

# WORKING P A P E R

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### Post-Deployment Mental Health and Divorces

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## Preface

Since 2003 about 14 percent of U.S. Army soldiers have been reporting symptoms of post-traumatic stress disorder (PTSD) following deployments. The objective of this study is to examine how symptoms of PTSD or of other mental health symptoms are correlated with the probability of divorce among married active duty Army soldiers. For this purpose, we combine Army administrative individual-level longitudinal data on soldiers' deployments, marital history and socio-demographic characteristics with the soldiers' self-reported post-deployment health information, available in the Post-Deployment Health Assessment (PDHA) and Post-Deployment Health Re-Assessment (PDHRA) forms. Our estimates indicate that time spent in deployment is associated with an increase in the divorce risk among Army enlisted personnel and that PTSD symptoms are associated with further increases in the odds of divorce. Although officers are generally less likely to screen positive for PTSD than enlisted personnel, we find a stronger association between PTSD symptoms and divorces among Army officers who are PTSD symptomatic.

This document should be of interest to policy makers and manpower analysts who are interested in supporting families in order to sustain readiness, morale, and family well-being.

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For more information on the Center for Military Health Policy Research, see <http://www.rand.org/multi/military/> or contact the co-directors Terri Tanielian at [Teri\\_Tanielian@rand.org](mailto:Teri_Tanielian@rand.org) and Susan Hosek at [Susan\\_Hosek@rand.org](mailto:Susan_Hosek@rand.org). For more information on the Forces and Resources Policy Center, see <http://intranet.rand.org/nsrd/frp/> or contact the director John Winkler at [John\\_Winkler@rand.org](mailto:John_Winkler@rand.org).

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The opinions expressed in this study do not represent the official position of the Department of Defense. Any remaining errors are the sole responsibility of the authors.



# Glossary

<b>Symbol</b>	<b>Definition</b>
AFHSA	Armed Forces Health Surveillance Activity
DEERS	Defense Enrollment Eligibility Reporting System
DMDC	Defense Manpower Data Center
GWOT	Global War on Terror
IV	Instrumental Variable
PDHA	Post-Deployment Health Assessment
PDHRA	Post-Deployment Health Re-Assessment
PTSD	Post-Traumatic Stress Disorder



# 1. Introduction

As part of the wartime operations since 9/11, there has been a large increase in the frequency and length of US military deployments,<sup>1</sup> with more than 1.5 million U.S. troops deployed to Iraq and Afghanistan in recent years. By 2007, service members deployed to such hostile areas were away one in three years of service, and many experienced more than one deployment (Hosek and Martorell, 2009).<sup>2</sup> Recent studies (Hoge et al., 2006; Milliken et al., 2007; Tanielian et al., 2008) document a high prevalence of psychological symptoms among service members returning from deployments, such as post-traumatic stress disorder (PTSD), and emphasize the substantial burden these conditions place on military families.<sup>3</sup> In response, policymakers have also committed to understanding and addressing the burden placed on military families by recent deployments and their likely consequences, such as physical and psychological injuries (White House Report, 2011).

Married service members account for more than half of the US military and many of them report post-deployment health symptoms that may subsequently affect their family life, potentially leading to marital dissolution (Tanielian et al., 2008). Indeed, our data show that both the annual rate of divorce and the

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<sup>1</sup> A deployment represents the movement of an individual military service member or a military unit to an overseas location to accomplish a task or mission. Such overseas missions include routine training or participation in war-related military operations.

<sup>2</sup> Hosek and Martorell (2009) provide an extensive overview of the duration and frequency of deployments over the period between 1996 and 2008.

<sup>3</sup> Tanielian et al. (2008) find that the incidence of and brain injury and symptoms of post-traumatic stress disorder is as high as 20 percent among recently deployed service members.

incidence of self-reported PTSD symptoms for Army active duty personnel are increasing over the 2003-2009 timeframe (Figure 1), suggesting a potential correlation between divorces and PTSD symptoms.<sup>4</sup> The main focus of this study is to investigate the relationship between post-deployment mental health symptoms, namely being PTSD symptomatic, and the marital stability of US military families.

Several studies estimate the impact of deployments on divorce and other family outcomes and generally find that deployments increase divorces. Using cross-sectional survey data, Angrist and Johnson (2000) focus on the first Gulf War period and find that deployments increase the divorce rates of female service members, but have virtually no effect on the divorce rates of male service members. In addition, they find that when males are deployed, the number of hours worked by their wives declines. A more recent study by Lyle (2006) documents a negative impact of parents' deployment on children's academic scores, using data on standardized tests from Texas. In a longitudinal study, Karney and Crown (2007) find that time spent in deployment reduces the probability of divorce among military families. They conclude that military couples are resilient and that the benefits deployed service members receive may be enough to compensate for the negative aspects of deployment for both spouses, thus decreasing their probability of divorce. However, their timeframe is relatively short, as they only analyze service members that entered the military, married, and were at risk of divorce between 2002 and 2005. In recent

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<sup>4</sup>The divorce rate presented in Figure 1 is constructed as the ratio between the number of divorces that occur over a given year and the number of married soldiers serving as of the beginning of that year. Similarly, we define the annual PTSD rate, as the number of deploying

years, the median time elapsed between the date of enlistment and the date of marriage is about two years for young recruits. Since deployments can be as long as a year, the time between the deployment end date and the end of the timeframe over which Karney and Crown evaluate the divorce risk is often very limited, potentially leading to an underestimate of the actual effect. Finally, Negrusa et al. (2011) use an extensive military longitudinal dataset that spans a longer observation period (1999 to 2008), to directly identify the effect of deployments on the risk of divorce. They find a sizeable negative impact of deployments on the stability of military families, with the effect being stronger for female service members and for service members who were sent on hostile deployments (typically, to Iraq and Afghanistan). The identification strategy in Negrusa et al. (2011) relies on the observation that in recent years active component deployments were strongly tied to unit deployments. Since the occurrence of unit deployments is the result of higher-level decisions, made at the division or brigade level, the individual deployment does not depend on the service member's preference for or against deployments, thus allowing for a direct identification of the effect of deployments on divorces. In addition, since the change in the nature of post 9/11 deployments could not have been anticipated by families formed before 9/11, Negrusa et al (2011) are able to estimate a causal effect of the post 9/11 deployments on the marital stability of such families. However, none of these studies of military families disentangles the exact mechanisms through which deployments affect marital stability, such as the contribution of post-deployment mental health symptoms.

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soldiers who report PTSD symptoms in a given year on a PDHA form, relative to the total number of soldiers who deployed at least once and also completed a PDHA form in that year.

To estimate the correlation between mental health symptoms and the marital stability of service members in the post-deployment period, we combine an extensive individual-level longitudinal Army administrative data with post-deployment health screening data. In our main analysis sample we include all married Army active duty soldiers who deployed over the March 2003 – June 2010 period and who filled a Post Deployment Health Assessment (PDHA) form or a Post-Deployment Reassessment (PDHRA) form.<sup>5</sup> This dataset contains information on each individual soldier’s deployment and marital history over our entire observation period, coupled with individual-level information on post-deployment mental and physical health.

There is some empirical evidence documenting a negative correlation between the occurrence of a mental health disorder and marital satisfaction and stability (Kessler et al. 1998; Bartel and Taubman 1986; Whisman, 2001; Davila et al. 2003). However, these studies typically focus on civilian populations and generally do not distinguish between PTSD and other diagnoses. In addition, these empirical studies on the effect of mental health on marital outcomes more broadly have been careful to acknowledge limitations such as ‘reverse causality’, that is, the possibility that not only mental health symptoms lead to divorce, but that divorces may in turn deteriorate mental health (Bartel and Taubman, 1986; Kessler et al., 1998). An advantage of our particular setting to that of past studies is that we are able to employ longitudinal data to construct clear time sequences of marriage, mental health symptoms onset and subsequent divorce.

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<sup>5</sup> Not all deployed soldiers fill out a PDHA form. The completion rate of PDHA is about 67 over our period of observation.

Only a few studies directly estimate the effect of post-deployment PTSD on marital outcomes of service members, mostly due to the lack of post-deployment mental health data. Controlling for pre-military characteristics and stress symptoms due to combat, Gimbel and Booth (1994) examined associations between combat exposure and a marital adversity index that included divorce, in 2,101 Vietnam veterans. Although the authors cannot distinguish between pre and post war marriages and divorces, their results indicated that combat exposure predicted more symptoms of PTSD for veterans who had experienced more emotional problems in childhood. Finally, combat exposure contributes to an increase in marital adversity because of PTSD symptoms. These findings are consistent with other results based on survey research on veterans with PTSD, which show that veterans with war-related PTSD experience higher levels of anger than nonveterans with PTSD or veterans with other psychiatric diagnoses (Chemtob et al., 1994). Similarly, Carroll et al. (1985) find that veterans with PTSD symptoms also report higher rates of domestic violence than those with other diagnoses. Using a nationally representative survey of 1,200 male Vietnam veterans Jordan et al. (1992) reached similar conclusions finding that individuals with higher levels of PTSD symptoms were more likely than other groups to engage in violent behavior within the home.

In the present study, we combine data measuring PTSD symptoms among Army service members returning from recent deployments with longitudinal marital outcomes data to estimate the effect of being symptomatic of PTSD on the risk of divorce. These data allow us to control for many factors unobservable to past researchers in both civilian and military studies, such as aptitude and pre-deployment marital histories. We employ a discrete time survival regression

analysis in which we control for a large number of time-varying and fixed military and socio-demographic characteristics and estimate a strong association between being PTSD symptomatic and the risk of divorce. Specifically, we find that PTSD symptoms are associated with an increase in the odds of divorce of 1.12 to 1.28 times among Army enlisted personnel, and with an increase in the odds of divorce of about 1.50 to 2.38 times among Army officers. These estimated associations correspond to an increase in the divorce probability of soldiers with PTSD symptoms relative to deploying soldiers without PTSD symptoms of about 10 to 20 percent for enlisted personnel, and of about 50 to 90 percent for officers. We interpret the stronger association for officers as consistent with the hypothesis that negative unanticipated shocks at the time of marriage lead to marital dissolution (Becker, 1973; Becker 1974). Historically, given the lower degree of combat exposure, the reported combat-related physical injuries and casualties are much less prevalent among officers than among enlisted personnel. It is therefore plausible that at the time of marriage, the expectations of having to deal with mental health problems after deployments are much lower among officer families than among enlisted families. The direction of these associations remains the same in instrumental variable models in which we account for the potential endogeneity of mental health symptoms with respect to divorce. While in the instrumental variable models we attempt to control for this potential source of endogeneity, we interpret the estimates from those models with caution, as their validity relies on the choice of the instrument.

## 2. Empirical Framework

One concern that frustrates the cross-sectional analyses of the relationship between PTSD and divorce is the issue of ‘reverse causality’, which arises because prior divorce may represent a trauma that in turn can lead to PTSD. An advantage of our study is that we avoid reverse causality by using longitudinal data and constructing a clear sequence of the date when PTSD symptoms are reported and the date of the subsequent divorce. For this purpose we focus only on individual soldiers who enter the Army as single and marry while in service. We use only observations corresponding to the first marriage and, to further ensure that we are not capturing the effect of any prior trauma from before marriage, we exclude from our analysis service members who report PTSD symptoms after deployments that were experienced while the service member was single.

We measure the contribution of PTSD symptoms to marital dissolution by comparing the divorce probability of deployed soldiers who report PTSD symptoms with the divorce probability of deployed soldiers who do not report PTSD symptoms post-deployment. In addition, we build a longitudinal measure of post-deployment PTSD symptoms, in which we combine information on PTSD symptoms from the PDHA form with information on PTSD symptoms from the PDHRA form (when available), which is typically filled out 3 to 6 months after the PDHA form. The advantage of our longitudinal measure is that it provides an update of the reported PTSD symptoms. This allows us to account in the empirical analysis for the possibility that soldiers develop or recover from PTSD symptoms after the completion of their initial PDHA form (Milliken et al.,

2007). To the extent that PTSD symptoms have a later onset, using only PDHA information would lead us to underestimate the relationship between PTSD and divorce.

A potential problem we face in estimating the relationship between mental health symptoms and marital stability may come from the fact that those who fill out PDHA/PDHRA forms are a non-representative sample of the entire population of Army deploying soldiers. However, as we discuss in the next section, previous research shows that PDHA completion appears uncorrelated with individual and military characteristics, especially in the case of Army soldiers. For instance, Hoge et al. (2006) document that, across observable characteristics, deployed Army service members that have no PDHA forms are very similar to their counterparts with PDHA forms.

There remains however the more general issue of the endogeneity of mental health symptoms to marital stability (e.g., Kessler et al. 2008). It is possible that omitted variables, such as childhood adversity, could increase both the likelihood of PTSD symptoms and the probability of subsequent divorce. However, we believe that some features of our longitudinal study help mitigate this concern. For instance, we primarily focus on a mental health disorder, PTSD, that has been shown to be driven mainly by combat exposure, rather than by other predispositional variables (e.g., Jordan et al. 1992), and combat exposure is arguably exogenous to divorce. Also, we have a rich, albeit not exhaustive, set of controls pre and post-deployment, including time in marriage. In addition, we pursue cross-sectional instrumental variables models to further explore the potential issue of endogeneity.

Finally, another potential concern is that the population of deploying soldiers may be a non-random sample. It is conceivable that some soldiers may engage in deployment avoidance, while others may volunteer for deployments. However, over our period of analysis individual deployments in the active components were strongly tied to unit deployments, and unit deployments were not related to the preferences for deployment of individual unit members, but rather on higher-level decisions regarding which unit to deploy and when. It follows that the individual deployment is an event that is a “treatment” applied independently of individual preferences. Lyle (2006) also argues that in recent years unit deployment decisions were made at the division or brigade level. Furthermore, Lyle (2006) and Savych (2008) use unit deployment as an instrument for individual deployment and conduct a Hausman test, rejecting the hypothesis that the individual-level deployment is not orthogonal to the error. It is therefore likely that within a branch and controlling for occupational specialty, the occurrence of a deployment does not depend on individual soldier’s preferences and thus selection in the population of deploying soldiers is unlikely to be a serious issue in our data.

### **Discrete Hazard Models**

We start by estimating a discrete hazard model in which the divorce hazard is a function of being symptomatic of PTSD after deployment, an indicator variable for being deployed, cumulative time deployed and other fixed and time-varying variables.<sup>6</sup> This approach allows us to divide the entire observation period into smaller time intervals (quarters) and assess the effect of

time-varying covariates on the outcome of interest in each period, without having to choose arbitrary at-risk timeframes. Military members go through multiple spells of deployment and the discrete hazard specification is particularly useful as it allows us to evaluate the impact of deployments in each marriage quarter  $t$ , given the deployment time the individual accumulates up to time  $t$ . If the service member is deployed again in quarters subsequent to  $t$ , that extra deployment time is added to his or her previous experience in evaluating the risk of marital dissolution in any period following the end of the new deployment. Also, this approach allows for the marriage duration to be included in the model as a time-varying variable to account for the possibility that the risk of divorce varies with time in marriage. For instance, civilian couples are observed to have a higher risk of dissolution earlier in marriage (Bergstrom, 1997).

Another advantage of the discrete hazard model over simple linear probability, logit or probit models is that it takes into account the problem of censoring, which arises from the fact that many marriages are intact at the end of the observation period. When duration data are censored and contain time-varying covariates, the preferable estimation approach, routinely used in studies analyzing changes in family structure, is the discrete hazard model (Teachman, 2011). This model requires arranging the data in the individual-period format, such that a conventional likelihood estimator is directly applicable, and it also accounts for censoring.

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<sup>6</sup> The hazard represents the probability of an event to occur in the current period, given that it has not occurred in any previous period,

Our discrete hazard model is described in equation (1) below.<sup>7</sup> In essence, this is a stacked logit model with period dummies as intercepts:

$$\text{logit } D_{i,t} = \gamma_1 Depl_{i,t} + \gamma_2 PTSD_{i,t} + \gamma_3 CumDepl_{i,t} + \tau M_{i,t} + Q_t' \delta + X_i' \beta + \varepsilon_{i,t} \quad (1)$$

The dependent variable,  $D_{i,t}$ , is a dichotomous variable which takes the value of 1 in the period when the service member is observed to divorce, and 0 otherwise. On the right hand side of equation (1), we include an indicator variable for whether the soldier experiences any deployments up to time  $t$ ,  $Depl_{i,t}$ , and an indicator variable for whether the soldier is PTSD symptomatic post-deployment,  $PTSD_{i,t}$ . We also include a variable indicating the cumulative number of months by member  $i$  in deployment up to quarter  $t$ ,  $CumDepl_{i,t}$ , marriage duration,  $M_{i,t}$ , calendar quarter dummies,  $Q_t$ , and other time-invariant observed characteristics,  $X_i$ , such as age at marriage, gender, education and race.<sup>8</sup> The coefficient  $\gamma_1$  estimates the impact of ever being deployed on the divorce hazard in quarter  $t$ , while the coefficient  $\gamma_3$  indicates the impact of an additional month spent in deployment on the log odds of the divorce hazard, conditional on being deployed. The main coefficient of interest in equation (1) is  $\gamma_2$ , which allows us to estimate the differential impact of screening positive for PTSD post-deployment on the divorce hazard  $D_{i,t}$ , relative to soldiers who return

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<sup>7</sup> An extensive treatment of this econometric framework is provided in Singer and Willett (1993) and Willett and Singer (1995).

<sup>8</sup> The discrete hazard model is an approximation of a linear hazard model, as the dependent variable is a log odds ratio (or logit). This approximation however, is sufficiently precise for small hazard rates (Teachman, 2011). In fact, our quarterly average divorce hazard in the data is about 1 percent.

from deployments without screening positive for PTSD. In the empirical analysis we use both measures of PTSD, that is, the one based on only the PDHA form and the one based on the PDHA and PDHRA forms. Since we have mental health information only on deploying soldiers, we assume that non-deploying individuals do not have PTSD symptoms. This means that the  $PTSD_{i,t}$  variable is in fact an interaction with the deployment indicator. We also estimate a version of the model in equation (1), in which we interact the PTSD indicator with cumulative time deployed to test whether PTSD symptoms are differentially associated with divorces when deployments are longer.

In addition to estimating the relationship between PTSD symptoms and marital dissolution, the specification in equation (1) enables us to estimate the effect of deployment and time in deployment on the divorce probability. Given that deployments are randomly allocated with respect to units and thus irrespective of the individual soldier's preference for deployment, the effect of deployments is estimated by comparing the divorce probability of those deployed with the divorce probability of non-deploying soldiers. We also investigate the relationship between deployment and marital dissolution by comparing the divorce probability of an individual service member before any deployment with the divorce probability of the same individual at different points in time after return from deployment. The inclusion of the cumulative time in deployment allows us to analyze whether additional time deployed around the mean duration of deployments has an additional impact on the divorce probability.

### 3. Data Description and Key Measures

#### Deployment and Marital Histories

We use multiple sources of data to construct and link longitudinal deployment and marital histories with individual-level data on post-deployment mental health symptoms. First, we use the Defense Manpower Data Center's (DMDC's) Proxy Perstempo file as the main source of data. This is a longitudinal file, consisting of individual-level records on active-duty service members. It contains information on time deployed, military occupation, education, pay grade and Armed forces Qualifying Test (AFQT) aptitude test score category. Deployment information is inferred from administrative files, namely pay records, and the military services and military members have strong incentives to ensure that these records are accurate and timely. Second, from the Defense Enrollment Eligibility Reporting System (DEERS), which is a computerized database of military service members and their families, we have highly accurate information on the marital status and number of children of service members.<sup>9</sup> Third, we use information on mental health symptoms from two health questionnaires, the Post-Deployment Health Assessment (PDHA) and Post-Deployment Health Reassessment (PDHRA).<sup>10</sup> The two health questionnaires are very similar and they are mandatory for all returning soldiers right after

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<sup>9</sup> All military members have strong incentives to update their family status in DEERS online or in paper form, as their updated status determines the conditions under which they have access to military health care (TRICARE) and other military family benefits.

<sup>10</sup> PDHA and PDHRA data are maintained by the Armed Forces Health Surveillance Activity (AFHSA).

deployment, i.e., PDHA form, and within 3 to 6 months after return from deployment in the case of the PDHRA form (Hoge et al., 2006; Milliken et al., 2008).

Over our period of analysis between March 1999 and June 2010, about 450,000 individuals joined the Army active duty component. About 27 percent of these individuals were married when they joined, while the rest were single. For the purposes of our analysis we keep only the individuals who married after they entered service to ensure that at the time of marriage both spouses were expecting to enter a military family. We drop all entrants who were single at the time of entry and who were not yet married as of June 2010, the end of our observation period. We therefore retain all single Army soldiers who entered service after March 1999, and got married in service at some point until June 2010, the end of our timeframe. This represents a number of 245,261 individuals (224,484 enlisted personnel and 20,777 officers). Further, we drop the observations that do not correspond to the soldiers' first marriage and we keep in our sample only two categories of individuals: (i) soldiers who deployed while married and filled out a PDHA form; and (ii) non-deploying soldiers. Since the PDHA was first administered in 2003, we exclude all soldiers who deployed exclusively between 1999 and 2003, as they do not have PDHA information. Also, since in the 2003 - 2010 period, the PDHA completion rate was about 67 percent in our data, we drop an additional 95,575 deploying enlisted members who do not have PDHA information.<sup>11</sup> Next, we exclude 2,959 enlisted personnel who report post-deployment PTSD symptoms prior to marriage and

remain with a final sample comprised of 69,557 individual enlisted soldiers and a number of 360,012 soldier-quarter observations. Of those, 59,827 were deployed at least once during their first marriage in the military and filled out at least one PDHA form. Of those with at least one PDHA form, about three fourths have only one form filled out while one fourth have two forms filled out. Few individuals have more than two PDHA forms completed. Finally, applying the same sample restrictions, we obtain a sample of 8,181 officers, and a number of 48,086 individual-quarter observations.

As reported in Table 1, the fraction of enlisted who are deployed in our sample is 86 percent, while the corresponding metric for officers is 90 percent.<sup>12</sup> Since we only keep deploying soldiers with completed PDHA forms, the remainder of individuals up to 100 percent is represented by non-deployed enlisted personnel. One issue with keeping only deployed soldiers that have a completed PDHA form may be that Army soldiers who complete the form are a selected sample. However, this does not seem to be the case, as documented by Hoge et al. (2006) who find that, across observable characteristics, deployed Army service members that have no PDHA form are very similar to their counterparts with PDHA forms. Finally, regarding demographic characteristics, our sample is representative of the Army service and military in general with

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<sup>11</sup> We also exclude from our sample the enlisted personnel who have PDHA information only from the time they were single, i.e., 19,205 individuals, as well as individuals with missing values for key analysis variables (about 60,000 individuals).

<sup>12</sup> Bonds et al. (2010) document that out of the active-duty strength of the 557,000 soldiers as of December 2008, the Army had deployed 67 percent of them (i.e., 373,000 soldiers). New entrants account for most of the Army's "not-yet deployed" numbers (about 109,000 soldiers). Most of these new entrants are also unmarried, so the fraction of soldiers who experienced deployments as of December 2008 increases to about 83 percent, when new entrants are excluded from the total number of soldiers. This fraction is similar to the fraction of ever-deployed soldiers we observe in our sample.

around 12 percent of the enlisted sample being female and 19 percent being black (Table 1). The average age at marriage for officers is around 25, almost 3 years higher than that for enlisted reflecting the higher educational attainment of officers relative to enlisted.

## **Post-deployment Mental Health Measures**

We follow Hoge et al. (2006) and construct our PTSD symptoms measure using the four-item screen for PTSD available in the PDHA and PDHRA forms. The screen for PTSD, developed by National Center for PTSD for primary care settings (“PC- PTSD”), includes questions covering four symptoms of PTSD: re-experiencing trauma, numbing, avoidance, and hyper- arousal. We consider endorsement of any two of the four questions to be symptomatic of PTSD.<sup>13</sup> While we are not able to observe clinical diagnoses of PTSD, the PC-PTSD has been shown in the literature to have a sensitivity of 0.91 and specificity of 0.72, meaning that 91 percent of cases of PTSD are correctly identified although 28 percent of those without PTSD screen positive for the disorder (Prins et al. 2004).<sup>14</sup> In the case of soldiers with multiple deployments we use the information from the most recent PDHA form.

In addition, we build a second measure of post-deployment PTSD symptoms, in which we combine PTSD information obtained from two sources: the first based on information obtained right after the service member returns from deployment (i.e., PDHA form) and the second based on information

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<sup>13</sup> The DoD uses endorsement of 3 or 4 affirmative questions on the PC-PTSD as a positive screen for PTSD symptoms.

obtained 3 to 6 months after a given deployment (i.e., PDHRA form). We refer to this variable as our longitudinal PTSD measure, since it uses information from two time instances following a given deployment. We note that we are able to update the information on PTSD symptoms derived initially from the PDHA form only for soldiers that fill in a subsequent PDHRA form. By contrast, for soldiers that do not fill in a subsequent PDHRA form, the longitudinal measure will only include information from the PDHA form, practically assuming there was no change in symptoms since the last health screening form.

The advantage of our longitudinal measure stems from the fact that, when available, subsequent information confers a valuable update on symptoms onset or symptom disappearance (Milliken et al., 2007).

Also, the PDHA form includes a two-question screen for depression and also inquires about a range of physical and mental health symptoms. We use this information to construct an indicator for depression taking the value of 1 if the service member answers in the affirmative to one of the two questions: “felt down, depressed, or hopeless” or “little interest or pleasure in doing things”. The PDHA’s two stem questions for depression are modified from a validated instrument widely used in primary care settings, the two-item Patient Health Questionnaire (Hoge et al., 2006). Finally, we use the rich set of questions regarding individual mental health to construct a general measure of mental health based on eight questions, designed and used by Hoge et al. (2006), named ‘any mental health concern’.<sup>15</sup>

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<sup>14</sup> Although PC-PTSD is highly predictive of PTSD diagnoses, it is important to note that PDHA and PDHRA information is only indicative of symptoms that require further assessment.

<sup>15</sup> The ‘any mental health concern’ indicator takes the value of 1 if the soldier gives a positive response to any of the eight criteria: little interest or pleasure (a lot); feeling down (a lot); interest

The PDHA form asks respondents to report whether their health improved, stayed the same, or worsened during deployment and how many days they were on sick call. We use the information on health change to create an indicator variable for whether a soldier's health deteriorated while deployed and an indicator variable for whether the soldier spent any time in sick call. This variable based on sick call days is used as our instrument when we estimate cross-sectional instrumental variables (IV) models to address the issue of potential endogeneity of mental health symptoms.

We summarize the main mental health variables we use in the analysis in Table 1, separately for enlisted and officers. Some of these variables are derived from single questions from the PDHA form, while others are derived from more detailed screens as we describe above. We calculate the incidence of mental health problems as the fraction of individuals with mental health symptoms in each quarter, averaged over the entire period. About 12 percent of the married enlisted in our sample screen positive for post-deployment PTSD, while the fraction of officers with more than 2 PTSD symptoms is 7.6 percent. The longitudinal PTSD measure that updates the PTSD symptom information when PDHRA data are available has a slighter higher incidence in our sample: 13.5 percent for enlisted and 7.7 percent for officers. For ease of comparison we also look at the symptoms of PTSD based exclusively on the data from PDHRA forms and find the same rate of symptom endorsement as Milliken et al. (2007) who report that about 12 percent of Army active duty soldiers returning from Iraq,

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in receiving help for stress, emotional distress, family problems (yes); thoughts of hurting self (some or a lot); PTSD screen positive; thoughts of serious conflicts with others (yes); thoughts of hurting someone or sense of a loss of control with others (yes); and have sought or intend to seek care for mental health (yes).

screened positive for PTSD at the end of deployment, while 17 percent screened positive for PTSD in their follow-up PDHRA form.

The incidence of depression symptoms in the sample is higher than that of PTSD symptoms, around 32 percent for enlisted personnel and 19 percent for officers. Finally, 27 percent of the enlisted personnel screen positive for 'any mental concern', while the corresponding fraction for officers is around 14 percent. Although the incidence of mental health symptoms is non negligible in our sample, only 10.2 percent of enlisted members, and even fewer officers (3.4 percent), state that they have sought help for a mental concern. Although our data do not allow us to further evaluate the reason why these proportions are so low, it is possible that they underscore the potential stigma associated with seeking mental health treatment.

## 4. Results

### PTSD Symptoms and Divorces of Enlisted Personnel

In Table 2 we present the regression coefficients for enlisted personnel obtained by estimating discrete hazard models based on equation (1) above.<sup>16</sup> The estimates in columns (1) of Table 2 correspond to a simpler variant of equation (1) and highlight the important result that enlisted soldiers who are deployed have an estimated log odds ratio of divorce that is higher by 1.93 than that of married soldiers who are not deployed. The PTSD coefficient in column (1) measures the additional contribution of deployments to the log odds of the divorce ratio among enlisted soldiers who screen positive for PTSD after they return from deployment. We estimate that PTSD differentially impacts the divorce probability of enlisted soldiers by increasing the log odds of the divorce ratio by 0.124, relative to soldiers who return from deployments without being PTSD symptomatic. More intuitively, if we transform the log odds divorce ratio in terms of odds ratios, we obtain that the estimated odds of divorce for deployed enlisted who return PTSD symptomatic are 1.13 times higher than the odds for deployed enlisted who are not PTSD symptomatic.<sup>17</sup>

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<sup>16</sup> We run all our discrete hazard models using robust standard errors clustered by individual, which allows for correlations across different observations belonging to the same individual.

<sup>17</sup> Similar to the regular logistic regression, exponentiating a coefficient, in our discrete hazard model, yields the estimated odds-ratio associated with a 1-unit change in the predictor of interest. In this case the PTSD regression coefficient is 0.124 and it corresponds to an impact on the estimated odds-ratio of:  $e^{0.124} = 1.13$ .

The estimates reported in column (2) correspond to the model in equation (1) that allows us to separately measure a baseline effect of ever being deployed, an additional effect of deployment duration and a differential impact of screening positive for PTSD on the divorce hazard. The baseline effect of deployments remains of the same order of magnitude as in column (1), while the PTSD differential impact decreases slightly from 0.124 to 0.112, without losing its statistical significance. Also, consistent with Negrusa et al. (2011), we find that a longer deployment around the average deployment duration has a strong positive effect on the divorce risk of Army families. Next, in column (3) we include an additional interaction term to test whether the contribution of PTSD symptoms to divorces varies with time deployed and find no additional PTSD effect coming through deployment duration.

The PTSD variable used in models (1)-(3) in Table 2 is based on information available in the PDHA form. Because the PDHA form is linked to the end of a deployment, for those soldiers who do not experience another deployment, and thus do not fill out another PDHA form, the PTSD screening is a cross-sectional measure. The major disadvantage of this measure is that it ignores the possibility that for instance, individual soldiers have several incentives to under-report their post-deployment PTSD symptoms. Previous studies argue that soldiers may willingly do this in order to avoid being delayed to reunite with their family or for fear of stigma (e.g., Hoge et al. 2004). In addition, even if individuals correctly report their PTSD symptoms or other mental health symptoms on the PDHA form, it is possible that these conditions subside as soon as soldiers are reunited with their families. Finally, it may be

that symptoms of PTSD and other mental health symptoms occur only after the PDHA form is filled out, at the end of the deployment.

Using the longitudinal measure of PTSD, which allows us to observe each soldier's PTSD symptoms at two different points in time after their return from a given deployment, we re-estimate the models from Table 2 and report the estimates in Table 3, in columns (4)-(6). As expected, the new estimate of PTSD symptoms in column (5) - our preferred model -, is larger and more precisely estimated than in column (2), corresponding to an increase in the log odds of divorce of 0.18 associated with PTSD symptoms. This difference is consistent with both the later onset of PTSD and the under-reporting of symptoms at the end of deployments. While we cannot distinguish between these two channels, the main conclusion we draw is that adding new relevant information to our PTSD measure generates larger and more precisely estimated relationships between PTSD symptoms and the divorce hazard.

Throughout our analysis we report estimates based on both measures of PTSD in order to assess the impact on our results of using a longitudinal, rather than a cross-sectional measure, of mental health.

To facilitate the interpretation of our regression coefficients, we construct predictions of the divorce hazard and the divorce cumulative hazard. In Figure 2 we present the predicted quarterly divorce hazard of enlisted active duty soldiers at different points in time after returning from a first deployment of 12 months. Soldiers who report PTSD symptoms have divorce hazards between 1.1 percent six months post-deployment and 1.6 percent 48 months post-deployment. These predicted values are 21.4 percent larger than those among soldiers without PTSD symptoms, whose predicted divorce hazard ranges

between 0.9 and 1.3 percent. In Figure 3, we plot the predicted cumulative hazard for soldiers who experience a first deployment of 12 months in their first years of marriage. We estimate that individuals who deploy for 12 months in their first two years of marriage have a cumulative hazard of divorce of 4.6 percent if they do not report PTSD symptoms, and a cumulative hazard of 5.5 percent (20 percent higher) if they report PTSD symptoms. The 20 percent difference between PTSD symptomatics and non-PTSD symptomatics remains the same over time, such that for a married service member deployed for 12 months in the first three years of marriage the divorce probability over the entire period of three years is 8.7 percent for non-PTSD symptomatics and 10.5 percent for PTSD symptomatics. Similarly, the divorce probability after four years in marriage is 13.1 percent for soldiers without PTSD symptoms and 15.7 for soldiers who report PTSD symptoms.<sup>18</sup> We acknowledge that our results apply to Army personnel with up to 10 years of service, given that we include in our sample only members who entered service between March 1999 and June 2010.

### **Impact of Socio-Demographic Characteristics on Divorce**

Regarding relevant demographic characteristics, their estimated effects on the risk of divorce are consistent with findings from previous literature. For instance, having children decreases the risk of divorce and so does having more education (e.g., Weiss and Willis, 1997). Also, Hispanics are relatively more insulated to divorce relative to Whites, while getting married at a younger age increases the divorce risk. In addition, consistent with Angrist and Johnson

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<sup>18</sup> The cumulative hazard is a probability measure that increases in each quarter proportionally with the quarterly hazard. Since the quarterly divorce hazard is always positive,

(2000) and Negrusa et al. (2011), we find that female servicemembers are much more likely to divorce as a result of deployment than male service members. Also, to the extent that the PTSD variable captures psychological health, the variable “health worse” picks up the additional impact of physical health, which in our data seems to reduce the divorce hazard. This finding is consistent with Charles and Stephens (2004), who also find that negative shocks in physical health may actually end up strengthening the marriage as opposed to other negative shocks such as loss of income.

Given the strong result that the marital stability of female service members is more likely to be affected by deployments, we further explore the possibility that post-deployment PTSD affects female service members differently than their male counterparts. We find that, independent of the PTSD measure we use, the relationship we estimate between PTSD symptoms and divorce is the same for male and female enlisted. The coefficient on the interaction term between PTSD and an indicator for female is statistically insignificant, as reported in columns (2) and (4) of Table 4. Therefore, while women’s marriages seem to be more negatively affected by deployments relative to their male counterparts, the effect is not likely to be driven by post-deployment PTSD.

### **PTSD Symptoms and Divorce in Officer Families**

Finally, as reported in Table 5, we find that screening positive for PTSD is strongly associated with divorce in the case of officers. The regression models

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the cumulative hazard of divorce always increases, but at a declining rate because the divorce hazard decreases over time.

reported in Table 5 are the same as those for the enlisted sample in Table 3. Using our cross-sectional measure of PTSD we find that being deployed increases the odds ratio of divorce by 1.74 times, while being deployed and PTSD symptomatic increases the odds ratio of divorce by 1.50 times, relative to non-symptomatic deployed officers (column 2). When using our longitudinal measure of PTSD, the estimated odds of divorce for deployed officers who return PTSD symptomatic are 1.69 times higher than the odds for deployed officers who are not PTSD symptomatic (column 5). This increase in the odds of divorce associated with PTSD status suggests that for officers, even more so than for enlisted, PTSD incidence is an important negative shock that increases the divorce risk. The stronger association between PTSD symptoms and divorce for officers is consistent with the conceptual framework according to which negative unanticipated shocks lead to marital dissolution (Becker, 1973; Becker 1974). In other words, post-deployment PTSD is an outcome that is probably much less expected by officers than among enlisted and therefore more disruptive for officers' marriages.

In Figure 4, using the estimates from Model 6 in Table 5, we present the estimated cumulative divorce hazards for officers returning from a first deployment of 12 months during their first few years in marriage. The estimated divorce probability is 2.8 percent for officers who deployed in the first two years of marriage and returned without PTSD symptoms, while the divorce probability for officers with PTSD symptoms is 75 percent higher, 4.9 percent. The divorce probability after three and four years is 5.4 and 8.1 for officers without PTSD symptoms, and 9.2 and 13.7 for officers reporting PTSD symptoms after a 12 month deployment.

## 5. Sensitivity Analyses and Alternative Specifications

Next, we perform several analyses to assess the robustness of our results, focusing on sub-samples by period and first PDHA form, and on additional measures of post-deployment mental health. We also estimate cross-sectional instrumental variables (IV) models to address the issue of potential endogeneity of mental health symptoms.

### Single vs. Multiple PDHA forms

So far, in our estimation we included all the observations for any given service member regardless of the number of deployments and subsequent PDHA/PDHRA forms, although we control for the cumulative time spent in deployment up to quarter  $t$ . To understand whether our estimated association between PTSD and divorce is the result of an accumulation over multiple deployments, we compare our estimates to those obtained from a sub-sample restricted to soldiers' first PDHA form only ("first PDHA"). Both in the case of enlisted (Table 6) and in the case of officers (Table 7) the PTSD coefficient estimates for "first PDHA" are close to those generated by the main sample, suggesting that most of the association is driven by the first deployment (or rather, the first PDHA form filled out). Also, the relationship between the PTSD estimates using the cross-sectional measure and the PTSD estimates using the longitudinal measure remains as in the general case. The PTSD longitudinal estimates are larger and more precisely estimated than the PTSD cross-sectional estimates.

### **Changes in the PDHA form**

As a result of the increased interest on the part of policy makers regarding soldiers' post-deployment mental health symptoms, starting in March 2008 both the PDHA and PDHRA forms were slightly changed in order to ensure a more comprehensive reporting of the soldiers' psychological problems. We include an interaction term between PTSD and the post 2008 period to investigate whether the above changes are affecting our estimated association between PTSD and divorces. We report our findings in Table 8 and find that while the effect of deployments on divorce increase after 2008, the same is not true for the PTSD estimates. Using the PTSD longitudinal measure yields a similar pattern of results.

### **Potential Endogeneity of PTSD and Divorces**

We acknowledge that there is the strong possibility that unobservable factors that make an individual more likely to have PTSD can also increase the probability of divorce after deployments. If that is the case, the PTSD effects obtained from our discrete hazard models are overestimated and cannot be interpreted as unequivocally causal. Similarly, the usual estimation of *cross-sectional versions* of equation (1) with a limited set of covariates yields biased estimates. To account for the potential endogeneity of PTSD with respect to divorce, we also estimate IV models of divorce, in which we use information on sick call visits during deployment to construct instruments for PTSD. In order

for our instrument to be valid, it must be correlated with PTSD but not correlated systematically with the probability of divorce.<sup>19</sup>

First, we estimate cross-sectional OLS models, evaluating the impact of PTSD symptoms at different points in time to allow us to distinguish between short-term and long-term effects. In this specification, the estimated coefficient on PTSD measures the estimated effect of PTSD symptoms on the probability of divorce. In Table 9 we present models in which service members are observed to be at risk of divorce within the first 6, 9 and 12 post deployment months, respectively. While the PTSD indicator captures the effect of mental health symptoms, the 'health worse' variable is indicative of the impact of changes in physical post-deployment health. Also, this variable is likely to capture the influence of pre-deployment health. Comparing the estimates of PTSD across columns in Table 9, we conclude that PTSD symptoms increase the probability of divorce, but the effect becomes apparent only 9 months after the return from deployment.

Next, we estimate several IV models and given that our endogenous variable, the outcome variable and the instrument are all indicator variables we use a two-stage least squares specification (2SLS).<sup>20</sup> We find that the PTSD effect remains positive significant following a similar pattern as the OLS results. We interpret the similarity between the two sets of results as suggestive evidence that endogeneity of PTSD does not play a major role in this cross-sectional

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<sup>19</sup> An F test for the joint significance of all instruments yields an F statistic that is highly significant and we reject the null hypothesis that the instrument does not have additional explanatory power at significance levels lower than 0.1 percent.

<sup>20</sup> Heckman and MaCurdy (1985) argue that 2SLS is the ideal specification when the instrument and the endogenous variable and the outcome are binary.

analysis and that the PTSD effect on divorce is positive after accounting for endogeneity. However, we view these results with caution and acknowledge that we cannot assess the exact magnitude of bias introduced by omitted variables. The lack of alternative and potentially better instruments, such as information on the exact deployment location is a limitation. This sensitivity analysis also highlights the importance of the timeframe choice to our estimated results, and the need for a flexible framework. We therefore, prefer the estimates generated by the discrete hazard framework that circumvents this problem. Given the rich set of controls in our discrete hazard models, it is possible that the bias introduced by omitted variables is mitigated to some extent.

Finally, we use two other mental health symptoms, depression and any mental health concern, to offer context to our PTSD estimated effects. Using the depression measure discussed in section 3, we estimate that those returning from deployment with depression symptoms have higher log odds ratio of divorce by 0.11 relative to those who return without depression symptoms, as reported in the third column of Table 10. Those with 'any mental concern' have a higher log odds ratio of divorce with 0.24 relative to those who return without PTSD symptoms.

## 6. Discussion and Conclusions

In this study we provide novel estimates of the relationship between PTSD symptoms and the divorce risk among Army soldiers, by combining longitudinal administrative data on individual deployments and marital histories with data measuring post-deployment PTSD symptoms. Using these data, we are able to control for a large number of fixed and time-varying socio-demographic and military characteristics, such as pre- and post-deployment marital histories, cumulative time deployed and change in PTSD symptoms over time. Our estimates from discrete hazard models of divorce indicate that service members who experience deployments are more likely to divorce than their non-deployed counterparts, and that service members who screen positive for PTSD after deployment are more likely to divorce than deploying soldiers without such symptoms. In addition, we estimate a stronger association between PTSD symptoms and the divorce risk for officers relative to enlisted personnel. The direction of the PTSD effect remains the same in our IV models in which we attempt to control for the possibility that unobservable characteristics making some soldiers more likely to screen positive for PTSD may also make them more likely to divorce.

We acknowledge the possibility that our discrete hazard estimates are biased. There are two potential sources of bias that could affect our effects in opposite directions. First, to the extent that the soldiers most affected by PTSD choose to leave the Army (Hoge et al., 2006), the effect of PTSD on divorces could be underestimated and second, to the extent that omitted variables drive both

PTSD and divorce, our estimates could overestimate the true effect. While we argue that the size of these biases may be mitigated by our rich set of variables and choice of mental health symptom (PTSD), our study is limited in that it cannot afford an exact assessment of the magnitude of these biases. Given that the majority of Army soldiers are married and that a large proportion of them experienced recent deployments, future research to better understand the impact of PTSD on family well-being is warranted.

We improve on the few existing cross-sectional studies that analyze the relationship between post-deployment PTSD symptoms and divorce, as we are able to construct temporal sequences of symptoms and outcomes using administrative longitudinal data. Also, we design a longitudinal measure of PTSD based on measures of symptoms at two points in time after a given deployment. This new measure enables us to more precisely estimate the differential impact of screening positive for PTSD on the divorce hazard. Relative to the estimates based on the cross-sectional PTSD measure, the estimates obtained using the longitudinal PTSD measure indicate that the correlation between PTSD symptoms and the divorce risk is larger for both enlisted personnel and officers. This difference may reflect either a later onset in PTSD symptoms, or a stigma-related reluctance of soldiers to accurately report their PTSD symptoms on their initial PDHA (Hoge et al., 2004).

As policymakers have shown increased concern with maintaining and improving the well-being of military families (White House Report, 2011), our exploratory study highlights several issues that may be taken into consideration in designing new policies for military families. The most important finding of our study is that post-deployment mental health symptoms, such as PTSD, have

consequences that are not limited to the individual soldier but spill over to the relationship with their spouse and affect the stability of their marriage. We believe that divorce should be a relevant outcome for policymakers, especially given the documented negative subsequent effects that the divorce itself may have on mental health (e.g., Kessler et al., 1998) and on children outcomes, like the children's educational attainment (e.g., Keith and Finlay, 1988). In fact, since spouses are more willing to seek medical care for themselves and for their families (Milliken et al., 2007), it may be the case that stable marriages encourage service members to seek treatment. Therefore, designing new intervention programs for married soldiers suffering from PTSD symptoms that would also co-opt their spouses may be part of a broader set of intervention and treatment policies aimed at enhancing the psychological well-being of soldiers and their families.

PTSD symptoms are associated with a higher risk of divorce, and therefore, family support services should be enhanced for returning soldiers that screen positive for PTSD. Also, our study suggests that once a soldier is observed to be PTSD symptomatic, the positive association between PTSD and divorce is already apparent. Therefore, timely intervention to help returning soldiers after the first positive screen is critical and the family support services should not wait for a second or third reoccurrence of symptoms to intervene.

While we have information on the timing of marriage and divorce for the married Army personnel, in this study we do not observe the mental health of the military spouse. Previous research using TRICARE data (Mansfield et al., 2010) documents that the wives of deployed soldiers have poorer mental health than wives of non-deployed soldiers. Further research is needed to understand

how the combined post- deployment mental health problems of both spouses affect marital stability.

Finally, while the focus of our study was to analyze the impact of post-deployment mental health of married soldiers, PTSD symptoms may also affect the marriage prospects of single soldiers. There is evidence (Teitler and Reichman, 2008) that in the civilian population mental illness is a barrier to marriage, and therefore further research is warranted to understand how post-deployment PTSD may affect the unmarried soldiers' marital prospects. Historically, the military has been considered a "family friendly" institution, making great efforts to offer services and support to military families. Our findings provide additional evidence for the need of comprehensive efforts to increase the psychological well-being of married Army soldiers.

# Appendix

Figure 1. Annual Divorce Rates and PTSD Incidence in the Army (Enlisted, 2003-2009)

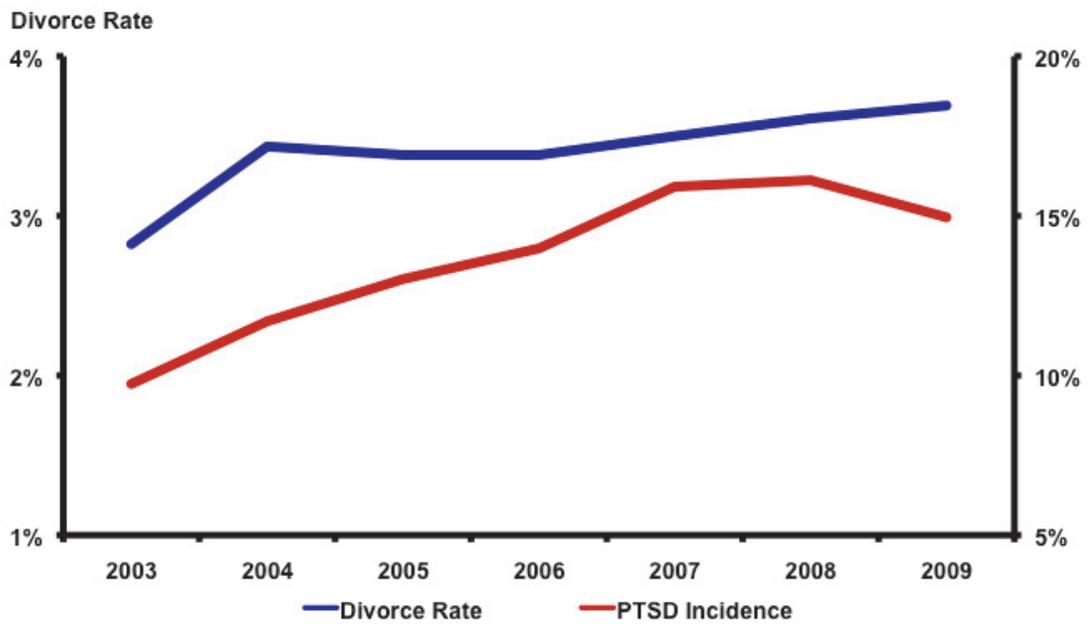


Figure 2. Predicted Divorce Hazard After A 12-Month Deployment (Army Active Duty, Enlisted Personnel, 2003-2010)

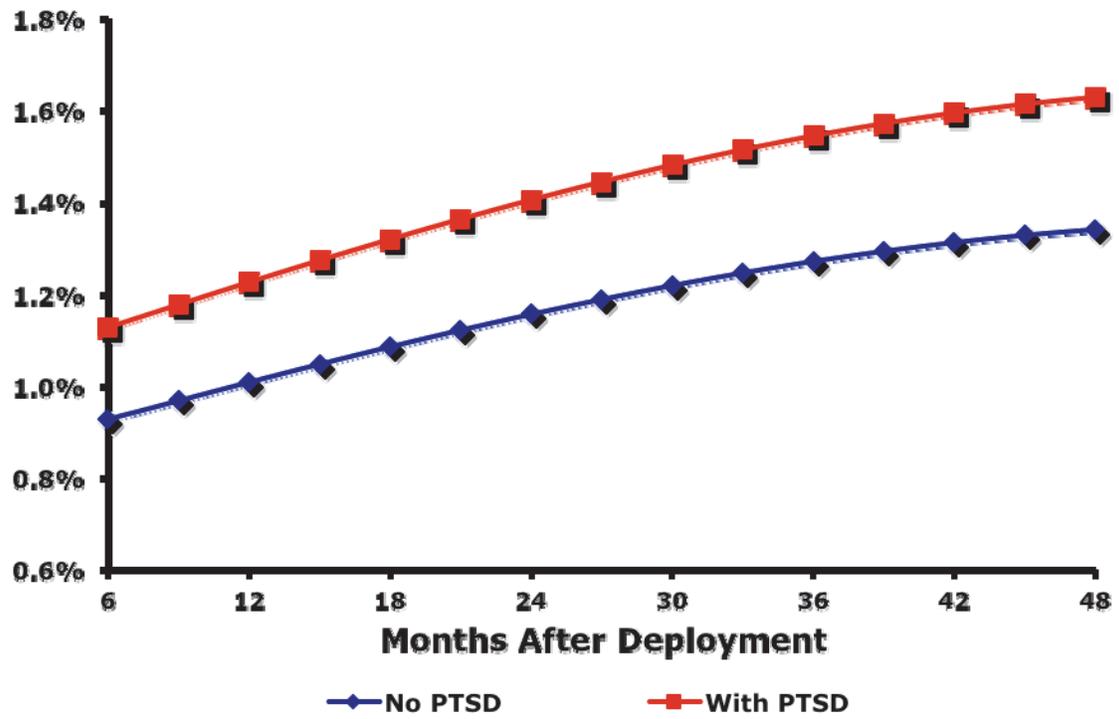


Figure 3. Predicted Probability of Divorce After A 12-Month Deployment (Army Active Duty, Enlisted Personnel, 2003-2010)

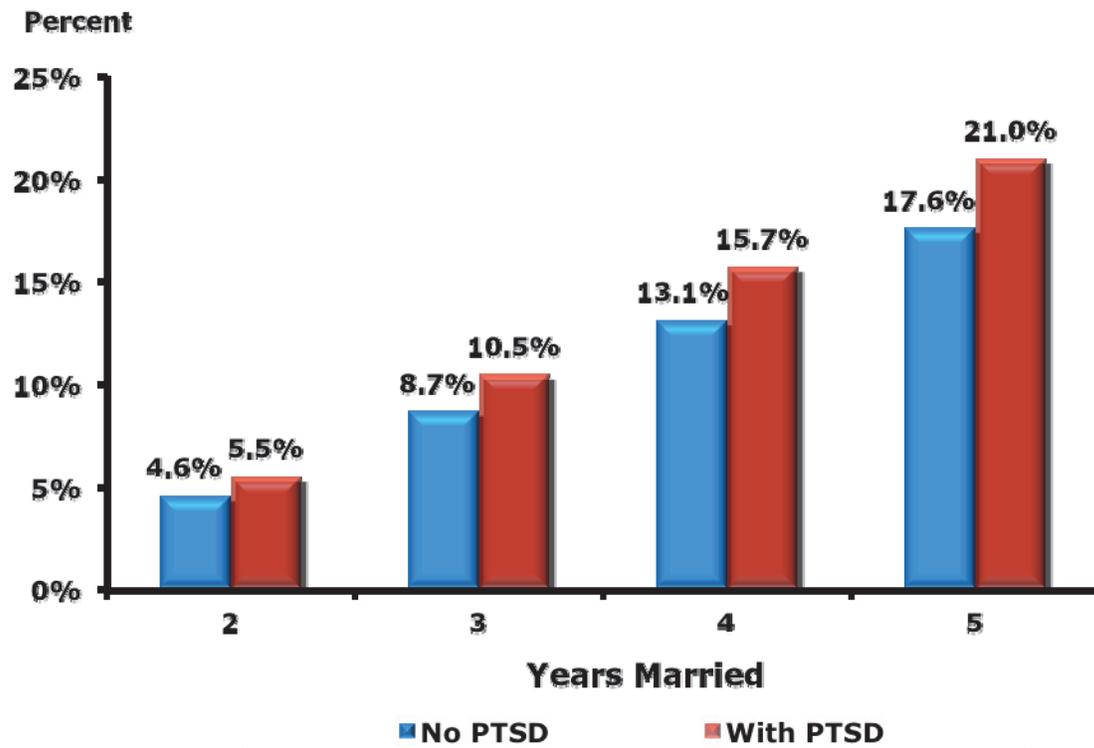
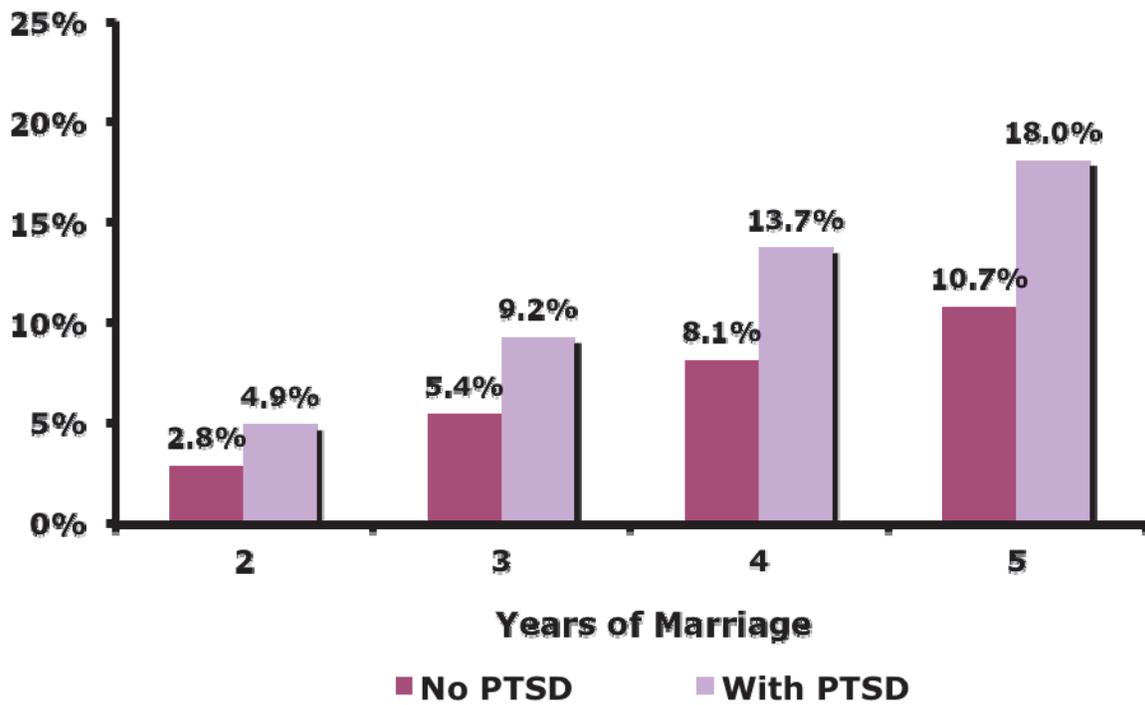


Figure 4. Predicted Probability of Divorce After A 12-Month Deployment (Army Active Duty, Officers, 2003-2009)



**Table 1. Summary Statistics on Socio-Demographic Characteristics, Mental Health Measures and Deployment Variables of Army Soldiers (2003-2010)**

	Enlisted	Officers
<i>Demographic Variables</i>		
Number of Children	1.1	0.8
Female	9.2 %	12.6 %
Age at Marriage	22.8	25.4
Hispanic	12.5 %	5.9 %
Black	18.5 %	8.9 %
Health worse	18.2 %	15.3 %
No HS diploma	1.9 %	--
High School Diploma	94.1 %	0.76 %
Some College	1.9 %	0.14 %
College	2.1 %	99.1 %
<i>Post-deployment Mental Health Variables</i>		
PTSD	12.0 %	7.6 %
PTSD Longitudinal	13.5 %	7.7 %
Depressed	31.8 %	18.7 %
Mental Risk	19.8 %	9.0 %
Any Mental Concern	27.1 %	14.4 %
Sought Help for Mental Con.	10.2 %	3.4 %
Any mental health referral	6.7 %	2.1 %
Family referral	1.3 %	0.3 %
Weakness Symptom	2.1 %	1.0 %
Memory Symptom	6.4 %	2.2 %
<i>Deployment Variables</i>		
Months deployed	12.6	13.3
One PDHA form	86 %	90 %
One PDHRA form	70.4 %	81.6 %
Two PDHA forms	16.6 %	15.6 %
Number of Observations	360,012	48,086

Note: PDHA data (2003-2010) linked to Army Administrative Individual level data (1999-2010)

**Table 2. Estimated Relationship between Screening Positive for PTSD Post-Deployment and the Divorce Hazard of Army Enlisted Service Members (2003-2010)**

	(1)	(2)	(3)
Deployed	1.931*** (0.121)	1.661*** (0.128)	1.661*** (0.128)
PTSD	0.124*** (0.043)	0.112** (0.043)	0.113 (0.107)
Months deployed	--	0.052*** (0.009)	0.052*** (0.009)
Months deployed x PTSD	--	--	-0.000 (0.006)
Health worse	-0.068* (0.039)	-0.072* (0.039)	-0.072* (0.039)
Children	-0.326*** (0.019)	-0.320*** (0.019)	-0.320*** (0.019)
Female	0.747*** (0.045)	0.762*** (0.045)	0.762*** (0.045)
Black	0.049 (0.040)	0.043 (0.040)	0.043 (0.040)
Hispanic	-0.086* (0.047)	-0.085* (0.047)	-0.085* (0.047)
Age at marriage	-0.021*** (0.006)	-0.021*** (0.006)	-0.021*** (0.006)
HS dropout	-0.026 (0.115)	-0.025 (0.115)	-0.024 (0.115)
Some college	-0.019 (0.108)	-0.013 (0.108)	-0.013 (0.108)
College	-0.324*** (0.121)	-0.316*** (0.121)	-0.316*** (0.121)
Time in service	0.000 (0.001)	0.001 (0.001)	0.001 (0.001)
Months deployed squared	--	-0.001*** (0.000)	-0.001*** (0.000)
Observations	360,012	360,012	360,012

\* , \*\* , \*\*\* significant at 10 %, 5%, 1 %. Estimated coefficients, standard errors (in parenthesis).

Regressions run with the covariates described in Section 3.

**Table 3: Estimated Relationship between Screening Positive for PTSD Post-Deployment and the Divorce Hazard of Army Enlisted Service Members (2003-2010)**

	Cross-sectional PTSD			Longitudinal PTSD		
	(1)	(2)	(3)	(4)	(5)	(6)
Deployed	1.931*** (0.121)	1.661*** (0.128)	1.661*** (0.128)	1.921*** (0.121)	1.658*** (0.128)	1.651*** (0.129)
PTSD	0.124*** (0.043)	0.112** (0.043)	0.113 (0.107)	0.193*** (0.040)	0.181*** (0.040)	0.249** (0.100)
Months deployed	--	0.052*** (0.009)	0.052*** (0.009)	--	0.051*** (0.009)	0.051*** (0.009)
Months deployed x PTSD	--	--	-0.000 (0.006)	--	--	-0.004 (0.006)
Months deployed squared	--	-0.001*** (0.000)	-0.001*** (0.000)	--	-0.001*** (0.000)	-0.001*** (0.000)
Observations	360,012	360,012	360,012	356,467	356,467	356,467

\* ; \*\* ; \*\*\* significant at 10 %, 5%, 1 %. Estimated coefficients, standard errors (in parenthesis).

Regressions run with the covariates described in Section 3.

**Table 4: Estimated Relationship between Screening Positive for PTSD Post-Deployment and the Divorce Hazard of Army Enlisted Service Members by Gender (2003-2010)**

	Cross-sectional PTSD		Longitudinal PTSD	
	(1)	(2)	(3)	(4)
Deployed	1.661*** (0.128)	1.493*** (0.134)	1.658*** (0.128)	1.394*** (0.140)
PTSD	0.112** (0.043)	0.119** (0.048)	0.181*** (0.040)	0.151*** (0.049)
Months deployed	0.052*** (0.009)	0.052*** (0.009)	0.051*** (0.009)	0.061*** (0.011)
Female	0.762*** (0.045)	-0.210 (0.354)	0.766*** (0.045)	-0.223 (0.355)
Deployed x Female	--	0.989*** (0.355)	--	0.983*** (0.356)
PTSD x Female	--	-0.033 (0.103)	--	0.132 (0.101)
Months deployed squared	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)
Observations	360,012	360,012	356,467	318,440

\* ; \*\* ; \*\*\* significant at 10%, 5%, 1%. Estimated coefficients, standard errors (in parenthesis).

Regressions run with the covariates described in Section 3.

**Table 5. Estimated Relationship between Screening Positive for PTSD Post-Deployment and the Divorce Hazard of Army Officers (2003-2010)**

	Cross-sectional PTSD			Longitudinal PTSD		
	(1)	(2)	(3)	(4)	(5)	(6)
Deployed	0.601** (0.293)	0.553* (0.326)	0.524 (0.335)	0.593** (0.294)	0.538 (0.328)	0.532 (0.330)
PTSD	0.423*** (0.146)	0.408*** (0.146)	0.869** (0.413)	0.541*** (0.138)	0.522*** (0.138)	0.639* (0.335)
Months deployed	--	0.011 (0.025)	0.011 (0.026)	--	0.012 (0.025)	0.012 (0.025)
Months deployed x PTSD	--	--	-0.029 (0.025)	--	--	-0.007 (0.019)
Months deployed squared	--	-0.000 (0.001)	-0.000 (0.001)	--	-0.000 (0.001)	-0.000 (0.001)
Observations	48,086	48,086	48,086	47,796	47,796	47,796

\* , \*\* , \*\*\* significant at 10 %, 5%, 1 %. Estimated coefficients, standard errors (in parenthesis).

Regressions run with the covariates described in Section 3.

**Table 6. Estimated Relationship between Screening Positive for PTSD Post-Deployment and the Divorce Hazard of Army Enlisted Service Members by PDHA Form (2003-2010)**

	Cross-sectional PTSD		Longitudinal PTSD	
	All	First PDHA	All	First PDHA
Deployed	1.661*** (0.128)	1.562*** (0.134)	1.658*** (0.128)	1.560*** (0.134)
PTSD	0.112** (0.043)	0.107** (0.047)	0.181*** (0.040)	0.182*** (0.043)
Months deployed	0.052*** (0.009)	0.063*** (0.011)	0.051*** (0.009)	0.061*** (0.011)
Months deployed squared	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)
Observations	360,012	321,709	356,467	318,440

\* ; \*\* ; \*\*\* significant at 10 %, 5%, 1 %. Estimated coefficients, standard errors (in parenthesis).

Regressions run with the covariates described in Section 3.

**Table 7. Estimated Relationship between Screening Positive for PTSD Post-Deployment and the Divorce Hazard of Army Officers by PDHA Form (2003-2010)**

	Cross-sectional PTSD		Longitudinal PTSD	
	All	First PDHA	All	First PDHA
Deployed	0.553* (0.326)	1.562*** (0.134)	0.538 (0.328)	0.366 (0.336)
PTSD	0.408*** (0.146)	0.107** (0.047)	0.522*** (0.138)	0.562*** (0.144)
Months deployed	0.011 (0.025)	0.063*** (0.011)	0.012 (0.025)	0.022 (0.025)
Months deployed squared	-0.000 (0.001)	-0.001*** (0.000)	-0.000 (0.001)	-0.000 (0.001)
Observations	48,086	42,766	47,796	42,490

\* ; \*\* ; \*\*\* significant at 10 %, 5%, 1 %. Estimated coefficients, standard errors (in parenthesis).

Regressions run with the covariates described in Section 3.

**Table 8: Estimated Relationship between Screening Positive for PTSD Post-Deployment and the Divorce Hazard of Army Enlisted Service Members by Period (2003-2010)**

	Cross-sectional PTSD		Longitudinal PTSD	
	(1)	(2)	(3)	(4)
Deployed	1.661*** (0.128)	1.460*** (0.151)	1.658*** (0.128)	1.368*** (0.156)
PTSD	0.112** (0.043)	0.111 (0.071)	0.181*** (0.040)	0.161** (0.067)
Months deployed	0.052*** (0.009)	0.052*** (0.009)	0.051*** (0.009)	0.061*** (0.011)
Deployed x Post '08	--	0.497** (0.232)	--	0.479** (0.232)
PTSD x Post '08	--	0.001 (0.087)	--	0.034 (0.085)
Months deployed squared	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)
Observations	360,012	360,012	356,467	318,440

\* ; \*\* ; \*\*\* significant at 10 % , 5% , 1 % . Estimated coefficients , standard errors ( in parenthesis ) .

Regressions run with the covariates described in Section 3 .

**Table 9. OLS and IV Cross-sectional Estimated Effect of Screening Positive for PTSD Post-Deployment on the Divorce Probability of Army Enlisted Service Members (2003-2010)**

	6 Months Post Deployment		9 Months Post Deployment		12 Months Post Deployment	
	OLS	IV	OLS	IV	OLS	IV
PTSD	0.00415 (0.0025)	0.13156*** (0.0432)	0.00653** (0.0030)	0.16290*** (0.0504)	0.00791** (0.0034)	0.18571*** (0.0571)
Months Deployed	0.00087*** (0.0002)	0.00053** (0.0003)	0.00103*** (0.0002)	0.00058* (0.0003)	0.00120*** (0.0003)	0.00061* (0.0003)
Health worse	-0.00271 (0.0021)	-0.02755*** (0.0089)	-0.00322 (0.0025)	-0.03447*** (0.0105)	-0.00423 (0.0030)	-0.03987*** (0.0120)
Observations	61,839	56,682	55,928	51,861	49,060	46,612

\* ; \*\* ; \*\*\* significant at 10 %, 5%, 1 %. Estimated coefficients, robust standard errors (in parenthesis).

Regressions run with the covariates described in Section 3.

The instrument used is an indicator variable for whether the soldier was seen in sick call during deployment.

**Table 10. Estimated Relationship between Screening Positive for Various Mental Health Symptoms and the Divorce Hazard of Army Enlisted Service Members (2003-2010)**

	<b>I</b>	<b>II</b>	<b>III</b>	<b>IV</b>
Deployed	1.944*** (0.121)	1.931*** (0.121)	1.939*** (0.121)	1.917*** (0.121)
PTSD	--	<b>0.124***</b> <b>(0.043)</b>	--	--
Depression	--	--	<b>0.111***</b> <b>(0.032)</b>	--
Any Mental Concern	--	--	--	<b>0.237***</b> <b>(0.033)</b>
Observations	360,012	360,012	360,012	360,012

\* ; \*\* ; \*\*\* significant at 10 % , 5% , 1 % . Estimated coefficients , standard errors ( in parenthesis ) .

Regressions run with the covariates described in Section 3 excluding deployment duration .



## References

- Bartel A. and Taubman P., "Some Economic and Demographic Consequences of Mental Illness," *Journal of Labor Economics*, Vol. 4, 1986, pp. 243-256.
- Becker, G. S., "A Theory of Marriage: Part I," *Journal of Political Economy*, Vol. 81, 1973, pp. 813-846.
- Becker, G. S., "A Theory of Marriage: Part II," *Journal of Political Economy*, Vol. 82, 1974, pp. S11-S26.
- Bergstrom, T. C. "A Survey of Theories of the Family," in *Handbook of Population and Family Economics*, M. R. Rosenzweig and O. Stark (eds.), 1997, pp. 21-79.
- Bonds, T. M., Baiocchi D., and L. L. McDonald, *Army Deployments to OIF and OEF*, Santa Monica, C.A.: RAND Corporation, 2010.
- Carroll, E. M., D. B. Rueger, D. W. Foy, and C. P. Donahoe. "Vietnam Combat Veterans with Posttraumatic Stress Disorder: Analysis of Marital and Cohabiting Adjustment," *Journal of Abnormal Psychology*, Vol. 94, No. 3, 1985, pp. 329-337.
- Charles, K. K and Stephens, M. Jr., "Disability, Job Displacement and Divorce," *Journal of Labor Economics*, Vol. 22, 2004, pp. 489-522.
- Chemtob, C. M., R. S. Hamada, H. L. Roitblat, and M. Y. Muraoka. "Anger, Impulsivity, and Anger Control in Combat-related Posttraumatic Stress Disorder," *Journal of Consulting and Clinical Psychology*, Vol. 62, No. 4, 1994, pp. 827-832.
- Davila, J., B. R. Karney, T. W. Hall, and T. N. Bradbury. "Depressive Symptoms and Marital Satisfaction: Within-subject Associations and the Moderating Effects of Gender and Neuroticism," *Journal of Family Psychology*, Vol. 17, No. 4, 2003, pp. 557-570.
- Gimbel, C., and Booth, A., "Why Does Military Combat Experience Adversely Affect Marital Relations?," *Journal of Marriage and the Family*, Vol. 56, 1994, pp. 691-703.

- Heckman, J. J. and MaCurdy, T. E., "A Simultaneous Equations Linear Probability Model," *The Canadian Journal of Economics / Revue canadienne d'Economique*, Vol. 18, No. 1, Econometrics Special, 1985, pp. 28-37.
- Hosek, J. R. and Martorell, F., How Have Deployments During the War on Terror Affected Reenlistment? Santa Monica, C.A.: RAND Corporation, 2009.
- Hoge, C. W., Castro, C.A., Messer, S. C. McGurk, D., et al., "Combat Duty in Iraq and Afghanistan, Mental Health Problems, and Barriers to Care," *New England Journal of Medicine*, Vol. 351, No. 1, 2004, pp. 13–22.
- Hoge, C. W., Auchterlonie, J. L., and Milliken, C. S., "Mental Health Problems, Use of Mental Health Services, and Attrition from Military Service After Returning from Deployment to Iraq or Afghanistan," *Journal of the American Medical Association*, Vol. 295, No. 9, 2006, pp. 1023–1032.
- Jordan, B. K., Marmar, C. R., Fairbank, J. A., Schlenger, W. E., Kulka, R. A., Hough, R. L., and Weiss, D. S., "Problems in Families of Male Vietnam Veterans With Posttraumatic Stress Disorder," *Journal of Consulting and Clinical Psychology*, Vol. 60, No. 6, 1992, pp. 916–926.
- Karney, B. and Crown J., Families Under Stress. An Assessment of Data, Theory, and Research on Marriage and Divorce in the Military. Santa Monica, Calif.: RAND Corporation, 2007.
- Keith, V. M. and Finlay, B., "The Impact of Parental Divorce on Children's Educational Attainment, Marital Timing, and Likelihood of Divorce", *Journal of Marriage and the Family*, Vol. 50, 1988, pp. 797-809.
- Kessler, R. C., E. E., Walters, and Forthofer, M. S., "The Social Consequences of Psychiatric Disorders, III: Probability of Marital Stability," *American Journal of Psychiatry*, Vol. 155, No. 8, 1998, pp. 1092–1096.
- Lyle, D. S., "Using Military Deployments and Job Assignments to Estimate the Effect of Parental Absences and Household Relocations on Children's Academic Achievement," *Journal of Labor Economics*, Vol. 24, No. 2, 2006, pp. 319-350.
- Mansfield A. J., Kaufman, J. S., Marshall, S. W., et al., "Deployment and the Use of Mental Health Services among US Army Wives," *New England Journal of Medicine*, Vol. 362, No. 2, 2010, pp. 101-109.

- Milliken, C. S., Auchterlonie, J. L. and Hoge, C. W., "Longitudinal Assessment of Mental Health Problems Among Active and Reserve Component Soldiers Returning from the Iraq War," *Journal of the American Medical Association*, Vol. 298, No. 18, 2007, pp. 2141-2148.
- Negrusa, S., Negrusa, B. and Hosek, J.R., "Gone to War: Have Deployments Increased Divorces?," Working Paper, RAND Corporation, 2011.
- Prins, A., Ouimette, P., Kimerling, R., Camerond, R. P., Hugelshofer, D. S., Shaw-Hegwer, J., Thrailkill, A., Gusman, F. D., and Sheikh, J. I., "The Primary Care PTSD Screen (PC-PTSD): Development and Operating Characteristics," *Primary Care Psychiatry*, Vol. 9, No. 1, 2004, pp. 9-14.
- Singer, J. D. and Willett, J. B., "It's About Time: Using Discrete-Time Survival Analysis to Study Duration and the Timing of Events," *Journal of Educational and Behavioral Statistics*, Vol. 18, 1993, pp. 155-195.
- Smith, M. W., Schnurr, P. P., and Rosenheck, R. A., "Employment Outcomes and PTSD Symptom Severity," *Mental Health Services Research*, Vol. 7, No. 2, 2005, pp. 89-101.
- Strengthening Our Military Families: Meeting America's Commitment, The White House, January 2011.
- Tanielian, T. and Jaycox, L. H. eds., *Invisible Wounds of War: Psychological and Cognitive Injuries, Their Consequences, and Services to Assist Recovery*, Santa Monica, C.A.: RAND Corporation, 2008.
- Teachman, J., "Modeling Repeatable Events Using Discrete-Time Data: Predicting Marital Dissolution," *Journal of the Marriage and the Family*, Vol. 73, 2011, pp. 525-540.
- Teitler, J. O. and Reichman, N. E., "Mental Illness as A Barrier to Marriage Among Unmarried Mothers," *Journal of the Marriage and the Family*, Vol. 70, 2008, pp. 772-782.
- Weiss, Y. and Willis R., "Match Quality, New information, and Marital Dissolution," *Journal of Labor Economics*, Vol. 15, 1997, pp. S293-S329.
- Whisman, M. A. The Association between Depression and Marital Dissatisfaction. In S. R. H. Beach (Ed.), *Marital and Family Processes in Depression: A Scientific Foundation for Clinical Practice*. Washington, D.C.: American Psychological Association, 2001, pp. 3-24.

Willett, J. B. and Singer, J. D., "It's Déjà Vu All Over Again: Using Multiple-Spell Discrete-Time Survival Analysis," *Journal of Educational and Behavioral Statistics*, Vol. 20, 1995, pp. 41-67.

Williams, C. M. The "Veteran System" with A Focus on Women Partners: Theoretical Considerations, Problems, and Treatment Strategies. In T. Williams (Ed.), *Post-Traumatic Stress Disorders of the Vietnam Veteran: Observations and Recommendations for the Psychological Treatment of the Veteran and His Family*. Cincinnati, Ohio: Disabled American Veterans, 1980, pp. 73-122.