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Long-Run Mortality Effects of Vietnam-Era Army Service: Evidence from Australia's Conscription Lotteries

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Abstract

We estimate the effect of Vietnam era Army service on mortality, exploiting Australia's conscription lotteries for identification. We utilise population data on deaths during 1994-2007 and military personnel records. The estimates are identified by over 51,000 compliers induced to enlist in the Army, including almost 16,000 who served in Vietnam. The implicit comparison group is the set of men who did not serve in the Army, but who would have served had their date of birth been selected in the ballot. We find no statistically significant effects on mortality overall, nor for any cause of death (by ICD-10 Chapter). Under reasonable assumptions on the death rate of compliers, the results can be expressed as relative risks (RR) of death during 1994-2007. The estimated overall RR associated with Army service is 1.03 (95% CI: 0.92, 1.19). On the assumption that Army

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service affected mortality only for those who served in Vietnam, the estimated RR for Vietnam Veterans is 1.06 (95% CI: 0.81, 1.51). We also find no evidence to support a hypothesis of offsetting effects due to domestic Army service (beneficial to longevity) and service in Vietnam (detrimental).

Research on the effects of Vietnam era military service on health, mortality and economic outcomes has benefited from the random assignment of draft eligibility in the US conscription lotteries (key studies include Angrist 1990; Angrist et al. 1996; Angrist and Chen 2008; Angrist et al. 2009; Conley and Heewig 2009; Hearst et al. 1986; Hearst et al. 1991). To our knowledge, no previous study has exploited the somewhat similar conscription scheme which operated in Australia between 1965 and 1972. Over 800,000 twenty year old Australian men registered in one of 16 biannual National Service ballots. Each ballot was relevant for a particular 6-month birth cohort (Langford 1997 provides an account of the scheme). Several features of the Australian conscription experience are useful for research purposes. First, the context of service varied greatly among the 16 cohorts. In particular, nobody from the last 4 cohorts served in Vietnam. Second, the standard of proof on disability compensation claims (under the *Veterans Entitlements Act 1986* (*VEA*)) is much more generous for veterans who served in Vietnam, compared to their contemporaries who served only in Australia. This aids in delineating the roles of domestic vs Vietnam Army experience as well as the role the veterans’ benefit system. Third, there was no GI Bill in Australia and there is little or no effect of ballot outcome on educational attainment. This is useful for attempts to estimate the contribution of military experience to human capital in studies of earnings. It also simplifies interpretation of mortality effects, since education may have a causal negative effect on mortality (Cutler and Lleras-Muney 2008; Lleras-Muney 2005). In the United States, a finding of no mortality effect could feasibly reflect elevated mortality associated with military experience, offset by lower mortality associated with higher education.

In an ongoing project, we are analysing the long term effects of Vietnam era Army service on economic and social outcomes for Australian servicemen. In this paper, we consider mortality. We find no evidence of elevated mortality rates.

1. Australia's involvement in the Vietnam War

Australia's involvement in the Vietnam War has points of comparison and difference with that of the United States. For both nations, the principal period of military deployment in Vietnam began in 1965 and ended in staged withdrawals in 1970-2. However, Australian military numbers, mostly ground forces, were much smaller, around 60,000 in total compared with over 3 million American troops, and they were largely confined to the Phuoc Tuy Province south-east of Saigon. Similarly, Australia's losses were far more modest, 520 were killed in Vietnam compared with over 58,000 US fatalities. In spite of the limited scale of Australian involvement, its troops were engaged in several fierce battles, such as that of Long Tan in August 1966. Both nations drew heavily upon conscripts who served for two years, which for some men included 12 months in Vietnam, mostly in the infantry. Draftees, or 'Nashos' (National Servicemen) as they are referred to in Australia, constituted about a third of Australia's Vietnam military personnel and a similar proportion of America's (see Edwards 1997 for the official history of Australia's involvement in the Vietnam War).

2. Previous Research on Mortality Effects

Over the last three decades, the Australian government has conducted or commissioned several major studies into the post-service mortality and health of Vietnam veterans. The mortality studies fall into two categories. In the first set, mortality rates of veterans are compared to that of the general community (Crane et al. 1997a; Wilson et al. 2005a). In the second set, the mortality rates of National Servicemen who served in Vietnam are compared to those who remained in Australia (Crane et al. 1997b; Fett et al. 1984; Fett et al. 1987a, 1987b; Wilson et al. 2005b). Both methods suffer the serious limitation of non-random selection of men into Vietnam service (although bias due to the 'healthy soldier effect' is avoided in the second set) (On selection for service in Vietnam, see Fett et al. 1984: Section IX). Nevertheless, the findings of the most recent studies are briefly summarised. The mortality rate for veterans is lower than the general population, presumably due to the high medical standards required to be admitted into the Army. The mortality rate for National Service veterans who served in Vietnam is significantly higher than for National Service non-veterans who served in Australia only. Deaths from neoplasms and liver disease are elevated in both sets of comparisons. Deaths from external causes are also higher for National Service veterans than for non-veterans.

Similarly, many US studies have compared Vietnam Veterans to non-Vietnam veterans and thus suffer from possible selection bias. We do not review those studies. We know of only three mortality studies that have avoided these issues by exploiting the draft lottery. The pioneering study of Hearst *et al.* (1986) found elevated rates of mortality overall, as well as for suicide and motor vehicle accidents. Reanalysing these data, Angrist *et al.* (1996) found no significant effects. More recently, using data on all deaths in the US during 1989-2002 (almost 250,000 deaths amongst men of relevant age), Conley and Heewig (2009) also found no evidence of differential mortality rates associated with ballot eligibility.

3. Estimation Strategy

We seek to estimate β, the effect of Vietnam era Army service (r) on the probability of mortality for person i:

$$y_i = \alpha + \beta r_i + \gamma ' C_i + \mu_i \quad (1)$$

where C is a vector of 15 binary indicators representing 6-month birth cohorts. Since r is almost certainly correlated with μ, we utilise binary ballot outcome indicators (in vs. out) in each cohort as a set of 16 instrumental variables (Z) in a first stage regression:

$$r_i = \pi_0 + \pi '_1 Z_i + \pi '_2 C_i + \varepsilon_i \quad (2)$$

A 2SLS estimate of β is a weighted average of the 16 (non-parametric) Wald estimates which correspond to Local Average Treatment Effects (LATEs) for 'compliers' in each cohort (Angrist and Pischke 2009; Imbens and Angrist 1994). Our approach resembles Two Sample 2SLS (Atsushi and Solon 2010), since the first stage regression uses one data set and the second stage uses a separate dataset with 'cross-sample' fitted values. However, each 'sample' here is actually the same (complete) population and so we treat the first stage coefficients as known.[2]

Next, under the assumption that mortality was only affected for personnel who served in Vietnam, we re-estimate (1) and (2), replacing r with v (service in Vietnam).

Finally, we consider a specification which includes both r and v as endogeonous regressors (with 2 corresponding first stage regressions). The coefficients of r and v are separately identified by considerable differences between cohorts in the probability of serving in Vietnam. If the mortality effect differs significantly between those who served in Vietnam and those who remained in Australia, this will be reflected in the coefficient of v.

[2] Whilst they include the same populations, the two data sets cannot be linked.

4. Data

The study population is the set of males born in 1945-1952 who were Australian residents when they turned 20 years of age. We construct two unit record population level databases. The mortality dataset contains y, C and Z and is used in the second stage regression. The first stage dataset contains r, v, C and Z.

Mortality Data

Tabulations of deaths were obtained from the AIHW National Mortality Database, after excluding men who immigrated after the age of 20. This database includes all deaths registered in Australia from 1965 onwards. Date of birth (DOB), however, is only included from 1994 onwards. The majority (approx. 58%) of post-ballot deaths were registered during 1994-2007. We exclude records with missing DOB. We also exclude records where DOB is recorded as the 15th day of any month, since this is the value used in the administrative system when the true day is unknown. With these exclusions, coverage of deaths registered in 1994-2007 is approximately 83% for this population. Some 37,196 deaths are thus identified, corresponding to 4.4% of the study population. There is no apparent reason to suspect that missing DOBs are more prevalent amongst balloted-in men. If the period of deaths registered is restricted to 2002-2007, coverage increases to 95%, and whilst the point estimates are larger, they remain statistically insignificant at the 5% level.

First Stage Data

The first stage data are described in summary form here and detailed more fully elsewhere (Siminski 2010). This dataset was synthesised using military personnel records and contemporaneous population aggregates.

First, we estimate the number of residents who were eligible for each ballot, using the Estimated Resident Population of 20 year old men at June 30 of each year between 1965 and

1973. Within each year of age, the proportion in each 6-month birth cohort is assumed to equal the corresponding proportion in the 2006 Census (after excluding migrants who arrived after the age of 20). Next, we assume that within each 6 month birth cohort, the proportion of men whose DOBs were balloted in equals the proportion of DOBs balloted in. We make adjustments to exclude men born on the 15th day of any month.

Military personnel unit records were obtained from the Nominal Roll of Vietnam Veterans (NRVV) and a Vietnam Era database (VED), which both include DOB. These two sources give the number of men with r = 1 and v = 1, respectively, by cohort and ballot outcome. For the rest of the resident population, r is equal to 0 (and hence v = 0). The NRVV is believed to be of high quality but excludes servicemen who remained in Australia. Data on the total number of Vietnam-era Army servicemen are sourced from the VED. Whilst the VED is not well documented, its original source was a database consisting of 'all Vietnam Veterans and non-veterans who served during the Vietnam conflict era' (AIHW 1992: 98), obtained from Central Army Records Office (CARO). The number of men induced into the Army in each cohort (see 1st stage regression estimates) conforms with expectations based on published statistics on the conscription scheme (Siminski 2010).

5. Results

Results from the first stage and reduced form regressions are shown in **Error! Reference source not found.**Table 1. The ballot outcomes are strong predictors of both r and v, with F-stats of 8,194 and 2,608, respectively. The only exception is the ballot outcome for the 16th cohort (z16), which is not statistically significant in either of the first stage regressions. This is sensible, since balloted in men in the last cohort were never called up and had no apparent incentive to volunteer.

Table 1 First Stage and Reduced Form Regression Results

	1st stage - Army service (r)		1st stage - Army Service in Vietnam (v)		Reduced Form - Mortality (y)	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Robust Std. Err.
Constant	0.0323	0.0019***	0.0219	0.0012***	0.0646	0.0017***
c2	0.0007	0.0024	-0.0001	0.0016	-0.0050	0.0022*
c3	0.0004	0.0024	-0.0004	0.0015	-0.0085	0.0021***
c4	-0.0015	0.0022	-0.0007	0.0015	-0.0118	0.0020***
c5	0.0052	0.0023*	0.0004	0.0015	-0.0146	0.0020***
c6	0.0074	0.0023***	-0.0001	0.0015	-0.0178	0.0020***
c7	0.0060	0.0023**	-0.0004	0.0015	-0.0187	0.0020***
c8	0.0034	0.0023	-0.0015	0.0015	-0.0204	0.0020***
c9	0.0045	0.0023	-0.0026	0.0015	-0.0219	0.0020***
c10	-0.0013	0.0022	-0.0063	0.0015***	-0.0244	0.0019***
c11	0.0002	0.0022	-0.0082	0.0015***	-0.0252	0.0019***
c12	-0.0020	0.0023	-0.0118	0.0015***	-0.0277	0.0019***
c13	-0.0019	0.0023	-0.0136	0.0015***	-0.0288	0.0020***
c14	-0.0040	0.0023	-0.0168	0.0015***	-0.0306	0.0019***
c15	-0.0063	0.0023**	-0.0188	0.0015***	-0.0295	0.0019***
c16	-0.0095	0.0022***	-0.0215	0.0015***	-0.0323	0.0019***
z1	0.3266	0.0025***	0.1198	0.0017***	-0.0021	0.0023
z2	0.3100	0.0026***	0.1193	0.0017***	-0.0012	0.0023
z3	0.2824	0.0028***	0.1185	0.0019***	-0.0018	0.0024
z4	0.2844	0.0028***	0.1391	0.0018***	0.0045	0.0024
z5	0.2641	0.0027***	0.1260	0.0018***	-0.0005	0.0022
z6	0.2547	0.0029***	0.1325	0.0019***	-0.0003	0.0023
z7	0.2665	0.0027***	0.1235	0.0018***	0.0037	0.0022
z8	0.2765	0.0030***	0.1105	0.0020***	-0.0009	0.0023
z9	0.2581	0.0026***	0.0871	0.0017***	-0.0007	0.0020
z10	0.2632	0.0032***	0.0610	0.0021***	0.0018	0.0024
z11	0.2510	0.0032***	0.0321	0.0021***	0.0011	0.0023
z12	0.2371	0.0028***	0.0063	0.0018***	0.0018	0.0020
z13	0.2115	0.0025***	0.0007	0.0016	0.0025	0.0018
z14	0.1901	0.0025***	0.0008	0.0016	0.0001	0.0017
z15	0.1275	0.0025***	-0.0013	0.0017	-0.0027	0.0017
z16	0.0015	0.0027	-0.0002	0.0017	0.0018	0.0018
F-stat for IVs	8,194		2,608			
N	840,071		840,071		840,071	

*** statistically significant at p < 0.001, ** p < 0.01, * p < 0.05

In contrast, the reduced form mortality regression shows that ballot outcome is not a significant determinant of mortality for any of the cohorts. None of the ballot outcome instruments are individually significant. If the effect of ballot outcome on mortality is constrained to be equal across cohorts, its estimated effect on mortality is 0.0004 (Standard Error = 0.0005). This is the 'Intention to Treat' interpretation of the results.[3]

The 2nd stage results, shown in Table 2, reveal that Army service is not statistically significant in any of the three specifications. The estimated effect of Army service (r) on the probability of death during 1994-2007 is +0.0012 (95% CI: -0.0032, +0.0055). If ballot outcome only affects mortality through induced service in Vietnam (v), the effect of v on the probability of death is +0.0022 (95% CI: -0.0100, +0.0144). When r and v are both included as endogenous regressors, neither is statistically significant and point estimates are close to zero. There is also no evidence of elevated mortality for any specific cause of death (at ICD-10 Chapter level) (regression results not shown).

Next, we translate the results into approximate Relative Risks (RR) of mortality under feasible assumptions. We know the proportion of each cohort that died (and DOB was validly recorded) in the period under consideration. We also know that the mortality rate for National Servicemen (who are a similar population to the set of balloted in compliers) was 27% lower than community norms between 1966 and 2001 (Wilson et al. 2005b). Taking these results and the distribution of compliers between cohorts, we estimate the mortality rate for Army service compliers to be 3.53%. Their counterfactual mortality rate is 0.12% lower (from regression results, Spec 1, Table 2). Thus the estimated RR is 3.53% / 3.41% = 1.03 (95% CI:

[3] Following Conley & Heewig (2009), we repeat the analysis using the same DOBs for females as a 'falsification test'. The 'Intention to Treat' estimate is also statistically insignificant and positive for females (and slightly larger than for males). Similarly, none of the 16 IVs are individually significant in the reduced form specification for females.

0.92, 1.19). Following a corresponding procedure assuming that only Vietnam veterans were affected, the estimated RR is 1.06 (95% CI: 0.81, 1.51). We feel that the precision of the estimates is best gauged when expressed in such terms.

Table 2 2SLS Regression Results

	Spec 1		Spec 2		Spec 3	
	Coef.	Robust SE	Coef.	Robust SE	Coef.	Robust SE
r	0.0012	0.0022			0.0021	0.0043
v			0.0022	0.0062	-0.0030	0.0121
N	840,071		840,071		840,071	

Notes: These 2nd stage estimates are from a linear regression of mortality on cross-sample fitted values of r and v from the 1st stage. A constant and 15 cohort dummies are also included in each specification.

*** statistically significant at $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

6. Conclusion

Using population data, we find no evidence of an elevated mortality rate between 1994 and 2007 amongst Australian Vietnam-era Army conscripts. One interpretation is that the compensation and programs received by veterans under the *VEA*, particularly health care and pension payments, has on average offset any direct negative long term effects of Army service. We suggest that methods which exploit the ballot are best suited for further monitoring of mortality effects.

Two qualifications are necessary. 1) The arguably large standard errors should be taken into account. 2) Since the estimated effects are not conditioned on survival to 1993, the probability of death in 1994-2007 could be artificially low for veterans if their earlier death rates were elevated. However, our results are virtually unchanged if servicemen who died in Vietnam are excluded from the analysis entirely (RRs increase by about 0.01). Similarly, if the results of (Fett et al. 1987a) and (Crane et al. 1997b) are taken as a guide, the number of excess post-service deaths up to 1994 amongst National Service Vietnam Veterans is roughly half that of the number who died in Vietnam. Finally, we find no evidence of ‘missing’ balloted in men in the 2006 Census (Siminski 2010).

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