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*Research Article*

# Deaths and survivors in war: The Italian soldiers in WWI

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# Deaths and survivors in war: The Italian soldiers in WWI

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## Abstract

**OBJECTIVE**
The aim of this paper is to study the selection effects of mortality among soldiers in WWI.

**METHODS**
Individual-level data of more than 62,000 soldiers born between 1874 and 1899 in north-eastern Italy was used. Almost 10% of these soldiers died in the war. A data set was constructed by linking two different sources, the call-up registers and the Roll of Honour of the fallen Italian soldiers of WWI.

**RESULTS**
The risk of death of soldiers in war depended partly on the soldier's assignment to corps and partly on personal behaviour and individual characteristics. A relatively small number of soldiers of large body size fell in battle. The most universal cause of death was illness. Literate soldiers were less likely to die in captivity.

**CONTRIBUTION**
The concept of mortality differential has rarely been applied to soldiers engaged in conflict. This is because they were supposed to experience similar perils and run similar risks during the war. However, our study found evidence of strong mortality differentials among soldiers, which were strictly associated with the striking differences in terms of literacy, education, and socio-economic status that permeated the Italian society of that time and that the universal enrolment allowed to highlight.

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# 1. Introduction

Epidemics, famines, wars: Every population has been faced with these three dramatic events throughout its history. Despite their intensity, frequency, and overall range, the risk of dying in those terrible circumstances was not uniform across and within populations. Even during the Black Death that spread across Europe in the 15$^{th}$ century, some people were more likely to die than others. Mortality differential was the norm. But if it is not unexpected to find differentials between social groups, gender (especially in wartime), or other categories, hypothesising mortality differentials among soldiers can become more difficult. Lack of documentation and of detailed records of death, common social origin of soldiers, and other complex factors may make it problematic to highlight the existence of differentials in mortality among soldiers. However, in a context such as WWI, where the enrolment was universal, the troops provided a representative picture of the whole population. Given that the Italian society of that time was characterised by striking differences in terms of literacy, education, and socio-economic status, World War I represents a good case study to test whether or not Italian soldiers had similar risks of death during the conflict.

Only very rarely have scholars focused on mortality selection among soldiers. Kriner and Shen (2016: 554), for example, observe that, with very few exceptions, “academic scholarship has not seriously explored inequality in military sacrifice.” When this issue has been researched, it has almost always been in relation to recent conflicts. Most studies, in fact, concern American troops in Vietnam. These papers focus largely, albeit not exclusively, on selection in terms of race and class (Badillo and Curry 1976; Little 1981; Appy 1993), which were questions that had become part of the national political debate at the time (Wilson 1995). Studies concerning the social class of soldiers have also involved differences of opinion (Barnett, Stanley, and Shore 1992; Gimbel and Booth 1996; Talbot and Oplinger 2014; Zeitlin, Lutterman, and Russell 1973; Mazur 1995; Allen, Herrmann, and Giles 1994). Analogous observations have also been made in relation to other conflicts (Schaefer and Allen 1944; Mayer and Hoult 1955) and, in particular, for the Iraq War (Maynard 2009; Gifford 2005).

While studies have focused on the importance of race and class in war deaths (Kriner and Shen 2010), in more recent times some have shifted onto other characteristics. Whalley and Deary (2001), for example, have highlighted how younger men with higher IQs were less likely to survive during WWII. MacLean and Parsons (2010), on the other hand, have argued that the best educated soldiers were more likely to survive the war.

A study that goes beyond social class and race for the Iraq War has looked at the odds of death and the characteristics of military personnel. Buzzel and Preston (2007) have highlighted how the likelihood of death for American soldiers in Iraq varied considerably depending on their rank and the corps they belonged to. The likelihood of a soldier's death was found to be significantly associated with demographic characteristics, such as age and place of origin (metropolitan vs non-metropolitan) of soldiers (Curtis and Payne 2010).

There is a limited number of research works that identify specific risk factors based on the anthropometric characteristics of individuals besides demographic, social, and racial characteristics or the deployment of troops in the operations theatre. An early example of this type of study comes from Sir Francis Galton, who, in the second half of the 19th century, claimed that tall soldiers were 33% more likely to be killed in combat than short ones (cited in Samaras 2007: 54).

In addition, one should also consider the role of individual attitudinal factors, i.e., relative degrees of ability to perform military tasks (Little 1981). From a practical point of view, this aspect is very important because identifying these factors would make it possible to minimise losses through the intelligent assignment of soldiers across various units.

Theoretical reflection indicates that the risk of death is largely determined before the start of the fighting through the differential selection into various army forces and the sorting mechanism into differential occupational assignments within the military (Kriner and Shen 2016: 564). In countries where there is no compulsory military service, access to the armed forces is different depending on educational levels and family background. In the United States, for example, young people with a high level of education are more likely to be able to enter the armed forces, while those with a very low level of education will find it more difficult to enrol. Once recruited, soldiers can be assigned to combat units or find themselves being used for tasks that do not involve the use of weapons. Again, educational level and background matter here (MacLean and Parsons 2010). Attitudinal factors kick in only when soldiers are employed out on operational missions.

The aim of the paper is to study, with the aid of individual data, the effects of selection on the mortality of Italian soldiers in the WWI. Our approach differs from previous investigations as we encompass a wider range of attributes, ranging from socio-economic characteristics to anthropometric ones and including variables related to the employment of soldiers in the army. This research is made possible by the availability of a large amount of data drawn from two different types of sources. The first includes about 60,000 call-up records and the second about 6,000 registrations of soldiers' deaths in the war.

Italian recruitment, as well as that of almost all the combatant armies, was carried out in WWI on a universal and compulsory basis, which clearly strengthens our research. The focus is, therefore, on the cohorts of all the young men who underwent military medical examinations and were found suitable for service in the army.

Differential selection was related only to the health and physical characteristics of young people, and, therefore, the sorting mechanism was applied to all suitable candidates. Thanks to this feature, we are able to determine, in addition to the influence of the sorting mechanism, the role that the causes of selection not attributable to individual choices, such as body size or attitudinal factors, had on the death risks.

We are also able to look at how selection operated on death causes or environmental contexts where the death occurred. Different factors of selection might influence whether soldiers were injured, ill, or in prison camps when they died.

Another original feature of our research is our decision to study WWI. The Great War represents a very different context from that of previous studies on death and demography in war. Not only were the number of deaths among soldiers incomparably greater than in Vietnam, Iraq, and other conflicts examined in this regard, but the situations in which WWI soldiers died from armed clashes seem to be badly correlated with the concept of selection. We refer here to trench warfare, in which the vast majority of soldiers were killed by prolonged bombardments preceding attacks; fell victim to rifle shots, chemical weapons, and hand-to-hand combat; or were killed by machine gun fire in no man's land during attacks. If war experiences were similar, differences were conversely the norm among soldiers.

In order to achieve this objective, the paper is divided into five parts. Section two discusses the characteristics of the conflict and the main elements associated with the deaths of soldiers in the war. Section three describes the sources used, and section four presents the descriptive analysis. Section five illustrates the results from survival models. Finally, the last section discusses the results in comparative terms.

## 2. Mortality and differential mortality in the Great War

Each conflict presents specific death risks for participating soldiers. WWI represented a watershed in this regard in many different ways. From a military point of view, it was not a war of movement due to trench warfare and unfamiliar styles of warfare. Weapons were, of course, developed to overcome the specific difficulties of a static war. These included gas attacks, tanks, and aviation. Other weapons, with a prior history, were used to an unprecedented extent in this unprecedented context, particularly artillery and machine guns.

In terms of cause of mortality, the Great War was also the first conflict in which the number of deaths by injury was higher than the number of deaths from illness. An exception are the deaths in the American army (Cirillo 2008), where illness accounted for more deaths than combat. But this is due to the fact that the US military forces were only deployed on a large scale in 1918, the year of the Spanish flu epidemic (see Byerly 2005).

From the demographic point of view, there had never been a war with such huge armies. It is estimated that no less than 65 million soldiers served in the conflict (Overmans 2004: 664). According to estimates, 8 to 10 million of them died in the various theatres of war, with most scholars agreeing on a figure of over nine million deaths (Prost 2014: 588). The absolute number of deaths were unprecedented as well as the concentration of deaths in brief periods of time. Not infrequently tens of thousands of lives were lost, during offensives, in a single day. In addition to deaths, there were also huge numbers of injuries, and many combatants were permanently disabled.

Italy entered the war on 24 May 1915, ten months after the conflict began. Although the Italian military effort did not reach the intensity of that of other powers engaged in the war, particularly France and Germany, there were more than five million Italian soldiers who took part in the conflict (Zugaro 1927): Even in the WWII Italy was unable to mobilise similar numbers. A total of 560,000 Italian servicemen died, and among the major European powers, Italy was the one that experienced the highest number of deaths due to illness among the its soldiers (Fornasin 2017a). In addition, about 50,000 deaths occurred in prison camps in Germany and Austria-Hungary, the largest contingent for any Western European country (Fornasin 2018a). There are a few Great War studies that attempt to identify the risk factors for death in service, though many often lack quantitative analyses. Two important exceptions are the work by Jules Maurin on the soldiers of Languedoc (1982) and more recently a paper from Guillot and Parent (2018). In a war in which almost all the countries involved were subject to compulsory conscription, the differential selection essentially operated on the judgements of the various medical commissions in ascertaining the physical fitness of young people to serve their country. Those who were in Great War armies, therefore, had not gone through a process of self-selection. Once recruited, however, WWI soldiers were subject to the sorting mechanism. This selection varied depending on national traditions and national armies. In the American army, for example, the death risks faced by white and black soldiers have been analysed from this point of view. White soldiers were more likely to fall in combat while black soldiers were frequently to be found in labour units because the American command had little faith in the combat ability of black American soldiers. Black soldiers were, on the other hand, more likely to die of illnesses (Keene 2002).

For Italy, but also in other European countries, research has focused on the mortality differentials between corps or, more often, between single units, not least to show which units were most often sacrificed. Italian military historians, for example, have observed that WWI infantry had the largest number of victims in both relative and absolute terms (Isnenghi and Rochat 2004). Most servicemen were infantry, of course, but there was also the question of the tasks given to infantry soldiers and the theatres of war in which infantry served.

Another aspect that points to mortality differentials is the different rate of the fallen between officers and soldiers. In the French army, for instance, the rate among the officers was 19%, against a value of 16% among rank-and-file soldiers (Huber 1931: 416). British officer mortality was higher than soldiers as well (Winter 1977). Research on the Italian army had not yet given us certain results: There is no agreement among scholars that mortality was higher among non-commissioned officers than it was among privates (Del Negro 2009). However, mortality by rank may reflect the social composition of casualties. In the United Kingdom it was the elites who paid the highest price (Winter 1977). In Italy, however, the opposite seems to have been true, even if the higher social groups were those who had been most in favour of intervention in the war. In what is perhaps the only study that concerns the war-related mortality of university students, it has been suggested that students were better insulated from death by illness than from death by injury because of their higher standard of living: University students belonged to the bourgeoisie (Del Negro 2015). Finally, some studies also refer to occupation as a possible element of discrimination (Ilari 1990: 479–495). Political propaganda in wartime, particularly that of the pacifist parties, highlighted that it was the working classes that made the greatest sacrifice in terms of lives lost (Isnenghi and Rochat 2004).

We do not know that there are studies on the level of schooling for combatant nations, save for the United Kingdom, though here there would be a relationship with the social class of origin. In France, the United Kingdom, and Germany there were almost no illiterate servicemen, whereas in Italy there were illiterate soldiers. In this regard, it is possible to distinguish how much more dangerous it was for soldiers who read and wrote than it was for the illiterate.

In a study on the body size selection among British soldiers, Satoshi Kanazawa (2007: 3002) determined that, looking at a sample of over 1,000 soldiers in the Great War, “surviving soldiers were on average more than one inch (3.33 cm) taller than fallen soldiers.” Kanazawa suggests three possible explanations for this evidence. First, taller and heavier soldiers may have been physically stronger. Second, in case of a positive correlation between height and intelligence, taller men were able to avoid the most dangerous combat situations. Third, if vital organs do not increase in size linearly with body size, “then it means that taller and heavier soldiers, while they may be more likely to be shot have nonetheless more room in their body where they can be ‘safely’ shot and still survive the injury” (Kanazawa 2007: 3007).

A number of special features that could have a selective effect on deaths are especially relevant among prisoners of war. The number of Italian soldiers who died in captivity was much greater than that of the other entente powers but also that of POW deaths among German soldiers. Italian war memorials are rich in descriptions of the sufferings of captive soldiers. From some of these testimonies (for example, Dalla Volta 1919) there come to light selection factors, already highlighted in the literature on famines, starting with pathologies such as oedema, which comes about with food deprivation and causes death by hunger. The various testimonies converge in describing how, during the months spent in captivity, prisoners experienced, in addition to dramatic weight loss, other results of caloric restriction of the physiological-biological order (such as apathy and increased hours of sleep). There were also problems of a cultural and social order, where some people knew how to better adapt to the terrible circumstances in which they found themselves.

A first factor of selection in captivity depended on the role within the armed forces and therefore was related to the different treatment of soldiers and officers. Officers enjoyed better living conditions in prison camps than the rank and file, so their mortality levels were also much lower. For privates, however, other factors were involved and were frequently described in diaries: physical fortitude, the ability to read and write, geographical origin, and skills related to their peacetime occupation.

The deaths of soldiers could, therefore, be the result of different effects which scholars have typically investigated in an anecdotal way. However, there are sources that allow us to investigate these matters from a more quantitative point of view.

## 3. Sources

The present study focuses on soldiers from Friuli, the Italian province at the extreme north-eastern edge of the country that bordered the Austro-Hungarian Empire on the eve of the conflict. The province had, at this date, 728,000 inhabitants (Istat 1914). The territory is almost equally distributed between the plains and the mountains, with a narrow intermediate hilly area. This area’s geography is of some importance in this work because the recruitment of soldiers was also done on a territorial basis. In particular, most young mountain people performed military service in the Alpine troops, an elite corps. The only urban centre of importance was Udine, with 47,000 inhabitants when the war began. From the economic point of view, the main activity of the province was agriculture, while most of the industrial activities were concentrated in Udine. Migration flows were very strong, almost exclusively for males: These men travelled into Central Europe in search of work. Most were involved in construction.

In order to study mortality in a war context, information is required on the number of fallen soldiers and the population at risk, i.e., the total number of soldiers. Happily, two separate databases offer the necessary information.

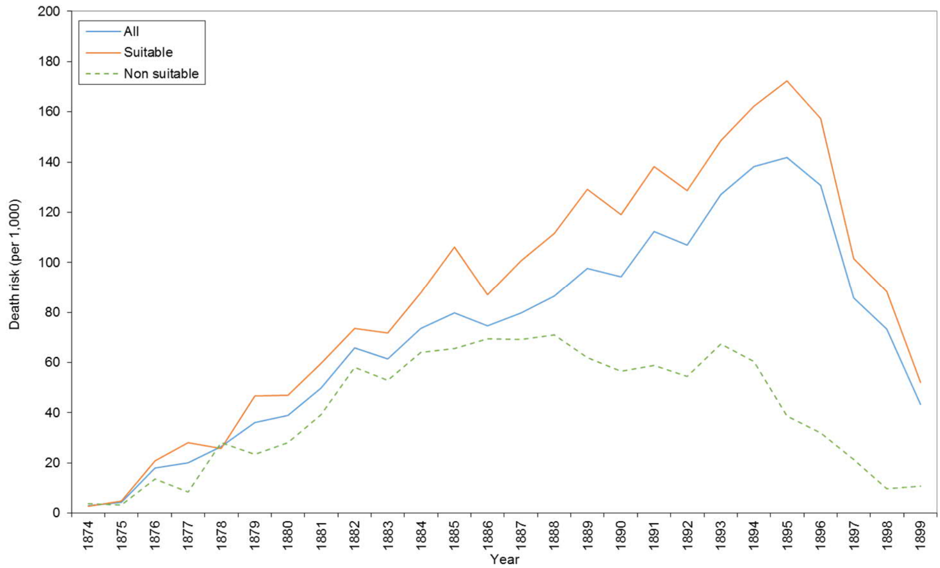
Data on soldiers who died in conflict comes from the *Albo d'oro dei caduti della Guerra* (Provveditorato generale dello Stato 1926–1964) while the at-risk population can be inferred from call-up records. The *Albo d'oro* is a register of honour in which the names of the Italian soldiers who died during the conflict or for causes directly attributable to it were recorded. This record has listed 529,025 Italian servicemen. The *Albo d'oro* had to include all the dead, not just those that fell in combat but also those who were missing in action, disappeared in captivity, and died due to illness or accidental causes, suicides, etc. (Zugaro 1926; Fornasin 2017b). Despite this ambitious remit the *Albo d'oro* does not report the names of all the fallen. It is estimated that about 5.5% are missing (Fornasin 2018b).

The second source is the Italian army's call-up records. This data is collected in the database Friuli/*in prin*, which includes more than 350,000 records concerning subjects born in Friuli between 1846 and 1900 (Marzona and Fornasin 2007). The information contained here, in addition to the outcome of military medical examinations and personal data, gives some physical characteristics of conscripts, such as height and chest circumference, occupation, and ability to read and write (Lamioni 2002). Depending on the birth cohort, the time span from the moment of the military medical examination, which took place at the age of 20, to that in which the soldier entered the population at risk of dying in war was naturally different. Here, however, we cannot separate out those who did not serve because they were removed after the military medical examination but prior to the beginning of the hostilities, those who died during the conflict but for reasons not related to it, those who were able to serve but deserted, or those who were employed in war production in manufacturing or non-military tasks.

A further element to consider is that during the war, in an effort to swell the ranks, rejected applicants in medical examinations before the war were called back for another visit to the doctor. Those who were affected by crippling diseases or severe malformations were not considered, but many who had a weak physical condition or pathology that could be healed were enlisted. In many cases, these young people actually fought; in others they were assigned to tasks where physical fitness was not considered necessary, and they served mainly at a safe distance from the front. Unfortunately, there is no way in the sources of distinguishing those who were selected and those who were not: It is only possible to distinguish between those who were deemed suitable after a medical exam and their peers who were rejected.

In order to account, at least in part, for the effect of this exclusion, Figure 1 shows the probability of death of those individuals still alive at the date of the military medical examination.

**Figure 1: Risk of death for suitable, not suitable in the last 'regular' medical examination before the war, and total conscripts by birth cohort**




Of course, those who had been fit for military service since the 'regular' visit had a much higher risk of death than others. This is evident, particularly with the cohorts of the late 1880s onwards. The highest levels of mortality were experienced by the birth cohorts that, at the outbreak of the conflict, provided the youngest soldiers, i.e., those of the 1894–1895 cohort.

## 4. Descriptive analysis

In order to carry out the analysis, the information from the two sources have been merged into a single data set, in which all the acts relating to a single soldier are linked together. A nominative linkage procedure has been used, which allowed an automatic reconstruction of the very large part of soldier career and acts. Only a minority was then completed in a semi-automatic mode, using information taken from both sources: name, surname, patronymic, and birthplace of the soldiers. In this way it has been possible to link the different information that has allowed us to identify possible selection factors. The fallen of the *Albo d'oro* that satisfies the requirements for the analysis are 7,633, while the number of medical examinations are 82,540. According to these figures, therefore, it would appear that about 9.2% of the young people who were able to perform a 'regular' medical examination died either in combat or from other war-related questions.

Table 1 summarises the number of deaths by cause and context from our data. The categories used in the table are the same as those used throughout the paper. As can be seen, only the first three refer to causes of death, while the last one refers to a context.

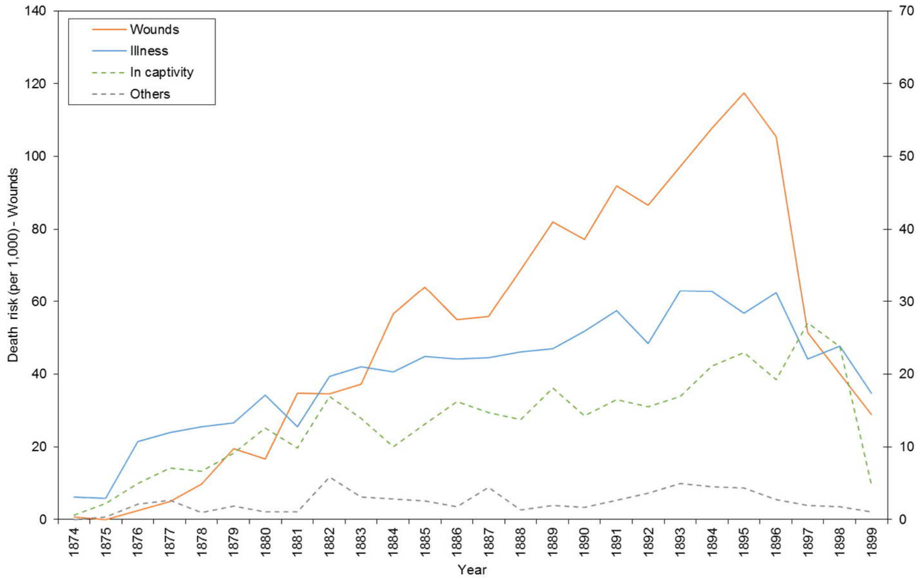
We need to clarify this choice. Those who died in captivity can also be divided into different causes, just as we have done for others. However, the unusual circumstances in which these deaths occurred convinced us of the need to consider them separately. Most of these deaths occurred in the first half of 1918 and concerned, for the most part, prisoners captured between October and November 1917. Almost all of these Italian POWs died of deprivation. It is however evident that the chance of dying in captivity is strictly associated with the probability of being captured and confined.

**Table 1: Casualties by cause of death**

| | N | % |
|---|---|---|
| Wounds | 4,522 | 59.2 |
| Illness | 1,717 | 22.5 |
| Other | 206 | 2.7 |
| In captivity | 1,188 | 15.6 |
| Total | 7,633 | 100.0 |

The risk of death also, naturally enough, varied according to the cause. Figure 2 shows the risk of death considered separately for illness and injury, while a separate breakdown describes the probability of death for prisoners. In this case we can see that if some birth cohorts were more susceptible to selection from combat, this happened only in a secondary way with regard to diseases. The mortality of soldiers, at least compared to their birth cohort, was mainly caused by death on the battlefield rather than other causes. The risk of dying from injuries gets lower as age gets older, while that from illness decreases much more slowly. Older cohorts had a higher death risk from illnesses than from combat injuries.

**Figure 2: Risk of death by cause and context. Birth cohorts 1874–1899**




On the Italian front, the number of soldiers captured by the Austro-Hungarian army and the number of deaths in captivity is comparatively high. Overall, the number of prisoners is estimated to be about 600,000, half of whom were captured at the start of the Battle of Caporetto (24 October 1917) and in the days immediately following. Perhaps in no other battle of the Great War were so many prisoners taken in such a short span of time. Of these prisoners, about 50,000 never returned home. Figure 2 highlights the risk of death in prison. As with the other causes of death, an increasing trend of risk is observed.

Assessed as a whole, it is clear that the risk of death increased from birth cohort to birth cohort. In part, this is explained by the fact that from the moment of the 'regular' medical examination to when the cohort began to be employed at the front, some could have died or been injured from other non-military causes, thus reducing the number of people exposed to the risk of dying in war. But, sadly, we cannot correct the number of soldiers exposed to war risk. Obviously, the more time passed, the greater these possibilities were. However, the time lag is not the only cause on which death risk depends. Other causes concern the age-related employment of soldiers. Those born before 1882 were not employed at the front but were part of the territorial militia. Although these soldiers should not in principle have been involved in armed clashes, the continuation of the conflict meant that this rule was increasingly waived. The date that the different cohorts were called to arms is another possible explanation. As the war progressed, in fact, younger and younger cohorts were called up, bringing forward the moment when the new soldiers would take up arms; older classes were also increasingly brought in. The effects of this are clearly visible from the generation of 1896 onwards, when death risks became significantly lower. However, mortality also depended on when new cohorts were called to the front. This effect stands out in the series of death risks in prison, which are distributed differently from those caused by injury and illness. In particular, the cohorts most affected by the POW experience were those of 1897–1898, which had been in the war between the end of 1916 and mid-1917, and which, at the time of the Battle of Caporetto, the greatest defeat in the history of the Italian military, were still relatively intact. They were, therefore, also the ones who were the most numerous among the prisoners taken in that battle. At the end, the determinants of death risks associated with birth cohort are numerous, which pressed us to use risk models in order to better interpret the single contribution of each of them.

## 5. The model

A survival analysis was carried out using both a binomial and a multinomial logistic model. The first model is aimed at capturing and investigating the effects of many potential factors on the risk of death for all soldiers in the Italian army, regardless of the cause of death and the context in which it occurred. The second one is a multinomial model that allows us to discriminate between the different causes of death of soldiers, highlighting differences in the mortality pattern of those who died either from injury, illness, or alternatively, from other less frequent causes. A distinct outcome is also reserved for those soldiers who died in captivity due to the very special characteristics of the context in which their death occurred.

The set of explanatory variables covers different aspects of the personal life and military career of soldiers. First of all, the soldier’s army corps mattered. Each army is divided into different specialties, which are assumed to determine different risks of death. Five different specialties were taken into account. Infantry, *Bersaglieri*, and Alpine troops were the three main corps of the army and those specifically employed on the battlefront. The Alpine troops in particular specialised in mountain warfare and operated mainly there. Artillery and logistic units (including healthcare units) were not generally employed on the battlefront, though they often operated close by. For these reasons, our hypothesis is that the infantry, *Bersaglieri*, and Alpines ran higher risks of death than soldiers belonging to the other two corps. Another element hypothetically affecting the risk of death is the territory of origin of the soldier. We have constructed this variable on a functional basis, differentiating between soldiers coming from the plains, hills, mountains, or Udine, the only important urban centre in the territory. The underlying hypothesis is that the environment of origin might in some way affect a soldier's chances of survival. On the one hand, the more soldiers were accustomed to adverse environmental and climatic conditions, the greater their resistance to disease should have been. On the other hand, soldiers born in Udine might have been more likely to be appointed to the rank of officer or to have had more opportunities to be employed in less risky tasks. We are assuming that citizens could enjoy a social advantage simply because they lived in close contact with a greater number of people of a higher socio-economic status and, therefore, that they could, through contacts, be assigned to less risky tasks (sorting mechanism).

Another group of variables deals with social and economic issues, namely occupation and literacy. As far as occupation is concerned, a simplified version of the Historical International Standard Classification of Occupations encoding system (Van Leeuwen, Maas, and Miles 2002) has been adopted. Conscripts at the moment of military medical examination were, therefore, classified as agricultural workers, construction workers, craft workers (including industrial workers), commerce employees (including transport operators), administration and high school occupations, and personal services (together with a number of non-specialised tasks, such as porters). Construction workers were classified in a separate category because of the importance of the construction sector in the economic structure of Friuli, as it was the occupation of most temporary emigrants. Obviously, the assumption is that the occupation reported at military examination did not change over time. The rationale of the introduction of occupation as an explanatory variable for risk of death is that conscripts might be assigned to different tasks according to their profession and socio-economic status. The higher the specialisation, the higher the probability that the soldier would be assigned to less risky tasks, just like those coming from higher social classes.

As for literacy, the military reports inform us as to whether the soldier was able to read and write or not at the age of 20. We speculate that literate soldiers were destined, more often than illiterate soldiers, for activities that were not strictly warlike ones. In particular, command positions had to be held by those who were literate. Another aspect to consider is whether the ability to read and write is not really a proxy for a more prudent behaviour on the part of those who had a higher education. Yet it had been the better educated people who had been on the interventionist front that had led to Italy entering the war. So being able to read may also be a proxy of greater adherence to patriotic ideals and, therefore, reflect a higher propensity to take risks in combat.

Finally, there are the physical characteristics of the conscripts as measured at the medical examination, namely height and chest measurements. Both can affect the risk of death in war in many different ways. On the one hand, low stature, as well as bad health, made it possible to avoid military service, thereby protecting many young people from the risks of death directly associated with the war (differential selection). On the other hand, shorter soldiers who were enrolled in the infantry ran very high risks of death. Soldiers who fought in the same corps, and who were, therefore, subject to similar risks of death, may represent easier or more difficult targets according to their body size. For this reason, it can be assumed that the soldiers who offered a larger body surface would be more at risk of being injured and, therefore, less likely to survive. However, a taller soldier might also be physically stronger and, therefore, more resistant to diseases and wounds.

In addition, each model controls for the birth year. This is because soldiers spent a different number of months in war and had a different jobs in the army depending on their year of birth. By way of example, soldiers born before 1882 were part of the territorial militia and were less likely to be directly involved in clashes. Another aspect associated with this variable is the time elapsed from the moment of the first military medical examination to the moment of serving on the battlefront. The longer this period, the higher the probability of dying or being disabled before the beginning of hostilities.

Table 2 reports the frequency for each category of the variables included in the models. It is immediately evident that some variables, such as ‘military corps,’ have many missing data, which will have to be taken into account when commenting on the results. It is impossible to recover such pieces of information from other sources, just as it is useless to generate them by means of a multiple imputation technique. In fact, after the procedures of medical examinations, only a part of the young men fit for military service was immediately destined to a corps. And this attribution was done through a real random selection procedure. The others were finally destined to a specific corps only upon their call to arms during the conflict, and the destination was always assigned by random selection (Cerutti 2017). In addition, we cannot even differentiate between officers and privates. In fact, the large majority of officers were appointed during the conflict, which was obviously impossible to know and record at the time of the military medical examination.

**Table 2: Frequency of model covariates (%)**

| Variables | Freq. % |
|---|---|
| Military corps (ref. Infantry) | 15.4 |
| Italian Alpine troops | 6.9 |
| *Bersaglieri* corps | 1.6 |
| Artillery | 3.5 |
| Logistics | 3.5 |
| No information | 69.1 |
| Birth area (ref. Plain) | 40.1 |
| Hills | 28.8 |
| Mountains | 24.0 |
| Town | 7.1 |
| Occupation sector (ref. Agriculture) | 27.9 |
| Construction | 20.6 |
| Artisans and working men | 13.4 |
| Trade and transportation | 4.1 |
| Upper class and public administration | 3.7 |
| Domestics and servants | 4.5 |
| Others and unknown | 25.8 |
| Literacy (ref. Able to read) | 46.9 |
| Unable to read | 7.2 |
| No information | 45.9 |
| Height (cm) | 167.7 ± 5.9 |
| Chest (cm) | 86.5 ± 3.8 |

The results of the general logistic model are shown in Table 3. The lack of information on the anthropometric characteristics of a fairly large number of soldiers has reduced both the number of observations included in the model, which pass from 82,540 to 62,365, and the total number of deaths from 7,633 to 5,655.

**Table 3: Model 1. The determinants of death in war**

| | Odds ratio | p-value |
|---|---|---|
| **Military corps** | | |
| Infantry (ref.) | 1.000 | |
| Italian Alpine troops | 1.043 | 0.517 |
| *Bersaglieri* corps | 1.106 | 0.348 |
| Artillery | 0.367 | <0.001 |
| Logistics | 0.345 | <0.001 |
| No information | 0.775 | <0.001 |
| **Birth area** | | |
| Plain (ref.) | 1.000 | |
| Hills | 1.031 | 0.381 |
| Mountains | 1.029 | 0.499 |
| Town | 0.877 | 0.040 |
| **Occupation sector (ref. Agriculture)** | | |
| Construction | 0.980 | 0.577 |
| Artisans and working men | 0.697 | <0.001 |
| Trade and transportation | 0.576 | <0.001 |
| Upper class and public administration | 0.431 | <0.001 |
| Domestics and servants | 0.810 | 0.001 |
| Others and unknown | 0.726 | <0.001 |
| **Literacy** | | |
| Able to read (ref.) | 1.000 | |
| Unable to read | 1.181 | 0.002 |
| No information | 0.902 | 0.105 |
| **Height (cm)** | 0.995 | 0.059 |
| **Chest (cm)** | 0.988 | 0.004 |
| Log likelihood | –17,686.3 | |
| Number of obs | 62,365 | |
| Deaths | 5,655 | |
| LR chi2(42) | 2,557.67 | |
| Prob > chi2 | <0.001 | |

The model highlights the existence of mortality differentials in each of the estimated variables. The risk of death was significantly lower for soldiers who were placed in corps that were not deployed on the front line, though the frequency of missing data for this variable makes any interpretation inconclusive. With regard to the soldier's origin, urban soldiers ran a 12% lower risk of death compared to soldiers born in the smaller villages of the plain. As far as occupation is concerned, peasants and construction workers were the categories at highest risk of death, just like illiterate soldiers, who were 18% more likely to die in war compared to the literate.

Anthropometric measures were relevant for mortality, in the sense tall and large chested men were more likely to survive.

The next step was to investigate the pattern of mortality by cause of death. As already mentioned, four different causal categories were taken into consideration, namely wounds, disease, death in captivity, and other less frequent causes. The results are shown in Table 4.

**Table 4: Model 2. The determinants of death in war by cause and context**

| | **Wounds** | | **Disease** | | **In captivity** | | **Others causes** | |
|---|---|---|---|---|---|---|---|---|
| | **Odds ratio** | **p-value** | **Odds ratio** | **p-value** | **Odds ratio** | **p-value** | **Odds ratio** | **p-value** |
| **Military corps** | | | | | | | | |
| Infantry (ref.) | | | | | | | | |
| Italian Alpine troops | 1.157 | 0.072 | 0.799 | 0.100 | 1.054 | 0.739 | 0.719 | 0.431 |
| *Bersaglieri* corps | 1.159 | 0.271 | 0.814 | 0.399 | 1.453 | 0.101 | 0.356 | 0.313 |
| Artillery | 0.201 | <0.001 | 0.597 | 0.005 | 0.498 | 0.005 | 0.990 | 0.981 |
| Logistics | 0.213 | <0.001 | 0.603 | 0.007 | 0.358 | 0.001 | 1.212 | 0.658 |
| No information | 0.747 | <0.001 | 0.788 | 0.009 | 0.865 | 0.192 | 0.720 | 0.216 |
| **Birth area** | | | | | | | | |
| Plain (ref.) | | | | | | | | |
| Hills | 1.008 | 0.853 | 1.186 | 0.014 | 0.918 | 0.295 | 1.050 | 0.815 |
| Mountains | 1.009 | 0.865 | 1.136 | 0.137 | 0.962 | 0.706 | 1.032 | 0.900 |
| Town | 0.844 | 0.039 | 0.959 | 0.737 | 0.755 | 0.093 | 1.692 | 0.098 |
| **Occupation sector** | | | | | | | | |
| Agriculture (ref.) | | | | | | | | |
| Construction | 1.023 | 0.631 | 0.938 | 0.396 | 0.882 | 0.143 | 1.079 | 0.722 |
| Artisans and working men | 0.718 | <0.001 | 0.763 | 0.003 | 0.550 | <0.001 | 0.696 | 0.187 |
| Trade and transportation | 0.593 | <0.001 | 0.752 | 0.047 | 0.354 | <0.001 | 0.315 | 0.056 |
| Upper class and public administration | 0.491 | <0.001 | 0.437 | 0.001 | 0.265 | <0.001 | 0.215 | 0.036 |
| Domestics and servants | 0.862 | 0.050 | 0.822 | 0.121 | 0.658 | 0.004 | 0.653 | 0.300 |
| Others and unknown | 0.683 | <0.001 | 0.871 | 0.396 | 0.691 | 0.075 | 0.799 | 0.617 |
| **Literacy** | | | | | | | | |
| Able to read (ref.) | | | | | | | | |
| Unable to read | 1.145 | 0.050 | 0.987 | 0.907 | 1.473 | 0.001 | 2.018 | 0.006 |
| No information | 0.939 | 0.432 | 0.890 | 0.366 | 0.689 | 0.017 | 1.455 | 0.316 |
| **Height (cm)** | 0.988 | <0.001 | 1.009 | 0.102 | 0.999 | 0.892 | 1.009 | 0.542 |
| **Chest (cm)** | 0.980 | <0.001 | 0.997 | 0.681 | 1.005 | 0.641 | 1.006 | 0.801 |
| Log likelihood | 23,263.1 | | | | | | | |
| Number of obs | 62,365 | | | | | | | |
| Deaths | | 3,353 | | 1,255 | | 903 | | 144 |
| LR chi2(176) | 3,058.0 | | | | | | | |
| Prob > chi2 | 0.000 | | | | | | | |

The pattern for soldiers who died of wounds, which accounts for the largest part of deaths, resembles, to a large extent, the one emerging from the general model. However, it is worth stressing the association between dying of wounds and anthropometric measures, which are, in this case, largely significant. Some changes are conversely present as far as deaths from illness are considered. In this case, the protective effect associated with an urban provenance is no longer statistically significant, while coming from the hilly territory of the province (+19%) put you at a significant disadvantage. More striking still is the difference in the role played by anthropometric characteristics and literacy. Unlike deaths from wounds, none of these factors play a statistically significant protective role for death from illness. For the soldiers who died in captivity, the pattern of mortality presents traits very similar to those noted in the previous two models. This can be partly attributed to the fact that the determinants of being captured and those of dying in combat may largely overlap. However, we must stress that the very large part of Italian prisoners was captured in one single episode, in which soldiers from all corps fell into enemy hands. Protective effects are associated with the corps not directly involved in operations on the front line, with soldiers with urban origins and job backgrounds in almost all the occupational sectors but agriculture, as well as with being literate. Conversely, no significant effect has been detected from height and chest circumference.

Finally, with regard to the last and residual group of causes, it should be first pointed out that the number of events is small (only 144 deaths), which reduces our ability to find significant effects. The only relevant result is the important role played by literacy in lowering the risk of death. In fact, soldiers unable to read show twice the risk of death from "other causes" as compared to their literate peers.

## 6. Discussion

The findings of the different models, if read together, allow us to accept or to reject some of the hypotheses that have been formulated in the literature about the risk of death of soldiers in war. First of all, we can discuss the categories or characteristics that work in a soldier's favour.

There is a clear difference between a soldier's corps and the tasks assigned to a soldier. As previously mentioned, the piece of information concerning the soldier's corps was not always recorded on call-up registers, but the results, although based on fewer observations, were according to expectations. The soldiers of the corps used in the front line experienced the highest death risks for all causes. This was not only true for wounds but also for diseases. The living conditions of those who lived for whole weeks, if not months, in the trenches, even when they were not directly involved in the fighting, were not amenable to good health. The findings of the model confirm the findings of literature on WWI, both for the Italians and the Western Front. Living conditions in the trenches forced soldiers not only to live in close contact with each other. In the periods of active duty on the front lines and those of the Italian army were among the longest; it was practically impossible to devote oneself to personal cleaning, and physiological functions were carried out in the immediate vicinity of the spaces where soldiers slept and ate. The constant risk of being hit by the enemy also prevented the recovery of fallen companions, whose putrefied bodies, along with those of their enemies, often lay just a few meters from the trenches. All this caused the spread of diseases such as cholera and gastroenteritis among Italian troops, which, particularly in the first summer of the war, affected some parts of the front (Sema 1992). Infantry also suffered more from death in captivity. In this context, however, the explanations might be different from those who died while serving. Soldiers enrolled in artillery and logistic services had greater skills than others, and this in the context of captivity could be worked to their advantage. Prisoners who showed higher skills had, more often than ‘generic’ ones, the opportunity to be employed in families outside prison camps, where living conditions were better and, therefore, where there were higher chances of survival (Dalla Volta 1919).

Another aspect of selection concerns the territory from which the soldier comes. An urban background favours survival from injury and in prison. This particular configuration of the advantages suggests that soldiers from an urban environment were assigned less dangerous roles. They were more likely to enter the ranks as officers, which protected them both in captivity and on the battlefield. It is also possible that a better knowledge network, which most likely characterised these soldiers simply because they came from a town, favoured them: They were more often than others destined for less dangerous tasks. As for the lower risks of death from illness for soldiers coming from the hilly areas, we can only formulate a tentative hypothesis. According to some studies, the hilly areas of Friuli were less subject to extremes of weather and climate, which were, instead, more common in the mountain territories or on the plain. We can, therefore, guess that people coming from the mountains and the plain were better suited to facing the harsh climatic conditions typical of life in the trenches (Gentilli 1964).

Another important selection point is occupation. Some occupations clearly show a significantly greater comparative disadvantage compared to all others: namely the reference category, i.e., agricultural workers and those employed in the construction sector. It is possible that the low specialisation of these young people and the relative ease with which their skills could be found among soldiers in the Italian army meant that they were more easily sacrificed and that, therefore, the most dangerous tasks were reserved for them.

Some occupations favoured survival in almost all circumstances, while others only in some cases. Being a craftsman or worker, an employee in the administrative sector, or a part of the upper class always made it easier to survive. It is necessary, though, to understand why. Having special skills, soldiers probably found it easy to use these skills in less dangerous activities than trench life. But they likely had, too, a greater familiarity with bureaucratic practices. Belonging to a higher class made entering the army administration a more natural step and gave them easier access to the officer class. This would explain how the higher mortality of peasants and construction workers, whose prospects of social advancement, even within the army, were minimal. The highly skilled were particularly more likely to survive disease. Life in the trenches, as we have seen, was very unhealthy. Transport workers, tertiary workers, and even those working in the domestic service or humbler jobs had, too, an advantage over peasants in terms of surviving wounds and imprisonment. Perhaps extreme situations could be better managed by people with a particularly low standard of living outside the military sphere.

Being illiterate was a serious obstacle to survival. Illiterate soldiers were, apart from the cause of death due to illness, always at a greater risk of death. This is particularly evident in the deaths in prison camps.

The selection of height and chest measurements reveals an advantage for soldiers with the largest and most developed physiques. The results are, therefore, consistent with those found during WWI for British soldiers (Kanazawa 2007). The possibility of distinguishing between different causes of death can help us to explore this aspect in greater depth. A robust body would protect soldiers from death by injury, but it would not help them resist disease and would not give an advantage if imprisoned. Of course, it might be assumed that the riskier missions were entrusted to smaller and more agile soldiers, while larger soldiers were passed over, as it was believed they could be more easily shot. In a war, however, where doctrine states, in the famous words of General John F. C. Fuller, “The artillery conquers, the infantry occupies,” so there are other considerations. The overwhelming majority of wounds were due to blind grenade throws or shrapnel blasts, while in attacks the tallest soldiers could certainly not be ordered to behave differently from the shortest soldiers. We, therefore, consider it unlikely that larger soldiers, who according to some hypotheses also had higher IQs, were favoured because they managed to avoid the most dangerous situations. While they could be injured more easily because of their physical size, they evidently found it easier to survive. Beyond these explanations, however, we should consider that in WWI hand-to-hand combat was still very common, where physical strength could represent a decisive advantage.

Where the ability to escape danger brought additional benefits, as well as in cases of death by disease, larger soldiers did not prove to be more resistant. And these aspects had a great importance in the particular context of WWI. In fact, trench pathologies and, above all, the Spanish flu that plagued young Italians in the autumn and winter of

1918 did not spare individuals on the basis of their physical constitution (Tognotti 2015; Fornasin, Breschi, and Manfredini 2018).

The results of these models also allow some observations to be made, albeit on the basis of indirect evidence, for the mortality of officers. First of all, it should be noted that on entering the war Italy did not have enough officers in relation to the masses of men who had been called up: This was a common problem as the combatant nations entered the Great War. In addition, a large number of permanent active service officers died in the early months of war. To make up for the shortage of executives, many new 'complementary' officers were created, whose rank applied only during the conflict. In this context, becoming an official was not particularly difficult for young people with higher educational attainments and from better social backgrounds. The lower mortality in these categories would, therefore, be consistent with lower mortality rates among officers in general. This lower mortality rate would have been due to both wounds and disease. However, this is seen particularly with mortality in captivity, where, as pointed out by both diarists and the relevant literature, officers experienced far better treatment than common soldiers and non-commissioned officers. The relatively little research into the topic of the selection of soldiers at war prevents us from identifying other general rules. However, it seems certain that technical and tactical military innovations, as well as advances in medicine, shifted risks over time from one category to another.

In WWI, when recruitment was compulsory and universal in almost all armies, differential selection was based on the health and physical characteristics of young men and not on schooling and socio-economic status as in contemporary volunteer armies. However, the sorting mechanism was also important. This mechanism played a fundamental role in determining mortality differentials in a context where masses of soldiers were employed in individual clashes and mortality was very high among the corps in the front line. It is possible that this has happened even in some wars closer to our own today, but the operative modalities of modern armies, for which there is no universal recruitment, make the sorting mechanism more important. Where the number of fallen soldiers is relatively small, the peril of the tasks assigned to individual units and soldiers proves decisive. In this context, the greater attention and time given to training men sent to war diminishes the differences due to individual characteristics. Among the soldiers carrying out the same tasks, however, other selection elements acted on different characteristics based on behaviour, skills, and physical properties. For this, too, evolution in military thinking has brought about changes. As for the schooling of soldiers, being more educated was an advantage during WWI, but it did not seem to have been an advantage in WWII.

The same applies to anthropometric characteristics. Until the end of the 19th century large body sizes were, at least in firefights, a disadvantage, but they became an advantage during WWI. However, large body sizes have once again been penalised in modern wars. The most dangerous tasks, such as infiltration missions into enemy lines or, in the context of the Great War, night missions in no man's land, were probably assigned to soldiers of smaller size. But, regardless of the perils of these missions, a simple fact remains: The infantry is the corps that, in general terms, have always suffered more victims than other corps in relation to the number of soldiers involved in military tasks.

## 7. Conclusions

The selection made by war on the survival of soldiers can be explained by different factors. The aim of this paper is to identify these factors and their different weight depending on the cause of death. Here we have taken into account death by wounds, that is, deaths in combat or resulting from the same; death by disease, thus indirectly generated by war but still induced by warlike circumstances; and, finally, all the other causes taken altogether. We have analysed separately deaths among Italian POWs because deprivation played a very strong role there.

The results of our analyses show that even in a conflict where, apparently, the risk of death would be equally distributed among troops, at least in combat, there were individual characteristics that proved to favour survival and others that did not. These characteristics depended in part on the selection that was made before the soldiers were assigned to the war zone, with their assignment to the different corps, which resulted in tasks that were more or less risky in terms of mortality. Others depended on individual behaviour and characteristics. Here we might mention the lower risks of death in captivity of the better educated or the lower risks of death in combat of bigger soldiers.

The most universal cause of death was illness. In this case, it was the conditions of life under arms rather than the social extraction and skills of individuals that determined the odds of survival. Conversely, the situation where inequality was felt most was in the prison camps. In this context soldiers' capabilities proved key. Having skills that countless people had proved a disadvantage that many paid for with their lives. The risks were lower, meanwhile, for those who had specific skills and for those who, in civil life, were involved in business.

The risk factors that affected soldiers in WWI cannot be said to apply to all conflicts. In a war of movement, for example, larger body sizes appear to be a disadvantage, and this is true of the conflicts preceding the Great War and, indeed, subsequent ones. An element that seems to be constant over time, at least for Italy, is that of social class. The higher the social class, the lower the risk of death. These lesser risks depend, in part, on the ability or opportunity to avoid military service. But in the army itself they helped some to avoid the most dangerous tasks and also gave access to less risky roles. These aspects, of course, are the result of a selection that is generated outside the military context and that does not depend on individual behaviour. For this reason illiterate peasants, who had the misfortune of being eligible for military service, were particularly at risk in the Italian army.

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