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Death, sex and nutrition:
analysis of the cause of death in the Coimbra human skeletal collection

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Abstract. The Human Skeleton Collection from the "Museu de Antropologia" of the University of Coimbra, consists of 505 individuals mainly adults. The data for each of these skeletons includes birthplace, the sex as well as the age and cause of death. From this series we have selected only those individuals born in the city of Coimbra. Historical documents provide some knowledge about the diet of these people whose lives span the period between the middle of the 19 th and the middle of the 20 th century. The aim of the present study is to try to establish a relationship between the nutritional status obtained from historical sources and the mortality rates for individuals according to their sex and probable cause of death as well as the demographic structure and seasonal differences in death.

Key words: nutrition; cause of death.

Resumo. Para o presente trabalho foram seleccionados, da Colecção de Esqueletos Identificados do Museu de Antropologia da Universidade de Coimbra, os indivíduos (n=101) naturais desta cidade. O principal objectivo deste estudo é a pesquisa de eventuais relações entre o *status* nutricional, conhecido através de documentos históricos, e a provável causa de morte por sexo e grupo etário, dados estes obtidos nos registos da referida Colecção. Testou-se ainda a hipótese de existir uma sazonalidade da morte dependendo do tipo de patologia.

Palavras chave: nutrição; causa de morte.

The sample

The individuals from the Human Skeleton Collection, at the Museum of Anthropology from the University of Coimbra, derive from portuguese localities with only a few originating from foreign countries mainly African portuguese ex--colonies. Each obituary record contains information for place as well as date of death, sex, age at death and the probable cause of death.

Among the 505 skeletons of the Collection we have chosen for this study 101 individuals (49 males and 52 females), adults and subadults (see figure 1) who were born in City of Coimbra. The birthplaces mentioned on records seem to be secure since the majority of births in the XIX century occurred at home (Cunha, 1994).

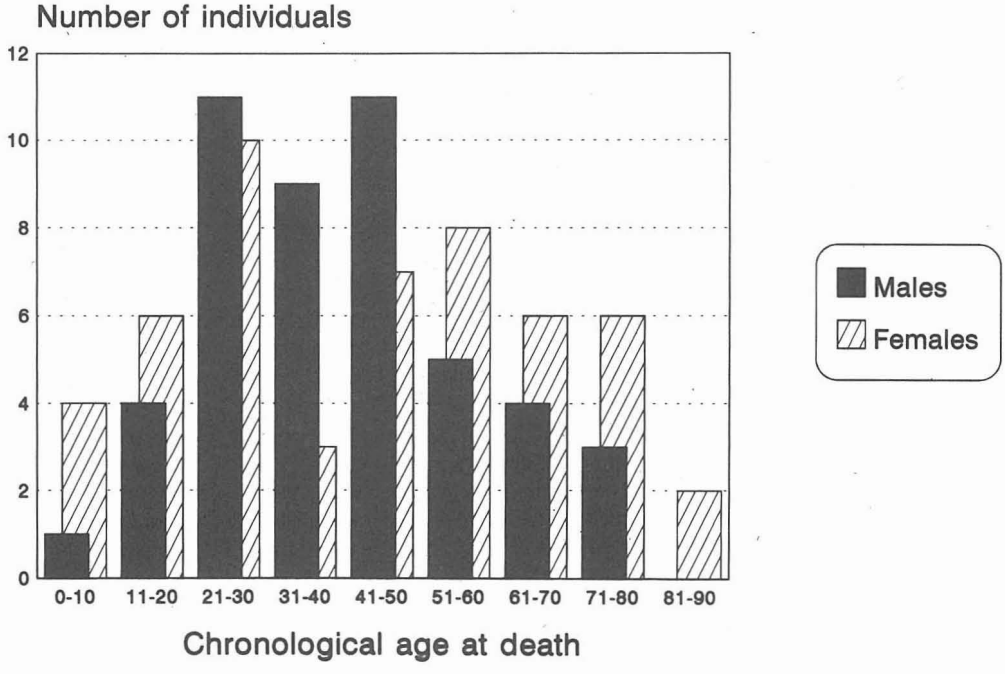

Fig. 1. Age at death distribution of the Coimbra sample.

Although the year of birth is not given on the obituary records, it was calculated subtracting the age at death plus one from the year of death. The dates of birth range from 1831 to 1921 with the mean year of birth being 1879. Only 23,8% (24/101) individuals were born after 1900; the majority, 74,3% (75/101), were born before 1900 and two of them (1,9%) had unknown dates of birth (see figure 2).

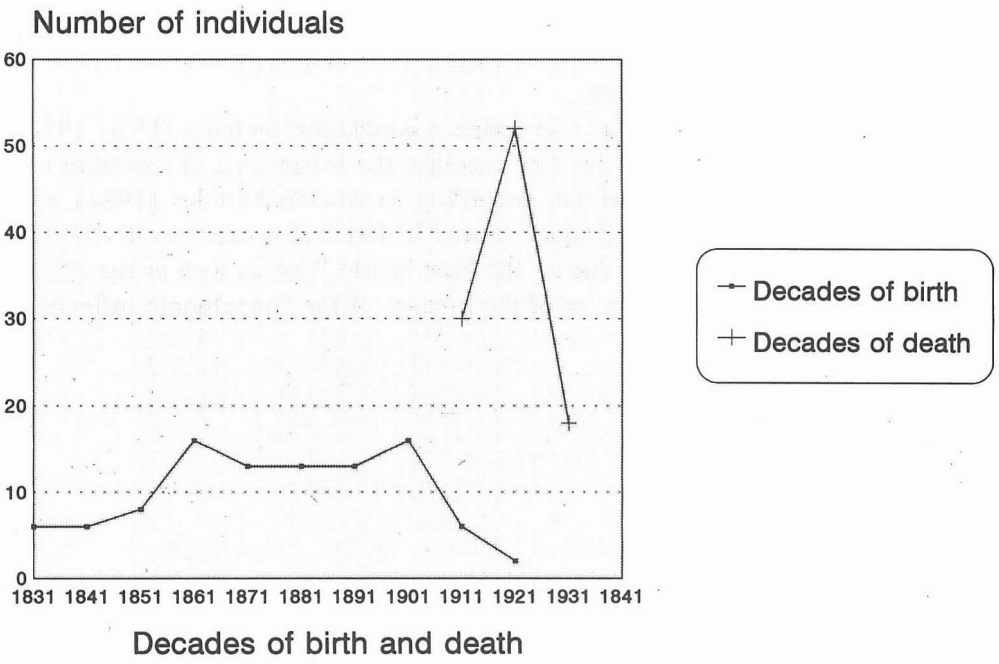

Fig. 2. Distribution of the years of birth and death.

Dates of death are concentrated in the period between 1910 and 1938 (see figure 2) with the mean year of death 1922.

Besides, there are historical references to nutrition of that period.

Historical and Dietary Background

According to historians the population of Coimbra, from the 19 th century, did not have adequate nutrition. Water was very often not potable and living accommodation was often unsatisfactory, imposing serious limitations on personal and collective hygiene (Roque, 1982).

In the middle of the last century Coimbra was still a small city with its inhabitants involved in the life of the University or the Church or who worked as either artisans and servants (Roque, 1988). The Collection records agree with this picture and also confirms that women almost exclusively (91,5%) worked as housekeepers.

It was the coming of the railway to Coimbra in 1880 (Dias, 1988) which heralded the very beginnings of a process of industrialization whose first phase

lasted until the turn of the century, with modern life starting to develop only after 1915 (Roque, 1988; Amado Mendes, 1984). Our sample, therefore, must be considered as a preindustrial one.

In the 19th century, it was registrated a population increase (Dias, 1988), and during the first quarter of the 20th century, the urban area of Coimbra had been considerably expanded which, according to Amado Mendes (1984), was facilitated by electric public transport, started in 1911. However, until 1920 the number of inhabitants declined due to the First World War, as well as the effects of emigration and not least because of the ravages of the "pneumonic influenza" (see figure 3).

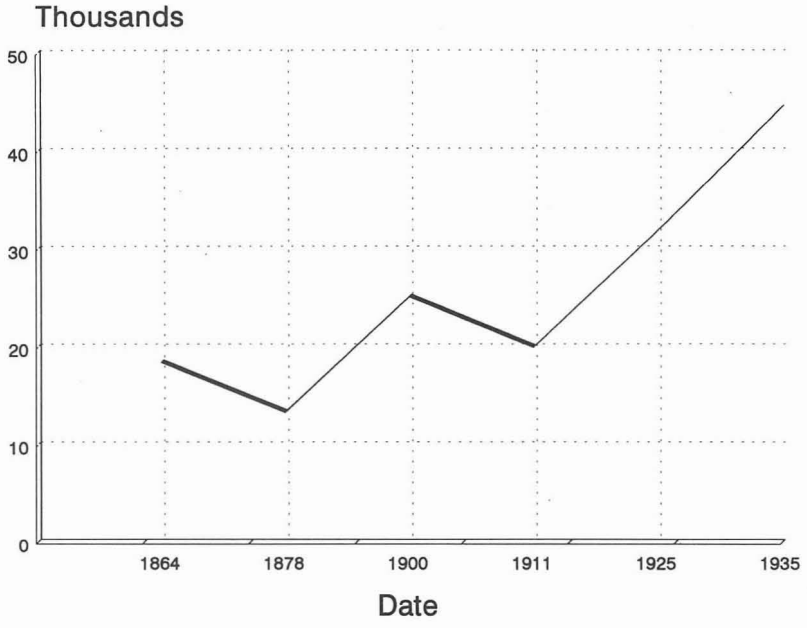

Fig. 3. Increase in population of Coimbra city.

"The diet of a population is a fundamental indicator of many elements of the society. It reflects technological status, resources, and land to population ratios" (Molleson and Cox, 1993). From the occupational data present on the records we know these individuals are of a low socioeconomic status. How can we know the nature of their diet?

It is well established that nutrition and socioeconomic status are interrelated. In our case the diet of the low socioeconomic group consisted mainly of cereals. Bread in the Coimbra region was made with maize. Even in the city of Coimbra

wheat bread was very restricted which contrasts to its later ubiquity at the end of the century. Before that, access to this last resource was almost exclusive to the higher socioeconomic group (Roque, 1982). Thus, for a typical adult journeyman, diary bread consumption was around 1150 gm (Nazareth *in* Roque, 1988).

The nutrition of the lower socioeconomic group included also green and dry vegetables eaten as soups ("sopas") and broths ("caldos") accompanied with potatoes, which not only increased the amount of food consumed but also made an important contribution to the quality of the diet. Soups were also prepared with maize flour (Roque, 1982). Additionally, a small (but not daily) intake of fish (usually sardine and salt codfish), bacon and olive oil could complement the nutrition (Bocquet-Appel *et al.*, 1987). Such a diet made of bread, vegetables and potatoes was called "the nourishment trilogy" (Roque, 1982). From a inquiry made by Nazareth, in 1903, we know that this diet represented about 55% of the average salary of a journeyman from Coimbra (*in* Bocquet-Appel *et al.*, 1987).

Lastly, a word about the consumption of "spoiled cereals" ("cereais avariados") - inside and outside the area of Coimbra - particularly during periods of crises, which provoked serious damage to the health of the population (Roque, 1982). Certain dietary deficiencies and excesses revealed osteological markers (Molleson and Cox, 1993). The analysis of stress indicators (Cunha, 1995) was conclusive "the stress indicators tend to support historical records that indicate that a high percentage of individuals had a low economic level". Enamel hypoplasia, *cribra orbitalia* and porotic hyperostosis are also well represented.

Cause of Death, Sex and Age Structure

One way of checking the validity of the cause of death of the present sample is to compare the age mortality patterns to a specific cause of death with the historical references to that specific disease in the Coimbra population. In agreement with some authors (McDaniel and Preston, 1994) "*cause of death* is a expression used to simplify the factors that contribute to an individual's death. It is now conventional to distinguish the main cause (the underlying cause) from the direct cause and the ancillary causes". But such distinctions were not made during the nineteenth century. Nonetheless it provides an understanding of the pattern of morbidity and mortality of populations of that time.

The Coimbra mortality rates in the period between 1926-1936 were reduced approximately by half. The population benefitted from good medical assistance provided by advanced technology. The University's Faculty of Medicine contributed significantly to this phenomenon (Meliço Silvestre, 1938).

On the bases of the probable cause of death stated in the records and with the invaluable help of a physician, we have created four categories of causes of death (see table 1).

Table 1. Distribution of the cause of death, in adult sample, concerning the nutrition ($\chi^2 = 53{,}776$, $p < 0{,}005$).

Category	Males		Females		Total	
	N	%	N	%	N	%
1. Directly related with nutrition	—	—	2	4,8	2	2,3
2. Probably related with nutrition	23	52,3	17	40,5	40	46,5
3. Not related with nutrition	17	38,6	19	45,2	36	41,9
4. Unknown origin / not in the catalogue	4	9,1	4	9,5	8	9,3

As we can see on table 1, only two women died with diseases linked to nutrition. Category 2 includes almost 52% of males and 40,5% of females, with being the tuberculosis the main cause of death. In the total sample, 41,9% of the individuals died with problems apparently independent from nutrition.

The subadult sample (20 years old or less) consist of 15 individuals, 5 males and 10 females. They died mainly (11/15) from diseases independent of nutrition, three died from tuberculosis, therefore they were included in group 2, and one died from an unknown disease.

A better state of knowledge concerning the cause of death in general is needed. Therefore we have created a new chart with categories based on W.H.O. standards (OMS, 1975). Table 2 present the distribution of causes of death, for the adults, by sex, and for the total sample.

During the 18 th and 19 th centuries, infectious diseases were amongst the most common causes of mortality. Tuberculosis was the most prevalent of them (Waldron *in* Molleson and Cox, 1993; McDaniel and Preston, 1994). Between 1926-1936 the mortality for people aged from 15 to 24 years old was mainly (54,1%) tuberculosis (Meliço Silvestre, 1938a). In our sample the infectious-contagious diseases are the main cause of death: 38,6% (39/101). From the 38,6% almost 35% (35/101) were due to tuberculosis. The cause of death of the remaining 4% includes measles, flu, typhoid fever and *hemorrhagic variola.*

Tuberculosis was such a significant cause of death that Queen D. Amélia of Portugal, on the 11th of June 1899, founded the Tuberculosis National Assistance ("Assistência Nacional aos Tuberculosos - A.N.T.") and the first *Sanatorium* (Castello Branco, 1949). After that date the number of *sanatoria* built

for this purpose increases considerably throughout the country. Nonetheless, the number of deaths likewise steadily increased. In 1910 a Republican Government came to power and political problems diverted attention from issues of public health. As an attempt to prevent this calamity in 1929 started events such as "Tuberculosis Week" (figure 4), whit people selling "anti-tuberculosis" stamps, improved the financial resources of the Association (Lopo de Carvalho, 1937).

Table 2. Cause of death by sex among the adult sample ($\chi^2 = 214{,}918$, $p < 0{,}005$).

Category	Males		Females		Total	
	N	%	N	%	N	%
1. Circulatory and heart diseases	11	25,0	14	33,3	25	29,1
2. Infectious / contagious diseases (eg. tuberculosis)	20	45,5	15	35,7	35	40,7
3. Respiratory diseases	5	11,4	3	7,1	8	9,3
4. Accidents and violence	2	4,5	—	—	2	2,3
5. Tumors	—	—	3	7,1	3	3,5
6. Senility	—	—	1	2,4	1	1,2
7. Digestive system diseases	1	2,3	4	9,5	5	5,8
8. Osteon-muscle diseases	—	—	—	—	—	—
9. Nervous system diseases	1	2,3	—	—	1	1,2
10. Urinary diseases	—	—	1	2,4	1	1,2
11. Disease of the mastoid process	1	2,3	—	—	1	1,2
12. Venereal diseases	1	2,3	—	—	1	1,2
13. Unknown meaning or not in the catalogue	2	4,5	1	2,4	3	3,5

A connection between occupation and tuberculosis is likely to have been the case. In the middle 1920's, women and children reached the highest rates (32% and 19,4%, respectively) in opposition to rural workers (3,1%), potters (2,2%), students (4,7%) and soldier (2,8%) (Meliço Silveste, 1938a).

In our sample, circulatory and heart diseases are responsible for 26,7% (27/ /101) of the deaths. Some authors (Porto and Ibérico Nogueira, 1940) maintain that these diseases are the principal disease responsible for mortality at this time.

"Most of evidence on diet and cancer is as yet inconclusive. There is, however, accumulating data indicating that modifications in diet may reduce the risk of cancer by as much as one third and possibly by as much as two thirds" (Austoker, 1994).

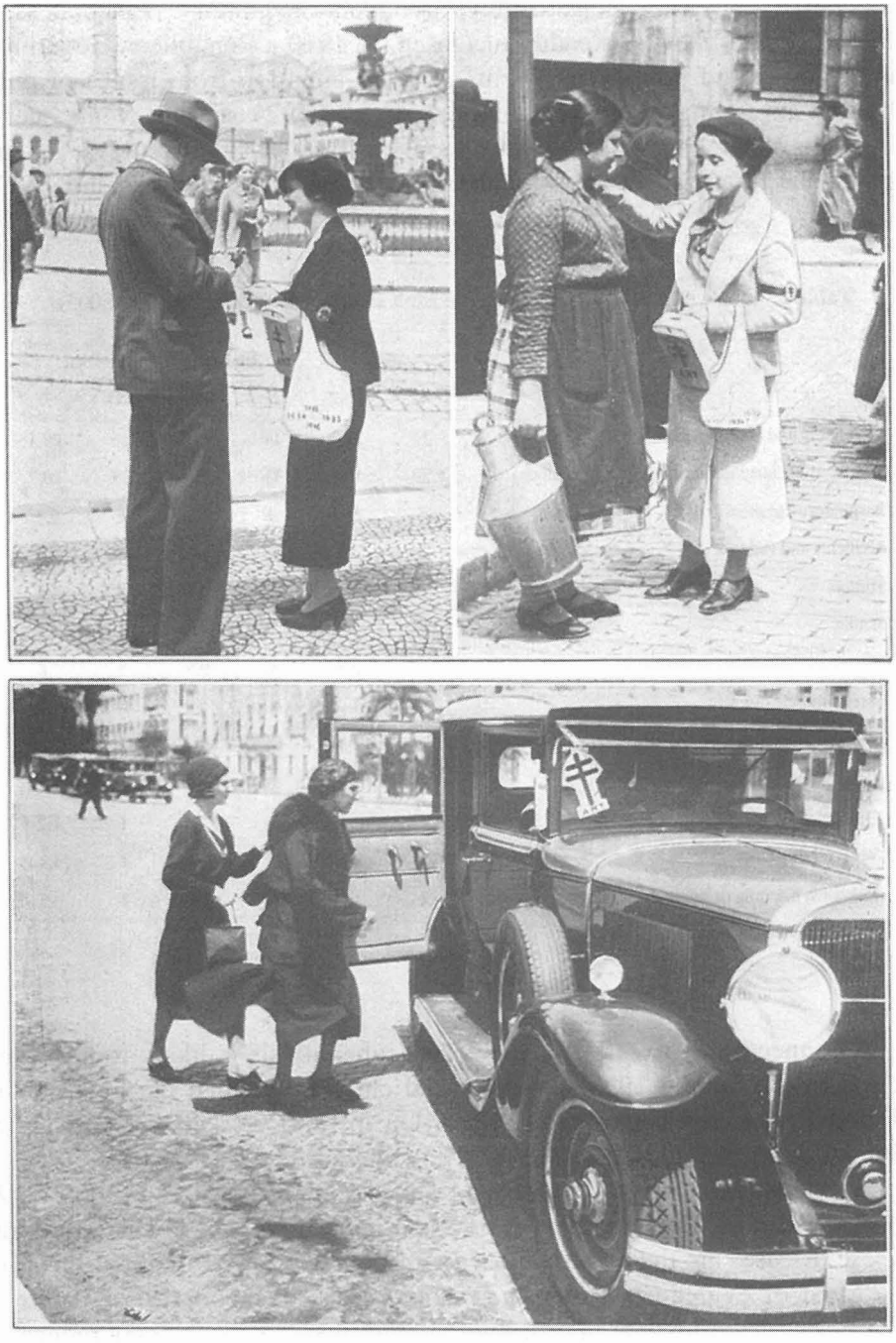

Fig. 4. Ladies selling "Anti-Tuberculosis" stamps and a free private car taxi service during that week (Lopo de Carvalho, 1937).

"There is strong and consistent evidence that a high intake of fruit and vegetables protects against various cancers. The association is most marked for cancers of the respiratory and digestive tracts" (Austoker, 1994). From the historians data (Roque, 1982; Bocquet-Appel et al., 1987) we know that cabbage was very important on diet, also kidney bean, broad bean, grain, pea and chestnut were used in the manner of soups. The incidence of cancer in our sample was only 3,0% (3/101).

The urban distribution of the occurance of cancer within Coimbra is very revealing. It predominates in the lower parts of the town, which is more humid and with a higher density of population (Gonçalves Ferreira, 1938). In addition to cancer, tuberculosis was rife in this part of the town. It can be demonstrated that tuberculosis frequency typically decreased in buildings as one ascended from the ground floor to the uppermost (Meliço Silvestre, 1938a).

Cause of Death and Seasonality

In our sample the highest values of mortality occurred in December (16 / /101), followed by April and June with 11 deaths each. However, this is a random distribution even when we analyzed the seasonality from each cause of death ($p>0,005$).

A study published by Meliço Silvestre, in 1934, about the seasonality of the infectious diseases in the area of Coimbra, for the period between 1912 and 1925, reveals peaks of mortality from pneumonia and influenza in February and October; tuberculosis in March and November, and typhoid fever and enteritis in August, September and October.

When compared with skeletons from the crypt of Christ Church of Spitalfields, we find a different pattern of seasonality of the mortality where the peaks were found in January, February and March (Molleson and Cox, 1993).

The Coimbra sample has only 10 females and 5 males, aged twenty or below. Therefore, the small sample size does not allow as a secure judgment about the seasonality of death, since the chi-square calculation is of doubtful use. Nevertheless, seven deaths occurred in June ($p<0,005$). Meanwhile the peaks of mortality for the 88 children (aged 18 or below) from the crypt of Christ Church of Spitalfields were in August and November (Molleson and Cox, 1993).

The peaks divergence, for both adults and subadults, can result from factors such as the different size of the samples (*e.g.* the crypt of Christ Church had 287 adults); the different socioeconomic status; samples which are not completely contemporaneous; and weather differences between Portugal and United Kingdom in the same month from distinct years of death can have diverse climatic conditions.

Conclusions

The historical data reveal to us that a great majority of the individuals came from lower socioeconomic groups and that their diet consisted essentially of bread, potatoes and green and dry vegetables. Nevertheless, in our sample, only a few number of individuals died from diseases directly linked to nourishment privation ($p<0,005$).

By far, the most important cause of death in adults were infectious / contagious diseases, like tuberculosis, ($p<0,005$) which account for about 40,7% of adults deaths. Second, are circulatory and heart diseases with 29,1% and in third respiratory diseases (9,3%).

In the subadult sample (15/101) the infectious diseases were the main cause of death. Concerning seasonality of mortality we found a peak in June ($p<0,005$). However, the seasonality pattern was not verified in the adult sample although the medical data, from that time, do not support this result in spite of the lack of statistical analyses.

Finally, one aspect that should be emphasized concerning these results is that they could be artifacts of the small sample sizes involved. Further studies on skeletal collections which have good documentation will surely provide valuable contributions to our knowledge of the health of past human populations.

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