credible dollar figures for these outcomes. If figures for these consequences were available, the costs of having these conditions would be higher. Our estimates represent costs incurred within the first two years after returning home from deployment, so they accrue at different times for different personnel. For service members who returned more than two years ago and have not redeployed, these costs have already been incurred. However, these calculations omit costs for servicemembers who may deploy in the future, and they do not include costs associated with chronic or recurring cases that linger beyond two

years. (Details of our model assumptions and parameters can be found in Tanielian and Jaycox [Eds.], 2008, Chapter Six).

Our microsimulation model predicts that two-year post-deployment costs to society resulting from PTSD and major depression for 1.64 million deployed servicemembers could range from \$4.0 to \$6.2 billion (in 2007 dollars), depending on how we account for the costs of lives lost to suicide. For PTSD, average costs per case over two years range from \$5,904 to \$10,298; for depression, costs range from \$15,461 to \$25,757; and for PTSD and major depression together, costs range from \$12,427 to \$16,884. The majority of the costs were due to lost productivity. Because these numbers do not account for future costs that may be incurred if additional personnel deploy and because they are limited to two years following deployment, they underestimate total future costs to society.

The costs associated with PTSD and major depression are high, but our model predicts that savings can be attained if evidence-based treatments are provided to a higher percentage of the population suffering from these conditions. Providing evidence-based care to every individual with the condition would increase treatment costs over what is now being provided (a mix of no care, usual care, and evidence-based care), but these costs can be offset over time through increased productivity and a lower incidence of suicide. Relative to the status quo based on prior literature showing that approximately 30 percent of those with PTSD and major depression receive treatment and 30 percent of this treatment is evidence-based (Hoge et al. 2004; Young et al., 2001; Wang et al., 2005), our microsimulation model predicts that we could save money by increasing the use of evidence-based treatment, particularly when we include the costs of lives lost to suicide in our estimates. Estimated costs, as well as potential savings associated with providing evidence-based care to all service members in need, are shown in Table 1:

**Table 1: Approximate Societal Costs for All Returning Service Members, and Potential Savings Associated with Evidence-Based Care**

	Costs for 1.6 million returning servicemembers, status quo*		Potential savings if all servicemembers in need received evidence-based care	
	Cost per case	Total cost	Savings per case	Total savings
PTSD only	\$10,298	\$1.2B	\$2,306	\$0.28B
Co-morbid PTSD and depression	\$16,884	\$2.0B	\$2,997	\$0.36B
Depression only	\$25,757	\$2.9B	\$9,240	\$1.1B
<b>Total</b>		<b>\$6.2B</b>		<b>\$1.7B</b>

\* Status quo assumes 30 percent of servicemembers in need get treatment, and 30 percent of care is evidence based. Table is based on Table 6.11 in Tanielian and Jaycox [Eds.], 2008, and reports only estimates that include the cost of lives lost due to suicide. Costs for co-morbid PTSD and depression are lower than costs for depression alone due to timing. Consistent with prior literature, individuals in the model can develop late onset PTSD and depression. Thus, some individuals with co-morbid illness do not begin to accrue costs until very late in the 2 year model time horizon. See Tanielian and Jaycox [Eds.], 2008, chapter 6 for more details.

By ensuring that 100 percent of those with PTSD or major depression receive evidence-based treatment, we could save \$2,306 per person with PTSD, \$2,997 per person with PTSD and depression, and \$9,240 per person with depression alone. When we account for lives lost to suicide in our model, we predict that we could have saved as much as \$1.7 billion by providing evidence-based treatment to all servicemembers who returned from Iraq or Afghanistan with PTSD or depression. Projected cost savings are highest for those with major depression; for those with PTSD or co-morbid PTSD and depression, the finding that evidence-based treatment saves money is sensitive to whether or not we include the cost of lives lost due to suicide in our estimates. The weaker findings for PTSD reflect a relatively limited evidence on the benefits of PTSD treatment (IOM, 2007), as well as a more limited literature on the relationship between PTSD and employment outcomes.

Given that costs of problems related to mental health, such as homelessness, domestic violence, family strain, and substance abuse, are not factored into our economic models and would add substantially to the costs of illness, we may have underestimated the amount saved by providing evidence-based care. However, a caveat is that we did not consider additional implementation and outreach costs (over and above the day-to-day costs of care) that might be incurred if DoD and the VA attempted to expand evidence-based treatment beyond their current capacity. An additional caveat is that, at times, we found that the literature needed to project costs over time was relatively

thin. In particular, information is lacking on the consequences of PTSD and depression for career outcomes within the military (including promotions and productivity), and information on the relationship between PTSD and employment outcomes among civilians is relatively scant. Data on remission and relapse rates over time was not sufficient for us to project costs beyond 2 years. In addition, for many of the costly outcomes that have been associated with PTSD and depression (substance abuse, homelessness, domestic violence, etc.), available data is insufficient to assert a causal relationship. While we left these outcomes out of our cost model, better information on the causal association between mental health conditions and these outcomes could improve our understanding of the cost of deployment related mental health conditions.

### **One-Year Societal Costs of Traumatic Brain Injury**

A challenge for building a micro-simulation model is the availability of information to estimate key parameters, such as the probability of developing a mental health condition, the probability of getting treatment conditional on having a condition, and the probability of experiencing secondary outcomes such as unemployment. Because these parameters must come either from published literature or secondary data analysis, the literature and available data must be relatively well-developed to ensure that the probabilities used in the model are credible. We found that while the literature on PTSD and major depression is reasonably well-developed (although, at points, it is thin), the literature on TBI is much less comprehensive. As a result, we cannot include TBI in our micro-simulation model and instead calculate the costs of TBI using a prevalence-based cost of illness approach. While the cost of illness approach enables us to predict costs associated with TBI in a particular year (in this case, 2005), we cannot use this methodology to evaluate policy changes, such as an increase in evidence-based treatment.

Our cost-of-illness analysis for TBI takes into account hospital acute care costs, in- and out-patient rehabilitation costs, costs due to TBI related deaths and suicides, and lost productivity. Because there is a high level of uncertainty around many of the parameters needed for TBI analysis, we develop different assumptions and generate estimates for both a low and high-cost scenario. We estimate that the cost of deployment-related TBI ranged from \$96.6 to \$144.4 million, based on a total of 609 cases of diagnosed TBI reported in 2005. These costs are based on data reported by DoD (Medical Surveillance Monthly Report, 2007), and are applicable to servicemembers who have accessed the health care system and received a diagnosis of TBI; they do not reflect costs for all individuals who have screened positively for probable TBI. Importantly, even those labeled as having mild TBI in our analysis accessed the health care system at least twice, and were given a formal diagnosis related to TBI. Thus, even the mild cases captured in our cost analysis are likely to be relatively severe. Costs and cost drivers vary substantially by severity of the injury. As a result

these costs cannot be generalized to the thousands of servicemembers who may have experienced a less severe mild TBI in theater but did not receive medical treatment or a diagnosis.

Estimated annual costs for servicemembers who have accessed the health care system and received a diagnosis of mild TBI range from \$27,259 to \$32,759 in 2007 dollars. Productivity losses account for 47 to 57 percent of the total costs, whereas treatment accounts for 43 to 53 percent in these estimates. Costs are much higher for moderate to severe cases, with per-case costs ranging from \$268,902 to \$408,519 in 2007 dollars. In moderate to severe cases, TBI-related death is the largest cost component (70 to 80 percent of total costs); productivity losses account for only 8 to 13 percent, and treatment costs, 7 to 10 percent. Suicide, which we consider separately from TBI-related death, can account for up to 12 percent of total costs. We estimated the total cost of deployment-related TBI by applying an adjusted per-case cost for 2005 to the total number of TBI cases reported in *Serve, Support, Simplify: The Report of the President's Commission on Care for America's Returning Wounded Warriors* (President's Commission on Care for America's Returning Wounded Warriors, 2007, p. 2). From this calculation, we estimate that one-year costs for diagnosed TBI range between \$591 and \$910 million. As with the cost estimates for PTSD and depression, these figures underestimate the total costs that will accrue in the future, both because they are one-year costs and because they do not account for TBI cases that may occur as the conflicts continue. They also do not account for individuals with mild TBI who did not access the health care system or receive a formal diagnosis.

### **Recommendations for Better Understanding and Addressing These Costs**

Our microsimulation model predicts that two-year post-deployment costs resulting from PTSD and major depression for 1.6 million deployed servicemembers could range from \$4.0 to \$6.2 billion, depending on how we account for the costs of lives lost due to suicide. One-year costs for TBI could range from \$591 to \$910 million. For all three conditions, we find that direct costs associated with treatment are only a fraction of the total societal costs. Our quantitative analysis shows that lost productivity and premature mortality account for at least half of all costs, even within a relatively short time horizon (1 year for TBI, and 2 years for PTSD and depression). These results likely understate the true magnitude of the societal costs, both because our time frame is limited, and because we omit downstream consequences such as substance abuse, homelessness, domestic violence, and family strain.

Despite these caveats, our micro-simulation predicts that savings can be attained if we provide evidence-based treatments to a higher percentage of the population suffering from these conditions. Providing evidence-based care to every individual with the condition would increase treatment costs over what is now being provided (a mix of no care, usual care, and evidence-based care), but

these costs can be offset over time through increased productivity and lower incidence of suicide. While our evaluation showed that the most effective treatments are being delivered in some sectors of the care systems for military personnel and veterans, gaps remain in system-wide implementation (Tanielian and Jaycox [Eds.], 2008, chapter 7). Our report identifies three recommendations that might be used to insure better access to evidence-based care. First, we should increase the cadre of providers who are trained and certified to deliver proven (evidence-based) care, so that capacity is adequate for current and future needs. Second, we should change policies to encourage active duty personnel and veterans to seek needed care. Many servicemembers are currently reluctant to seek mental health treatment due to fear of negative career repercussions. Policies must be changed so that there are no perceived or real adverse career consequences for individuals who seek treatment, except where functional impairment compromises fitness for duty. Finally, we should deliver evidence-based care to servicemembers and veterans whenever and wherever they seek treatment. This might require strategies that make providers accountable for providing evidence-based treatment, as well as providing servicemembers information to enable them to judge whether they are receiving appropriate care.

Our analysis further revealed some gaps in our understanding of the long term consequences of PTSD, TBI, and depression. We currently have limited information on the full range of problems (emotional, economic, social, health, and other quality-of-life deficits) that confront individuals with post-combat PTSD, major depression, and TBI. Moreover, we do not fully understand how these illnesses develop, remit, and recur over time, or how relapse and recurrence are influenced by access to evidence based treatments. Policymakers need to be able to accurately measure the costs and benefits of different treatment options so that fiscally responsible investments in care can be made. Addressing these gaps requires a sustained, national research agenda aimed at better understanding the long term costs and consequences of PTSD, depression, and TBI. An initial strategy for implementing this research agenda could include launching a longitudinal study on the natural course and consequences of mental health and cognitive conditions among OEF/OIF veterans.

In conclusion, I emphasize that costs for individuals returning from OEF and OIF with mental health and cognitive conditions are high, and far exceed the direct costs associated with mental health treatment. We, as a society, can save money by investing more in evidence-based care for these individuals. However, to fully understand the magnitude of the long-term costs and consequences of these conditions, as well as to improve our understanding of how to provide effective care, we need a coordinated national research effort that studies returning servicemembers over the long term.

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