Early Results From the 'Diggers to Veterans' Longitudinal Study of Australian Men who Served in the First World War. Short- and Long-Term Mortality of Early Enlisters

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Early Results From the 'Diggers to Veterans' Longitudinal Study of Australian Men who Served in the First World War

Short- and Long-Term Mortality of Early Enlisters

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ABSTRACT

As the world marks the centenaries of the First World War, we still know remarkably little about the life course effects of military service. This paper reports on the first iteration of a cradle-to-grave dataset of men who enlisted and served overseas in the First World War from the state of Victoria, Australia. It examines mortality during military service and in civilian life and finds that mortality in both cases was strongly correlated with individual characteristics. Tall men and young single men were more likely to die in the war. In civilian life, mortality followed closely the pattern for Australian men, and was again highly correlated with individual characteristics and social class.

Keywords: War trauma, Resilience, Social class, Toxic stress, Early life effects, First World War

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1 INTRODUCTION: THE AUSTRALIAN SOCIAL LABORATORIES

This paper reports on a preliminary analysis of early data from the cradle-to-grave study of a systematic sample of men who embarked for overseas service in World War 1 in units raised in the Australian state of Victoria. It explores early themes and future questions.

A century has now passed since the end of World War 1 (also known as the Great War or the First World War), yet we still know remarkably little, at a population level, about the impact of war service and exposures on the life courses of the combatants in Anglophone countries. As Dora L. Costa's studies of the mid-nineteenth-century Union Army have revealed, the life course approach to war service provides the best measures of the cost and opportunities of war exposure. The work of Costa and colleagues has also unleashed immense potential for fine-grained data on early life and civilian life effects, as well as war exposures. The Union Army project is now embarking on a genealogical study for intergenerational effects (Costa et al., 2017; Wimmer, 2003).

Our study, 'Diggers[1] to Veterans', focuses on the twentieth century. Post-war tracing of life courses is easier for this period. In contrast to the Union Army study, 'Diggers to Veterans' uses vital registrations and electoral rolls rather than individual census data. Births and marriages are taken from the Victorian Registry of Births, Deaths and Marriages online indexes. Causes and conditions of death come from death certificates and coronial inquiries, and socio-economic status is calculated by a combination of occupational, residential and social data. War service is recorded in detailed records of troop movements, time in combat, wounds, illnesses and time in hospital or rehabilitation, conduct offences and punishments, as well as valour awards and promotions. Later analysis will include pension and civilian medical historical data. The post-war personal repatriation files—containing information on post-war pensions, rehabilitation, and medical care—will be considered in later publications. This paper concentrates on an early analysis of mortality both during war service and in civilian life after the war, looking at life-course factors that may have affected lifespan.

MacLean and Elder in a review of the life course and military service from World War 2 onwards, point to the importance of changing historical contexts and potential confounding factors such as race and delinquency (Maclean & Elder, 2007). The only comparable World War 1 study is from Wilson, Clement, Summers, Bannister and Harper (2014) on two small New Zealand random samples of 350 men who experienced war exposure and 350 who enlisted too late to be sent to the front (Wilson et al, 2014). Our study attempts to undertake similar life course reconstruction on a much larger scale.

The reasons for a lack of World War 1 life course studies internationally are logistical: tracing veterans' lives from registered birth to registered death is difficult in large national populations, especially with outmigration, varied civil registration regimes, lost records and restrictions on public searching. The US Censuses enable tracing in time and place from census to census, but ascertainment of death with certified causes of death can be more elusive. For later wars, where veterans remained registered with government agencies, tracing is easier (Cowper, Kubal, Maynard, & Hynes, 2002; Fisher, Weber, Goldberg, & Davis, 1995). After World War 1, veterans were less likely to remain under the gaze of the authorities as pensions were not automatic and had to be applied for. It would be not until their old age, with changing government policies, that Australian World War 1 veterans were widely registered with Veterans' Affairs for health care and service pensions. This means that many who died before the 1970s were unobserved by the Repatriation Department. As for other countries, the British army records were destroyed in the Blitz and the United States records were disposed of in 1970, while New Zealand's World War 1 veteran files are patchy (NZ Archives). Canada has veteran death files with single causes of death, but scant social information, and historical searching for death certificates is restricted by varying state regulations. Australia is therefore fortunate in having both surviving war service and pension medical files, which, combined with access to rich civil registration data, electoral rolls, probate, welfare and criminal records and digitised historical newspapers, make it possible to construct cradle-to-grave prosopographies of servicemen.

Anglophone imperial societies inherited British bureaucratic habits, and with that, often early civil registration. The former British dominions of New Zealand and Australia, while usually considered peripheral to global historical action, provide useful social laboratories for population reconstruction. They are small enough to be manageable for manual tracing; they remained undisturbed by total war

1 The eponymous 'Diggers' is a term for Australian or New Zealand soldiers. Its first usage has been traced to the Western Front in the First World War.

during the twentieth centuries; and they were observed by conscientious bureaucrats in a political system relatively free of corruption. Moreover, both were pioneers of universal suffrage, and Australia's electoral rolls from 1903 are exceptional for their comprehensiveness in an electoral regime that introduced compulsory voting and enrolled those without a fixed address (Brett, 2019). In providing residential address, occupation and details of male and female relatives co-habiting or living nearby, they compensate to some degree for the destruction of the census returns by the federal government. Both countries' war service records have survived intact from World War 1, as have their veterans' pension and medical files. Both countries have embarked on major digitisation projects of historical newspapers, coronial inquests, criminal records, probates and other tools for family history. Former Dominions' military records have been effectively mined for anthropometric study of the standard of living (Inwood & Ross, 2016).

New Zealand has the advantage of being a unitary state with uniform record keeping across the country and also between Pakeha and Maori. This has enabled Paul C. Weaver, for instance, to undertake a study of suicide that includes every identifiable suicide in the country over a full century, and which tracks changes in incidence and motivation in the rich context of a century of New Zealand history (Weaver, 2014). Civil registration in both Australia and New Zealand was inspired by its institution in England and Wales in 1837, with Tasmania commencing civil registration in 1838, followed by New Zealand in 1848, and the other Australian colonies from the 1840s and 1850s.

New Zealand and Victoria, like Scotland in 1855, required greater detail in registration than did other British colonies, and mandated the certification of causes of death by a medical practitioner according to a certified nosology. In 1855, William Henry Archer, the first registrar of the colony of Victoria (now the Australian State of Victoria), was able to institute the full recommendations of the London Statistical Society for the ideal system of registration, the only place in the world to do so (Hopper, 1986). New Zealand's registration was similar, but still lacked details on family formation at all levels—birth, death and marriage—that Victoria required, thereby creating a population register within the civil registration archive. Finally, the time restrictions on public access are more generous in Victoria: thirty years from a death compared to half a century across the Tasman. This brings almost the entire cohort of men who enlisted for World War I within the reach of the researcher. Indexes are detailed, but full certificates still have to be purchased, either individually or in bulk for approved projects.

In 1914, the state of Victoria had 1.4 million people, while the population of the country of New Zealand was 1.1 million. Around 100,000 New Zealanders embarked for overseas service in World War I, while only 85,000 did so from Victoria. New Zealanders were less conflicted than Victorian Australians about service in a British Imperial war, explaining their enlistment in greater numbers. Radical and Irish-Catholic Australians, like French Canadians, mounted significant opposition to conscription and British imperialism (Beaumont, 2013; Bollard, 2013). With two failed plebiscites in Australia to introduce conscription in 1916 and 1917, the Australian Imperial Force remained a fully volunteer army.

Australia went to war, as did the other Dominions, because it was required to by the British Government, but it did so with enormous initial enthusiasm—most of the 330,000 men in the Australian Imperial Force who embarked for service overseas enlisted in the early months of the war in 1914 and 1915. In total, one third of Australian men aged 18–39 years enlisted and served abroad during the war (Robson, 1973; Smith, 2007). Butler noted that while in 1915 men were trying to conceal medical problems in their eagerness to serve, by 1916 with the general call up, three quarters of those found fit applied for exemption from service, and over half of those were successful (Butler, 1943). By April 1917 the Australian Imperial Force struggled to enlist fit men, with the minimum height requirement dropping to just five feet.

The Australian and New Zealand divisions (known together as the ANZACs, for Australian and New Zealand Army Corps) comprised proportionately more front-line infantry than their British counterparts, so that their risk of death and disability was higher in the new twentieth-century warfare employing machine guns, advanced artillery, chemical weapons, and aircraft. Sixty thousand members of the Australian Imperial Force died and around 150,000 returned injured or ill (Garton, 1996; Robson, 1973, pp. 737–749). The body of this paper discusses the socio-economic context of the study and its historically specific classification of socio-economic status, the nature and scope of the archival records and the expertise employed by volunteer researchers. The context of the sample and the methods reveal the extent and nature of the variables available for analysis.

2 THE SAMPLE IN HISTORICAL CONTEXT AND METHODS

The study 'Diggers to Veterans: Risk, Resilience and Recovery in the First Australian Imperial Force' traces a systematic random sample of 12 thousand of all the 85 thousand men who embarked in units raised in the Australian state of Victoria (McCalman & Kippen, 2018). These units were raised as part of the Australian Imperial Force, formed in August 1914 as a consequence of the declaration of war on Germany by Britain and her Empire. All Australian units were demobilised from the end of the war in November 1918, with the Australian Imperial Force officially disbanded in 1921. Around 80 per cent of our sample survived their war service, and, of these, we have found Repatriation personal files of pension applications and medical examinations for roughly half. These data will be discussed in later papers.

Embarkation records held by the Australian War Memorial form the sampling frame, with men grouped by unit, and ordered alphabetically by surname and first name. Occasional duplicates were identified and eliminated where possible. The full 'Diggers to Veterans' sample of 12,032 comprises 1 in 4 (2,756) men who embarked from October 1914 until March 1915, and 1 in 8 (9,276) men who embarked from April 1915 until 7 November 1918, just before the signing of the Armistice. Late embarkations will serve as a control group of men who did not see service, similar to the New Zealand study by Wilson et al. (2014). The change to a 1 in 8 sample was forced by the time restraints of the project's funding. This exploratory paper draws on the first 6,183 of our Victorian sample (just over half the full sample), who enlisted in the first years of the war, 1914 and 1915. These men served in the Middle East, including Gallipoli, and later in France.

Victoria was selected because of the quality and accessibility of state records, and because the Department of Veterans' Affairs archives for the state are held locally and are easy to access. The sample includes those who did not return from service and those who did. Death certificates have been obtained for all those who died in Victoria up to 1988, while year of death has been entered for those who died elsewhere or who died after 1988, where traced. The number of men who disappear entirely from sight and cannot be traced to death is less than ten per cent.

The sample covers all ranks and service including artillery, infantry, light horse, cyclists, transport, sappers, service and field ambulance. Around 20 per cent of the sample were born outside Australia and a further portion in other states. The men are coded for geographic place of origin which provides a wide sample of environments in early life from rural communities, to 'residential suburbs' and 'industrial suburbs' both in Australia and abroad. Births were checked against the detailed indices of birth certificates created by the Victorian Registry of Births, Deaths and Marriages. Siblings and birth order were similarly reconstructed from both birth indices and newspaper reports.

Other early-life conditions such as socio-economic status and familial integrity (parental loss, illegitimacy) were determined from data in birth records, enlistment papers, newspapers and criminal and child welfare records. Parents' history was similarly researched with their origins, family formation, occupations, other marriages, deaths and addresses from the electoral rolls. Immigration and convict records provided deeper family history, so that where possible, family trees were reconstituted. Newspaper reports of court appearances provided data on parents with alcohol problems, domestic violence and criminal convictions, as well as those who were prominent in business or society. Each individual is followed through his war experience and later life through to death where possible. The three phases of the veteran's life course—before, during, and after war service—and variables collected, are set out in Table 1.

As in other historical life-course studies we have led—such as 'Founders and Survivors: Life Course Ships Project' (Kippen & McCalman, 2016; McCalman & Kippen, 2017)—we followed the method pioneered by Henry in France (Rosental, 2003), and Wrigley and Schofield (1989) in England, of recruiting skilled volunteers to research and code data. These volunteer researchers draw on two skill sets: historical and medical. The genealogists follow detailed instructions provided specifically for the project. We have a history team of 18 genealogists, and a medical team comprising seven doctors, a physiotherapist, and a nurse with experience in both general and psychiatric nursing—all of them retired. Paid research assistants support and train the volunteers and verify their data.

Table 1 *Three phases of the life course, variables and data sources, Diggers to Vetarans project*

Early life: formative influences and exposures	**War service exposures and insults**	**Life after war service**
Childhood socio-economic status (SES) and geographic location (Australian electoral rolls and UK censuses for SES for British-born)	Time in battle field (calculated from service record and battalion war diary (Australian War Museum)	Pension awards and pension applications (Department of Veterans's Affairs (DVA) files)
Family integrity and Next of Kin (from electoral rolls, attestation paper); family reconstitution via Ancestry, family history (via digitised newspapers, child welfare archives)	Infectious diseases, including sexually transmitted diseases, of time in hospital and out of the field (recorded and calculated from casualty record)	Diagnoses of physical and/or psychiatric conditions that were or were not accepted as being due to war service (DVA files)
Triangulation with SES, geography and known epidemics and mortality profiles	Wounds, with time out of field	Evidence of post-traumatic stress from correspondence and notes in DVA files
Education and work training (from attestation papers and electoral rolls)	Stress and psychiatric conditions (shellshock, neurasthenia, Not Yet Diagnosed, etc. with time out) (casualty record)	Occupation and SES from DVA files and electoral rolls
Occupation (attestation papers)	Conduct record: offences and time out (service record)	Death and causes of death from either DVA files or searched death certificate if DVA files does no exist
Physical characteristics: height, weight, chest expansion	Promotions, decorations and commendations for service or valour	Marriage and fertility from death certificate and/or DVA files
Siblings in AIF		Personal history from newspaper and other historical sources, such as regimental histories

The history team are producing early and later life data of extraordinary detail, enabling us to identify levels of advantage or deprivation in childhood that may have later life effects: early death of parents, criminal offending, alcohol and violence, marriage breakdown and removal as wards of the state. At the same time, the historical researchers have identified those who went to private schools and had upper class social affiliations (from newspaper social pages). For later civilian life they are extracting data on career milestones, community leadership as well as antisocial behaviour, and data on veterans' children that may have reached the newspapers. The history team also record and code war service from digitised records available online through the National Archives of Australia, noting times in and out of the line, all insults with time out of service, conduct offences, valour awards and promotion. They are coding a range of wounds and illnesses for later analysis against morbidity and mortality.

Even though this paper does not include data from the medical team's work which will be for later papers, their work should be described here with that of the history team. The medical team includes personnel who have worked with veterans during their careers in private practice, in the repatriation general hospital, and in the military mental hospital. They analyse the Repatriation personal file, providing a clinical summary of the veteran's post–war health and putative effects of the war, and an assessment of his treatment by the authorities. Again, social factors gleaned from the Repatriation file are also coded: such as psychiatric illness, alcoholism, criminal conduct or post-war syphilis.

The data are recorded in a FileMaker Pro database with seven 'pages': Background, Attestation, Service, Exit from Service, Civilian Life, Department of Veterans' Affairs/Repatriation personal files, and Civilian Death. The database includes text that is then coded for analysis. Data are exported in a flat file for statistical analysis. The underlying framework for analysis is demographic prosopography, where multiple variables derived from historical sources enrich the core demographic data.

3 CLASSIFICATION OF SOCIO-ECONOMIC STATUS (SES)

This wider range of historical detail informed the structuring of the social-economic classification. First, work over the last thirty years by one of the authors has utilised a modified form of the SES classification developed by Charles Booth for this *Life and Labour of the People of London*, first published in 1889 (Booth, 1892–1897; McCalman, Morley, & Mishra, 2008). Booth took great pains to divide the poor into grades of relative income security and insecurity, finishing with his 'black streets' of destitute people, many of them criminals (Stedman Jones, 1971). Booth had seven grades; we have six:

Black: lowest class, destitute, some criminal

Dark Blue: unskilled or casual workers

Light Blue: skilled or regular workers

Mauve: comfortable, lower middle class

Red: middle-class, well-to-do

Yellow: upper class, wealthy

We have elided the 'casual poor' into the 'unskilled' and the 'mixed' in to the 'skilled'. Booth had detailed information on weekly income which we do not and his classification was for a short time period, whereas ours needs to work for a century as skills and occupations changed. We have also added special grades for rural and regional people: 'unskilled' (labourers and farm workers who did not own land) and 'skilled', which might include small to medium business; and finally 'farmers' who owned land.

Skill classifications are insufficient when skills were being supplanted by technology or when individual lives were damaged by illness, disability or alcoholism. Therefore, in the urban context (both in Melbourne and regional cities), the social status of residential address qualifies occupational status. The poor clustered in places with the lowest rents. These might be in otherwise prosperous neighbourhoods, down back streets, lanes and rights-of-way, or beside railway lines or main roads, as well as in what Australians called 'the industrial suburbs.' Historical SES needs to account for the significance of irregularity of income on the lives of the poor, especially on women and children. Irregular income, especially if it meant frequent changes of address or 'midnight flits', often inflicted great stress on families, disrupting supportive local networks and schooling. Australian working-class communities, where skilled workers were relatively few, remained trapped in the casual economy until after World War 2, and the expansion of government instrumentalities where workers were unionised and covered by industrial awards. In the Australian context, this was the first time that most unskilled men enjoyed income security and full industrial protection. Before that, even much manufacturing was seasonal, driven by the agricultural seasonal economy and the climate, while much non-agricultural rural work was in casual gangs working on infrastructure such as irrigation, roads and the transportation of produce. Government jobs, such as on the railways, the trams and for municipalities enjoyed a level of income security even for the unskilled, and therefore men from such families or who found permanent employment in later life, were classified as 'skilled' as a proxy for their income security. Building trades workers were insecure because of the weather and economic cycles; railway labourers were always paid, even when it rained (McCalman, 1984). Significantly for this study, veterans were given preference for government jobs, especially in the 1930s, and therefore more income security.

Moving up the social scale, lower middle-class, middle-class and upper-class classifications were judged by job description in the electoral roll and the death certificate, although that was more often than not, too vague to be helpful (e.g. 'manager' or 'clerk'). Therefore, it had to be largely by residential address, often checked against Google Maps for the actual building or quality of buildings in the street. Attendance at a private school has long been a marker of middle-class identity in Victoria and could often be ascertained from both military, newspaper and old-school attendance records (e.g. Liber Melburniensis, 1965). The lower middle class was often difficult, again because of vague occupational descriptions, so residential address was important. Class lines blurred for tradesmen who might have done an apprenticeship or attended technical school, but who later went into business on their own account and did well: men with mechanical skills and electricians were able to take advantage of the growing need for their expertise despite the economic difficulties between the wars. They often cemented their upward social mobility by sending their children to private school. However, an important group were middle-class men whose fathers had died leaving a widow and children poorly provided for, or who had been ruined by the failure of the banking system in the severe economic

depression of the 1890s as they were growing up. Downward mobility was often traumatic and had life-long effects (McCalman, 1993). These SES classifications, therefore, are perhaps idiosyncratic in that they depend on deep, local historical knowledge, but they are intended to be historically and geographically specific and to capture the potential impacts of early-life insecurity and security. That specificity, we believe, can measure the SES of the full life course more accurately for this study.

4 RESULTS

We discuss early results from our mortality analysis of the first half of the 'Diggers to Veterans' sample, who enlisted in the first years of the war. Mortality is analysed for three separate time periods:

(1) 1915–1918. Mortality for each of these four calendar years is calculated for all 6,183 men in the early 'Diggers to veterans' sample of men who enlisted in 1914 and 1915. (No deaths for our sample occurred in 1914.)

As shown in Table 2, 1,387 men in our sample (22%) died from 1915 to 1918. This includes a small number (29) of men who were discharged before the end of the war, who were at higher risk of short-term mortality due to injury or other effects of war.

(2) 1919–1921. Since mortality of veterans was significantly higher than normal in the first three years after the war, mortality for this period is analysed separately, and for the 4,189 men in the sample who survived to the end of 1918 and whose death was subsequently traced. Deaths were not able to be traced for 607 men (10%) who survived their war service (Table 2).

(3) 1922 onwards. Longer-term post-war mortality was analysed for the 4,088 men in the sample who survived to the end of 1921 and whose death was subsequently traced (Table 2).

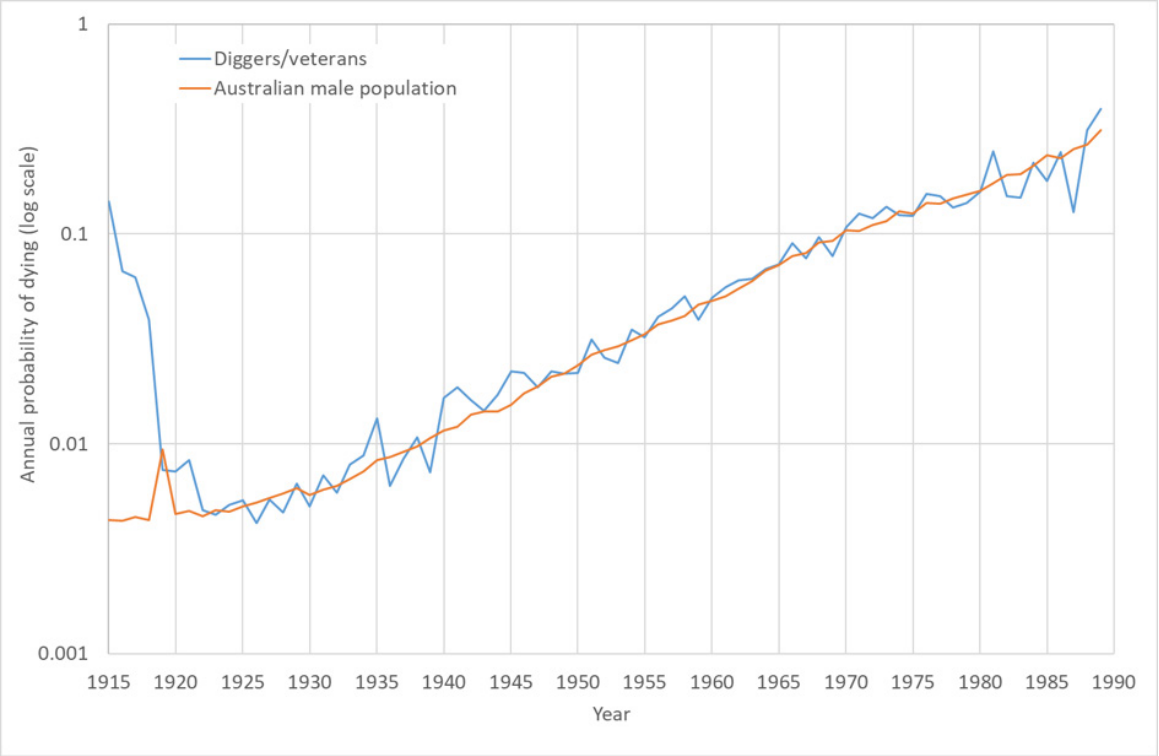
Table 2 *Traced outcomes of Diggers to Veterans 1914 and 1915 sample, n=6,183*

Outcome	**n**	**%**
Died during service, 1915–1918	1,358	22.0
Died after discharge, 1915–1918	29	0.5
Died 1919–1921	101	1.6
Died 1922 onwards	4,088	66.1
Survived service, death not traced	607	9.8
Total	6,183	100.0

4.1 OVERALL MORTALITY FROM 1915

Using dates of birth, dates of embarkation and dates of death, we calculated annual probabilities of dying for our early 'Diggers to Veterans' sample from 1915, and compared these figures to those of the general male Australian population, matched by age and year, using single-year-of-age Australian-level male mortality rates from the Human Mortality Database (2018) for 1921 onwards (the earliest year available) and from the Australian Demographic Databank (Smith, 2007) for 1915–1920. Results are shown in Figure 1.

Figure 1 *Annual probability of dying, 1915–89, Australian diggers/veterans of World War I (Diggers to Veterans sample), and Australian male population matched to Diggers to Veterans sample for age and year*

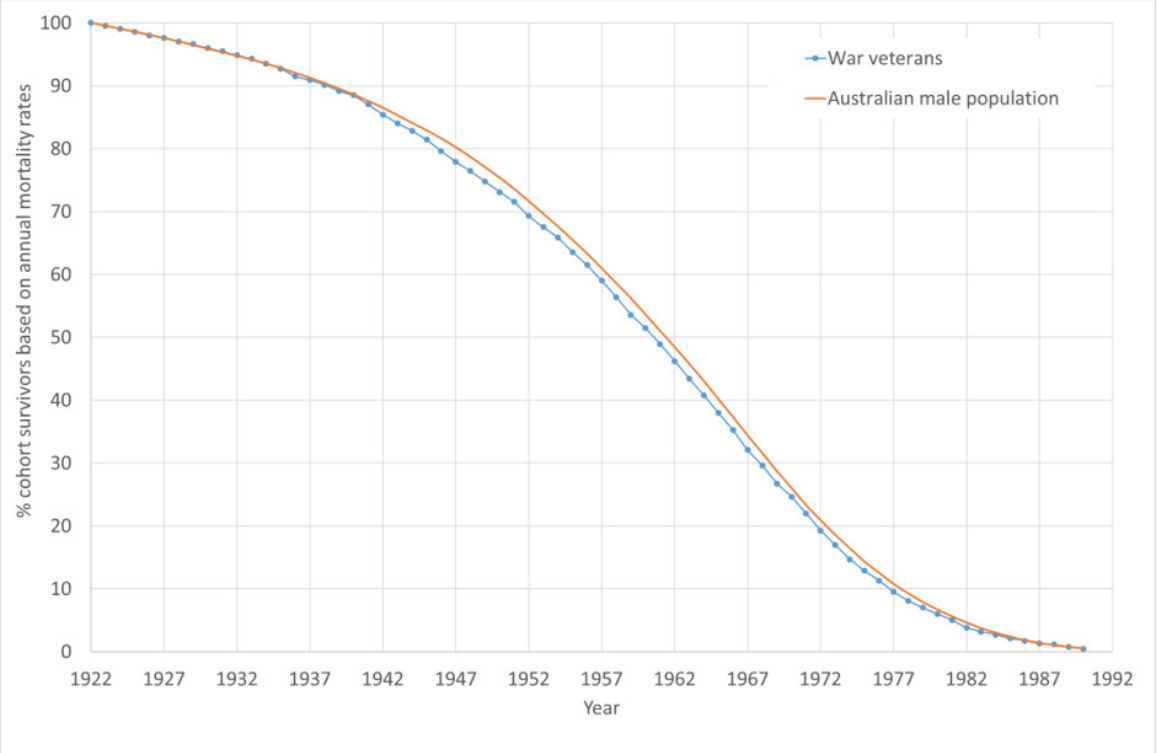


As expected, mortality of men during active war service, 1915–1918, was much higher than for the general Australian male population of the same age during the same period—around 35 times higher in 1915 (143 deaths compared to 4 deaths per 1,000 men), reducing to 10 times higher in 1918 (39 deaths compared to 4 deaths per 1,000 men). (First and Second World War deaths are not included in the general Australian mortality measures.)

Deaths for the 'Diggers to veterans' sample remained relatively high in the immediate post-war period, at around 8 deaths per 1,000 population annually for the three years 1919–1921. This was twice the rate for the general Australian male population in 1920 and 1921. However, rates for both populations were similar for 1919, due to a spike in deaths for the general Australian population in that year from the influenza pandemic of 1918–1920, which seemingly did not affect the 'Diggers' sample of early enlistees (Figure 1). Shanks et al. (2010) have found that early enlisters in the Australian Imperial Force had very low pneumonia–influenza mortality in 1918–1919, probably due to acquired immunity from earlier, milder infections.

After 1921, longer-term veteran mortality is remarkably similar to that of the general Australian male population, with both following the expected loglinear pattern, and both increasing in tandem from 5 deaths per 1,000 men in 1922 to around 30 deaths per 1,000 men in 1989, when all two-dozen surviving veterans (and their matched general-population sample) were aged in their 90s. There is higher veteran mortality during World War 2 and its immediate aftermath, 1940–46 (Figure 1). This increase may be due to war-related deaths of veterans enlisting in this second war. This will be investigated in future research. This higher veteran mortality during World War 2 is also evident in Figure 2 which shows survivorship curves for the two populations, for longer-term mortality from 1922. The figure shows very similar mortality for both populations, with a slight divergence beginning in the early 1940s.

Figure 2 *Survivorship curve, 1922–1989, Australian veterans of World War I (Diggers to Veterans sample), and Australian male population matched to Diggers to Veterans sample for age and year*



The mortality experience of the 'Diggers to veterans' sample, and that of the comparable general Australian male population, is summarised in Table 3, which shows future life expectancy from 1915 for each population. This is based on the calculated annual probabilities of dying (as shown in Figure 1). Taking into account war deaths, and short- and long-term postwar mortality, the diggers' future expectation of life, at 31.45 years, is shorter by 11.78 years than that of the general Australian male population of the same age. However, a temporal decomposition shows that the vast majority of this difference (11.13 years, or 94%) is due to mortality during war service. Post–war, the remaining difference is due to higher short-term mortality in 1919–1921, which results in lower life expectancy of 0.12 years, and higher longer-term mortality after 1921 which accounts for the remaining 0.53 years (Table 3).

The remaining results section of this paper investigates in more detail for our sample mortality during war service, and postwar short- and long-term mortality.

Table 3 *Decomposition of differences in future life expectancy from the beginning of 1915 between Diggers to Veterans sample and Australian male population (probabilities of dying as in Figure 1)*

	Years
Future life expectancy — Diggers to Veterans sample	31.45
Future life expectancy — Australian male population	43.23
Difference	11.78
Difference decomposed using Arriaga's formula	
1915–1918	11.13
1919–1921	0.12
1922 onwards	0.53

4.2 DIGGERS: MORTALITY IN SERVICE, 1915–1918

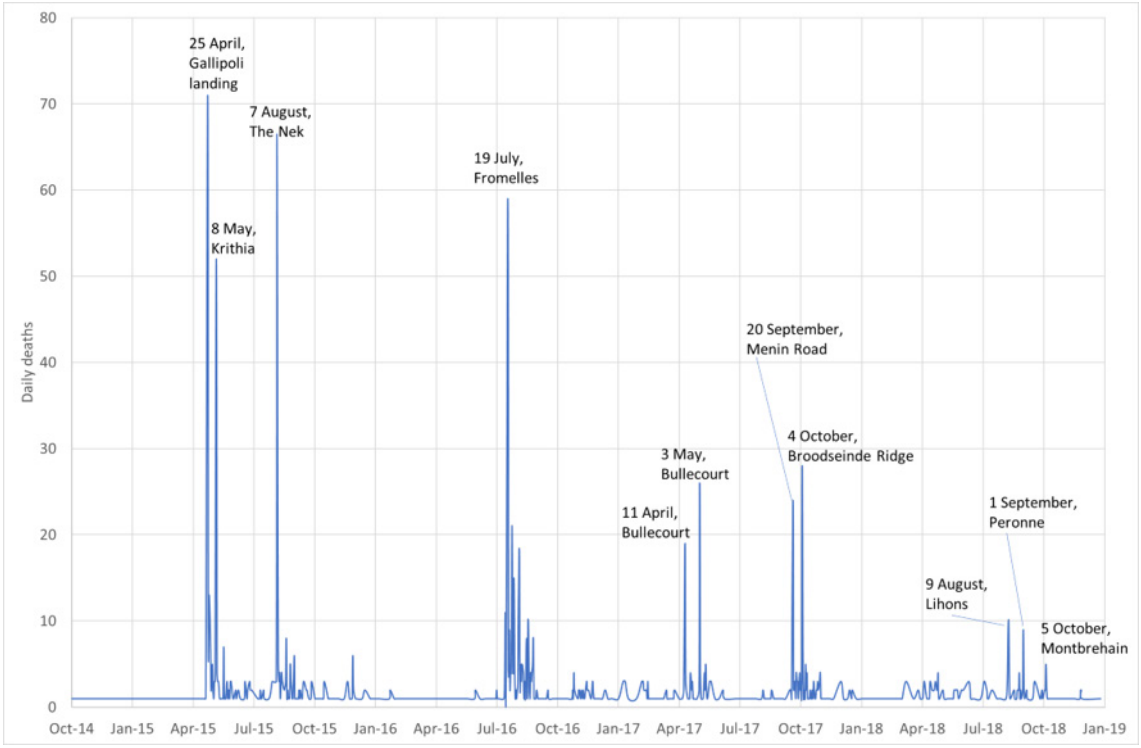
We carried out a binary logistic regression to assess which soldier characteristics were associated with dying during war service or surviving to discharge. Of the 6,284 men in our early sample, 1,387 (22%) died during war service, from 1915 to 1918 (Table 3). Figure 3 shows that there was severe temporal clustering of these war deaths on single days of battle. Therefore, time series analysis was not considered appropriate. For this sample, a quarter of deaths during the war occurred on 7 individual days. The Great War consisted of long stretches of time behind the lines and rotations in the trenches, with only a small number of 'big pushes' when troops were under bombardment or gas attack, or in an offensive. When the full sample is analysed, including later enlistments and embarkations, deaths in battles after Fromelles in July 1916 will be higher.

Bivariate analyses of the variables considered are shown in Figures 4–11. Birth year was linearly related to the probability of dying in service, with those born later (younger during service) more likely to die (Figure 4). Month of embarkation from Australia was also correlated with the probability of dying during war service, with men who enlisted and embarked earlier having a higher probability of war death (Figure 5). Taller men also had a higher risk of mortality (Figure 6), with each extra inch of height associated with an increase in mortality probability of around one percentage point.

In bivariate analysis, mortality risk during war service also appears to vary by education, social class, and marital status, with lowest risk for those who left school by age 14 years (Figure 7), for men with a skilled working class background (who had completed an apprenticeship) (Figure 8), and for married men (Figure 9). Mortality varied enormously by unit and rank at enlistment, with men in the Infantry, and 2nd Lieutenants experiencing the highest mortality, and men in Service units, and Lance Corporals, experiencing the lowest (Figures 10 and 11).

Other variables tested in bivariate analysis were Body Mass Index, and highest rank attained. Body Mass Index was not related to mortality in service. Both rank variables were problematic, as ranks varied widely for a significant proportion of individual men as they were promoted over time during the war. (Most officers were promoted from the ranks, although those promoted were more likely to have had more education and a white-collar occupation before enlistment.) Often, rank was a function of survival rather than the reverse. We have decided that a better measure for future research will be a time-varying covariate of rank, taking into account change over time.

Figure 3 *Deaths to the end of 1918, by individual date of death, Diggers to Veterans 1914 and 1915 sample, deaths=1,387*



Figures 4-11 *Probability of dying during World War One service by (4) birth year, (5) embarkation month, (6) height in inches at enlistment, (7) education at enlistment, (8) family social class, (9) marital status at enlistment, (10) unit at enlistment; and (11) rank at enlistment, Diggers to Veterans sample*

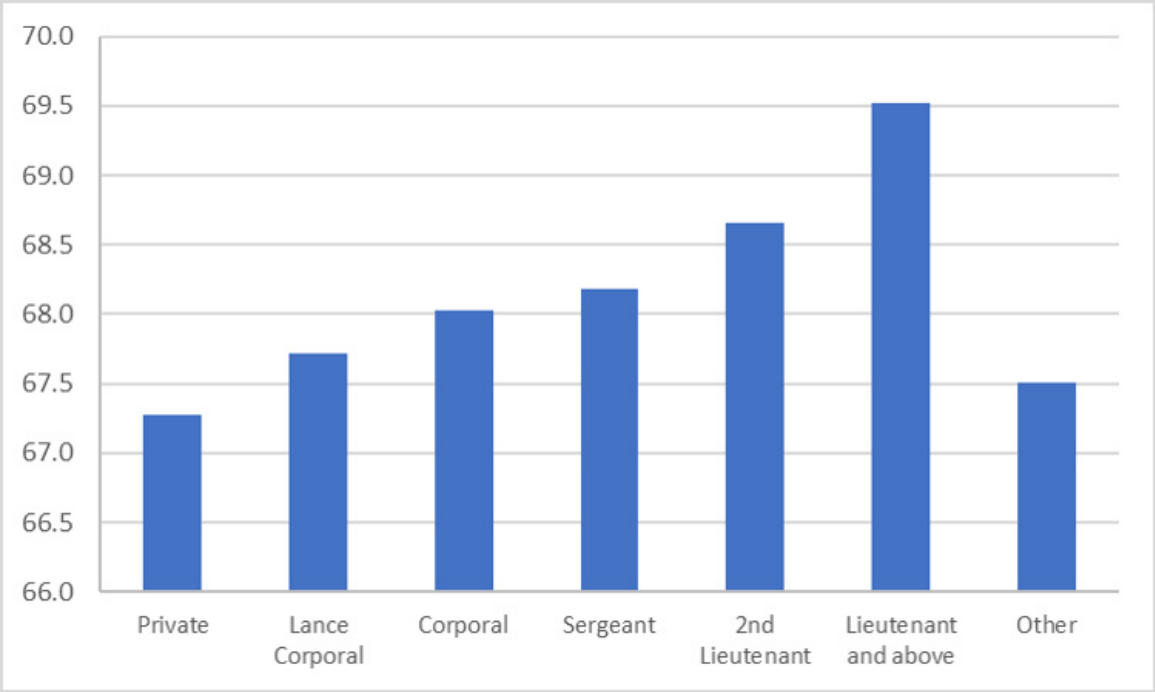
The multivariate logistic regression model for death during the war is shown in Table 4, displaying odds ratios, 95 per cent confidence intervals for each odds ratio, p-values and sample size. P-values of less than 0.05 are considered statistically significant and are shaded. Included in the model are birth year, height and embarkation month as continuous variables; family social class; and education, marital status, unit and rank at enlistment as categorical variables. Seventy (1.1%) of the 6,183 men in our sample were excluded from the logistic regression because their height was not recorded, reducing the sample size for analysis to 6,113.

Table 4 *Logistic regression. Soldier characteristics associated with dying 1915–1918, Diggers to Veterans sample*

Characteristics		OR	95% CI		p-value	n
Birth year		1.01	1.00	1.02	0.208	6,183
Height in inches		1.06	1.03	1.09	0.000	6,113
Embarkation month		0.75	0.64	0.88	0.000	6,183
Education at enlistment	Primary school only	1.00				5,405
	Left at 14 years of age	1.30	0.96	1.75	0.088	334
	Private school	2.68	1.85	3.86	0.000	194
	Technical college	4.62	2.53	8.44	0.000	50
	University	2.11	1.16	3.84	0.015	96
	Other/not given	0.80	0.46	1.38	0.422	104
Family social class	Skilled working class	1.00				1,207
	Unskilled working class	1.07	0.86	1.32	0.537	985
	Skilled regional	1.09	0.83	1.43	0.538	436
	Unskilled regional	1.16	0.94	1.44	0.168	928
	Upper middle class/ Rich	0.76	0.52	1.11	0.156	333
	Lower middle class	1.05	0.80	1.39	0.707	468
	Farmer	1.21	0.89	1.66	0.226	319
	Casual poor/Criminal	1.09	0.62	1.90	0.769	77
	Unknown	1.14	0.92	1.42	0.225	1,430
Marital status at enlistment	Single	1.00				5,389
	Married	0.73	0.58	0.93	0.010	717
	Other/Not given	0.75	0.40	1.40	0.361	77
Unit at enlistment	Infantry	1.00				4,015
	Light Horse	0.53	0.42	0.66	0.000	731
	Artillery	0.37	0.27	0.51	0.000	540
	Medical	0.24	0.15	0.37	0.000	251
	Engineers/Sappers	0.24	0.15	0.39	0.000	243
	Service	0.12	0.06	0.23	0.000	210
	Machine Gun	0.22	0.08	0.64	0.005	47
	Signal	0.16	0.05	0.52	0.002	46
	Other	0.13	0.05	0.33	0.000	100
Rank at enlistment	Private	1.00				4,835
	Lance Corporal	0.45	0.20	1.03	0.058	52
	Corporal	0.81	0.48	1.38	0.439	97
	Sergeant	1.17	0.75	1.85	0.485	120
	2nd Lieutenant	1.82	0.98	3.37	0.058	54
	Lieutenant and above	0.70	0.37	1.34	0.283	84
	Other	1.17	0.91	1.51	0.213	941

OR: Odds ratio; 95% CI: 95% confidence interval

Figure 12 *Average height in inches at enlistment by rank at enlistment, Diggers to Veterans sample*



As in the bivariate analysis, taller men had higher mortality in service, controlling for other characteristics. Each extra inch in height was associated with an increase in the odds of dying of 6 per cent. Since officers were significantly taller on average than enlisted men (Figure 12), and may have had higher mortality (Figure 11), we also tested the multivariate logistic regression model with only men who remained privates throughout the war (half the sample). The height effect remained significant (not shown).

Those who enlisted and embarked from Australia later had lower mortality; each month's delay in embarkation reduced the odds of dying by 25 per cent. Education was highly correlated with the likelihood of dying during war service, with men who had attended a private school, technical college, or university, experiencing odds of mortality of 2.1 to 4.6 times those with primary-school education only. Married men had lower odds of mortality than did single men, by 27 per cent, controlling for other characteristics.

The type of unit in which men served was significantly associated with the probability of dying. Mortality was highest for men who served in the Infantry, and significantly lower for every other category (odds ratios of 0.12–0.53). Controlling for other characteristics, year of birth, family social class and rank at enlistment were not associated with mortality during war service.

On enlistment, the veterans had marked differences in height, according to social class. Those who enlisted as officers were more privileged than those who were later commissioned from the ranks. This first sample enlisted when physical standards were high and before anti-war sentiment cut enlistments well below the levels required. Physically, these pre-Gallipoli volunteers were the fittest and tallest of the First Australian Imperial Force: their height would suggest a good biological standard of living in childhood. Figure 12 illustrates the embodied social status by rank at enlistment (Inwood & Ross, 2016).

4.3 VETERANS: MORTALITY AFTER SERVICE, FROM 1919

We also carried out logistic regression for short-term postwar mortality, investigating factors associated with dying in the first three years after the war, for those who survived their war service (Table 5). Those more likely to die soon after the war were older men (earlier birth year), taller men, and those from an unskilled working-class background. However, the most significant factor was the type of discharge that men received. Those discharged medically unfit, or partially/totally permanently disabled, had

odds of dying of 2 and 6 times those discharged as fully medically fit. Those dishonourably discharged had 4 times the odds of dying. By definition, those who died after the war, but before discharge, had much higher odds—26 times—of dying soon after the war. Education at enlistment, marital status at enlistment, unit at enlistment and highest rank attained were not associated with short-term postwar mortality (Table 5).

Table 5 *Logistic regression. Characteristics associated with dying 1919–1921, Diggers to Veterans sample*

Characteristics		**OR**	**95% CI**		**p-value**	**n**
Birth year		0.94	0.92	0.97	0.000	4,189
Height in inches		1.12	1.03	1.22	0.011	4,138
Embarkation month		0.81	0.47	1.38	0.434	4,189
Education at enlistment	Primary school only	1.00				3,677
	Left at 14 years of age	0.40	0.09	1.80	0.230	230
	Private school	0.95	0.19	4.64	0.947	116
	Technical college	3.51	0.40	31.13	0.260	25
	University	2.32	0.37	14.62	0.370	69
	Other/not given	1.74	0.50	6.05	0.382	72
Family social Class	Skilled working class	1.00				857
	Unskilled working class	2.06	1.01	4.19	0.048	666
	Skilled regional	0.95	0.33	2.76	0.928	317
	Unskilled regional	1.43	0.67	3.08	0.360	646
	Upper middle class/ Rich	1.66	0.44	6.34	0.457	235
	Lower middle class	1.33	0.47	3.72	0.594	330
	Farmer	2.09	0.78	5.57	0.143	222
	Casual poor/Criminal	1.91	0.40	9.03	0.416	52
	Unknown	2.10	0.96	4.59	0.062	864
Marital status at enlistment	Single	1.00				3,624
	Married	0.54	0.28	1.07	0.076	512
	Other/Not given	1.95	0.62	6.15	0.253	53
Unit at enlistment	Infantry	1.00				2,537
	Light Horse	0.83	0.41	1.66	0.591	526
	Artillery	1.12	0.49	2.59	0.784	409
	Medical	0.51	0.15	1.77	0.288	207
	Engineers/Sappers	0.53	0.12	2.31	0.398	188
	Service	2.23	0.93	5.33	0.072	163
	Machine Gun	0.00	0.00	.	0.998	40
	Signal	0.00	0.00	.	0.998	32
	Other	0.85	0.19	3.69	0.824	87

Highest rank	Private	1.00				1,941
	Lance Corporal	0.48	0.17	1.37	0.170	317
	Corporal	0.66	0.29	1.51	0.328	415
	Sergeant	0.96	0.52	1.75	0.882	704
	2nd Lieutenant	0.00	0.00	.	0.998	35
	Lieutenant and above	0.28	0.07	1.11	0.070	316
	Other	0.76	0.34	1.69	0.498	461
Discharge type	Fully medically fit	1.00				1,889
	Medically unfit	2.05	1.22	3.44	0.007	2,130
	Partially/Totally permanently disabled	6.46	2.06	20.24	0.001	56
	Dishonorable discharge	4.07	1.13	14.63	0.032	53
	Venereal disease	5.09	0.58	45.02	0.144	17
	Died before discharge/Unknown	26.72	10.85	65.78	0.000	44

Results for longer-term (post-1921) mortality, using Cox regression, are shown in Table 6, controlling for year of birth. As with short-term postwar mortality, men from an unskilled working-class background had higher mortality than those from a skilled working-class background, as did those from casual poor/criminal families. Farming men had the lowest mortality. Also with low death rates were engineers/sappers, and corporals and sergeants. Once again, discharge status proved to be a significant predictor of mortality outcomes. Longer-term, men discharged as medically unfit had 15% higher mortality than those discharged fully medically fit. Those discharged as partially/totally permanently disabled had 45% higher mortality, while those discharged due to venereal disease experienced death rates that were more than twice as high. Education and marital status at enlistment were not associated with longer-term mortality (Table 6).

Figure 13 summarises the mortality experience from 1922 for the early 'Diggers to veterans' sample, by selected characteristics, and controlling for year of birth. In general, veterans in this sample who survive to 1922 and whose death is traced, lived to an average of 68.8 years, compared to 69.3 years for the general population. In terms of family social class, those with the lowest life expectancy are the Casual poor/Criminal (63.4 years) and the Unskilled working class (66.8 years) and those with the highest age at death are Farmers (72.1 years).

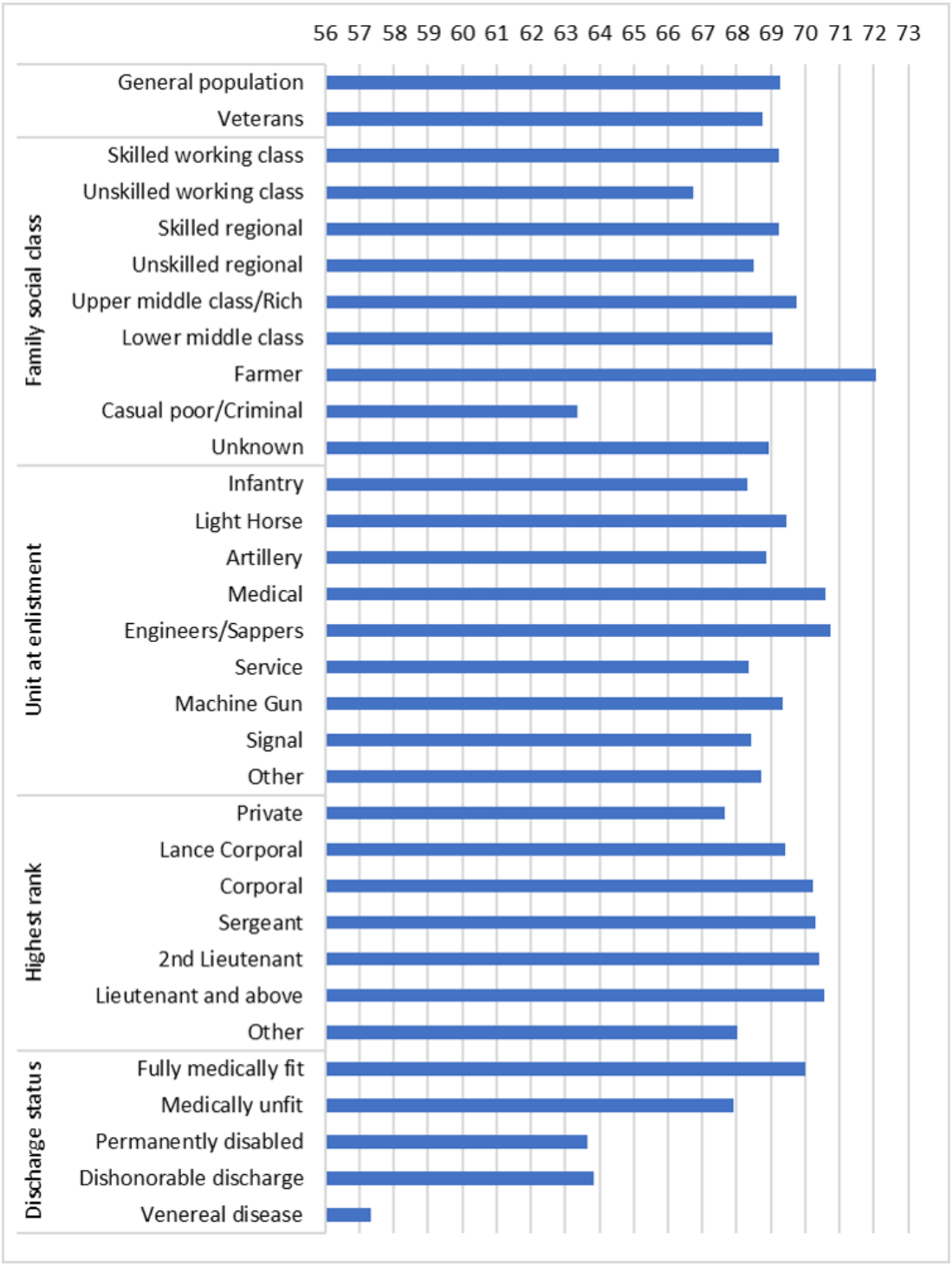
Those in Engineer/Sapper units had the lowest long-term mortality, resulting in an average age at death of 70.7 years. Corporals and sergeants also had significantly lower mortality, with life expectancies of 70.2 and 70.3 years respectively. Discharge status continued to impact on mortality long term. Men discharged fully medically fit, who survived to 1922, could expect to live to an average of 70.0 years, 0.7 years more than for the general population. In contrast, other discharge categories had much lower life expectancies: medically unfit, 62.0 years; permanently disabled, 63.7 years; dishonourable discharge, 63.9 years; and venereal disease, 57.3 years.

Table 6 *Cox regression. Soldier characteristics associated with hazard of dying after 1921, Diggers to Veterans sample*

Characteristics		**HR**	**95% CI**		**p-value**	**n**
Birth year		1.00	1.00	1.00	0.000	4,088
Height in inches		1.00	0.98	1.01	0.680	4,038
Embarkation month		1.00	1.00	1.00	0.366	4,088
Education	Primary school only	1.00				3,587
	Left at 14 years of age	1.03	0.89	1.20	0.696	228
	Private school	1.18	0.95	1.48	0.136	114
	Technical college	1.00	0.66	1.50	0.991	24
	University	0.93	0.69	1.25	0.611	67
	Other/not given	0.98	0.75	1.28	0.902	68
Family social class	Skilled working class	1.00				844
	Unskilled working class	1.15	1.03	1.27	0.012	642
	Skilled regional	0.98	0.86	1.12	0.803	312
	Unskilled regional	1.00	0.90	1.12	0.952	630
	Upper middle class/ Rich	0.98	0.81	1.18	0.808	230
	Lower middle class	1.01	0.88	1.15	0.930	324
	Farmer	0.77	0.66	0.90	0.001	215
	Casual poor/Criminal	1.58	1.18	2.11	0.002	50
	Unknown	1.02	0.91	1.13	0.768	841
Marital status at enlistment	Single	1.00				3,540
	Married	0.98	0.88	1.09	0.718	499
	Other/Not given	0.90	0.67	1.22	0.514	49
Unit at enlistment	Infantry	1.00				2,472
	Light Horse	0.99	0.89	1.10	0.813	514
	Artillery	0.98	0.87	1.11	0.784	400
	Medical	0.87	0.75	1.01	0.071	204
	Engineers/Sappers	0.84	0.72	0.98	0.027	186
	Service	0.94	0.79	1.12	0.472	155
	Machine Gun	0.99	0.72	1.35	0.941	40
	Signal	0.89	0.62	1.27	0.515	32
	Other	1.02	0.81	1.27	0.896	85
Highest rank	Private	1.00				1,884
	Lance Corporal	0.90	0.80	1.02	0.094	313
	Corporal	0.83	0.74	0.93	0.001	408
	Sergeant	0.85	0.78	0.94	0.001	686
	2nd Lieutenant	0.98	0.69	1.39	0.903	35
	Lieutenant and above	0.89	0.78	1.03	0.119	313
	Other	1.06	0.94	1.19	0.377	449

Discharge type	Fully medically fit	1.00				1,867
	Medically unfit	1.15	1.07	1.23	0.000	2,068
	Partially/Totally permanently disabled	1.45	1.09	1.93	0.011	52
	Dishonorable discharge	1.30	0.98	1.74	0.072	50
	Venereal disease	2.63	1.57	4.41	0.000	16
	Died before discharge/Unknown	0.95	0.67	1.35	0.781	35

Figure 13 *Average age at death for men who survived to 1922, by selected characteristics*



4.4 UNTRACED DEATHS

Out of the 'Diggers to veterans' early sample of 6,183, a death could not be traced for 607 men (10%, Table 2). A logistic regression (not shown) was run to compare the characteristics of those whose post-1918 death were traced, to those who survived the war but subsequent death was not found. Compared to the reference categories, those more likely to have a death traced were those from a skilled regional family background, those whose highest rank was lieutenant or above, and those who were discharged medically unfit. Those less likely to have a death traced were those whose family social class is unknown, those who served in Service or Signals, and those with a dishonourable or venereal disease discharge.

Of these, only discharge characteristics are associated with post-1918 mortality differences (Tables 5 and 6). Being discharged medically unfit, dishonourably, or with venereal disease are all associated with higher mortality. Post-1918 deaths were found for 87% of men discharged fully medically fit, 88% of those medically unfit, 95% of the permanently disabled, 67% of dishonourable discharges, 74% of those discharged with venereal disease and 92% of 'other'. Assuming that untraced deaths have similar mortality patterns to traced deaths for each category, tracing the same proportion (or all) deaths for each category would decrease overall post-1918 veteran life expectancy by 0.01 years (5 days). That is, there would be virtually no effect.

5 DISCUSSION AND CONCLUSION

This is an early exploratory study examining mortality during military service and in civilian life after the war. Mortality of Australian enlistees during service in World War 1 was highly correlated with individual characteristics. Taller men and single men were more likely to die during the war, controlling for other characteristics (Table 4). Perhaps these men were more likely to volunteer (or be volunteered) for dangerous assignments, and perhaps taller men were simply a larger target. When we have the full sample of AIF we will also be able to look in closer detail at the units and the engagements that suffered the highest casualty rates. The finding for taller men is in contrast to a study by Kanazawa (2007), who found that British enlistees in World War 1 were more likely to survive if they were taller.

Family social class was not associated with the likelihood of dying during war service, however those men with a higher education (private school, technical college, university) had a higher probability of death in service. The reasons for this are to be investigated. Men who served in the Infantry had the greatest risk of mortality and few escaped without injury or illness if they were 'in the line'.

Overall, men who had served in the Australian Imperial Force had higher age-specific mortality and lower life expectancy than the general Australian male population in the immediate post-war period, excepting the pandemic year of 1919 where mortality in the general young-adult population was twice its usual level. However, three years after the war, mortality for the surviving veteran cohort throughout the rest of the life course was very similar to that of the general Australian male population, with a life expectancy differential of only 0.years (less than 2 per cent). It also needs to be noted that after Armistice was declared 11 November 2018, the Australian veterans were repatriated through 1919 and early 1920, after delays caused by the shortage of troop ships. This prolonged repatriation, however frustrating, permitted psychologically-distressed men a gentler adjustment to post-war life while surrounded by their mates, and for the physically injured, longer physiotherapy to return function to wounded bodies (McMeeken, 2018). None the less, those with severe disabilities or tuberculosis were more likely to die in the early years after the war, leaving a surviving cohort of men with partial or no disabilities, who were closer in health to the general population.

This will be for many an unexpected finding, as it was for us. Much has been invested in a war-trauma narrative of a broken generation. While this may be true of nations that suffered much higher casualties such as France and Germany, Australian scholars have used war service and repatriation medical records without a demographic framework, so that severe cases are too easily represented as speaking for the full veteran population (Blackmore, 2008; Larsson, 2009). Noonan (2014) has argued that all post-war veteran deaths until the outbreak of World War 2 should be conceptualised as World War 1 casualties. Wilson et al. (2014) have included war deaths in the survival analysis for

New Zealand World War 1 servicemen which inflates the apparent impact on survivors. Our analysis shows that it is important to decompose mortality differences by war deaths, and short- and long-term post-war deaths.

Our analysis in this paper has been of early enlisters who had to pass stricter standards of fitness such as height, chest measurements, dental health, foot deformities (flat feet), eyesight and hearing. As volunteers dried up in 1916, standards were dropped and men embarked who were not fit for military service at all because of poor vision and tuberculosis. More older men enlisted because of unemployment, along with boys who falsified their ages. These 'senile' or 'under-age' or unfit enlistees were usually detected once they reached Britain or the Middle East and were either assigned work behind the lines or sent home. It is too early to speculate on the postwar health of the later enlistees, but we note that they will include a useful sample of men who embarked but who arrived after the Armistice.

Until we analyse individual causes of death, such conclusions remain uncorroborated. Likewise, the rise in deaths during World War 2 of those men who had served during World War 1 needs careful analysis of individual cases. Rheumatic fever was rife on Gallipoli but not in France or the Middle East, and we will be looking at subsequent cardiac and renal health across the sample for any differences in exposures and outcomes. Other critical exposures to be analysed include being blown up and buried, removal from the line for nervous conditions, trench fever, and gassing.

We will also need to account for medical care and its possible effects on survival. Medical care was privatised, with working-class people paying into Friendly Societies for subsidised care from private practitioners, or seeking care as outpatients in public hospitals. Veterans who were found to be suffering from a disability that could be linked to an injury, exposure or disease in their conduct record, received free medical care. Most disabilities were judged to be partial, however, and many of the health conditions reported to the Repatriation Department were the results of ageing and poverty. By the time these men were old in the early 1970s, all veterans received free care while their compatriots did not until the 1980s. Many applications for a pension were refused because no clear link could be established between the complaint and the war. Free medical care may have extended the lifespan of some disabled veterans, but again this will require careful analysis of individual cases. We can note at a population level that the comparative advantages veterans enjoyed between the two world wars were preference for employment over non-veterans (which was much resented); increased opportunity to government jobs which were secure; assistance with housing through the War Service Home Loans scheme, and with that, a reluctance on the part of the banks to foreclose on ex-servicemen during the Great Depression.

We can also say that mortality varied between groups who had served and that life course factors persisted despite war exposures. Survival after the war was strongly correlated with family social class —in addition to war exposure, highest rank attained and the state of health classified at discharge (Table 6). It may be that less supported early lives were more risky and resulted in poorer recovery from the physical and psychological trauma of war. This finding correlates with our work on convicts transported to Van Diemen's Land (1812–1853) where the most persistent relationships with mortality were the social conditions of their birthplace, with those from sea ports where life was perilous for women (their mothers) having the shortest life spans (McCalman & Kippen, 2017; McCalman & Kippen, 2019). These historical findings support modern studies of the effects of toxic stress in utero and early life on cognitive development and on mental and physical health in later life (Kelly-Irving et al., 2013; Ellis, Dowrick, & Lloyd-Williams, 2013; Luby et al., 2013). The Diggers to Veterans and Founders and Survivors datasets suggest that resilience to traumatic events in adult life was mediated by early life exposures in the past as well as the present.

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REFERENCES

Beaumont, J. (2013). *Broken nation: Australians in the Great War*. Crows Nest: Allen & Unwin.

Blackmore, K. (2008). *The dark pocket of time: War, medicine and the Australian state, 1914–1935.* Adelaide: Lythrum Press.

Bollard, R. (2013). *In the shadow of Gallipoli: The hidden history of Australia in World War One.* Sydney: New South Publishing.

Booth, C. (1892-1897). *Life and labour of the people in London*. London: Macmillan.

Brett, J. (2019). *From secret ballot to democracy sausage: How Australia got compulsory voting*. Melbourne: Text Publishing.

Butler, A. G. (1938–1943). *The official history of the Australian Army Medical Service in the war of 1914–18* (Vols. 1–3). Canberra: Australian War Memorial. Retrieved from https://www.awm.gov.au/collection/C1416843

Costa, D. L., DeSomer, H., Hanss, E., Roudiez, C., Wilson, S. E., & Yetter, N. (2017). Union Army veterans, all grown up. *Historical Methods*, *50*(2), 79–95. DOI: 10.1080/01615440.2016.1250022

Cowper, D. C, Kubal, J. D., Maynard, C., & Hynes, D. M. (2002). A primer and comparative review of major US mortality databases. *Annals of Epidemiology, 12*(7), 462–468. DOI: 10.1016/S1047-2797(01)00285-X

Ellis, J., Dowrick, C., & Lloyd-Williams, M. (2013). The long-term impact of early parental death: Lessons from a narrative study. *Journal of the Royal Society of Medicine, 106*(2), 57–67. DOI: 10.1177/0141076812472623

Fisher, S. G., Weber, L., Goldberg, J., Davis, F. (1995). Mortality ascertainment in the veteran population: Alternatives to the National Data Index. *American Journal of Epidemiology, 141*(3), 242–250. DOI: 10.1093/oxfordjournals.aje.a117426

Garton, S. (1996). *The cost of war: Australians return.* Melbourne: Oxford University Press.

Hopper, J. L. (1986). The contribution of W. H. Archer to vital statistics in the colony of Victoria. *Australian Journal of Statistics*, *28*(1), 124–137. DOI: 10.1111/j.1467-842X.1986.tb00590.x

Human Mortality Database 2018. Australian annual single-year-of-age mortality rates (qx) by sex, 1921–2014, obtained from the Australian Bureau of Statistics. University of California, Berkeley (USA), and Max Planck Institute for Demographic Research (Germany). Retrieved from www.mortality.org

Inwood, K., Ross, J. A. (2016). Big Data and the military: First World War personnel records in Australia, Britain, Canada, New Zealand and British Africa. *Australian Historical Studies, 47*(3), 430–442. DOI: 10.1080/1031461X.2016.1205639

Kanazawa, S. (2007). Big and tall soldiers are more likely to survive battle: A possible explanation for the 'returning soldier effect' on the secondary sex ratio. *Human Reproduction*, *22*(11), 3002–3008. DOI: 10.1093/humrep/dem239

Kelly-Irving, M., Lepage, B., Dedieu, D., Bartley, M., Blane, D., Grosclaude, P., Lang, T., & Delpierre, C. (2013). Adverse childhood experiences and premature all-cause mortality. *European Journal of Epidemiology, 28*(9), 721–734. DOI: 10.1007/s10654-013-9832-9

Kippen, R., & McCalman, J. (2016). Crowdsourcing convict life courses, or, the value of volunteers in the age of digital data. In K. Matthijs, S. Hin, J. Kok, & H. Matsuo (Eds.), *The future of historical demography: upside down and inside out* (pp. 201–204). Leuven: Acco.

Larsson, M. (2009). *Shattered Anzacs: Living with the scars of war*. Sydney: University of New South Wales Press.

Liber Melburniensis. Centenary Edition (1965). South Yarra: Melbourne Church of England Grammar School, South Yarra.

Luby, J., Belden, A., Botteron, K., Marrus, N., Harms, M. P., Babb, C., Nishino, T., & Barch, D. (2013).The effects of poverty on childhood brain development. *JAMA Pediatrics*, *167*(12), 1135–1142. DOI: 10.1001/jamapediatrics.2013.3139

MacLean, A., & Elder, G. H. (2007). Military service in the life course. *Annual Review of Sociology, 33,* 175–196. DOI: 10.1146/annurev.soc.33.040406.131710

McCalman, J. (1984). *Struggletown: Public and private life in Richmond*. Melbourne: University Press.

McCalman, J. (1993). *Journeyings: A biography of a middle-class generation*. Melbourne: University Press.

McCalman, J., & Kippen, R. (2017). *Founders and survivors: Life course ships project*, dataset of 25,000 convicts transported to Tasmania, figshare. DOI: 10.4225/03/59ed402437518

McCalman, J., & Kippen, R. (2018). *Diggers to veterans database*, life-course dataset of 11,954 men who served in Victorian-raised units in the First Australian Imperial Force, World War One, 1914–18, figshare, DOI: 10.4225/03/5a97820682e78

McCalman, J. & Kippen, R. (2019). The life-course demography of convicts transported to Van Diemen's Land. *The History of the Family.* DOI: 10.1080/1081602X.2019.1691621

McCalman, J., Morley, R., & Mishra, G. (2008). A health transition: Birth weights, households and survival in an Australian working-class population sample born 1857–1900. *Social Science & Medicine, 66*(5), 1070–1083. DOI: 10.1016/j.socscimed.2007.11.040

McMeeken, J. (2018). *Science in our hands: physiotherapy at the University of Melbourne, 1895–2010*. Parkville: Faculty of Medicine, Dentistry and Health Sciences, University of Melbourne.

National Archives of Australia (NAA). Available from https://discoveringanzacs.naa.gov.au/browse/groupstories/7396

New Zealand Archives (NZA). Available from https://archives.govt.nz/search-the-archive/do-research/research-guides/war/world-war-one-1914-1918

New Zealand Government (NZ). Available from https://nzhistory.govt.nz/war/maori-in-first-world-war/introduction

Noonan, D. (2014). *Those we forget: Recounting Australian casualties for the First World War.* Melbourne: MUP Academic.

Robson, L. L. (1973). The origin and character of the first A.I.F., 1914–1918: Some statistical evidence. *Australian Historical Studies*, *15*(61), 737–749. DOI: 10.1080/10314617308595502

Rosental, P. A. (2003). The novelty of an old genre: Louis Henry and the founding of historical demography. *Population* (English Edition), *58*(1), 97–129. DOI: 10.3917/popu.301.0103

Shanks, G. D., MacKenzie, A., Mclaughlin, R., Waller, M., Dennis, P., Lee, S., & Brundage, J. F. (2010). Mortality risk factors during the 1918–1919 influenza pandemic in the Australian Army. *Journal of Infectious Diseases, 201*(12), 1880–1889. DOI: 10.1086/652868

Smith, L. (2007). *Australian Demographic Databank, 1901–2003*, dataset of annual deaths and population by age and sex. Canberra: Australian Data Archive. Available from https://pkg.robjhyndman.com/addb/

Stedman Jones, G. (1971). *Outcast London: A study in the relationship between classes in Victorian society*. London: Clarendon Press, Oxford, University Press.

Weaver, J. C. (2014). *Sorrows of a century: Interpreting suicide in New Zealand, 1900-2000.* Montreal: McGill-Queen's University Press.

Wilson, N., Clement, C., Summers, J. A, Bannister, J., & Harper, G. (2014). Mortality of first world war military personnel: comparison of two military cohorts. *BMJ, 349*(g7168), pp. 1–5. DOI: 10.1136/bmj.g7168

Wimmer, L. T. (2003). Reflections on the early indicators project: A partial history. In D.L. Costa, *Health and labor force participation over the life cycle: Evidence from the past* (pp. 1–10). Chicago: University of Chicago Press. Retrieved from https://ideas.repec.org/h/nbr/nberch/9626.html

Wrigley, E. A., Schofield, R. S. (1989). *The Population History of England, 1541–1871*. Cambridge, Cambridge University Press.