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SEASONALITY AND CYCLIC TENDENCY OF MORTALITY IN A PYRENEAN POPULATION[1]

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SUMMARY.- Mortality characteristics exert a great influence on the demographic framework of the population, determined by different factors: internal (genetical and cultural specific features), external (dependent on the ecosystem), and intermediate ones (the population's capacity to adapt itself to the environment). The analysis of seasonal distribution of 3313 deaths recorded at Parish Registers from El Pont de Suert (Alta Ribagorça, Catalonia, Spain) from 1664, is evidence of the importance of all these factors. The distribution patterns show the relationship between mortality and climatic conditions, epidemiological conditions, as well as socio-economical and demographical transformations. The cyclical trend model, common to many Iberian mountain populations, does not show up in this particular population.

RESUMEN.- Las características de la mortalidad influyen decisivamente en la estructura demográfica de las poblaciones, regida por diferentes factores: internos (rasgos específicos genéticos y culturales), externos (características del ecosistema) e intermedios (capacidad de la población de autoajustarse al ambiente). El estudio de la distribución estacional de las 3313 defunciones registradas en la Villa de El Pont de Suert (Alta Ribagorça, Cataluña) desde 1664 evidencia la importancia de todos estos factores. Los patrones de distribución muestran el influjo de las condiciones climáticas, de los ambientes epidemiológicos, así como de las transformaciones socioeconómicas y demográficas. El modelo de tendencia cíclica en la mortalidad, común a muchas poblaciones ibéricas de montaña, no se evidencia en esta población.

RESUMÉ.- Les caractéristiques de la mortalité influent sur la structure démographique des populations, qui est, à son tour, déterminée par diférents facteurs: internes (traits génétiques et culturelles spécifiques), externes (caractéristiques de l'écosystème) et intermédiaires (capacité de la population de s'adapter à l'environnement). L'analyse de la distribution saisonnière

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des 3313 décès enregistrés, depuis 1664, à El Pont de Suert (Alta Ribagorça, Catalogne, Espagne) montre l'importance de tous ces facteurs. Les patrons de distribution mettent en évidence l'influence des conditions climatiques, des ambiences épidémiologiques, ainsi que les transformations socio-économiques et démographiques. Le modèle de tendance cyclique de la mortalité, commun à beaucoup de populations ibériques de montagne, n'est pas ici évident.

Key words: *Adaptation, mortality, Pyrenees.*

The importance for urgent research into anthropology in the Pyrenees is largely justified by the rapid and gradual loss of the population in this mountainous region. There are numerous and very different sorts of factors that cause this situation. From socioeconomic factors (labour pressures, improvement of communication routes, land and cattles reform) to genetic ones (mainly migratory movements), all are interrelated. Up to now these human entities have been independent of the biological dynamic outside the Pyrenees perhaps causing specific characteristics of adaptation to demographical peculiarities. This work considers all of them.

We are dealing with a flexible material: human distribution governed by genetic characteristics and influenced by external events such as epidemics, wars and natural disasters, which in most cases affect biodemography quantitatively. This fact requires an objective approach. We have to point out the importance of routine in rural life. This fact usually escapes critic's attention due to its difficulty and problematic determination. The contact of human beings with the ecosystem shapes the biological conditions, which determine the demographic structure of the population, the birth rate, marriage and the death rate. They will configure the basic structure of the population, both in its temporal evolution and in its present development. These three phenomena, from an anthropological point of view, are the representative symbols of the genetics of a group of people. This work exclusively tries to analyze the last fact, mortality, and particularly the seasonal distribution of people in the Pyrenean town of El Pont de Suert from 1664 until the present. These statistics will permit us to know the distribution of this phenomenon in a particular period, its environmental development, as well as an approximation of the climatic variations that place pressure upon humanity.

Moreover, we will try to connect our results to the ones in earlier studies of both Pyrenean and extrapyrenean regions; all of them have comparable characteristics although they are distant geographically. We have to bear in mind the biosocial differences among them, for they will help us to know the demographic dynamics that govern this collection of people and the situation of our population in this context. The studies referred to before have followed an investigation outline of our Department, with examples such as Luna (1981), Bailo (1986), Hernandez *et al.* (1987), among others.

In order to make comprehension of the possible results easier, we have to approach the context of the population, sketch the conditions under which

it has developed and the to determine what stage it has reached. El Pont de Suert is situated in the province of Lleida, 126 km from the capital, on the river bank of Noguera Ribagorçana, at a height of 843 m. It enjoys prepyrenean weather with temperatures which, while not extreme, are markedly low in winter and mild in summer. Mid-season months are quite rainy. El Pont de Suert is the capital of the recently defined district *(comarca)* of Alta Ribagorça, and the socioeconomic and health core of the district. The historic status of this town has been variable, as well as the size of its population. Until the years of Spanish Civil War the population ranged from 400 to 600 inhabitants. In the 1950s, coinciding with the hydro-electric development, the population increased, and nowadays there are about 3000 people living in El Pont. This fact is extremely important for the present-day representation of our population in the regional context. The traditional system of sustenance until this epoch was based on migrating farm stock and on fallow land. The routes of geographical contact with neighbouring districts have a great importance because they are a connective line with external populations. Direct communication with the Val d'Aran is made nowadays by means of the Viella Tunnel (1947); before it was built contacts seem scarce. The connections towards East and South (Pallars Sobirà and Pallars Jussà) are also difficult; nevertheless, we must consider the existence of cattle trails. The closest relation is with the Aragonese Ribagorça, where the contact area is bigger, and the extenuating geographical circumstances are more evident.

1. Material and methods

The data used have been obtained from the parish archives; they have been extracted by the authors after a complete revision of the Burial Record Books which can be found in perfect conditions, registering a continuity in death certificates from 1664 until nowadays, except the Spanish Civil War years, during which the deceased people were not listed. In spite of the complete information that most of certificates give us, this study has exclusively considered the date (month and year) and age of the dead people; some complementary notes about possible cause of death have been used as indicators, but it was not possible for us to organize this material systematically. The items of data that were entered in the accounts numbered 3313 and they were grouped into sufficiently numerous periods for the total number of dead people for each group to be significant, on statistical treatment. We obtained seven periods of fifty years, except the last one, which comprises thirteen years. This decrease is not contradictory to what we have expounded before, because the number of deceased in this last period is markedly greater when compared to the rest. The number of deaths per month and period, as well as the marginal totals are represented in Table I. Other kinds of groups have also been dealt with which will indicate the general tendency of the different periods as well as their temporal evolution. These groupings are quarterly and six-monthly. To group the months quarterly, we considered the three months approximately corres-

pondent to astronomical seasons: January, February and March, winter; April, May and June, spring; July, August and September, summer; October, November and December, autumn. The half-yearly grouping was made with the "cold" months (autumn and winter) and the "hot" ones (spring and summer).

TABLE I
Monthly distributions of the deaths.

GROUPS	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
1664-1713	28	36	19	34	21	22	26	30	24	39	16	35	330
1714-1763	22	20	23	25	19	12	26	34	18	17	16	17	249
1764-1813	35	30	30	28	22	23	30	35	30	22	35	24	344
1814-1863	60	34	27	27	31	28	34	39	28	36	40	32	416
1864-1913	92	56	58	56	62	45	57	80	70	86	68	80	810
1914-1963	75	71	63	64	65	54	60	71	60	46	43	71	743
1964-1986	47	33	41	38	30	39	26	44	26	26	34	37	421
TOTAL	359	280	261	272	250	223	259	333	256	272	252	296	3313

To obtain the seasonality coefficients we applied Henry's method (1972), with results shown in Table II. To evaluate the intra and extraregional comparisons and meanings we used two other systems: Chi-square for general and extraregional comparisons and the verosimilitude ratio test for comparisons among the groups. Edwards' model (1981) was applied to obtain the death frequency approximation to a circular function so that this method shows us the feasible cyclical tendency of this phenomenon. We must take into account the fact that when we make subgroups, we decrease the size of the sample, with the possibility of decrease in test potency; thus, the probability of introducing hardly truthful or unreal items of information in the conclusion can increase.

TABLE II
Monthly coefficients of seasonality of deceased.

GROUPS	J	F	M	A	M	J	J	A	S	O	N	D
1664-1713	102	145	70	100	76	83	95	109	91	142	60	127
1714-1763	104	104	109	122	90	59	123	161	88	81	78	81
1764-1813	120	113	103	99	75	79	103	120	106	75	124	83
1814-1863	170	106	77	79	88	80	97	111	82	102	117	91
1864-1913	134	90	85	84	91	66	83	117	106	125	103	117
1914-1963	119	124	100	105	103	86	95	113	98	73	71	113
1964-1986	131	101	114	110	84	109	72	123	75	72	106	103
TOTAL	128	89	93	100	89	82	92	118	94	97	93	105

2. Discussion

We will analyze this information from three different points of view: 1) The monthly general distribution and its meaning, as well as the quarterly and half-yearly general distributions, which will give us supplementary information concerning environmental circumstances. 2) The evolution of seasonal distributions by means of periods already defined. 3) The comparison of results with other populations in order to get a comprehensive idea about the situation of our population in the pyrenean and extrapyrenean context, as well as the possibility of presence of a mathematic cyclic model that governs the obituary phenomena in many populations.

2.1. *General groupings*

The processing of data without breakdown thereof is represented in Figure 1. We can appreciate three graphics belonging to the total seasonal variations and their quarterly and six monthly groupings. In all of them we can observe a significant seasonality, that is, the frequency of deceased -as we

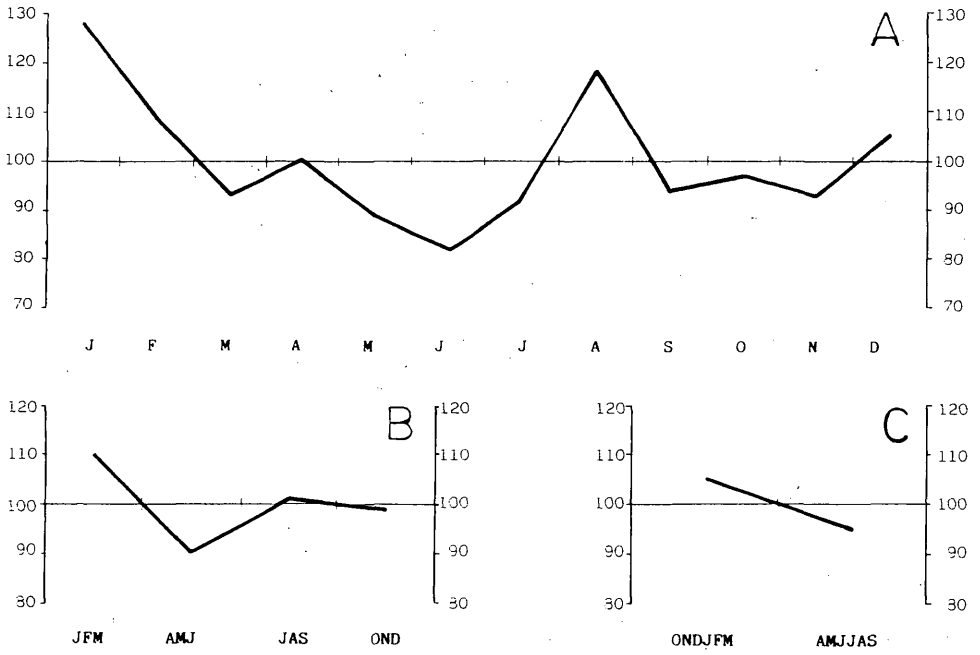

Fig. 1. Seasonality coefficients of mortality in El Pont de Suert (1664-1986). A: monthly distribution. B: quarterly. C: Half-yearly.

expected- is higher at particular periods of the year; what is more, it follows the typical pattern of the rural mountain populations, with two maximums: one of them is in the winter and of major importance in january, and the other (but slightly lower) is in summer, in August. This "a priori" model of two maximums is regulated by different, but interrelated, coordinates. We can point to an external factor of great importance, whose effects are determinant: the climate, which apart from its effect on the productivity of resources, favours the development of different pathologies in particular seasons. Thus, the winter crisis is related to respiratory illnesses, while the summer one can be explained by gastro-intestinal pathologies.

The deviations that this model can present have its origin in the influence of other kinds of factors: internal and intermediate ones. Among the internal variables we find the demographic structure: infectious mortality is different depending on the age group; while respiratory pathologies (more frequent in winter) affect mainly aged people, gastro-intestinal illnesses have a bigger incidence among the youth (HERNANDEZ *et al.*, 1987). This fact is clearly evident in our population. It is also necessary to take into consideration the population's social structure in which the circumstances of mortality will be different depending on the individual status, and the expectations of life vary with the labour sector. This sort of analysis is almost impossible in past populations, although indirect evidences from other pyrenean populations (DIAZ, 1986; TORREJON, 1986; TOJA, 1987) indicate a general uniformity in the way of life for all people.

There appears one minimum in June. It is important to have in mind this fact and its relation with the study made by one of the authors (GONZALEZ-MARTIN, in press) about the seasonal distribution of the births in the same population: in this work we observe a maximum of natality in February, that is, a maximum in conception corresponding to June. Thus, we can assure that it is at the end of spring when the population is in its best development conditions: it is logical, due to coincidence of the pleasantest weather and the largest quantity of available resources. Many populations exhibit similar features (v.g., COWGILL, 1966; MALINA & HIMES, 1977), although relative influence of the climate and/or the nourishment is not always clear.

The analysis of quarterly groupings states that it is during the first three months that death frequencies are more markedly significant. If we compare this maximum with the one in July, August and September we observe that the latter, apart from being lower that the former, occurs more gradually and its standard deviation is more noticeable. On the other hand, if we add the frequencies of mortality in summer and spring (the "warm" months), the result is significantly lower than the amuount corresponding to autumn and winter (the "cold" months). Nevertheless, every half-yearly grouping must be evaluated carefully, over all in districts where the climatic seasons do not adjust to astronomic ones.

2.2 *Periodical groupings*

This is the most suitable focusing in order to evaluate the temporal evolution, and to detect and justify the more significant facts of each period. These groupings are represented in Figure 2, where the three columns of graphics are set out by periods, from left to right, monthly, quarterly and half-yearly distributions. The foremost characteristics shown by graphics, and

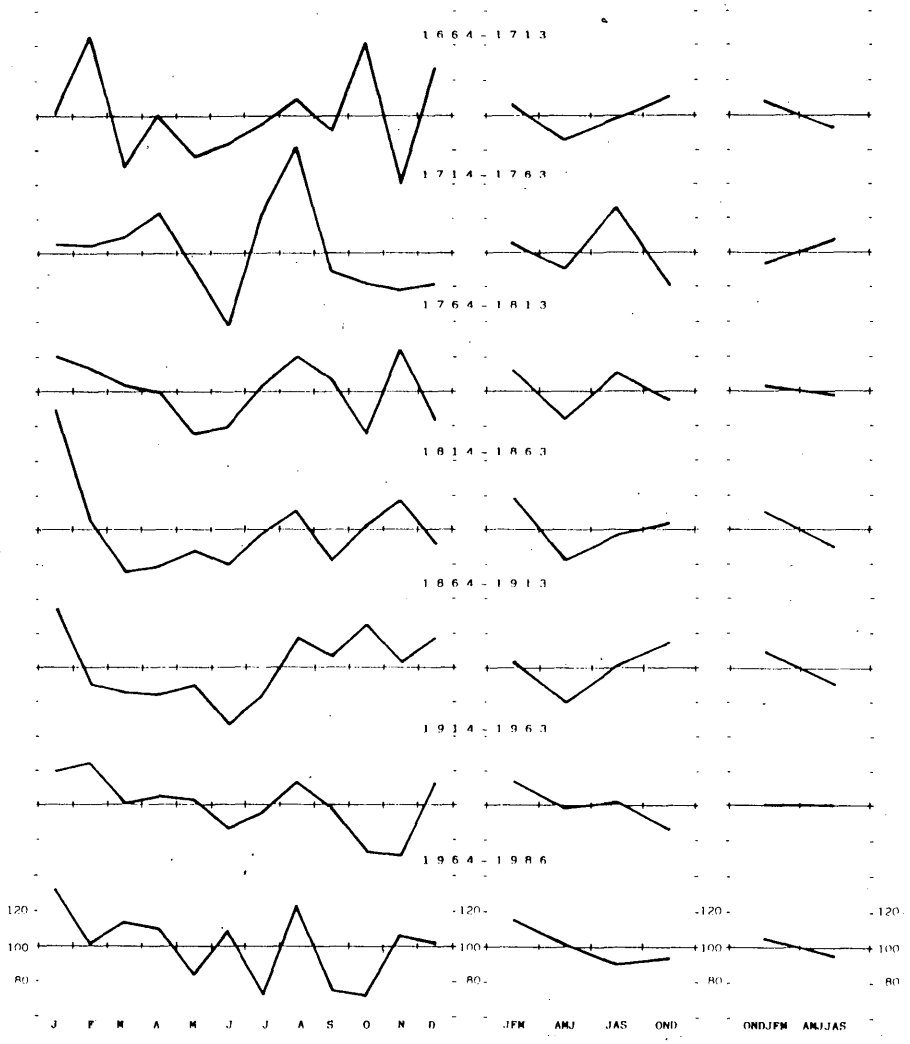

Fig. 2. Distributions of seasonality coefficients by periods. See further explanation in text.

confirmed by statistics, are the following: 1) the non-existence of a general model that includes all periods, both in monthly and quarterly or six-monthly distributions; 2) on the other hand, we could expect that the former would be due to a gradual evolution of distribution patterns over time: nevertheless, there is no such thing.

In order to explain these facts it is necessary to emphasize the long time span, which has witnessed the assynchronic evolution of many kind of factors related to mortality: 1) the epidemiological framework; 2) the socio-economical crisis; 3) the demographical structure; 4) the changes of sustenance resources.

The first of these factors provides us with a basis enough to explain the anomalous distributions in the second period (1714-1763), which is the only one with a predominancy of mortality in the warm months. In a general outline, the Modern Age can be divided into three consecutive epochs from the point of view of the epidemic landscape in Western Europe, corresponding, respectively, to pest, smallpox and cholera. Although the last pandemic plague of pest was the Naples' pest (1648-1653), the illness persisted, local and recurrently, until the first years of 18th Century. At this time, it seems that the responsible bacillus *(Yersinia pestis)* was substitued by another which is less virulent *(Yersinia pseudotuberculosis)* (McEVEDY, 1988). The disappearance of pest, which is an illness with particular incidence in the winter months, implies the relative increase of summer infections, typhus and, over all, smallpox, which had in 18th Century a marked development in European rural countries. But it is possible that factors like socio-economical crisis could strengthen the peculiarities of distributions of the deceased in this period: the effects of Dynasty change (i.e. Succession War, fall of cattleship...) generated a wave of subsistence crisis in the first half of 18th century (ANES, 1974).

The influence of the factors above, grouped as 3) and 4), can be seen, for instance, in the distributions of 1864-1913 period. In this period there is no increase of population, but there is marked increase of mortality. This fact can only be explained by means a combination of change in demographic structure (the population decreases by emigration of reproductive classes) and evolution in the way of life (pyrenean wool became less competitive with "merina" wool from America and Australia). It is difficult to know the arrangement of these facts, but we suspect that the population of Alta Ribagorça, like the whole Pyrenean population, achieved in these years the maximum of population that the traditional way of life could allow (TOJA, 1987).

2.3. *Extrapopulational comparisons and cyclical tendencies*

There are not many studies on seasonality of mortality which could be compared with our data. Among them, we have selected three pyrenean populations and an extrapyrenean one: Salazar Valley (in the province of

Navarra, 150 km from El Pont de Suert), Aragonese Ribagorza and Pallars Sobirà (that perform, respectively, the western and part of the eastern boundaries of Alta Ribagorça); the extrapyrenean population is from Alta Alpujarra (Andalusia). The tendency of each population we consider is notably different from our own population. However, it is necessary to go deeply into the dynamic of each one in order to find explanations for both concordants and divergent matters.

Pallars Sobirà presents a classical tendency, with a minimum in July and a single maximum in January, like our population. Nevertheless, there are significant divergences about temporal evolution, which is continous and regular in Pallars. The features of seasonality in Aragonese Ribagorça are similar, and the Alpujarra's population also exhibits the same general pattern, although the position of maximum and minimum is displaced with respect to the pyrenean populations. It is logical to think that this fact is due to differences between the general conditions of both mountainous chains (Pyrenees and Sierra Nevada).

The three former populations share another feature. The seasonality of mortality presents a cyclical tendency; that is, it corresponds to a mathematical model as the monthly distributions do not differ significantly from a sinusoidal curve (EDWARDS, 1981; HERNANDEZ *et al.*, 1987).

On the other hand, neither Salazar's population nor our one present a cyclical tendency, although the general pattern of distributions do not differ from the other compared populations. Two possibilities may be considered in orden to explain the discordance: 1) the sample size, which is smaller in Salazar and El Pont de Suert; 2) the heterogeneity induced by the wider time span covered by the study in these latter populations. The comparison by periods between Salazar and El Pont de Suert indicates a similar evolution for both populations, which seems to strengthen the second explanation.

3. Conclusions

The results of the present study seem to point towards two different kinds of conclusions: on the one hand, considerations about the position of the population of El Pont de Suert within the pyrenean context; on the other hand, application possibilities of our results in order to evaluate the environmental pressure upon human collectives.

Seasonality features of mortality in El Pont de Suert agree notably with the general pyrenean framework: there is a significant seasonality, although the presence of a secondary maximum in the monthly distribution does not agree with the pattern of many other pyrenean populations; nevertheless, this particularity can be explained by the relatively open situation of the town, not frequent in mountain countries. Moreover, the lower seasonality significance and the higher incidence of mortality in winter months are characteristics shared with most of the pyrenean districts. There are enough reasons, in our opinion, to include El Pont de Suert among the typical pyrenean populations.

All data and results, when compared with the ones from other populations, outline a general ecological conclusion: Internal characteristics of population determine in most cases "who" dies; but the environmental pressures are responsibles for "how" and, over all, "when" the individual dies.

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