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ABSTRACT

The Military VSL*

Our research reviews theory and empirical evidence in the economics literature and provides a standard value of a statistical life (VSL) applicable to the Department of Defense (DOD). We follow Viscusi (2018a) by conducting a meta-analysis consisting of 1,025 VSL estimates from 68 different labor market studies and find a best-set average VSL estimate of $11.8 million (US$2021) across all studies. For DOD analysts and practitioners, we advocate using our best-set VSL estimate for the vast majority of benefit-cost analyses (BCAs) within the DOD. In addition to providing a VSL benchmark to use in DOD BCAs, we also breakdown casualty types and provide a range of VSL estimates to use in sensitivity analyses. Employing restricted data from the DOD on over 6,700 U.S. military fatalities in Afghanistan and Iraq from 2001 to 2021 we show that (1) fatalities are highly concentrated among young, white, and enlisted males, and that (2) fatality rates in the Army and Marines are in contrast to the low number of fatalities (less than 5%) in the Air Force and Navy. Applying standard VSL pay grade and income adjustments to U.S. military fatalities in Afghanistan and Iraq, we find adjusted VSL estimates ranging in value from $3.2 million to $27.6 million per statistical life (US$2021).

JEL Classification: H56, I18, J17, J28
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1. Introduction

The Department of Defense (DOD) is the largest government agency in the United States, employing roughly 1.3 million active duty service members and 600,000 civilians with an annual budget of $715 billion (US$2022) (Federal Register 2022, US DOD 2021). Critical procurement decisions are made annually in the DOD by allocating resources to protect our nation and save lives (examples are body armor and armoring vehicles). Government guidelines (see Circulars A-4 and A-94 for details) recommend the use of standard benefit-cost analysis (BCA) techniques to make important safety enhancing policy decisions. Arguably the most important component of a standard BCA when allocating resources to save lives is the use of accurate value per statistical life (VSL) estimates in the analysis. Despite decades of research and widespread use of VSL estimates within other government agencies, the DOD still does not have a standard VSL framework to use in its own internal analyses, and we present here how to improve the DOD's calculations of the value of reducing combat casualties.

We begin by reviewing theory and empirical evidence in the economics literature and provide a standard VSL applicable to the DOD. We build upon a growing body of literature that has used VSL estimates in the context of military operations and force protection.[1] In addition, our findings expand the use of VSL estimates to another (major) U.S. government agency. Currently, three agencies (EPA 2010, DOT 2016, and HHS 2016) have standard VSL estimates in place for researchers to use in benefit-cost analyses. EPA uses an updated value of $11.0 million, DOT uses an $11.9 million valuation, and HHS uses an $11.6 million valuation per statistical life (US$2021). Although the values currently used by other agencies are useful for

[1] A wide range of VSL estimates have been used in military applications (Armey et al. 2022, Bilmes and Stiglitz 2006, 2008, Davis et al. 2006, Edwards 2014, Greenberg et al. 2021, Rohlfs 2012, Rohlfs and Sullivan 2013, Rohlfs et al. 2015, Rohlfs et al. 2016, Viscusi 2021, Wallsten and Kosec 2005). See Kniesner et al. (2015) and Viscusi (2019) for a review of the literature on applications of VSL to the military.

BCAs in the context of environmental, transportation and health, they might not be appropriate for BCAs in the military. The estimates presented here provide a specific value for analysts to use in the context of military BCAs.

To provide a specific VSL for the military we first follow Viscusi (2018a) by conducting a meta-analysis of 1,025 VSL estimates from 68 different labor market studies. To maintain consistency, we primarily focus on the results from studies that use Census of Fatal Occupational Injury (CFOI) data in their analyses. Using the sorting criterion of only CFOI based studies we find a best-set average VSL estimate of $11.8 million (US$2021) across the studies. For DOD analysts and practitioners, we advocate using our best-set VSL estimate for the vast majority of BCAs within the DOD.

In addition to providing a VSL benchmark to use in DOD BCAs, we also use restricted data from the Defense Manpower Data Center (DMDC) to break down casualty types and provide a range of VSL estimates to use in sensitivity analyses. The DMDC personnel records include detailed demographic information on over 6,700 U.S. military fatalities in Afghanistan and Iraq from 2001 to 2021. The breakdown of fatalities generally follows the findings of previous studies in the literature (Armey et al. 2022). Fatalities are highly concentrated among young, white, and enlisted males. In addition, we find higher fatality rates in the Army and Marines in contrast to the low number of fatalities (less than 5%) in the Air Force and Navy. Over 80% of the fatalities are categorized as being killed in action or died of wounds.

A variety of methods have been used to adjust the VSL by using demographic information in the literature (Kniesner and Viscusi 2019, Viscusi 2010, 2018a, 2018b). Examples include adjusting the VSL by gender, race, immigration status, or job type. We advise *against* using typical demographic adjustments such as race, gender, or age due to equity and ethical concerns.

Instead, for our sensitivity analysis we focus on providing a range of estimates by using pay grade and income data from the DOD. Applying standard VSL pay grade and income adjustments to U.S. military fatalities in Afghanistan and Iraq, we find adjusted VSL estimates ranging in value from $3.2 million to $27.6 million per statistical life (US$2021).

In summary, we highly recommend that the DOD implement our primary VSL estimate of $11.8 million (US$2021) as the standard benchmark to use in future DOD BCAs. In addition, pay grade and income adjusted VSL estimates provide a range of values to use in sensitivity analyses. The DOD appears to be uniquely situated to use disaggregated values of a statistical life in their internal analyses. Many lives and billions of dollars are at stake and require the use of the best estimates available. We believe that the VSL estimates presented here are the most up to date and relevant for analysts within the DOD and strongly advocate their usage in future DOD BCAs.

2. The Value of a Statistical Life (VSL)

Historical connections and theory in the VSL literature can be traced back to Adam Smith (1776) and his discussion of compensating wage differentials in labor markets. That said, the modern day VSL literature was largely initiated by way of military analyses in the RAND Corporation in the 1950s and 1960s. Carlson and Schelling built off the initial framework within RAND and applied their method of valuing lives toward saving Air Force pilots and casualty probabilities in their seminal work on the VSL (Banzhaf, 2014). Since the 1950s the literature has made large advances with the method and precision in estimating the VSL.

The basic concept of the VSL is that individuals often make everyday tradeoffs between wealth or income and fatality risks. Economists then use quantified tradeoffs to calculate the implicit valuation that individuals place on their own lives. A variety of techniques (revealed preference or stated preference studies) have been used over the years to provide VSL estimates across numerous market settings (various safety products, labor market studies). A standard practice is to examine how much money individuals are willing to pay (or be paid) for small changes in their probability of death.

One of the most common methods is to use labor market data to estimate the VSL of workers by comparing the connection between wages and fatality risk (Kniesner et al. 2012, Kniesner and Viscusi 2019, Leeth and Ruser 2003, Viscusi 1993, 2018b, Viscusi and Aldy 2003).[2] The idea being that workers are willing to take on more dangerous jobs, *ceteris paribus*, as long as they are paid an acceptable compensating wage differential.

As a hypothetical example, suppose Audie Murphy, a worker in the widget making industry is trying to decide between two identical jobs that differ only in terms of fatality risk. One of the jobs (Job A) is completely safe with a yearly workplace fatality rate of 0 per 100,000 workers. Job B on the other hand has a fatality rate of 1 per 100,000 workers. Mr. Murphy is willing to take on job B only if he is offered a compensating wage differential of at least $110 per year. The implicit valuation of his own life in the example can be calculated by taking the compensating wage differential of $110 and dividing it by the additional fatality risk from job B. Therefore, the calculation in this example can be shown as

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[2] The predominate labor market model used to estimate the VSL is via the wage equation

$$wage_i = \beta_0 + \beta_1 \, fatality\ rate_i + \boldsymbol{X}_i'\beta_2 + \varepsilon_i \tag{1}$$

where $wage_i$ is worker i's hourly wage rate, $fatality\ rate_i$ is the annual fatality rate for worker i's job, and $\boldsymbol{X}_i'$ is a vector of control variables including worker i's demographic characteristics such as race and gender, job type characteristics such as union membership and occupation, and regional characteristics. See Viscusi (2018a) for details.

$$VSL_{Audie\ Murphy} = \frac{\$110}{1/100{,}000} = \$11{,}000{,}000. \tag{2}$$

The example of Mr. Murphy shows the implicit valuation (or VSL) of $11 million for his own life. However, this is just one (hypothetical) case among many in the marketplace for fatality risk. The same type of calculation could be done in other labor markets with more or less fatality risk. Some examples might show relatively high VSL estimates ($20 million or more) for risk averse, high-income individuals or low estimates ($1 million or less) among risk seeking individuals with low incomes. In addition, similar calculations might be made across individuals purchasing safety products such as air bags or seatbelts to reduce their risk of death or injury (Blomquist 2004, Hakes and Viscusi 2007, Rohlfs et al. 2015, Svensson 2009).

The above types of calculations in real world settings have led to a wide range of VSL estimates in the literature. After decades of research on the VSL across numerous markets, economists have found the most precise estimates appear to hover around the $11 million to $12 million range (US$2021) (Kniesner et al. 2012, Kniesner and Viscusi 2019, Robinson and Hammitt 2016, Viscusi 2018b, 2020, 2021a,b, US DOT 2016, US HHS 2016, EPA 2010). So, the average individual in the United States appears to value risk reductions at a rate of about $110 to $120 for every 1 per 100,000 reductions in fatality risk. The estimated values of health risk reductions just mentioned are similar to ones used in government agencies that include the EPA, HHS, and DOT. As highlighted throughout our paper, we advocate using similar estimates within the DOD.

3. A VSL for the Department of Defense

Every year the Department of Defense conducts a wide variety of BCAs across the different services. The literature has shown that DOD force protection decisions involving the tradeoff between dollars spent and lives saved requires the use of accurate VSL estimates in their analyses (Kniesner et al. 2015). We now develop a standard VSL benchmark to use in future BCAs in the DOD.

We first follow Viscusi (2018a) by conducting a meta-analysis using 1,025 VSL estimates from 68 different labor market studies after updating the values for inflation.[3] Table 1 shows the distribution of VSL estimates from these studies by quantile. Table 1 shows the all-set estimates (all estimates presented by the authors in the original articles) and the best-set estimates (estimates preferred by the authors). Further breakdowns are shown by U.S. specific estimates versus non-U.S. estimates and estimates based on the Bureau of Labor Statistics Census of Fatal Occupational Injuries (CFOI) data versus non-CFOI based estimates.

The top panel of Table 1 shows the all-set VSL estimates. The median value for the all-set estimates for the whole sample is about \$11.06 million per statistical life. As is clear from the table, there are a wide range of estimates depending on the type of data used in the analysis. The lowest value for the all-set estimates shows a VSL of about −\$5.59 million for the U.S. non-CFOI based studies at the 5th percentile. In contrast, the VSL estimate for non-U.S. studies at the 95th percentile is about \$72.23 million. Table 1 also shows that U.S. based studies generally have higher median VSL estimates in comparison to their non-U.S. based counterparts. The median VSL estimate for U.S. based CFOI studies is about \$12.7 million versus a value of about \$4.62 million for U.S. non-CFOI studies.

The bottom panel of Table 1 shows values for the best-set estimates from the meta-analysis. The median best-set estimate for the whole sample is about \$11.6 million per

[3] All values shown here in Section 3 are in U.S. 2021 dollars. Appendix A shows a list of the VSL studies used in the original Viscusi (2018a) meta-analysis.

statistical life. However, the range across studies is quite broad with a low of $0.94 million for non-U.S. studies at the 5^{th} percentile up to about $45.06 million for non-U.S. studies at the 95^{th} percentile. For the best-set estimates, the median estimates are much closer in value in comparison to the all-set estimates. The median best-set estimate for U.S. CFOI based studies is about $11.71 million versus a value of about $10.33 million for U.S. non-CFOI based studies.

Considering that we are trying to provide a benchmark VSL for the U.S. DOD, it makes sense to primarily focus on the U.S. based estimates that use CFOI data. The literature has shown that CFOI based VSL studies are generally considered the *gold standard* in economics due to their rigor. Viscusi (2018b) provides a rationale for this consideration in a short passage from his book (page 27, see below):

Beginning in 1992, the BLS developed the gold standard in fatality rate data through its Census of Fatal Occupational Injuries (CFOI). Instead of relying on a sample of firms and individual reports of fatalities, these data are based on a comprehensive census of all occupational fatalities, each of which must be verified using multiple sources, such as reports by the firm, death certificates, and workers' compensation records. These statistics are also available on an individual fatality basis including information about the characteristics of the worker and the fatality event. As a result, instead of assuming that all workers in the industry face the same risk, it is possible to construct risk measures based on both the industry and occupation of a worker, thus providing a more accurate reflection of the risk faced by the worker.

To maintain consistency, therefore, we focus on the results from studies using CFOI data. This narrows the range of values and restricts the analysis to the most precise estimates available in the literature. Using only CFOI-based studies from the meta-analysis we find a publication bias-corrected estimate of $11.4 million, a mean best-set VSL of $11.8 million, and a mean all-set VSL of $13.1 million, which are shown in Table 2.[4]

Each of these estimates are useful in their own right and could technically provide a range of estimates to be used in sensitivity analyses. However, the federal government has generally advised analysts and practitioners to use best-set estimates from the literature for their regulations and programs (DOT 2016, HHS 2016, EPA 2010). To keep with standard practice, therefore, we advise using the mean best-set value of $11.8 million (US$2021) per statistical life for the vast majority of BCAs within the DOD.

4. Military Fatalities and Sensitivity Analysis

We now home in on U.S. military fatalities in the two most recent wars – Iraq and Afghanistan. In particular, we provide a breakdown of fatalities in the two recent conflicts and present a range of VSL estimates based on data specific to pay grade and income that can be used in sensitivity analyses. In addition, we include a discussion about the theoretical and empirical arguments (pros and cons) for adjusting the VSL across demographic traits of military personnel.

4.1 Distribution of Fatalities

We now use restricted data from the Defense Manpower Data Center (DMDC) to disaggregate

[4] One concern with some estimates that has been discussed in the economics literature is that publication selection bias may play a role in the final calculations (Viscusi 2018a). Basically, authors may cherry-pick their estimates for publication purposes because editors are less likely to publish outlier VSL estimates, which is one reason why we might see large differences between the best-set and all-set averages. To correct for publication selection bias effects we use the bias-correction method outlined in Viscusi (2018a), which yields a mean bias-corrected VSL estimate of $11.4 million (US$2021) across all studies as shown in Table 2.

individual casualty types within the U.S. military.[5] The dataset includes detailed information on all DOD fatalities in Iraq and Afghanistan from 2001 to 2021. The variables in the DMDC dataset includes individual level fatality data by age, gender, race, conflict (Iraq or Afghanistan), service (Air Force, Army, Marine Corps, or Navy), pay grade, various categories of casualty causes and types, and compensation.

Table 3 provides summary statistics for the DMDC fatality data and Figure 1 displays the data graphically. Our final sample includes 6,722 fatalities after cleaning the dataset for any inconsistencies.[6] We find fatalities are highly concentrated among young, white, and enlisted males. For example, males comprise 98% of the fatalities in the DMDC data. Whites represent 83% of theater deaths with blacks and other races accounting for 9% and 7% of the fatalities, respectively. The number of fatalities in Iraq (4,398, 65%) are almost double the amount found in Afghanistan (2,324, 35%). In addition, we find higher fatality rates in the Army (4,936, 73%) and Marines (1,463, 22%) in contrast to the low number of fatalities (less than 5%) in the Air Force and Navy.

Enlisted personnel dominate the fatality totals with roughly 90% of the observations categorized as enlisted versus 10% listed as officers. The average age for fatalities is 26 years old. However, the distribution is highly skewed with 1,784 fatalities concentrated in the 18-21 year old population age group, 2,071 in the 22-25 age group, 1,206 in the 26-29 age group, and a steady decline in the fatality totals until the age 40 and above group, which had a total of 370 observations.

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[5] The DMDC is the central data depository for personnel records within the Department of Defense. Similar data requests by authorized personnel can be made to the DMDC data request portal at: https://dmdcrs.dmdc.osd.mil/dmdcrs/public/

[6] The original dataset included detailed information on 6,723 fatalities in Iraq and Afghanistan from 2001 to 2021. One observation lacked demographic information, so we dropped it from the analysis. Our final dataset therefore includes information on 6,722 fatalities.

Over 80% of the fatalities are categorized as a "Hostile" fatality. As for the type of fatality, we find 61% of the observations are listed as Killed in Action (KIA), 20% are listed as Died of Wounds, 12% were Accidents, 5% were Self Inflicted, and 3% were in the "Other" category. In terms of causes, we find 20% were due to an explosion, 22% were due to gunshots, 27% were listed as Multiple Trauma, and 31% were listed as "Other Causes or Unknown".

4.2 Adjusting the Military VSL by Pay Grade and Income

Previous research has shown higher (or lower) incomes or wealth can change the VSL calculations (Viscusi 2018b). This is one reason why government agencies such as the DOT and HHS have advocated updating the VSL across time periods by using inflation and earnings adjustments, and not by inflation levels alone.[7] Overall, the VSL income elasticity literature has shown the elasticity values generally range from 0.6 to 1.4, indicating a 10% increase in income or wealth will result in an increase of 6% to 14% in the VSL (DOT 2016, Doucouliagos et al., 2014, Hammitt and Robinson 2011, HHS 2016, Lindhjem et al. 2011, Kniesner et al. 2010, Viscusi and Aldy 2003, Viscusi and Masterman 2017a, Viscusi and Masterman 2017b, Masterman and Viscusi 2018). So, using a sensitivity analysis it is possible to adjust the

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[7] For reference, the DOT (2016) guidance uses an income elasticity adjustment of 1.0 in their VSL calculations. The following formula (see pages 8-9 in the DOT guidance) is used to update VSL estimates across time periods:

$$VSL_T = VSL_0 * (P_T/P_0) * (I_T/I_0)^e \qquad (3)$$

where
0 = Original Base Year
T = Updated Base Year
P_T = Price Index in Year T
I_T = Real Incomes in Year T
e = Income Elasticity of VSL

military VSL depending on the income level of the DOD personnel.

One unique feature of the DMDC data is the availability of basic pay data that are linked in from the financial accounting system in the DOD.[8] The basic pay data are merged into the same fatality dataset as shown in Table 3. The key difference is that there were 81 observations missing the basic pay variable for the time period we study. Therefore, there is only basic pay information on 6,641 observations in comparison to the 6,722 observations as shown in Table 2. The data include the last basic monthly pay for the service members prior to their death. We multiply this value by 12 to calculate their annual basic pay salary. All basic pay data are updated to 2021 US dollars.

Table 4 details fatality totals and annual basic pay averages for military personnel broken down by pay grade. Pay grades E01 (equivalent to a private) through E09 (equivalent to a command sergeant major) describe the enlisted pay grade data. Pay grades O01 (equivalent to a second lieutenant) through O07 (equivalent to a brigadier general) describe the officer data. Pay grades W01 (warrant officer 1) though W05 (chief warrant officer 5) describe the warrant officer data.

Fatality totals are heavily weighted toward the lower pay grades with 72% (4,792 of the 6,641 fatalities) of the fatalities at the pay grade of E5 (equivalent to a sergeant) or below. In contrast, only two general officers were in the fatality totals. In terms of average annual basic pay, the dollar values range from a low of $19,488 for E1s up to $166,009 per year (US$2021) for the O7 general officer rank. The average annual basic pay for all 6,641 observations is $34,839 (US$2021).

[8] Other pay variables from the DMDC were available as well including information on special pays, bonuses, and basic allowance for housing (BAH). Unfortunately, the other pay variable data appears to be wildly inaccurate due to missing observations and possible miscoding. After discussions with DMDC analysts, we deemed the so-called other pay data to be unreliable and left them out of the analysis.

In Table 4, we convert the average annual basic pay data into VSL values using an income elasticity of 1.0 (DOT, 2016). Other assumptions include using a US gross national income (GNI) per capita of $70,930 (The World Bank, 2021) as a comparison income value and a baseline VSL of $11.80 million from our best set uncorrected average estimate that we advocate in Table 2 below. The basic pay VSL values range from $3.24 per million for the E01 pay grade up to $27.62 million per statistical life (US$2021) at the O07 pay grade. The 6,641 observations have a weighted average VSL of $5.80 million per statistical life (US$2021).

In addition to the estimates provided in Table 4, we tried a variety of robustness checks with the basic pay data. One limitation from using the basic pay data is the fact that some of the observations appear to be outliers. To address concern over outliers, we limit the observations to only include those within the bounds of the 2021 military basic pay chart values (DFAS, 2021).

Using the sorting mechanism just described, we use a lower bound basic pay cutoff of $1,650.30 per month (or $19,803.60 per year) and an upper bound cutoff of $16,608.30 per month (or $199,299.60 per year). The lower bound cutoff ($19,803.60) is taken from E1s with less than 4 months of service and the upper bound cutoff ($199,299.60) is taken from O10s with 40 years of service. Our method eliminates one high end observation ($357,542.70) and 464 low end observations, leaving a total of 6,176 observations with an average annual basic pay salary of $36,660.94. The weighted average VSL is $6.10 million per statistical life (US$2021) using pay grade bounds.

Another concern with the estimates presented in Table 4 is that they only include the basic pay component of overall compensation. It is well known that military personnel have many other compensation components (bonuses, tax savings, BAH, and other special pays). So, the values from Table 4 should be taken as *lower bound* estimates. Later we relax this and include estimates on fringe benefits from the literature in a sensitivity analysis to see how the values might change if other pay values are considered.

We include fringe benefit estimates from BLS (2023) into the VSL calculations to estimate how overall compensation levels might impact our values. BLS (2023) states that private industry workers' benefits account for about 29% of total employer compensation costs on average. We use the 29% value as a proxy for military fringe benefits. Adding in fringe benefits increases the weighted average VSL in Table 4 to $7.51 million per statistical life from the previous value of $5.80 million.

Another consideration for the estimates provided in Table 4 is how the values might change when using different income elasticities. The main estimates that we provide use an income elasticity of 1.0 (DOT, 2016). As discussed previously, income elasticity estimates from the literature generally range from 0.6 (Viscusi and Aldy, 2003) to 1.4 (Kniesner et al., 2010). Using an income elasticity of 0.6 lowers the weighted average VSL in Table 4 to $3.48 million per statistical life and using a 1.4 elasticity increases the weighted average VSL to $8.11 per statistical life (US$2021).

We also include a variety of robustness checks including separate analyses across pay grades, elasticity adjustments, and the inclusion of fringe benefits in the VSL calculations. The primary military VSL estimates as presented in Table 4 range from a low of $3.24 million for the E01 pay grade up to $27.62 million for the O07 pay grade with a weighted average value of $5.80 million per statistical life for all observations. Due to the many different ways researchers might adjust the VSL, Table 4 highlights the importance of using a range of VSL estimates in sensitivity analyses for any DOD BCA.

4.3 Discussion

Our calculations emphasize that the types of fatalities that take place in military settings (young, heavily male dominated) do not appear to closely resemble the typical distribution of deaths displayed in the rest of society. Results presented lead to several theoretical and empirical questions. For example, is it ethical to value one group of individuals in society at different levels in comparison to others? How does equity play a role in the valuations? Should combat training and capabilities be considered in the valuations? Are there other characteristics that should be considered when adjusting the military VSL? The questions just posed require a further dive into the VSL literature.

Due to equity and ethical concerns, we generally advise against using demographic characteristics to adjust the military VSL. Historically, government regulations have generally not adjusted the VSL by use of demographic traits.[9] Although most of the current government guidelines require the use of an invariant population-wide VSL, it is possible that changing regulations could require demographic adjustments of the VSL in future BCAs. We therefore now discuss various options and review the literature for these possible adjustments for future researchers in this section.

As shown in section 4.2, adjusting the VSL by pay grade and income can lead to different VSL estimates for military members. Notably, using pay grade and income adjustments is the only consideration we currently advocate for sensitivity analyses. That said, other characteristics (mainly demographic adjustments) have been used in the past to adjust in

[9] One notable exception is when the EPA used an age adjusted VSL in their 2003 analysis of the Clear Skies Initiative. In that example, the EPA initially discounted the lives of the elderly by 37% in their analysis. The EPA only changed their discount policy after an outcry from senior citizen advocacy groups. Since that time period, there have been no VSL age adjustments used in EPA studies on this topic. See Kniesner et al. (2023) for details.

previous research (Viscusi, 2010). One such consideration is age (Aldy and Viscusi, 2008; Kniesner and Viscusi, 2019; Kniesner et al., 2006; Kniesner et al., 2022; Murphy and Topel, 2006; Robinson et al., 2021; Viscusi and Aldy, 2007; Viscusi, 2018b; Viscusi, 2020; Viscusi, 2021b, 2021c).

A commonly used way to adjust the VSL by age is the inverse-U technique. Aldy and Viscusi (2008) provide a standard outline for how researchers might adjust the VSL values by age when using the technique. Their findings show that the VSL follows an inverted-U shape (or hump shape) over the course of peoples' life cycles. More specifically, it has been found that the VSL increases as people age up until around mid-life and then declines as they approach old age. As a practical example, we apply the inflation adjusted values from Aldy and Viscusi (2008) to military fatalities in Appendix B. We find adjusting the military VSL estimates by age creates a range of values from $7.99 to $10.29 million (US$2021) per statistical life.

Another consideration is race. The DMDC data show that 84% of the military fatalities in Iraq and Afghanistan are white. Blacks and other races represent only 9% and 7% of the military fatalities, respectively. As a comparison, whites represent 76% of the general population and blacks represent 14% of the general population (U.S. Census 2021).

The literature has shown that whites generally have higher VSLs in comparison to blacks (Viscusi, 2003). Part of the reason is that for blacks, the wage equation is flatter and lower than for whites. Plus, in the general public blacks work fewer hours at lower wages, so their VSL is typically much lower. On the extreme end, some estimates indicate the VSL for whites may be as much as twice as high as that for the black population (Viscusi, 2003). Adjusting the military VSL by race, therefore, would increase the values since the DMDC data show higher white fatality totals in the military in comparison to the general population. Once again, to be clear, we do not support adjusting the military VSL by race due to equity concerns.

The gender composition of the fatalities is another consideration. The DMDC data indicate males comprise 98% of military fatalities in the wars in Iraq and Afghanistan. It is possible that adjusting the military VSL by gender could alter the values. However, the literature shows a mixed picture for VSL differences across genders with a wide range of estimates – some showing differences and others indicating none (Hersch, 1998; Leeth and Ruser, 2003; Viscusi, 2004).

Leeth and Ruser (2003) estimate VSL differences by gender using standard labor market regressions. They find mixed results with some point estimates indicating a VSL premium for women and others showing no premium. Notably, the largest VSL premium for women is more than double that of men (Leeth and Ruser, 2003). Hersch (1998) analyzes value of statistical injury estimates using labor market data and finds little to no difference in the valuations between males and females for blue-collar workers. Lastly, Viscusi (2004) uses Bureau of Labor Statistics (BLS) and Current Population Survey (CPS) data to estimate the VSL for both men and women. He finds a VSL of $7.0 million for blue-collar males, and $8.5 million for blue-collar females (US$1997) – indicating a 21% VSL premium for females in that study.

In contrast to the results in Leeth and Ruser (2003) and Viscusi (2004), a number of factors could be used to justify a lower VSL for females. Women often work on much safer jobs in comparison to men and there is no danger heterogeneity comparable for women as for men. Plus, in the general public more women are simply out of the workforce and have lower incomes which could lead to lower VSL estimates. In our view, there is not enough evidence (even without equity concerns) in the VSL literature to justify adjusting the values by gender.

Therefore, adjusting the military VSL by gender should not be used in sensitivity analyses.

Previous research has documented how the type of death may also play a role in the calculations. Particularly dreadful deaths have been shown to have a VSL premium – meaning people are willing to pay more, *ceteris paribus*, to avoid dreadful deaths in comparison to "normal" deaths such as car accidents. For example, cancer deaths have been shown to have a VSL premium of about 21% in comparison to other death types (Viscusi et al., 2014). Other VSL premiums have been found with deaths associated with severe acute respiratory syndrome (SARS), terrorism, and deaths related to influenza (Gyrd-Hansen et al., 2008; Liu et al., 2005; Robinson et al., 2010). The studies indicate people are generally willing to pay more to avoid dreadful deaths. Should we consider military deaths as a dreaded death type?

Possibly, but the answer to that question is highly uncertain. It largely depends on how closely related military death types might be to others in the literature. For example, terrorism deaths have been shown to have a VSL premium of roughly two times that of normal deaths (Robinson et al., 2010). It can be argued that many military deaths closely resemble terrorism deaths. The DMDC cause of casualty data (see Table 3) show explosions make up 20% of fatalities and gunshots make up 22% of fatalities in Iraq and Afghanistan. If one considers these closely related to terrorism type deaths, then it would justify a VSL premium based on past estimates in the literature. There are also a large number of "other causes or unknown" deaths (31%) in the DMDC data. Some of these could involve extreme outcomes such as captured and tortured victims in the military. Those types of deaths would almost certainly justify a VSL premium given the extreme nature and suffering involved in the incident.

In contrast, a recent paper by Greenberg et al. (2021) suggests the military VSL should be discounted in comparison to the population average VSL. In that paper, the authors used reenlistment data on roughly 430,000 U.S. Army soldiers to examine the tradeoff of wealth and mortality risk for military members. They find average VSL estimates for military personnel ranging from $500,000 to $900,000. The Greenberg et al. (2021) paper provides suggestive evidence that military members might not be nearly as risk averse as the general population. Thus, they do not appear to need as much compensation to take on fatality risks as the population at large. This is hardly surprising given the general feeling by service members of sacrificing for their county and a strong focus on patriotism within the ranks.

If the estimates in Greenberg et al. (2021) are accurate, then the implicit personal VSL valuations of military members are far lower than those found in the general economics literature. This leads to a more complex question of whether we should consider external benefits to society in valuing military personnel. As an example, in 2011 a group of 15 U.S. Navy Sea, Air, and Land (SEAL) operators from Team Six's Gold Squadron died in a helicopter crash in Afghanistan (Pruitt 2018). Of note, SEAL Team Six is the same unit that conducted the raid on Osama bin Laden's compound in Pakistan. Therefore, they are some of the most highly trained military personnel in the world. The training and expertise of these military members almost surely makes them more valuable than the standard VSL estimates found in the literature. Should the DOD take this into consideration when applying VSL estimates for BCAs?

The answer to this question is unclear. As an asset, the years of training for high level operators could justify a higher value for them in a standard BCA. However, using this type of methodological adjustment would be a step away from the typical guidance utilized in other U.S. government organizations. Most of the estimates used by DOT, HHS, and EPA are calculated from labor market data that regress wages on job market fatality risk. The estimated values are, therefore, personal willingness-to-pay (WTP) or -accept (WTA) estimates to avoid risk. They do not include a premium for additional societal benefits. Further research would be needed to provide more detailed estimates on such further adjustment. Until the literature becomes more advanced on the topic of societal externalities, we advocate continuing to use the standard VSL estimates provided in Table 2.

The size of the risk factor is another variable to consider for military personnel. Most of the estimates in the VSL literature are calculated by analyzing small changes in fatality risk for wealth or income. As discussed in Section 2, an average person in the United States is typically willing to pay about \$110 to \$120 for every 1 per 100,000 reduction in fatality risk. This equates to a standard \$11 million to \$12 million VSL. However, estimates can change dramatically depending on the size of the risk factor (Alolayan et al., 2017; Eeckhoudt and Hammitt, 2001, 2004; Hammitt, 2020; Kaplow, 2005; Robinson et al., 2021). For example, most people are not willing to pay \$1.1 million to reduce their fatality risk by 1 in 10 (equating to a similar \$11 million VSL). The reason is straightforward, budget constraints become much more restrictive at a 1 in 10 fatal risk reduction level for most ordinary citizens.

As a practical matter, the literature has generally found that the size of the risk factor does not change the calculations until fatality risks reach around 1 per 1,000 (Hammitt, 2020; Robinson et al., 2021). Most military personnel do not face this high a risk level, even in combat units. For example, Armey et al. (2021) found U.S. military personnel on average increase their fatality risk by 45 per 100,000 when deployed to Iraq or Afghanistan – a far cry from the risk levels needed to cause any kind of distorted VSL calculations. However, some of the more elite units (Delta Force, SEAL Team 6) often have much higher fatality risks in comparison to regular units. Baffer (2020) found Navy SEAL personnel deployed to Iraq or

Afghanistan had a total likelihood of death of 800 per 100,000. Therefore, it appears that some of the elite units in the DOD begin to approach the 1 per 1,000 fatality risk threshold as outlined in previous VSL research. Therefore, the VSL for some of those personnel might be lower if adjusted for higher risk factors.

As discussed in this section, there are a large number of variables that could be used to adjust the military VSL based on previous research. Although some of the adjustments just mentioned could be justified on empirical grounds, our view is that ethical and equity concerns outweigh the possible benefits for using a modified VSL. Due to these concerns, we generally advise against using demographic characteristics to adjust the military VSL. For sensitivity analyses, we advise using the range of VSL estimates provided in Table 4 that focus on pay grade and income adjustments.

In addition to the VSL estimates provided here, we introduce a case study in Appendix C for practitioners to use as an example for how to value the statistical lives lost in military BCAs. Specifically, the case study emphasizes calculating the mortality costs of lost U.S. military personnel in the recent military conflicts in Iraq and Afghanistan. The case study highlights how mortality cost estimates can vary significantly due to a variety of assumptions used in the analysis such as different data sources, timelines, and contrasting VSL estimates. The best point estimates available show a total mortality cost of $79 billion (US$2021) for the wars in Iraq and Afghanistan from 2001 through 2021 (see Appendix C for details).

5. Conclusion

For years, analysts in the U.S. DOD have had to rely on outside VSL estimates for their internal BCAs – often borrowing VSL benchmarks from other agencies such as the EPA or DOT. It is unclear whether other agencies benchmark values are appropriate for military personnel. Given the size of the DOD and their unique mission, it makes sense that they should have a standard VSL benchmark in place for their own personnel and internal BCAs. This requires the use of accurate VSL estimates directly related to the DOD in BCA analyses.

Here we have reviewed theory and evidence from the VSL literature and provide a benchmark VSL to use in future DOD BCAs. In addition, we have provided a range of estimates (adjusting the VSL by pay grade and income) for use in sensitivity analyses. Our findings indicate the pay grade and income adjusted VSL estimates range in value from $3.2 million to $27.6 million per statistical life. Although we find a wide range of estimates depending on fatality type and method, our preferred estimates are obtained from CFOI based studies. Using the recommended sorting criteria, we find a mean best-set VSL estimate of $11.8 million (US$2021). For analysts and practitioners, we strongly advocate using the mean best-set VSL estimate of $11.8 million as a benchmark for the vast majority of BCAs within the DOD.

References

Aldy, J. E., & Viscusi, W. K. (2008). Adjusting the value of a statistical life for age and cohort effects. *The Review of Economics and Statistics*, *90* (3), 573-581.

Alolayan, M. A., J. S. Evans, and J. K. Hammitt (2017). Valuing mortality risk in Kuwait: Stated-preference with a new consistency test. *Environmental and Resource Economics*, *66* (4), 629–646.

Armey. L., Kniesner, T., Leeth, J., & Sullivan, R. (2022). Combat, Casualties, and Compensation: Evidence from Iraq and Afghanistan. *Contemporary Economic Policy*, *40* (1), 66-82.

Baffer, B. E. (2020). Casualties and Combat Pay: Examining Combat Fatality Risk for Navy Special Warfare Seal Operators in Iraq and Afghanistan. Naval Postgraduate School.

Banzhaf, H. S. (2014). Retrospectives: the Cold-War origins of the value of statistical life. *Journal of Economic Perspectives*, *28* (4), 213-26.

Bilmes, L., & Stiglitz, J. (2006). The economic costs of the Iraq war: An appraisal three years after the beginning of the conflict (No. w12054). National Bureau of Economic Research. Available at: https://www.nber.org/papers/w12054.pdf

Bilmes, L. J., & Stiglitz, J. E. (2008). The three trillion dollar war: The true cost of the Iraq conflict. WW Norton & Company.

Blomquist, G. C. (2004). Self-protection and averting behavior, values of statistical lives, and benefit cost analysis of environmental policy. *Review of Economics of the Household*, *2* (1), 89-110.

Bureau of Labor Statistics. (2023). Employer costs for employee compensation. June 2023. Available at: https://www.bls.gov/news.release/pdf/ecec.pdf

Crawford, N. C. (2017). United States Budgetary Costs of Post-9/11 Wars through FY 2018: A Summary of the $5.6 trillion in Costs for the US Wars in Iraq, Syria, Afghanistan and Pakistan, and Post-9/11 Veterans Care and Homeland Security. Report prepared for the Costs of War project by the Watson Institute for International and Public Affairs.

Crawford, C. (2023). Blood and Treasure: United States Budgetary Costs and Human Costs of 20 Years of War in Iraq and Syria, 2003-2023. Report prepared for the Costs of War project by the Watson Institute for International and Public Affairs.

Davis, S. J., Murphy, K. M., & Topel, R. H. (2006). War in Iraq versus containment (No. w12092). Available at: https://www.nber.org/system/files/working_papers/w12092/w12092.pdf

Defense Finance and Accounting Service (2021). 2021 Military Active & Reserve Component Pay Tables. Available at: https://www.dfas.mil/militarymembers/payentitlements/Pay-Tables/

Eeckhoudt, L. R. and J. K. Hammitt (2001). Background risks and the value of a statistical life. *Journal of Risk and Uncertainty*, *23* (3), 261–279.

Eeckhoudt, L. R. and J. K. Hammitt (2004). Does risk aversion increase the value of mortality risk? *Journal of Environmental Economics and Management*, *47* (1), 13–29.

Edwards, R. D. (2014). US war costs: Two parts temporary, one part permanent. *Journal of Public Economics*, *113*, 54-66. Available at: https://www.nber.org/papers/w16108.pdf

Environmental Protection Agency (2010). Mortality risk valuation estimates.

Federal Register. (2022). Defense Department. Available at: https://www.federalregister.gov/agencies/defense-department

Greenberg, K., Greenstone, M., Ryan, S. P., & Yankovich, M. (2021). *The Heterogeneous Value of a Statistical Life: Evidence from US Army Reenlistment Decisions* (No. w29104). National Bureau of Economic Research.

Gyrd-Hansen, D., P. A. Halvorsen, and I. S. Kristiansen (2008). Willingness-to-pay for a statistical life in the times of a pandemic. *Health Economics*, *17* (1), 55–66.

Hakes, J. K., & Viscusi, W. K. (2007). Automobile seatbelt usage and the value of statistical life. *Southern Economic Journal*, *73* (3), 659-676.

Hammitt, J. K. (2020). Valuing mortality risk in the time of covid-19. *Journal of Risk and Uncertainty*, *61* (2), 129–154.

Hammitt, J. K., & Robinson, L. A. (2011). The income elasticity of the value per statistical life: transferring estimates between high and low income populations. *Journal of Benefit-Cost Analysis*, *2* (1), 1-29.

Hersch, J. (1998). Compensating differentials for gender-specific job injury risks. *The American Economic Review*, *88*(3), 598-607.

Kaplow, L. (2005). The value of a statistical life and the coefficient of relative risk aversion. *Journal of Risk and Uncertainty*, *31* (1), 23–34.

Kniesner, T. J., W. K. Viscusi, and J. P. Ziliak (2006). Life-cycle consumption and the age-adjusted value of life. *Contributions in Economic Analysis & Policy* 5 (1).

Kniesner, T. J., Viscusi, W. K., & Ziliak, J. P. (2010). Policy relevant heterogeneity in the value of statistical life: New evidence from panel data quantile regressions. *Journal of Risk and Uncertainty*, *40* (1), 15-31.

Kniesner, T. J., W. K. Viscusi, C. Woock, and J. P. Ziliak (2012). The value of a statistical life: Evidence from panel data. *Review of Economics and Statistics*, *94* (1), 74–87.

Kniesner, T. J., & Viscusi, W. K. (2019). The value of a statistical life. *Forthcoming, Oxford Research Encyclopedia of Economics and Finance, Vanderbilt Law Research Paper*, (19-15).

Kniesner, T., Leeth, J., & Sullivan, R. (2015). A New Approach to Evaluate Safety and Force Protection Investments: The Value of a Statistical Life. In Melese, F, Richter, A., & Solomon B. (Eds.), *Military Cost-Benefit Analysis: Theory & Applications*. Taylor & Francis (Routledge).

Kniesner, T., Sullivan, R., & Viscusi, K. (2023). What are 750,000 Senior Covid Deaths Worth? *Regulation*, *45* (8), 8-10.

Kniesner, T. J., & Viscusi, W. K. (2023). Promoting Equity through Equitable Risk Tradeoffs. *Journal of Benefit-Cost Analysis*, 1-27.

Leeth, J. D., & Ruser, J. (2003). Compensating wage differentials for fatal and nonfatal injury risk by gender and race. *Journal of Risk and Uncertainty*, *27* (3), 257-277.

Lindhjem, H., Navrud, S., Braathen, N. A., & Biausque, V. (2011). Valuing mortality risk reductions from environmental, transport, and health policies: A global meta-analysis of stated preference studies. *Risk Analysis: An International Journal*, *31* (9), 1381-1407.

Liu, J. T., J. K. Hammitt, J. D. Wang, and M. W. Tsou (2005). Valuation of the risk of sars in Taiwan. *Health Economics*, *14* (1), 83–91.

Masterman, C. J. and W. K. Viscusi (2018). The income elasticity of global values of a statistical life: stated preference evidence. *Journal of Benefit-Cost Analysis*, *9* (3), 407–434.

Murphy, K. M. and R. H. Topel (2006). The value of health and longevity. *Journal of Political Economy*, *114* (5), 871–904.

Nordhaus, W. D. (2002). The economic consequences of a war in Iraq (No. w9361). National Bureau of Economic Research. Available at: https://www.nber.org/system/files/working_papers/w9361/w9361.pdf

Office of Management and Budget. (2022). Circular A-4 Regulatory Analysis. Available at: https://obamawhitehouse.archives.gov/omb/circulars_a004_a-4/

Office of Management and Budget. (2022). Circular A-94 Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs. Available at: https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/circulars/A94/a094.pdf

Pruitt, Sarah. 2018. The Costliest Day in SEAL Team Six History. History.com. Available at: https://www.history.com/news/the-costliest-day-in-seal-team-six-history

Robinson, L. A., J. K. Hammitt, J. E. Aldy, A. Krupnick, and J. Baxter (2010). Valuing the risk of death from terrorist attacks. *Journal of Homeland Security and Emergency Management*, *7* (1).

Robinson, L. A. and J. K. Hammitt (2016). Valuing reductions in fatal illness risks: Implications of recent research. *Health Economics*, *25* (8), 1039–1052.

Robinson, L. A., M. Eber, and J. Hammitt (2021). Valuing covid-19 mortality and morbidity risk reductions.

Robinson, L. A., Sullivan, R., & Shogren, J. F. (2021). Do the benefits of COVID-19 policies exceed the costs? Exploring uncertainties in the Age–VSL relationship. *Risk Analysis*, *41* (5), 761-770.

Rohlfs, C. (2012). The economic cost of conscription and an upper bound on the value of a statistical life: Hedonic estimates from two margins of response to the Vietnam draft. *Journal of Benefit-Cost Analysis*, *3* (3), 1-37.

Rohlfs, C. & Sullivan, R. (2013). The Cost-Effectiveness of Armored Tactical Wheeled Vehicles for Overseas U.S. Army Operations. *Defence and Peace Economics*, *24* (4), 293-316.

Rohlfs, C., Sullivan, R., & Kniesner, T. (2015). New estimates of the value of a statistical life using air bag regulations as a quasi-experiment. *American Economic Journal: Economic Policy*, *7* (1), 331-59.

Rohlfs, C., Sullivan, R., Treistman, J., & Deng, Y. (2015). Using Combat Losses of Medical Personnel to Estimate the Value of Trauma Care in Battle: Evidence from World War II, Korea, Vietnam, Iraq, and Afghanistan. *Defence and Peace Economics*, *26* (5), 465-490.

Rohlfs, C., Sullivan, R., & Kniesner, T. (2016). Reducing Risks in Wartime Through Capital-Labor Substitution: Evidence from World War II. *Journal of Risk and Uncertainty*, *52* (2), 163-190.

Smith, Adam. (1776). *The Wealth of Nations*. New York: Modern Library, [1776] 1937.

Svensson, M. (2009). Precautionary behavior and willingness to pay for a mortality risk reduction: Searching for the expected relationship. *Journal of Risk and Uncertainty*, *39* (1), 65-85.

U.S. Census Bureau. (2021). Quick Facts Population Estimates. Available at: https://www.census.gov/quickfacts/fact/table/US/PST045221

U.S. Department of Defense. (2021). National Defense Budget Estimates for FY 2022. Available at: https://comptroller.defense.gov/Portals/45/Documents/defbudget/FY2022/FY22_Green_Book.pdf

US Department of Health and Human Services (2016). Guidelines for regulatory impact analysis.

US Department of Transportation (2016). Revised departmental guidance on valuation of a statistical life in economic analysis.

Viscusi, W. K., J. Huber, and J. Bell (2014). Assessing whether there is a cancer premium for the value of a statistical life. *Health Economics*, *23* (4), 384–396.

Viscusi, W. K. and J. E. Aldy (2003). The value of a statistical life: a critical review of market estimates throughout the world. *Journal of Risk and Uncertainty* 27 (1), 5–76.

Viscusi, W. K. and C. Masterman (2017a). Anchoring biases in international estimates of the value of a statistical life. *Journal of Risk and Uncertainty*, *54* (2), 103–128.

Viscusi, W. K. and C. J. Masterman (2017b). Income elasticities and global values of a statistical life. *Journal of Benefit-Cost Analysis*, *8* (2), 226–250.

Viscusi, W. K. (1993). The value of risks to life and health. *Journal of Economic Literature*, *31* (4), 1912–1946.

Viscusi, W. K. (2003). Racial differences in labor market values of a statistical life. *Journal of Risk and Uncertainty*, *27* (3), 239-256.

Viscusi, W. K. (2004). The value of life: estimates with risks by occupation and industry. *Economic Inquiry*, *42* (1), 29-48.

Viscusi, W. K. (2010). The heterogeneity of the value of statistical life: Introduction and overview. *Journal of Risk and Uncertainty*, *40* (1), 1-13.

Viscusi, W. K., & Aldy, J. E. (2007). Labor market estimates of the senior discount for the value of statistical life. *Journal of Environmental Economics and Management*, *53* (3), 377-392.

Viscusi, W. K. (2018a). Best estimate selection bias in the value of a statistical life. *Journal of Benefit-Cost Analysis*, *9* (2), 205-246.

Viscusi, W. K. (2018b). Pricing lives. In *Pricing Lives*. Princeton University Press.

Viscusi, W. K. (2019). The mortality cost metric for the costs of war. *Peace Economics, Peace Science and Public Policy*, *25* (3).

Viscusi, W. K. (2020). Pricing the global health risks of the COVID-19 pandemic. *Journal of Risk and Uncertainty*, *61* (2), 101-128.

Viscusi, W. K. (2021a). Extending the domain of the value of a statistical life. *Journal of*

Benefit-Cost Analysis, *12* (1), 1–23.

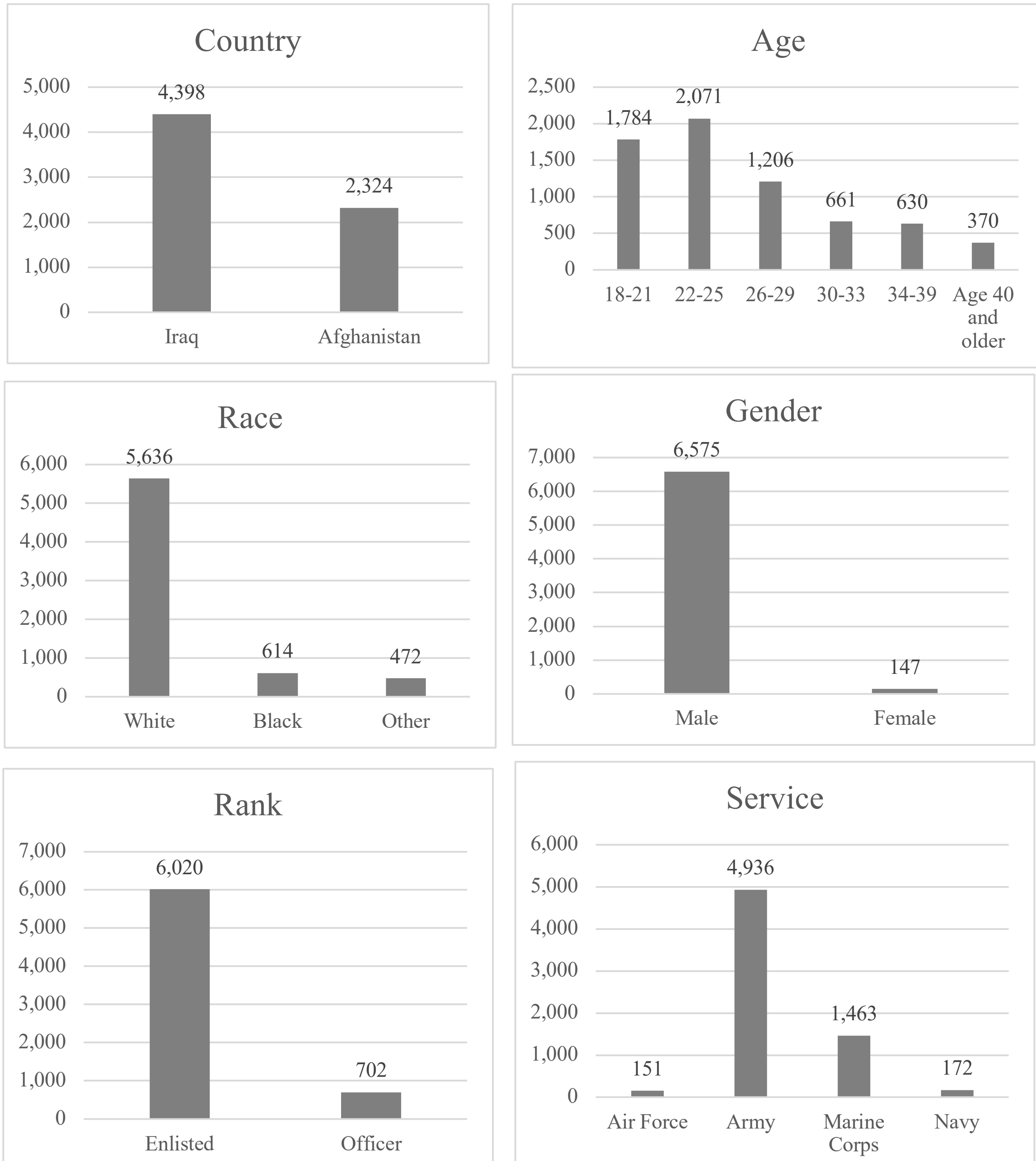
Viscusi, W. K. (2021b). Economic lessons for COVID-19 pandemic policies. *Southern Economic Journal*, *87* (4), 1064-1089.

Viscusi, W. K. (2021c). Efficient Ethical Principles for Making Fatal Choices," *Notre Dame Law Review*, *96* (4), 1461-1478.

Wallsten, S., & Kosec, K. (2005). The economic costs of the war in Iraq. AEI-Brookings Joint Center Working Paper, (05-19). Available at: https://core.ac.uk/download/pdf/6665535.pdf

The World Bank (2021). GNI per capita, United States 2021. Available at: https://data.worldbank.org/indicator/NY.GNP.PCAP.CD?locations=US

Figure 1: U.S. Fatalities in Iraq and Afghanistan by Demographic



Notes: Data for the figure are taken from DMDC records from Oct. 7, 2001, through Dec. 21, 2021.

Table 1: Distributions of VSL estimates by quantile

	5%	10%	25%	50%	75%	90%	95%
All-set estimates							
Whole sample	-1.938	0.508	5.133	11.058	17.576	29.191	40.838
USA	-1.938	1.016	6.018	11.724	17.623	28.392	38.127
Non-USA	-2.037	0.043	1.254	8.167	17.460	29.865	72.233
USA CFOI	2.050	4.915	8.273	12.699	19.196	31.689	40.839
USA non-CFOI	-5.587	-1.980	0.655	4.618	14.841	28.381	28.381
Best-set estimates							
Whole sample	1.421	1.681	4.961	11.589	17.899	25.930	30.221
USA	1.681	2.197	5.203	11.634	15.386	21.941	25.930
Non-USA	0.094	1.421	3.785	8.979	23.473	28.640	45.065
USA CFOI	3.826	6.169	9.434	11.709	15.445	22.506	37.789
USA non-CFOI	1.526	1.681	3.861	10.326	15.386	21.941	25.930

Note: For the all-set sample, $N = 1{,}025$. For the best-set sample, $N = 68$.
See text in Viscusi (2018a) for details. All values in million USD 2021.

Table 2: CFOI Based VSL Estimates

Method	VSL
Publication Bias Adjusted Using All Set Data	11.4
Best Set Uncorrected Average	**11.8**
All Set Uncorrected Average	13.1

Note: For the all-set sample, $N = 1{,}025$. For the best-set sample, $N = 68$.
See text in Viscusi (2018a) for details. All values in million USD 2021.

Table 3: Summary Statistics

	Mean	Standard Deviation	Minimum	Maximum
Age	26.37593	6.656257	18	60
Male	0.978132	0.146265	0	1
White	0.838441	0.3680732	0	1
Black	0.091342	0.2881161	0	1
Other Race	0.070217	0.2555317	0	1
Iraq	0.65427	0.4756412	0	1
Afghanistan	0.34573	0.4756412	0	1
Air Force	0.022464	0.1481965	0	1
Army	0.734305	0.4417353	0	1
Marine Corps	0.217644	0.4126744	0	1
Navy	0.025588	0.1579133	0	1
Enlisted	0.895567	0.3058444	0	1
Officer	0.104433	0.3058444	0	1
Hostile	0.808539	0.3934802	0	1
Non-hostile or Pending	0.191312	0.3933635	0	1
Casualty Type				
Accident	0.116483	0.3208273	0	1
Died of Wounds	0.195329	0.3964831	0	1
Killed in Action	0.612169	0.4872919	0	1
Self-Inflicted	0.049093	0.2160773	0	1
Other Casualty Type	0.026927	0.1618807	0	1
Cause of Casualty			0	1
Explosion	0.195478	0.3965974	0	1
Gunshot	0.221363	0.415195	0	1
Multiple Trauma	0.27224	0.4451461	0	1
Other Causes or Unknown	0.310919	0.4629043	0	1

Notes: Data for this table are taken from DMDC records for all fatalities in Iraq and Afghanistan from Oct. 7, 2001, through Dec. 21, 2021. *N* = 6,722.

Table 4: Income Adjusted Life Valuation
(All values shown are in US$2021)

Pay Grade	Fatalities	Average Annual Basic Pay Salary	VSL (in millions of dollars)
E01	48	$19,488	$3.24
E02	299	$22,779	$3.79
E03	1,436	$24,301	$4.04
E04	1,842	$27,765	$4.62
E05	1,167	$33,509	$5.57
E06	776	$40,875	$6.80
E07	280	$49,022	$8.16
E08	75	$59,219	$9.85
E09	24	$69,644	$11.59
O01	66	$43,077	$7.17
O02	163	$52,738	$8.77
O03	213	$72,881	$12.12
O04	78	$85,125	$14.16
O05	39	$102,338	$17.02
O06	9	$124,109	$20.65
O07	2	$166,009	$27.62
W01	6	$48,028	$7.99
W02	71	$56,949	$9.47
W03	29	$68,073	$11.32
W04	14	$82,322	$13.70
W05	4	$102,990	$17.13
Total Fatalities:			**6,641**
Weighted Average VSL (in millions of dollars):			**$5.80**

Notes: We use the $11.8 million Best Set VSL from Table 2 for our baseline value.
We use a 1.0 income elasticity to adjust the VSL estimates by income.
We use a baseline GNI of $70,930 taken from World Bank (2021).
We include all observations that had basic pay data available in this analysis.
Data for this table are taken from DMDC records for all fatalities in Iraq and Afghanistan from Oct. 7, 2001, through Dec. 21, 2021.

Appendix A. Bibliography of Included Studies in Viscusi (2018)

Aldy, Joseph E., and W. Kip Viscusi (2007). Adjusting the Value of a Statistical Life for Age and Cohort Effects. *The Review of Economics and Statistics*, *90* (3), 573–581.

Arabsheibani, G. Reza, and Alan Marin (2000). Stability of Estimates of the Compensation for Danger. *Journal of Risk and Uncertainty*, *20* (3), 247–269.

Arnould, Richard J., and Len M. Nichols (1983). Wage-Risk Premiums and Workers' Compensation: A Refinement of Estimates of Compensating Wage Differential. *Journal of Political Economy*, *91* (2), 332–340.

Baranzini, Andrea, and Giovanni Ferro Luzzi (2001). The Economic Value of Risks to Life: Evidence from the Swiss Labour Market. *Swiss Journal of Economics and Statistics*, *137* (2), 149–170.

Berger, Mark C., and Paul E. Gabriel (1991). Risk Aversion and the Earnings of US Immigrants and Natives. *Applied Economics*, *23* (2), 311–318.

Brown, Charles (1980). Equalizing Differences in the Labor Market. *The Quarterly Journal of Economics*, *94* (1), 113–134.

Cousineau, Jean-Michel, Robert Lacroix, and Anne-Marie Girard (1992). Occupational Hazard and Wage Compensating Differentials. *The Review of Economics and Statistics*, *74* (1), 166–169.

DeLeire, Thomas, Shakeeb Khan, and Christopher Timmins (2013). Roy Model Sorting and Nonrandom Selection in the Valuation of a Statistical Life. *International Economic Review*, *54* (1), 279–306.

Dillingham, Alan E., and Robert S. Smith (1983). Union Effects on the Valuation of Fatal Risk. In Industrial Relations Research Association Series: Proceedings of the Thirty-Sixth Annual Meeting (pp. 270–277). Madison, WI: IRRA

Dillingham, Alan E. (1985). The Influence of Risk Variable Definition on Value-of- Life Estimates. *Economic Inquiry*, *23* (2), 277–294.

Dorman, Peter, and Paul Hagstrom (1998). Wage Compensation for Dangerous Work Revisited. *Industrial and Labor Relations Review*, *52* (1), 116–135.

Dorsey, Stuart, and Norman Walzer (1983). Workers' Compensation, Job Hazards, and Wages. *Industrial and Labor Relations Review*, *36* (4), 642–654.

Evans, Mary F., and Georg Schaur (2010). A Quantile Estimation Approach to Identify Income and Age Variation in the Value of a Statistical Life. *Journal of Environmental Economics and Management*, *59* (3), 260–270.

Garen, John (1988). Wage Differentials and the Endogeneity of Job Riskiness. *The Review of Economics and Statistics*, *70* (1), 9–16.

Gegax, Douglas, Shelby Gerking, and William Schulze (1991). Perceived Risk and the Marginal Value of Safety. *The Review of Economics and Statistics*, *73* (4), 589–596.

Gentry, Elissa Philip, and. Kip Viscusi (2016). The Fatality and Morbidity Components of the Value of Statistical Life. *Journal of Health Economics*, *46*, 90–99.

Giergiczny, Marek (2008). Value of a Statistical Life – the Case of Poland. *Environmental and Resource Economics*, *41* (2), 209–221.

Gunderson, Morley, and Douglas Hyatt (2001).Workplace Risks and Wages: Canadian Evidence from Alternative Models. *The Canadian Journal of Economics*, *34* (2), 377–395.

Hersch, Joni, and W. Kip Viscusi (2010). Immigrant Status and the Value of Statistical Life. *Journal of Human Resources*, *45* (3), 749–771.

Kim, Seung-Wook, and Price V. Fishback (1999). The Impact of Institutional Change on Compensating Wage Differentials for Accident Risk: South Korea, 1984–1990. *Journal of Risk and Uncertainty*, *18* (3), 231–248.

Kniesner, Thomas J., and John D. Leeth (1991). Compensating Wage Differentials for Fatal Injury Risk in Australia, Japan, and the United States. *Journal of Risk and Uncertainty*, *4* (1), 75–90.

Kniesner, Thomas J., and W. Kip Viscusi (2005). Value of a Statistical Life: Relative Position vs. Relative Age. *American Economic Review*, *95* (2), 142–146.

Kniesner, Thomas J., W. Kip Viscusi, and James P. Ziliak (2006). Life-Cycle Consumption and the Age-Adjusted Value of Life. *Contributions to Economic Analysis & Policy*, *5* (1), Article 4.

Kniesner, Thomas J., W. Kip Viscusi, and James P. Ziliak (2010). Policy Relevant Heterogeneity in the Value of Statistical Life: New Evidence from Panel Data Quantile Regressions. *Journal of Risk and Uncertainty*, *40* (1), 15–31.

Kniesner, Thomas J., W. Kip Viscusi, Christopher Woock, and James P. Ziliak (2012). The Value of a Statistical Life: Evidence from Panel Data. *The Review of Economics and Statistics*, *94* (1), 74–87.

Kniesner, Thomas J., W. Kip Viscusi, and James P. Ziliak (2014). Willingness to Accept Equals Willingness to Pay for Labor Market Estimates of the Value of a Statistical Life. *Journal of Risk and Uncertainty*, *48* (3), 187–205.

Kochi, Ikuho, and Laura O. Taylor (2011). Risk Heterogeneity and the Value of Reducing Fatal Risks: Further Market-Based Evidence. *Journal of Benefit-Cost Analysis*, *2* (3), 1–28.

Lanoie, Paul, Carmen Pedro, and Robert Latour (1995). The Value of a Statistical Life: A Comparison of Two Approaches. *Journal of Risk and Uncertainty*, *10* (3), 235–257.

Leeth, John D., and John Ruser (2003). Compensating Differentials for Fatal and Nonfatal Injury Risk by Gender and Race. *Journal of Risk and Uncertainty*, *27* (3), 257–277.

Leigh, J. Paul, and Roger N. Folsom (1984). Estimates of the Value of Accident Avoidance at the Job Depend on the Concavity of the Equalizing Differences Curve. *Quarterly Review of Economics and Business*, *24* (1), 56–66.

Leigh, J. Paul (1991). No Evidence of Compensating Wages for Occupational Fatalities. *Industrial Relations*, *30* (3), 382–395.

Leigh, J. Paul (1995). Compensating Wages, Value of a Statistical Life, and Inter- Industry Differentials. *Journal of Environmental Economics and Management*, *28* (1), 83–97.

Liu, Jin-Tan, James K. Hammitt, and Jin-Long Liu (1997). Estimated Hedonic Wage Function and Value of Life in a Developing Country. *Economics Letters*, *57* (3), 353–358.

Low, Stuart A., and Lee R. McPheters (1983). Wage Differentials and Risk of Death: An Empirical Analysis. *Economic Inquiry*, *21* (2), 271–280.

Marin, Alan, and George Psacharopoulos (1982). The Reward for Risk in the Labor Market: Evidence from the United Kingdom and a Reconciliation with Other Studies. *Journal of Political Economy*, *90* (4), 827–853.

Martinello, Felice, and Ronald Meng (1992). Risks and the Value of Hazard Avoidance. *The Canadian Journal of Economics*, *25* (2), 333–345.

Meng, Ronald A. (1989). Compensating Differentials in the Canadian Labour Market. *The Canadian Journal of Economics*, *22* (2), 413–424.

Meng, Ronald A., and Douglas A. Smith (1990). The Valuation of Risk of Death in Public Sector Decision-Making. *Canadian Public Policy*, *16* (2), 137–144.

Meng, Ronald A., and Douglas A. Smith (1999). The Impact of Workers' Compensation on Wage Premium for Job Hazards. *Applied Economics*, *31* (9), 1101–1108.

Miyazato, Naomi (2012). Estimating the Value of a Statistical Life Using Labor Market Data. *The Japanese Economy*, *38* (4), 65–108.

Miller, Paul, Charles Mulvey, and Keith Norris (1997). Compensating Differentials for Risk of Death in Australia. *The Economic Record*, *73* (223), 363–372.

Moore, Michael J., and W. Kip Viscusi (1988). Doubling the Estimated Value of Life: Results Using New Occupational Fatality Data. *Journal of Public Policy Analysis and Management*, *7* (3), 476–490.

Moore, Michael J., and W. Kip Viscusi (1988). The Quantity-Adjusted Value of Life. *Economic Inquiry*, *26* (3), 369–388.

Olson, Craig A. (1981). An Analysis of Wage Differentials Received by Workers on Dangerous Jobs. *Journal of Human Resources*, *16* (2), 167–185.

Parada-Contzen, Marcela, Andr´es Riquelme-Won, and Felipe Vasquez-Lavin (2013). The Value of a Statistical Life in Chile. *Empirical Economics*, *45* (3), 1073–1087.

Rafiq, Muhammad, Mir Kalan Shah, and Muhammad Nasir (2010). The Value of Reduced Risk of Injury and Deaths in Pakistan – Using Actual and Perceived Risks Estimates. *The Pakistan Development Review*, *49* (4), 823–837.

Sandy, Robert, and Robert F. Elliott (1996). Unions and Risk: Their Impact on the Level of Compensation for Fatal Risk. *Economica*, *63* (250), 291–309.

Schaffner, Sandra, and Hannes Spengler (2010). Using Job Changes to Evaluate the Bias of Value of a Statistical Life Estimates. Resource and Energy Economics, 32(1), 15–27.

Scotton, Carol R., and Laura O. Taylor (2011). Valuing Risk Reductions: Incorporating Risk Heterogeneity into a Revealed Preference Framework. *Resource and Energy Economics*, *33* (2), 381–397.

Scotton, Carol R. (2013). New Risk Rates, Inter-Industry Differentials and the Magnitude of VSL Estimates. *Journal of Benefit-Cost Analysis*, *4* (1), 39–80.

Shanmugam, K. Rangasamy (2000). Valuations of Life and Injury Risks. *Environmental and Resource Economics*, *16* (4), 379–389.

Shanmugam, K. Rangasamy (2001). Self-Selection Bias in the Estimates of Compensating Differentials for Job Risks in India. *Journal of Risk and Uncertainty*, *22* (3), 263–275.

Siebert, William Stanley, and Xiangdong Wei. (1994). Compensating Wage Differentials for Workplace Accidents: Evidence for Union and Nonunion Workers in the UK. *Journal of Risk and Uncertainty*, *9* (1), 61–76.

Smith, Robert S. (1974). The Feasibility of an 'Injury Tax' Approach to Occupational Safety. *Law and Contemporary Problems*, *38* (4), 730–744.

Smith, Robert S. (1976). The Occupational Safety and Health Act: Its Goals and Its Achievements. Washington DC: American Enterprise Institute for Public Policy Research.

Thaler, Richard, and Sherwin Rosen (1975). The Value of Saving a Life: Evidence from the Labor Market. In Nestor Terleckyj (Ed.), Household Production and Consumption (pp. 265–302). New York: Columbia University Press.

Tsai,Wehn-Jyuan, Jin-Tan Liu, and James K. Hammitt (2011). Aggregation Biases in Estimates of the Value per Statistical Life: Evidence from Longitudinal Matched Worker-Firm Data in Taiwan. *Environmental and Resource Economics*, *49* (3), 425–443.

Viscusi,W. Kip (1978). Labor Market Valuations of Life and Limb: Empirical Evidence and Policy Implications. *Public Policy*, *26* (3), 359–386.

Viscusi,W. Kip (1981). Occupational Safety and Health Regulation: Its Impact and Policy Alternatives. *Research in Public Policy Analysis and Management*, *2*, 281–299.

Viscusi, W. Kip (2003). Racial Differences in Labor Market Values of a Statistical Life. *Journal of Risk and Uncertainty*, *27* (3), 239–256.

Viscusi,W. Kip (2004). The Value of Life: Estimates with Risks by Occupation and Industry. *Economic Inquiry*, *42* (1), 29–48.

Viscusi,W. Kip (2013). Using Data from the Census of Fatal Occupational Injuries to Estimate the 'Value of a Statistical Life.' *Monthly Labor Review* (October), 1–17.

Viscusi, W. Kip, and Joseph E. Aldy (2007). Labor Market Estimates of the Senior Discount for the Value of Statistical Life. *Journal of Environmental Economics and Management*, *53* (3), 377–392.

Viscusi, W. Kip, and Elissa Philip Gentry (2015). The Value of a Statistical Life for Transportation Regulations: A Test of the Benefits Transfer Methodology. *Journal of Risk and Uncertainty*, *51* (1), 53–77.

Viscusi, W. Kip, and Joni Hersch (2008). The Mortality Cost to Smokers. *Journal of Health Economics*, *27* (4), 943–958.

Weiss, Peter, Gunther Maler, and Shelby Gerking (1986). The Economic Evaluation of Job Safety: A Methodological Survey and Some Estimates for Austria. *Empirica*, *13* (1), 53–67.

Appendix B. Adjusting the Military VSL by Age

A variety of demographic characteristics (gender, race) have been used to adjust the VSL over the years. Notably, adjusting the VSL by age is one of the most common modifications found in the literature (Aldy and Viscusi, 2008; Kniesner and Viscusi, 2019; Kniesner et al., 2006; Kniesner et al., 2022; Murphy and Topel, 2006; Robinson et al., 2021; Viscusi and Aldy, 2007; Viscusi, 2018b; Viscusi, 2020; Viscusi, 2021b; 2021c). In this section, we show a practical example for how researchers might use age to change their calculations.

One of the most common techniques used to adjust the VSL by age is the inverse-U technique. Aldy and Viscusi (2008) provide a standard outline for how researchers might adjust the VSL values by age when using the inverse-U technique. We follow their work as a basis for the age adjusted analysis below.

Aldy and Viscusi (2008) use standard labor market regressions (regressing wages as a function of job market fatality risk and a vector of control variables) to back out VSL estimates by age. They use five different age categories in their primary analysis (18-24, 25-34, 35-44; 45-54, and 55-62 years old). In addition, they provide both Cross-section as well as Cohort-adjusted VSL estimates. Regardless of the method used, Aldy and Viscusi (2008) produces VSL estimates that follow an inverted-U shaped pattern across the age groups.

For the Cross-section results, Aldy and Viscusi (2008) find a \$3.74 million VSL for the 18-24 age group, \$9.43 million for the 25-34 age group, \$9.66 million for the 35-44 age group, \$8.07 million for the 45-54 age group, and a \$3.43 million VSL for the 55-62 age group (US\$2000). As for the Cohort-adjusted values, Aldy and Viscusi (2008) find a \$3.80 million VSL for the 18-24 age group, \$6.00 million for the 25-34 age group, \$7.50 million for the 35-44 age group, \$7.57 million for the 45-54 age group, and a \$5.75 million VSL for the 55-62 age group (US$2000).

In Table B1, we update the Aldy and Viscusi (2008) age adjusted VSL values into 2021 dollars and group the DMDC fatality data into similar age bins. The DMDC data shows that the number of fatalities are highly grouped into the younger age categories. The 18-24 age group has a total of 3,403 fatalities, the 25-34 group has 2,450, the 35-44 group has 737, the 45-54 group has 119, and the 55-62 age group only has 13 fatalities.

Panel A in Table B1 shows the main cross-section values for military personnel lost in Iraq and Afghanistan. The far right column shows the total life value lost for each of the respective age bins. The 25-34 age bin shows a total life lost value of around $36 billion. The smallest value is shown in the 55-62 age bin with a loss of life of $70 million. The total life value lost for all age bins using the Cross-section results is $69 billion. The final weighted average, age-adjusted VSL is $10.29 million per statistical life.

Panel B in Table B1 shows the cohort-adjusted values. Similar to the cross-section results, the cohort-adjusted values indicates the 25-34 age bin has the largest life value lost ($23 billion) among the different age bins. Next is the 18-24 age group with a total life value lost of around $20 billion. The age bin with the lowest life value lost ($118 million) is the 55-62 age group. The total life value lost for all age bins using the cohort-adjusted results is $54 billion. The final weighted average, age-adjusted VSL for the cohort-adjusted results is $7.99 million per statistical life.

After adjusting the values by age, we find the total life value lost in the Iraq and Afghanistan wars is between $54 billion to $69 billion with a weighted average value of $7.99 million to $10.29 million per statistical life.[10]

[10] The values are only for fatalities and do not include non-fatal injury valuations. In addition, the values do not adjust for earnings changes over time. If earnings are included in the adjustments, the numbers are increased. For example, using a 1.0 income elasticity adjustment increases the weighted average values to $8.80 million for the cohort-adjusted results and $11.33 million for the cross-section results.

Table B1: Age Adjusted Military VSL (US$2021 millions)

Panel A: Aldy and Viscusi (2008) Cross-Section Values

Age Group	Age Adjusted VSL (million USD 2021)	Fatalities	Total Life Value (million USD 2021)
18-24	$5.89	3,403	$20,027
25-34	$14.84	2,450	$36,355
35-44	$15.20	737	$11,203
45-54	$12.70	119	$1,511
55-62	$5.40	13	$70
Total Life Value (million USD 2021):			**$69,167**
Total Fatalities:			**6,722**
VSL Average (million USD 2021): Total Life Value/Total Fatalities			**$10.29**

Panel B: Aldy and Viscusi (2008) Cohort-Adjusted Values

Age Group	Age Adjusted VSL (million USD 2021)	Fatalities	Total Life Value (million USD 2021)
18-24	$5.98	3,403	$20,349
25-34	$9.44	2,450	$23,132
35-44	$11.80	737	$8,698
45-54	$11.91	119	$1,417
55-62	$9.05	13	$118
Total Life Value (million USD 2021):			**$53,713**
Total Fatalities:			**6,722**
VSL Average (million USD 2021): Total Life Value/Total Fatalities			**$7.99**

Appendix C: Case Study of U.S. Military Fatalities in Iraq and Afghanistan

As with any military operation the cost of the wars in Iraq and Afghanistan includes standard budgetary costs as well as the loss of human life. Previous research has attempted to quantify these costs using a wide range of assumptions and methods (Bilmes and Stiglitz 2006, 2008; Crawford 2017, 2023; Davis et al. 2006; Edwards 2014; Nordhaus 2002; Viscusi 2019; Wallsten and Kosec 2005). Their estimates include detailed accounts of various costs including personnel costs, military hardware, medical care, and macroeconomic effects. Here we focus our attention on a critical component of the overall cost puzzle – the cost of U.S. military fatalities in Iraq and Afghanistan. What follows is effectively a case study for practitioners to use for how to calculate the value of lives lost in future military BCAs.

Table C1 shows the total mortality cost of the wars in Iraq and Afghanistan for U.S. military personnel using VSL estimates provided here. The table displays U.S. military fatality totals from October 7, 2001, through December 21, 2021. Our preferred estimates in Panel A use an $11.80 million VSL from the best set uncorrected average results as shown in Table 2. Multiplying the $11.80 million value by the number of U.S. military fatalities across conflicts (4,398 in Iraq and 2,324 in Afghanistan) provides an aggregate mortality cost of $51.90 billion for the Iraq War, $27.42 billion for the war in Afghanistan, and a total mortality cost of $79.32 billion for the combination of both wars.

Panel B in Table C1 uses the income adjusted VSL estimate of $5.80 million from Table 4 as a basis for the overall mortality cost of the wars. As a comparison the income adjusted results in Panel B are roughly half of the values shown in Panel A. The income adjusted results show a mortality cost of $25.51 billion for the Iraq War, $13.48 billion for the Afghanistan War, and $38.99 billion for both wars combined.

Panel C in Table C1 updates the income adjusted VSL of $5.80 in Panel B by adding fringe benefit estimates from BLS (2023) into the VSL calculations. BLS (2023) states that private industry workers' benefits account for 29.4% of total employer compensation costs on average. We use this as a proxy for military fringe benefits. Increasing the $5.80 million income adjusted VSL by 29.4% results in an income and fringe benefits adjusted VSL of $7.51 million. Using the income and fringe benefits adjusted VSL results in a mortality cost of $33.01 billion for the Iraq War, $17.44 billion for the Afghanistan War, and $50.45 billion for the combination of both wars.

The estimates provided in Table C1 detail how adjusting the VSL can have a dramatic impact on the overall totals. The overall values for both wars range from a low of $38.99 billion to a high of $79.32 billion. The driving force for these differences is directly related to how practitioners might adjust the VSL. We recommend future researchers use a range of VSL estimates in their sensitivity analyses, similar to the example shown here.

A comparison of our estimates with those found in the general economics literature is shown in Table C2. Panel A shows the mortality cost estimates for the wars in Iraq and Afghanistan from previous studies. The early Iraq War studies such as Wallsten and Kosec (2005) and David et al. (2006) had to use strong assumptions about how the war might play out in terms of fatalities.[11] The two studies estimated US military fatalities in Iraq would be between

[11] We are unaware of any early mortality cost estimates for the war in Afghanistan. This is likely due to the speed of the military operation for that conflict. The deployment of troops to Iraq was more delayed in comparison to Afghanistan and planning took more time allowing for the development of more rigorous academic studies on the Iraq War. Mortality cost estimates for Afghanistan did not take place until far later in the conflict.

4,000 and 5,846 by the end of the war. Notably, the early fatality projections appear to have been quite accurate given the uncertainty of combat. As a comparison, our final fatality total for U.S. military personnel in Iraq was 4,398 (see Panel B in Table 6). Furthermore, the early studies all used similar VSL estimates in the $6 million to $7 million range which resulted in the final projected total mortality cost for Iraq being in the $28 billion (US$2003) to $38 billion (US$2005) range.

The NBER working paper by Bilmes and Stiglitz (2006) provides a detailed cost breakdown for the war in Iraq roughly three years into the conflict. For the mortality cost estimates, Bilmes and Stiglitz (2006) assumed a $6.5 million (US$2005) VSL. Their medium war scenario (five-year occupation) estimated a total of 4,462 fatalities with a total mortality cost of $29 billion (US$2005). A follow-up book by Bilmes and Stiglitz (2008), titled *The Three Trillion Dollar War*, extended the work of their previous NBER working paper. However, in their 2008 work the authors updated their numbers to include new cost estimates for Afghanistan and more up-to-date fatality estimates for Iraq. Furthermore, they used a $7.2 million (US$2007) VSL for their final calculations in comparison to the $6.5 million (US$2005) VSL used previously. Bilmes and Stiglitz (2008) projected an estimated 8,889 U.S. fatalities in Iraq and Afghanistan by the end of 2017 with a total mortality cost of $64 billion (US$2007).

Edwards (2014) uses an ex-post approach to calculating total mortality costs for the wars in Iraq and Afghanistan. His data cover a total of 5,376 U.S. military fatalities from 2001 through 2010. Applying a $9.2 million VSL (US$2008), Edwards (2014) estimates a total mortality cost of $49 billion for the wars in Iraq and Afghanistan.

Viscusi (2019) provides mortality cost estimates for U.S. contractors and military personnel in Iraq and Afghanistan from 2001 through 2019. He uses an $8.9 million VSL (US$2010) and breaks down fatality estimates across each of the wars (6,229 for Iraq and 4,142 for Afghanistan). Viscusi (2019) finds a total mortality cost of $57 billion in Iraq, $38 billion in Afghanistan, and $95 billion for both wars in total.

How do our estimates compare against others in the literature? Our preferred estimates, as detailed in Panel B in Table C2, show a total mortality cost of $79 billion (US$2021) for the wars in Iraq and Afghanistan. This number is somewhat different when compared to previous estimates for a variety of reasons. The main contrasts occur because of different timelines as well as different assumptions used on the VSL and estimated number of fatalities.

For example, the mortality cost estimate of $49 billion (US$2008) by Edwards (2014) is lower than our figure (even after adjusting for inflation) because he used a shorter time period. The updated casualty figures that we use inflate the numbers due to the time period correction. In contrast, Viscusi (2019) has the highest mortality cost estimates in the literature. Viscusi (2019) finds an estimated mortality cost of $95 billion (US$2010) for the wars in Iraq and Afghanistan. The main reason his numbers are higher than our estimates is that the fatalities were totaled differently. Viscusi (2019) includes both U.S. contractors and military personnel in his analysis in contrast to our estimates which only include U.S. military personnel. Furthermore, our estimates here only include U.S. military personnel who died in Iraq and Afghanistan. Our dataset omits personnel who may have been injured in Iraq or Afghanistan, but later died in another country due to their wounds. This naturally reduces the fatality totals in our dataset. Therefore, it is not surprising that Viscusi (2019) has a higher mortality cost total in comparison to our analysis.

The above case study is just one example about how practitioners might value the lives lost in military BCAs. Although we focus on the mortality cost for the wars in Iraq and Afghanistan, we believe our above case study provides a blueprint for how other studies might use VSL estimates in their calculations. As discussed throughout the text, we recommend practitioners to use a range of VSL estimates in their sensitivity analyses such as the income adjusted values shown in the text. For specific point estimates, we recommend using the best set uncorrected average VSL of $11.80 million (US$2021) for military BCAs.

Table C1: Total mortality cost of the wars in Iraq and Afghanistan

Panel A: Average VSL Cost Estimates			
	Iraq War	Afghanistan War	Total mortality cost
US military fatalities	4,398	2,324	6,722
VSL (in millions)	$11.80	$11.80	$11.80
Total mortality cost (in billions)	**$51.90**	**$27.42**	**$79.32**

Panel B: Income Adjusted VSL Cost Estimates			
	Iraq War	Afghanistan War	Total mortality cost
US military fatalities	4,398	2,324	6,722
VSL (in millions)	$5.80	$5.80	$5.80
Total mortality cost (in billions)	$25.51	$13.48	$38.99

Panel C: Income and Fringe Benefits Adjusted VSL Cost Estimates			
	Iraq War	Afghanistan War	Total mortality cost
US military fatalities	4,398	2,324	6,722
VSL (in millions)	$7.51	$7.51	$7.51
Total mortality cost (in billions)	$33.01	$17.44	$50.45

Notes: Data for the above table are taken from DMDC records for all fatalities in Iraq and Afghanistan from Oct. 7, 2001, through Dec. 21, 2021. All values shown are in US$2021.
Panel A estimates obtained from Table 2 and Panel B estimates from Table 4 here.
Panel C estimates obtained by including an additional fringe benefit calculation from BLS (2023).
See text for details.

Table C2: Mortality cost estimates of the wars in Iraq and Afghanistan

Panel A: Previous Literature

Authors	War	Time Period	VSL	US Military Fatalities	Total mortality cost
Wallsten and Kosec (2005)	Iraq	2003-2015	$6.5 million (US$2005)	5,846*	$38 billion (US$2005)
Davis et al. (2006)	Iraq	2003-2008	$6.9 million (US$2003)	4,000	$28 billion (US$2003)
Bilmes and Stiglitz (2006)	Iraq	2003-2015	$6.5 million (US$2005)	4,462*	$29 billion (US$2005)
Stiglitz and Bilmes (2008)	Iraq and Afghanistan	2001-2017	$7.2 million (US$2007)	8,889*	$64 billion (US$2007)
Edwards (2014)	Iraq and Afghanistan	2001-2010	$9.2 million (US$2008)	5,376	$49 billion (US$2008)
Viscusi (2019)	Iraq	2003-2019	$8.9 million (US$2010)	6,229*	$57 billion (US$2010)
Viscusi (2019)	Afghanistan	2001-2019	$8.9 million (US$2010)	4,142*	$38 billion (US$2010)
Viscusi (2019)	Iraq and Afghanistan	2001-2019	$8.9 million (US$2010)	10,371*	$95 billion (US$2010)

Panel B: This Study

Authors	War	Time Period	VSL	US Military Fatalities	Total mortality cost
Kniesner et al. (2024)	Iraq	2003-2021	$11.8 million (US$2021)	4,398	$52 billion (US$2021)
Kniesner et al. (2024)	Afghanistan	2001-2021	$11.8 million (US$2021)	2,324	$27 billion (US$2021)
Kniesner et al. (2024)	Iraq and Afghanistan	2001-2021	$11.8 million (US$2021)	6,722	$79 billion (US$2021)

* Indicates US contractors were included with US military fatality totals.