

The Spanish influenza pandemic in occidental Europe (1918–1920) and victim age

Anton Erkoreka

Basque Museum of the History of Medicine (UPV/EHU), Leioa (Bizkaia), Spain.

Correspondence: Prof. A. Erkoreka, Medikuntza Historiaren Euskal Museoa, Faculty of Medicine, University of the Basque Country, E-48940 Leioa (Bizkaia), Spain. E-mail: a.erkoreka@ehu.es

Accepted 14 December 2009. Published Online 10 February 2010.

Background Studies of the Spanish Influenza pandemic (1918–1920) provide interesting information that may improve our preparation for present and future influenza pandemic threats.

Methods We studied archives from France, Italy, Spain and Portugal, obtaining high-quality data that allowed us to calculate mortality rates associated with the Spanish flu and to characterize the proportional distribution of influenza deaths by age in the capital cities of these countries.

Results French and American troops who fought in the First World War began to be affected from April 1918 onwards by a benign influenza epidemic, which hardly caused any deaths. The first occidental European country in which the pandemic spread to large sectors of the population, causing serious mortality, was Spain. The associated influenza provoked in Madrid a mortality rate of 1.31 per 1000 inhabitants between May and June (1918). In the following months of June and July, the epidemic spread to Portugal, but did not reach the Pyrenees. In September 1918, the influenza pandemic spread with tremendous virulence, presenting itself simultaneously during the month of October in South Western European countries. In Madrid, the 1918 excess

mortality due in large part to the influenza pandemic is estimated at 5.27 per 1000. In Paris, the 1918 mortality rate provoked by the influenza and pathologies of the respiratory system was 6.08 per 1000. In South Western European countries, mortality rates oscillated between 10.6 and 12.1 per 1000 inhabitants. A study of the age distribution of deaths due to influenza between 1916 and 1921 reveals that the Spanish influenza principally affected men and women between 15 and 44 years of age. Deaths associated with the seasonal influenza of 1916, 1917 and 1921 represented 19.7%, 12.5% and 21.0% of all deaths respectively, whereas during the rawest moments of the Spanish influenza, in 1918, the proportion of deaths due to flu for those aged between 15 and 44 years of age reached 68.2% in Paris and 66.3% in Madrid.

Conclusion Victim age is an important criterion that can be used to evaluate the phase and evolution of pandemic influenza. The Spanish Influenza affected particularly the 25- to 34-year-old and 15- to 24-year-old age groups.

Keywords Pandemic, influenza pandemic, Spanish flu, mortality age, virus mutation, influenza A.

Please cite this paper as: Erkoreka A. (2010) The Spanish influenza pandemic in occidental Europe (1918–1920) and victim age. *Influenza and Other Respiratory Viruses* 4(2), 81–89.

Introduction

The extensive influenza pandemic of 1918–1920, known as the ‘Spanish influenza’, was provoked by an extremely virulent virus that had three fundamental characteristics: it provoked large mortality, deaths occurred rapidly after the appearance of the first symptoms and the majority of victims were young adults. This predilection for young adults has been explained in terms of an excessive immune response due to the vitality of the organism at these young ages. In addition, the virus A(H1N1)^{1,2} had particular antigenic characteristics, intense virulence, a unique course of development^{3,4,5} and a persistent legacy.^{6,7} Together with an additional series of external factors, this combination of events had an explosive consequence.

One of the characteristics of pandemic influenza is predilection for young adults. To analyse this feature more in depth, we visited a variety of Archives in various countries in Western Europe, examining novel data about mortality between 1916 and 1921. This analysis has allowed us a better understanding of the Spanish influenza pandemic, whose climax occurred practically simultaneously throughout the world, between October and November of 1918. In order to respond optimally to the current flu pandemic, we consider that it is necessary that the scientific community adopt a multidisciplinary approach to the problem, including analyses from disciplines as diverse as molecular biology and the history of medicine. We believe that the novel historical data presented here is of much potential interest to influenza clinicians and/or researchers who are searching

for patterns in the present pandemic, in order to anticipate its behaviour more accurately.

Methods

Data collection

In Paris, we consulted the 'Archives de Paris', the 'Bibliothèque Interuniversitaire de Médecine' and the Archives of the Army Health Services ('Archives du Services de Santé des Armées', ASSA) located in Val-de-Grâce. Here, the typed catalogue was a rich source of information.⁸ Sources of consultation in Rome included the Capital Historic Archives ('Archivio Storico Capitalino'), the 'Biblioteca Universitaria Alessandrina' in the La Sapienza University and the 'Archivio Segreto Vaticano', situated in the Città del Vaticano. In Madrid, sources included the General Archive of the City of Madrid ('Archivo General de la Villa de Madrid') and the Madrid Municipal Hemeroteca ('Hemeroteca Municipal de Madrid'), both of which are located in the Conde Duque Cultural Centre. Other archives of smaller cities such as Porto, Bilbao or Pau were used to contrast and compare data. The populations of the three studied cities were: Paris (1919) 2 906 472 inhabitants; Rome (1920) 651 625; and Madrid (1918) 648 760.

The principal sources of information that were managed were the institutional Yearly Reports ('Annales') and Bulletins which compile official statistical data, taking into account the intrinsic limitations associated with the use of such sources. Some of the most important sources included the *Annuaire Statistique de la Ville de Paris*, *Bollettino di Statistica del Comune di Roma*, *Bollettino dell'Ufficio Municipale del Lavoro*, *Estadística Demográfica Madrid* and the *Boletín de la Estadística Municipal de Madrid*. These publications, in which individual numbers can on occasion be missing, were complemented with collections of files, as well as newspapers, journals and books.

Regarding data quality, it should be pointed out that at the beginning of the 20th century, medicine practiced in France and Germany was of the highest world standards, indicating that the clinical and epidemiological data recorded in the medical bulletins and reports are highly reliable. It could be argued that military censorship in France may have negatively affected data quality. However, the complete data from 1915 to 1918 were published eventually in 1921, and it is the latter data that were used in this study.

Statistical analysis

In the text, the term 'mortality' refers to percentages and per thousands for the overall general population and is represented in histograms and sequential diagrams in absolute numbers.

Results

The 1916 influenza

Elderly people together with the chronically sick are the principal victims of seasonal influenza epidemics. We examined mortality provoked by seasonal influenza in Madrid during 1916 as a function of age (Figure 1). It can be seen that of the 183 people who died due to influenza, 34.4% were older than 65, 19.7% were between 15 and 44, and 8.7% were between 0 and 4 years of age.

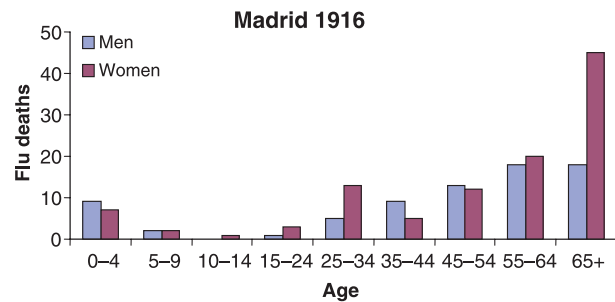


Figure 1. Age distribution of people who died of influenza in Madrid during 1916. The ordinate represents the absolute number of people who died. The majority of influenza victims were in the +65 years age bracket.

The 1917 influenza

In Paris, during 1917, influenza provoked the death of 127 people. In Figure 2, we see the age distribution of these mortalities: 41.7% of these victims were older than 65 years; 12.5% were between the ages of 15 and 44 years, and 7.1% were younger than 4 years. The majority died during the first months of the year (27 in January, 45 in February, 23 in March, 10 in April and 5 in June), 2 in July and the remainder during the last 3 months of the year (2, 7 and 6 respectively).

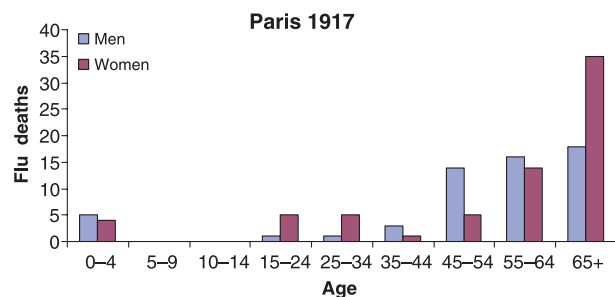


Figure 2. Age distribution of flu victims in Paris during 1917. About 80% of patients were older than 45 years.

The first months of 1918

Patterson and Pyle,⁹ among others, consider that the Spanish Influenza pandemic began in the Camp Funston

military base (Kansas, USA) in March 1918. However, this specification of a precise date for the beginning of the pandemic is problematic, because there are reports of episodes that occurred in the previous 2–3 years, which should be considered to belong to the prehistory of the pandemic of the Spanish Influenza.¹⁰ What can be stated with certainty is that troops from America and other countries who participated in the Great War acted as vectors of the pandemic, from April 1918 onwards.

Among the abundant documentation that is conserved in the Archive of the Health Services of the French Army (ASSA), there is a 'Note regarding influenza in the army from April to 10th November of 1918',¹¹ in which it is affirmed that the first cases of influenza appeared in the Third Army (*3^e Armée*) in Villers-sur-Coudun and in the training field of Fère-Briange from 10 to 20 April (1918). Influenza broke out in the American army that was based on French soil, towards 15 April (1918), in the outskirts of Bordeaux. It presented in the form of an epidemic of benign fever accompanied by cold-like symptoms; the American doctors considered that the underlying aetiological agent was the 'Pfeiffer bacillus' (currently known as *Haemophilus influenzae*).¹²

This epidemic wave of the Spring of 1918 was benign, affecting many soldiers but causing few deaths. In the French army, 24 886 flu patients were recorded in May with 7 deaths, 12 304 in June with 24 deaths, and 2369 patients in July with 6 deaths, all of whom were diagnosed with 'grippe'. Reports by the American army doctors indicate that there were 1850 cases of 'influenza' in April, 1124 in May, 5700 in June and 5788 in July. During the latter month, the first five American soldiers died due to the flu.

The French population was also affected by this Spring pandemic wave. Flu cases were mild and there were no significant increases in mortality. In some cities in which we have obtained data, there is a slight increase in mortality between the end of March and the middle of April, but this does not appear to be related to the influenza.¹³ In Paris, increased mortality during the month of March was due to deaths associated with tuberculosis and violent deaths. As can be seen in Figure 3, significant influenza mortality in Paris began towards the end of September and reached its climax in the month of October (1918).

It must also be mentioned that among the Indochinese troops stationed in France, there were multiple epidemic outbreaks which the military doctors classified as '*pneumonie des Annamites*'. These outbreaks are well documented in the ASSA files in 1916, 1917 and up to the summer of 1918. In some cases, there are references to the appearance of the influenza in military personnel and civilians, as documented by Darmon,¹⁴ in Montpellier, Grenoble and Rennes, although 'there is no documentation which allows me to appreciate the extent of this first epidemic among

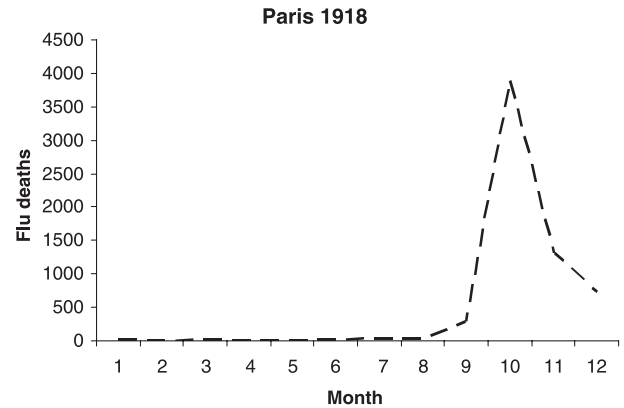


Figure 3. Mortality associated with influenza in Paris during 1918. Influenza mortality in Paris began towards the end of September and reaches its climax in the month of October (1918).

the civil population'. On the basis of the reported symptomatology, it is likely that these were cases of influenza rather than of pneumococcus infections (*infections à pneumocoques*). In some cases, the military doctors called it influenza, as in the outbreak that occurred in Pau between the months of May and June 1918:¹⁵ 'It is my honour to inform you that the Pau Aviation School have brought to my attention five new cases of influenza among the Indo-chinese'. In my opinion, this virus of '*pneumonie des Annamites*', together with the virus imported by the American troops, played a very important role in the genesis of the Spanish influenza. No significant increase in mortality was recorded during the Spring of 1918 in Turin or in any other important city in Italy.¹⁶

Spring-Summer of 1918

The first country in Occidental Europe in which the pandemic spread to wide sectors of the population, causing significant mortality, was Spain, thus justifying the denomination 'Spanish influenza', which is used to refer to this pandemic. The first reference in the Spanish press to an epidemic outbreak in the Spring of 1918 can be found in the Madrid newspaper '*El Sol*', which published its first headline about the subject on 22 May 1918.¹⁷ The report goes as follows:

'it seems that many cases are appearing among the soldiers of the Madrid garrison of a sickness which has not yet been diagnosed by doctors. Among an artillery regiment, 80 soldiers have been affected by this disease. In other regiments, the number ascends to up to 50 similar cases. .../... Undoubtedly, there is little difference between the sickness observed in the prisons by our reporters and that which has been affecting Madrid for the last few days. .../... The symptoms associated with the disease are headache, shivering, weakness, fever and joint pains, and the

condition sometimes presents itself at thoracic or intestinal levels'.

During the months of May and June (1918), there were 276 influenza deaths¹⁸ in Madrid, which represents a mortality rate of 0.42 per 1000 (i.e. 0.42 deaths per 1000 people in the general population). During the same period, another 852 deaths were of patients who had been diagnosed with different pathologies of the respiratory system. If deaths due to influenza are combined with those due to all other pathologies of the respiratory system, we obtain a mortality rate of 1.31 per 1000, which would be the highest mortality figure attributable to this epidemic outbreak.

The age distribution of deaths due to influenza during the months of May and June is represented in Figure 4. It can be seen that this mortality profile is clearly distinct to that associated with a seasonal influenza epidemic, despite the fact that the underlying virus still had not acquired that intense virulence that characterized the Spanish influenza pandemic. It can thus be reasonably claimed that this May/June (1918) outbreak was provoked by a virus with a medium/high virulence, leading to a moderate mortality rate. It is very significant that 52.6% of all deaths due to influenza were between 15 and 44 years of age. The percentage of deaths in the >65-year group dropped to 12.3%, whereas those within the 0- to 4-year age bracket represented 5.8% of the total population.

All consulted sources indicate that the first Spring pandemic wave arrived in Portugal from Spain and affected this country during the months of June and July. An official report from that time¹⁹ mentions that on 31 May 1918, a first warning was emitted to all the health delegations throughout the country, to begin preparations for the epidemic which 'represents an immediate threat for the frontier municipalities and the big cities'. The first place to be affected by the pandemic was Vila Viçosa, in the border

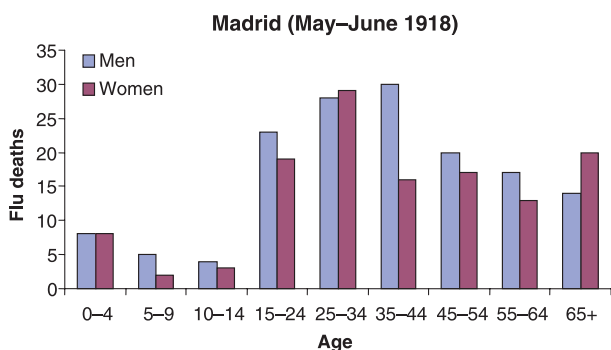


Figure 4. Age distribution of influenza-related deaths during the months of May/June (1918) in Madrid. This mortality profile is clearly different to that associated with a seasonal influenza epidemic (compare with Figure 1). In particular, 52.6% of all influenza-related deaths were between 15 and 44 years of age, whereas the percentage of deaths in people older than 65 dropped to 12.3%.

province of Évora. According to the health authorities, the disease was brought by agricultural workers who were returning from Badajoz and Olivenza (Spain). On 6 June, the pandemic presented itself in Terragem and Assumar (near Arronches) in the Porta Alegre region, which also borders with Extremadura in Spain. On 10 June, the epidemic affected the city of Porto and, 1 day later, on 11 June, it was announced that 50 cases had appeared in Monsanto Prison, in Lisbon. The report refers to 'its influenza characteristic, similar to the classical pandemic of 1888–1890 and to the recent one in the United States (1915–1916)'.²⁰ A comparison of this first outbreak of the spring of 1918 with the 1889–1890 epidemic also appeared in a note by the Koch Institute, which was published in the *Berliner Tagblatt* on 29 June 1918.

The 1918 autumn

In Spain, the influenza epidemic disappeared in Summer, but in September 1918, the press informed again about the appearance of new cases. In the beginning, only isolated cases appeared, such as the Lorca epidemic (in the province of Murcia) of 7 September,²¹ which subsequently expanded from the 12th, and was described in terms that had been used to refer to the Spring epidemic, such as the 'Fashion Illness' (*el mal de moda*) or the 'Naples Soldier' (*el soldado de Nápoles*), a song in fashion at that time. It should be noted that initial reports underlined the digestive complications associated with its clinical manifestations,²² and other possible pathologies such as typhoid, cholera or dysentery were cited. On 16 September, the subject appeared again in the newspaper headlines and begun to be important news. The first health announcements were published on 17 September,²³ informing about the closing of the French border on 20th²⁴ and of the Portuguese border on 30 September 1918.²⁵

The highest number of deaths occurred during the month of October, and the epidemic began to remit during the month of November. During these months of October/November 1918, 407 people with an influenza diagnosis died in Madrid (184 men and 223 women), representing a mortality rate of 0.62 per 1000. During the same period, another 757 deaths were associated with different pathologies of the respiratory system. When we combine deaths due to influenza with those due to all pathologies of the respiratory system, we obtain a mortality rate of 1.79 per 1000, which is the highest figure attributable to the Spanish influenza at its moment of maximal activity during the Autumn of 1918.

The age distribution of deaths in Madrid due to influenza during the months October/November can be seen in Figure 5. The 'W' profile of the graph is a signature of pandemic flu, as Simonsen *et al.*,²⁶ Olson *et al.*,²⁷ Taubenberger and Morens,²⁸ and others have pointed out, and

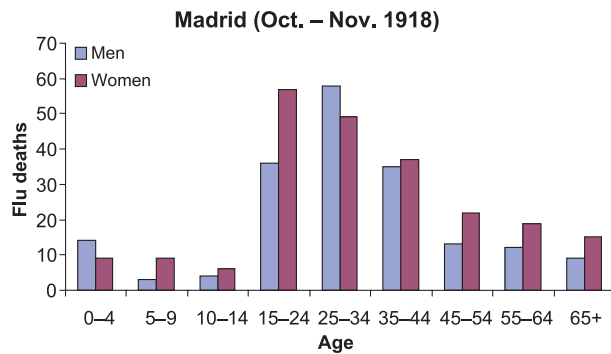


Figure 5. Age distribution of influenza deaths in Madrid, during the months October/November (1918). This represents the most intense period of the pandemic. The proportion of influenza deaths for people between the ages of 15–44 rose to 66.3%; for those older than 65 years, the proportion was reduced to 5.9%, whereas for those between the ages of 0 and 4, the proportion was stable at 5.7%.

indicates that this is the most intense period of the pandemic. Changes have occurred in the virus associated with altered gene function. Virulence increased causing high mortality with deaths occurring shortly after infection, particularly among young adults. The proportion of influenza deaths in the 15–44 age bracket rose to 66.8%. The proportion of deaths among those older than 65 years was reduced to 5.9%, whereas this proportion for those between the ages of 0 and 4 was stable at 5.7%.

In 1918, there were a total of 18 974 deaths due to all causes, which represents a gross mortality rate of 29.24 per 1000. In order to appreciate the real impact of the Spanish influenza pandemic in Madrid, we can calculate the excess mortality for 1918 on the basis of the previous 5 years. Taking data from the 1916 *Estadística Demográfica*, the average annual number of deaths in Madrid between 1912 and 1916 was 15 549. Comparing this with the number of deaths in 1918 gives us an excess mortality of 3425 deaths. The mortality rate that could be calculated from this, due to the influenza pandemic of 1918 would be 5.27 per 1000 for the city of Madrid. Porras,²⁹ has also pointed out that the Madrid data are lower than those of other places in Spain.

In Paris, the majority of influenza deaths were concentrated in the month of October, although the epidemic wave spread between September and December. In 1918, a total of 7777 people died of influenza (flu-specific mortality rate 2.67 per 1000). The total number of deaths in Paris in 1918, due to all causes, rose to 59 306 (gross mortality rate due to all causes of 20.40 per 1000). We cannot reliably estimate excess mortality in France, as the country was immersed in the terrible First World War and the data are incomplete. Nevertheless, we can estimate the real incidence of the Spanish influenza pandemic in terms of the sum of deaths due to influenza and all pathologies of the respiratory system, thus obtaining a mortality rate of 6.08 per 1000.

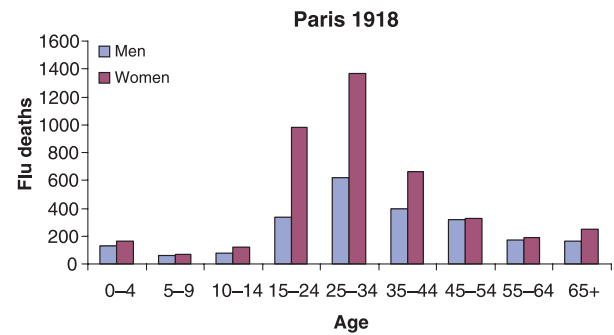


Figure 6. Age distribution of deaths in Paris during 1918 associated with an influenza diagnosis. It can be seen that the distribution is similar to that of Madrid (Figure 5), indicating the presence of the extremely virulent virus.

The age distribution of deaths in Paris during 1918 associated with an influenza diagnosis is represented in Figure 6. It can be seen that the distribution is similar to that of Madrid, indicating the presence of the same mutated and extremely virulent virus. We have reported elsewhere that the mutation of the virus would have taken place in the summer of 1918 in different places, such as the French–Spanish border,³⁰ subsequently radiating from there to the rest of the continent.

In Paris, the proportion of deaths due to influenza in the 15- to 44-year age bracket rose to 68.2%. The percentage of deaths in the >65-year group was 6.4% and in the 0- to 4-year bracket was 4.5%. The large difference between the male and female data is due to the fact that young men were engaged in fighting at the war fronts, explaining why the number of dead women is much higher (in the 15–24 age bracket, 25.7% of deaths were men with the remaining 74.3% being women).

Induced mortality

The mortality rates that we have estimated for Paris (6.08 per 1000) and Madrid (5.27 per 1000) for 1918 are relatively low when compared with estimates for other places in Europe. We studied a wide sample of the population in the Basque Country and, on the basis of the Death Certificates, we obtained³¹ a mortality rate of 6.8 per 1000 with a flu diagnosis (*'grippe, pneumonía grippal, broncopneumonía grippal, enteritis grippal ...'*) and a mortality rate of 5.3 per 1000 for deaths associated with respiratory system complications (*'broncopneumonía, pneumonía ...'*). The sum of the two yields a mortality rate attributable to the Spanish Influenza pandemic of 12.1 per 1000 inhabitants for the annual period between May 1918 and April 1919.

Echeverri³² estimated that the Spanish influenza pandemic in Spain provoked a mortality rate of 12.0 per 1000. Tognotti, citing Collier,³³ reported an estimate of 10.6 per 1000 for Italy, which was considered in its day to

be the highest figure in Europe: ‘according to some sources, Italy recorded 10·6 deaths per 1000 inhabitants, the highest mortality rate in Europe, occupying the first position in the world after India, Madagascar, Mexico, Africa, New Zealand, Guatemala, Eastern India and Chile’. In this respect, see also the book by Phillips and Killin-gray³⁴ and the article by Ansart *et al.*³⁵ in which the mean mortality in all of Europe was estimated as 11·0 per 1000: ‘one can deduce that ~2·6 million excess deaths (1·1% of the total population) occurred in Europe during the period when Spanish flu was circulating’.

The first months of 1919

In Paris, the number of influenza victims during 1919 was 2270 (ascending to 2722 if we include those residing outside Paris). Practically half of these, i.e. 1087, died during the month of February. In fact, the majority of deaths due to influenza occurred between January and March 1919 (Figure 7).

The age distribution of deaths due to influenza in 1919 is represented in Figure 8. It can be seen that the number of deaths among the elderly has increased significantly. The proportion of deaths in the >65-year group rose to 12·1%, whereas that proportion in the 15–44 age group substantially descended to 57·4%. The proportion of deaths in the under 5-year-old group was maintained at 5·2%. In the light of this data, it could be considered that part of the population had already been immunized, that the virus may have lost much of its virulence and that it had now become less specific for young adults. The mortality rate of deaths due to influenza in 1919 descended to 0·93 per 1000.

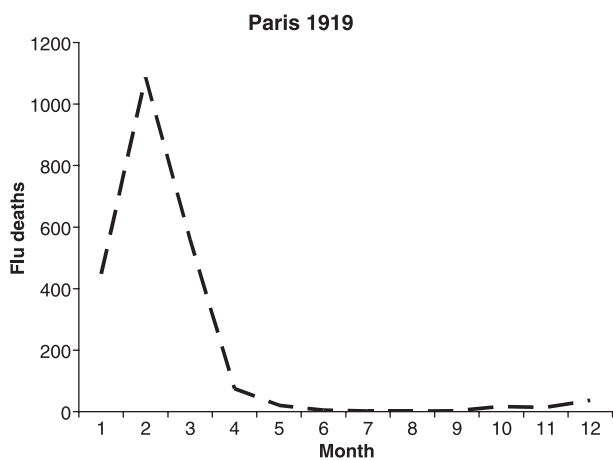


Figure 7. Deaths due to influenza in Paris during 1919. The majority of deaths due to influenza occurred between January and March 1919, with over half of the total number of deaths occurring during the month of February.

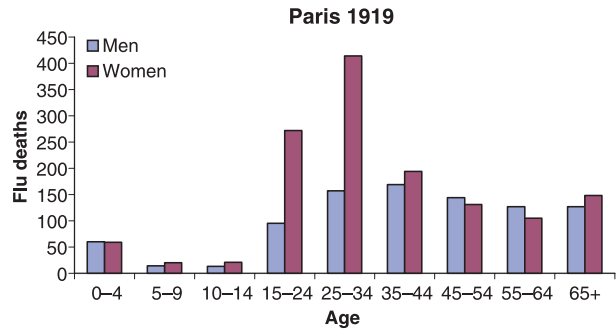


Figure 8. Age distribution of deaths associated with an influenza diagnosis in Paris in 1919.

The first months of 1920

During the first months of 1920, a new epidemic outbreak of the influenza occurred, which can be considered to be the last wave of the Spanish influenza pandemic. In 1920, Madrid had a population of 645 387 inhabitants. During that year, 467 people died of influenza, with the majority (311) taking place in the month of January. A similar profile is associated with deaths due to illnesses of the respiratory system: 3·097 deaths in 1920, with the majority 1·118, taking place in January. The mortality rate due to influenza in 1920 rose to 0·72 per 1000. If we add deaths due to influenza and due to all pathologies of the respiratory system in the month of January 1920, we obtain a mortality rate of 2·21 per 1000, which is the peak value due to this last wave of influenza pandemic that occurred during the month of January 1920.

The distribution by age of deaths associated with a flu diagnosis in Madrid during 1920 underwent changes as can be seen in Figure 9. This change would suggest that younger children were not immunized (deaths in the age group 0–4 years old increased significantly), that the virus lost virulence and that we are at the final phase of the pandemic of the Spanish Influenza. Of the 467 deaths due to

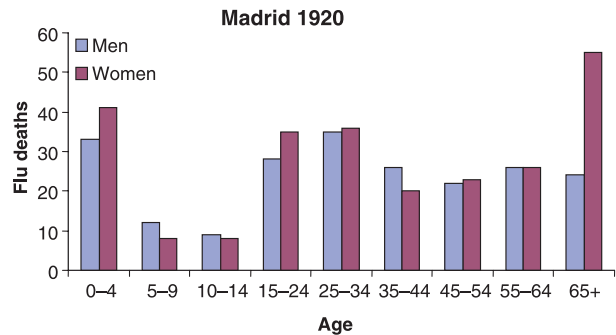


Figure 9. Age distribution of deaths due to influenza in Madrid during 1920. The distinct profile signals the final phase of the Spanish influenza pandemic.

influenza, 38.6% were between 15 and 44 years of age. The percentage of elderly people >65 years who died from influenza rose to 16.9% whereas those between 0 and 4 years represented 15.8% of influenza deaths.

In Rome, between January and March, 837 people who had been diagnosed with influenza died (the majority, 578 in February). The age distribution of these deaths can be seen in Figure 10, and is based on data from the 1920 Statistics Bulletin (*Bollettino di Statistica del Comune di Roma 1920*), which classified deaths into age groups that are different to those used in other cities and that does not distinguish male and female deaths. About 27.5% of deaths were over 60 years of age, whereas only 34.6% were between 20 and 40 years (47.1% between 15 and 50 years). The proportion of deaths in the 0- to 5-year-old group rose to 13.3%. Data from Madrid and Rome confirm the immunization of the population and the benign nature of this 1920 outbreak in Occidental Europe. The age distribu-

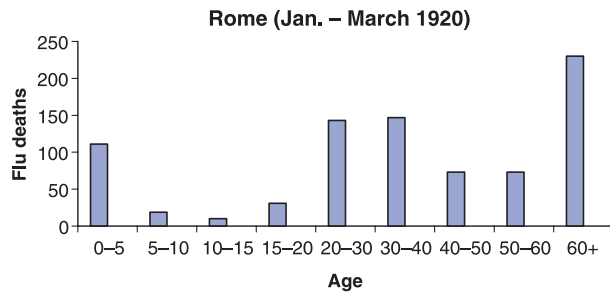


Figure 10. Age distribution of deaths due to influenza in Rome, between January and March, 1920; based on data from the 1920 Statistics Bulletin (*Bollettino di Statistica del Comune di Roma 1920*) that classified deaths into age groups, that are different to those used in other cities, and that does not distinguish male and female deaths.

tion of deaths began to resemble that of epidemics associated with seasonal influenza, with a higher incidence in older people.

The influenza in 1921

During 1921, a total of 16 215 people died in Madrid (gross mortality rate due to all causes of 23.89 per 1000). Of these, 209 were diagnosed with influenza. There was no significant epidemic outbreak and the cases occurred principally during the Spring and Autumn. In Figure 11, it can be seen that the age distribution of deaths due to influenza is identical to that due to seasonal influenza, with a predominance of older aged people. Of the 209 people who died due to influenza, 27.8% were older than 65; 21.0% were between 15 and 44 years and 18.7% were between 0 and 4 years of age. The cycle has now been completed and we return to the situation from which we set out in 1916 and 1917 (Figures 1 and 2).

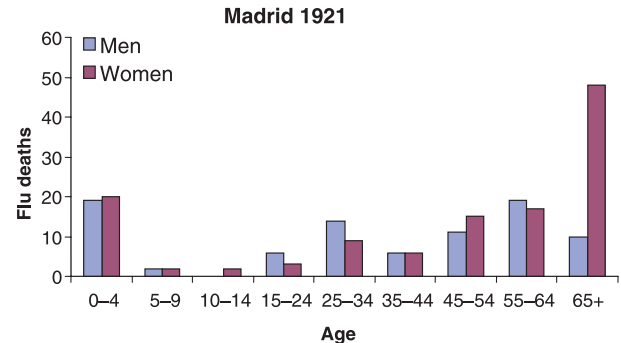


Figure 11. Age distribution of deaths due to influenza in Madrid 1921. The profile is indicative of seasonal influenza, with a predominance of deaths among older aged people.

Table 1. Proportional distribution of influenza deaths by age (%)

Age (years)	Madrid 1916	Paris 1917	Madrid 1918 (May-June)	Madrid 1918 (Oct.-Nov.)	Paris 1918 (Sep.-Dec.)	Paris 1919	Rome 1920 (Jan.-Mar.)*	Madrid 1920	Madrid 1921
0-4	8.7	7.1	5.8	5.7	4.5	5.2	13.3	15.8	18.7
5-9	2.2	0.0	2.5	2.9	2.0	1.5	2.3	4.3	1.9
10-14	0.5	0.0	2.5	2.5	3.1	1.5	1.2	3.6	1.0
15-24	2.2	4.7	15.2	22.9	20.6	16.2	3.7	13.5	4.3
25-34	9.8	4.7	20.7	26.3	31.1	25.2	17.1	15.2	11.0
35-44	7.7	3.1	16.7	17.7	16.5	16.0	17.6	9.9	5.7
45-54	13.7	15.0	13.4	8.6	10.1	12.1	8.7	9.6	12.4
55-64	20.8	23.6	10.9	7.6	5.7	10.2	8.7	11.1	17.2
>65	34.4	41.7	12.3	5.9	6.4	12.1	27.5	16.9	27.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

*The age groups of those who died of influenza in Rome are: 0-5, 5-10, 10-15, 15-20, 20-30, 30-40, 40-50, 50-60 and >60 years of age.



Figure 12. The first information about the 1918 influenza pandemic, which was published on the front page of a European newspaper (E1 Sol, Madrid, 26 May 1918).

In Table 1, we present the proportional distribution of influenza deaths by age for the three cities examined in this study. It is evident from the data that the majority of flu-associated deaths during the height of the pandemic (autumn 1918) were between 15 and 44 years of age. Closer inspection reveals that the age group in which most deaths were found is the 25- to 34-year-old group, followed by the 15- to 24-year-old group.

Conclusion

The data presented in this study contribute novel information about the beginnings of the Spanish Flu pandemic, from April 1918, in the American and French armies who fought in Europe. The first Occidental European country in which the pandemic spread from the month of May onwards to large sectors of the population, causing serious mortality, was Spain. After a period of calm during the summer of 1918, the flu presented itself with tremendous virulence in September, simultaneously affecting in October many countries in Southwestern Europe, spreading to the whole continent by November. The mortality rates that were calculated for Paris (6.08 per 1000) and Madrid (5.27 per 1000) for 1918 are relatively low in comparison with those calculated for the whole pandemic period for countries in Southwestern Europe, which oscillate between 10.6 and 12.1 per 1000. This study also corroborates the thesis that victim age is an important parameter with which to understand pandemic behaviour and to facilitate good decisions when faced with future influenza pandemics.

This latter characteristic of victim age has been commented upon by Collins³⁶ during the 1930s, Simonsen *et al.* regarding the USA, Olson *et al.* for New York and Viboud *et al.*³⁷ regarding the 1951 flu epidemic. It is clear from this study that one of the highest risk groups in a future influenza pandemic, which exhibits characteristics similar to those of the Spanish Flu, is men and women between the ages of 25 and 34, followed by those between the ages of 15 and 24.

Acknowledgements

Thanks to Aitor Erkoreka for his invaluable help with data processing and the elaboration of the table and graphs; to Sonia Feira for obtaining data in Portugal; to Saturnino Ruiz de Loizaga for help in Rome; to Xavier Tabbagh and C. Gargar for help in the Archive du Service de Santé des Armées in Val-de-Grâce (Paris); to other researchers and employees at the archives in Paris, Rome, Madrid, Pau, Biarritz and Bilbao who have contributed to the oftentimes arduous task of collating data; to Juan Bilbao, Jose Mencia, David J. Fogarty, Ricardo Franco and Ramón Cisterna of the University of the Basque Country; to Josep Danon of the Fundació Uriach (Barcelona); and finally to Begoña Madarieta and Aitor Anduaga from the Basque Museum of the History of Medicine for their constant support and collaboration.

Conflict of interest

The author declares that he has no conflicts of interest.

References

- 1 Taubenberger JK, Reid AH, Lourens RM *et al.* Characterization of the 1918 influenza virus polymerase genes. *Nature* 2005; 437:889–893.
- 2 Tumpey TM, Basler CF, Aguilar PV *et al.* Characterization of the reconstructed 1918 Spanish influenza pandemic virus. *Science* 2005; 310:77–80.
- 3 Nelson MI, Viboud C, Simonsen L *et al.* Multiple reassortment events in the evolutionary history of H1N1 influenza virus since 1918. *PLOS Pathog* 2008; 4:1–12.
- 4 Smith GJD, Bahl J, Vijaykrishna Dh *et al.* Dating the emergence of pandemic influenza viruses. *PNAS* 2009; 106:11709–11712.
- 5 Crosby AW. *America's Forgotten Pandemic. The Influenza of 1918.* Cambridge: University Press, 2003 (1989).
- 6 Morens DM, Taubenberger JK, Fauci AS. The persistent legacy of the 1918 influenza virus. *N Engl J Med* 2009; 361:225–229.
- 7 Morens DM, Taubenberger JK. Understanding influenza backward. *JAMA* 2009; 302:679–680.
- 8 Fabre A. Archives historiques du Service de Santé Militaires conservées au Musée du Val-de-Grace. Paris: 3 vol, *circa* 1977.
- 9 Patterson KD, Pyle GE. The geography and mortality of the 1918 Influenza Pandemic. *Bull Hist Med* 1991; 65:4–21.
- 10 Erkoreka A. Origins of the Spanish influenza pandemic (1918–1920) and its relation to the First World War. *J Mol Genet Med* 2009; 3(2):190–194.
- 11 Ministère de la Guerre. Sous Secretariat d'Etat du Service de Santé Militaire. Services Techniques. Section de Médecine. "Notes sur la grippe aux Armées du mois d'avril au novembre 1918" (Archives du Services de Santé des Armées, ASSA, carton 814): "*La grippe semble avoir fait son apparition aux Armées du 10 au 20 Avril 1918. Elle a été signalée en premier lieu par le Médecin-consultant de la 3^e Armée à Villers-sur-Coudun. Peu de temps après, elle apparaît à la D.F. du G.A.N. (Camp d'Instruction de Fère-Briange). Dès la fin d'Avril, l'affection présente un caractère de diffusion extrême et atteint toutes les Armées*".
- 12 Sous Secretariat d'Etat du Service de Santé Militaire. Services Techniques. Section Franco-Américaine. Haven EMERSON a Monsieur le Médecin Major de 1ère classe RAYNAUD. Mission Française – TOURS. "La grippe dans l'Armée Américaine" (*circa* sep.1918) (ASSA, carton 813): "*A peu près vers le 15 Avril une épidémie de fièvre bénigne accompagnée des symptômes catarraux se manifesta parmi les Troupes Américaines dans les environs de Bordeaux. Depuis cet époque jusqu'au jour actuel, cette effection de forme épidémique a continué à servir avec plus ou moins de gravités sur nos troupes, en France et en Angleterre. Le caractère bénin du début de l'épidémie nous fit douter que nous nous trouvions en présence d'une affection due au bacille de Pfeiffer, mais des cas précoces, soumis à un soigneux examen par les méthodes bactériologiques, montrèrent, dans la grande majorité des cas, la présence du bacille de Pfeiffer qui, depuis est considéré comme étant incontestablement l'agent étiologique*".
- 13 Pau, between 31st March and 25th April; Biarritz, between 26th March and 9th April.
- 14 Darmon P. Une tragédie dans la tragédie: la grippe espagnole en France (avril 1918 – avril 1919). *Ann Demogr Hist* 2000; 2:153–175.
- 15 18e Région. Direction du Service de Santé. n° 8598/c. Le Médecin Principal de 1re Cl. Bergasse, Directeur du Service de Santé de la 18e Région à Monsieur le Sous-Secrétaire d'Etat du Service de Santé – 1^{re} Division Technique. Paris. (Bordeaux, le 30 Mai 1918) (ASSA, carton 814).
- 16 Tognotti E. La 'Spagnola' in Italia. Storia dell'influenza che fece temere la fine del mondo (1918–19). Milano: Franco Angeli, 2002.
- 17 *El Sol*. "¿Cuál es la causa? Una epidemia en Madrid" (What is the cause? An epidemic in Madrid). *El Sol*, Madrid, 22 May, 1918.
- 18 Ministerio de Instrucción Pública y Bellas Artes: Boletín de la Estadística Municipal de Madrid (mayo 1918), (junio 1918). *s.l.; s.a.*
- 19 Jorge R. A influenza. Nova incursão peninsular. Relatório apresentado ao Conselho Superior de Higiene na sessão de 18 de Junho de 1918. Lisboa: Imprensa Nacional, 1918.
- 20 "Seu carácter influncial, similar ao da pandemia clássica de 1888–1890 e da recente dos Estados Unidos (1915–1916)".
- 21 *El Sol*. "Epidemia de gripe en Lorca" (Flu epidemic in Lorca). *El Sol*, Madrid, 7 September 1918.
- 22 *El Sol*. "El mal de moda Resurge el 'soldado de Nápoles'" (Current evil: The reappearance of the 'Naples Soldier'). *El Sol*, Madrid, 12 September 1918.
- 23 *El Sol*. "La salud en España. Víctimas de la epidemia" (Health in Spain. Epidemic victims). *El Sol*, Madrid, 17 September 1918.
- 24 *El Sol*. "Última hora. La frontera francesa" (Latest news. The French border). *El Sol*, Madrid, 20 September 1918.
- 25 *El Sol*. "La salud pública en España" (Public Health in Spain). *El Sol*, Madrid, 30 September 1918.
- 26 Simonsen L, Clarke MJ, Schonberger LB *et al.* Pandemic versus epidemic influenza mortality: a pattern of changing age distribution. *J Infect Dis* 1998; 178:53–60.
- 27 Olson DR, Simonsen L, Edelson PJ *et al.* Epidemiological evidence of an early wave of the 1918 influenza pandemic in New York City. *PNAS* 2005; 102:11059–11063.
- 28 Taubenberger JK, Morens DM. 1918 influenza: the mother of all pandemics. *Emerg Infect Dis* 2006; 12:15–22.
- 29 Porras MI. Un reto para la sociedad madrileña: la epidemia de gripe de 1918–19. Madrid: Comunidad – Editorial Complutense, 1997.
- 30 Erkoreka A. Spanish influenza in the heart of Europe. A study of a significant sample of the Basque population. *Gesnerus, Swiss J Hist Med Sci* 2008; 65:30–41.
- 31 Erkoreka A. La pandemia de gripe española en el País Vasco (1918–1919). Bilbao: MHM, 2006.
- 32 Echeverri B. La gripe española. La pandemia de 1918–1919. Madrid: Siglo XXI, 1993.
- 33 Collier R. L'epidemia che atterri il mondo. Milano: Mursia, 1982.
- 34 Phillips H, Killingray D. The Spanish Influenza Pandemic of 1918–1919. New Perspectives. London: Routledge, 2003.
- 35 Ansart S, Pellat C, Boelle PV *et al.* Mortality burden of the 1918–1919 influenza pandemic in Europe. *Influenza Other Respiratory Viruses* 2009; 3:99–106.
- 36 Collins SD. Age and sex incidence on influenza and pneumonia morbidity and mortality in the epidemic of 1928–29 with comparative data for the epidemic of 1918–19. *Public Health Rep* 1931; 33:1909–1937.
- 37 Viboud C, Tam Th, Fleming D *et al.* 1951 influenza epidemic, England and Wales, Canada, and the United States. *Emerg Infect Dis* 2006; 12:661–668.