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Consanguinity in Two Spanish Regions: La Cabrera and Fuentes Carrionas. Dispensations and Isonymy

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A B S T R A C T

In this work the level and structure of consanguinity is analysed in two Spanish rural regions of similar geographic and orographic characteristics for the period between 1880 and 1979, employing two different methodologies. The estimates according dispensations shows that the total levels (a_4=0.00552 in La Cabrera and 0.00405 in Fuentes Carrionas) and the structures of consanguinity (C22/C33=0.43 and 0.34) are similar in both regions, but have evolved differently. Whereas in La Cabrera both parameters have remained stable, in Fuentes Carrionas they fluctuated through the period analysed. On studying the structure of consanguinity more closely using the isonymic method, it can be seen that in La Cabrera total consanguinity (Ft=0.0206) should be attributed mainly to environmental factors (Fr=0.0193) and to a lesser extent to socio-cultural factors (Fn=0.0013), whereas in Fuentes Carrionas it derives, almost exclusively, from the former (Ft=0.01270; Fr=0.01589; Fn=-0.00325).

Key words: *consanguinity, isonymy, dispensations, surnames, La Cabrera, Fuentes Carrionas*

Introduction

Historical-demographic sources contain data with relevant information that can be used to reconstruct the biological history of a population[1]. In particular, the matrimonial registers allows trustworthy estimates of the level of consanguinity of populations and their evolution to be determined with little difficulty.

Historically, the study of consanguinity began in the sixties[2,3], studies carried out on Spanish populations being particularly numerous[4] given that in them the mean level of consanguinity reported is very high[5] and has remained so for longer than in the rest of Europe[6]. It was only from the middle of the XX century that, coinciding with the abandonment of the rural populations as a consequence of industrialisation and the improvement in communications[7–9], consanguinity began to decrease. Such studies suggest that consanguinity is a complex phenomenon in which there are different mixtures of demographic, socio-cultural and geographical factors in each population and historical period analysed[5,6,10–12].

The estimation of consanguinity has been approached using different methodologies. First, the information contained in the dispensations expedited by the Catholic Church have been used[13,14]. The second approach has been based on the study of surnames[15–17], with the added advantage that the Spanish system of surname inheritance (in which two surnames are inherited, the first paternal and the second maternal) multiplies the information, the relationships of the two family lines thus being reflected[1].

In the present work a comparative study of the structure and evolution of consanguinity was carried out based on dispensations and isonymy in 2 Spanish rural regions (La Cabrera and Fuentes Carrionas) with similar geographical and socio-economic characteristics. Combined use of the two complementary techniques and the comparison between these two populations afforded a finer approximation to the structure and evolution of consanguinity in human communities and the factors that determines it.

Material and Methods

La Cabrera is a region situated to the south-west of the province of León (Spain). It has an area of 784.2 km^2,

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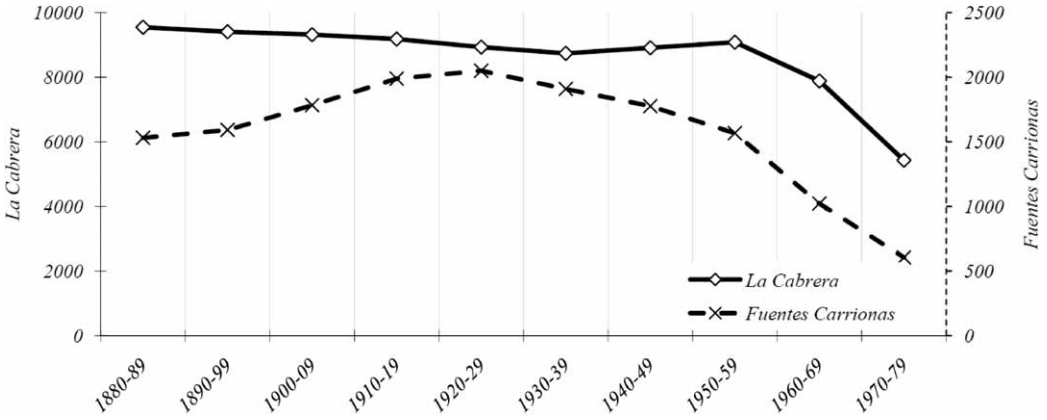

Fig. 1. Temporal evolution of the number of inhabitants.

surrounded both to the north and to the south by very high mountain ranges (over 2000m). Its inhabitants (average 8644) are distributed in 37 parishes, grouped in four municipalities. The census population remained more or less stable until the year 1960, after which it fell sharply as a consequence of a rural exodus towards the more industrialised cities of the country (Figure 1).

Fuentes Carrionas, situated in the north of the province of Palencia (Spain), has an area of 221.86 km^2, and it is surrounded by mountain chains (also with heights over 2000 m) of similar altitude. The region comprises 10 parishes distributed among four town councils. The number of inhabitants (average 1582) remained steady until 1949, after which emigration, similar to that recorded for La Cabrera, occurred (Figure 1). It is noteworthy that, coinciding with the period of the study, in Fuentes Carrionas two reservoirs were built: Camporredondo (between 1916 and 1930) and Compuerto (between 1949 and 1960).

As sources of information, the ecclesiastical registers of 5663 marriages in La Cabrera and 1243 in Fuentes Carrionas were used, corresponding to the totality of the unions celebrated between 1880 and 1979. 85.23% of these marriages were endogamous in La Cabrera and 69.01% in Fuentes Carrionas.

From these registers, the place and date of celebration, the names, surnames and places of birth of the couple and whether or not dispensation was required for the celebration and, in this case, the type of relationship stated in the dispensation, were extracted.

Dispensations

From the dispensations, the percentage of marriages of each type of relationship was estimated. Although in this study only two of them, C22 and C33 has been used.

The proportion between C22 (first cousins) and C33 (second cousins) was used to estimate the possible preference for close or remote consanguinity of the population. A value higher than the expected one (0.25) indicates a preference for unions between first cousins[13].

The coefficient of consanguinity of the population was estimated using the expression proposed by Jacquard in 1971[18]:

$$a = \sum p_i F_i$$

where a is the coefficient of consanguinity of Bernstein; p_i is the relative frequency of each type of relationship; and F_i is the coefficient of particular consanguinity[14]. As of 1918 (Codex Iuris Canonici), the Catholic Church ended the demand of dispensation for relationships further away than third degree. Thus, after that moment relationships further away than third degree were not recorded in the ecclesiastical registers. Accordingly, α was calculated in two different ways: first using all the relationships registered (α_4) and second excluding the relationships more distant than third degree (α_3). The levels of total consanguinity (α_4) permitted a comparison of the estimation of consanguinity with that available in other regions, calculated in the same way, whereas (α_3) was more homogeneous and adequate for the observation of the evolution of consanguinity.

The possible relationship between the evolution of the levels of consanguinity (α_4) and of the principal types of relationship (C22, C33 and C22/C33) were studied with the Spearman correlation test.

To study the evolution of these parameters (C22, C33, C22/C33 and alpha) the period under study was divided into shorter sub-periods of 10 years each.

Isonymy

Consanguinity was estimated from the surnames of the partners using the method proposed by Crow and Mange in 1965[19], later reformed by Crow in 1980[15]. This method permits the breakdown Ft according to the following expression:

$$F_t = F_r + F_n - F_r F_n$$

where:

- F_t = Proportion of marriages sharing the same surname (inherited from a common ancestor).
- F_r = Random component (random inbreeding), is a measure of the random marriages within the popu-

lation as consequence only of name frequency. It is a estimation of the consanguinity derived from environmental influence.

- F_n = Non-random component (non-random inbreeding): an estimator of the consanguinity derived from behaviour that alters the frequencies of unions between relatives.

Both surnames (in Spain each citizen must have two surnames by law) of each partner were used and all combinations between couples (1st male – 1st female, 1st male – 2nd female, 2nd male – 1st female and 2nd male – 2nd female) were used in the calculations. Then, their average values were calculated[1].

To study the evolution of isonymy, the period studied was also divided, but this time periods of 25 years each were selected.

For the calculations of Isonymy, two different geographic levels were considered: first the regions in their entirety, and second the parishes comprising them. To choose the most suitable level and to study the possible sub-division or Wahlund effect[20] within the two geographical levels, the RP (Repeated Pairs) were used[21]. Thus:

$$RP = \frac{\sum_i \sum_j [S_{ij}(S_{ij}-1))]}{[N(N-1)]}$$

where S_{ij} is the number of marriages with surnames »i« and »j«, and Ni is the total number of marriages. The RP coefficient estimates the likelihood of certain pairs of surnames being repeated, attributing a progressively greater weight to the pairs that are most repeated, and is linked to environmental factors and the size of the population. To complete the study it is necessary to compare this value with that expected from a random distribution of marriages, RPr[16,17], given by:

$$RPr = \{[1/N(N-1)]\sum_i S_i^2 - [1/(N-1)]\}\{[1/N(N-1)]\sum_i S_i^2 - [1/(N-1)]\}$$

Comparison of both values was performed measuring the proportional difference between both ((RP-RPr)/RPr). This value allows the population subdivision to be estimated[22].

TABLE 1
STATISTICAL RELATIONSHIP (SPEARMAN TEST) BETWEEN α AND FREQUENCIES OF RELATIONSHIPS BETWEEN COUPLES

	α			
	La Cabrera		Fuentes Carrionas	
	R	p-value	R	p-value
C22/C33	0.001	0.875	0.638	0.047
C22	0.001	0.879	0.845	0.002
C33	0.038	0.661	0.648	0.043

C22/C33 = Proportion between C22 and C33
C22 = First cousins
C33 = Second cousins

Results

Dispensations

During the period studied (1880–1979), both in La Cabrera and in Fuentes Carrionas, very high coefficients of consanguinity (Figure 2) were recorded (α_4=0.00552 and α_4=0.00405, respectively as means), sustained by a high percentage of unions between relatives (23.05% and 21.32%, respectively).

According to the Spearman correlation test, these values of consanguinity were significantly related (Table 1) to the frequencies of relationships between couples most repeated: first cousins (C22-3.46% in La Cabrera and 4.24% in Fuentes Carrionas) and second cousins (C33-10.14% in La Cabrera and 9.84% in Fuentes Carrionas).

Evolution of consanguinity

The value of α_3 in La Cabrera remained stable up to the year 1960 (Figure 2), after which the levels of consanguinity have declined (0.00513-1950-59; 0.00284-1960-69; 0.00105-1970-79). The evolution of the C22/C33 ratio was similar (Figure 3), and remained stable and surpassed the value of 0.25 throughout the period studied.

The consanguinity in Fuentes Carrionas (Figure 2) persists at high values, but does not present the same

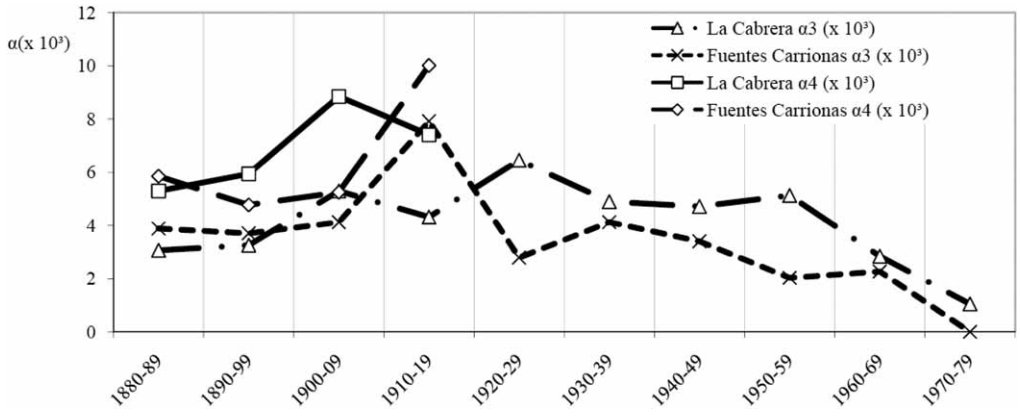

Fig. 2. Temporal evolution of the Berstein a coefficient.

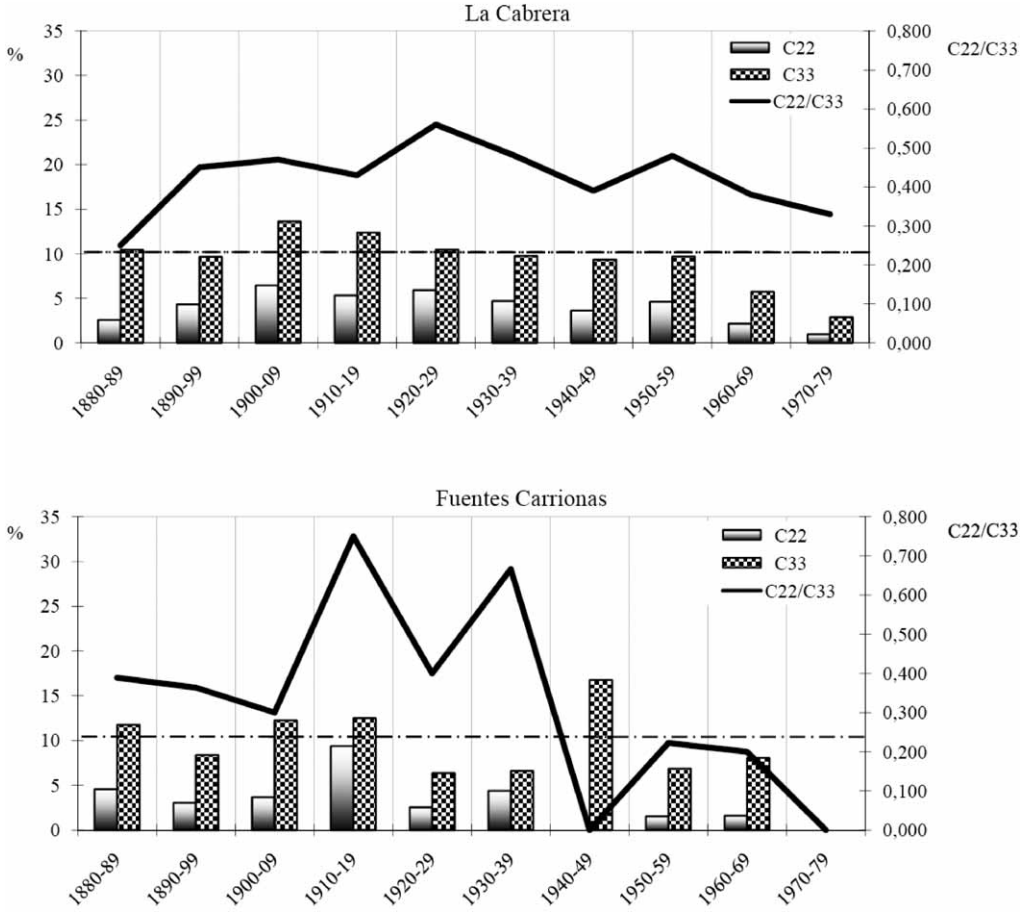

Fig. 3. Evolution of the C22 – first cousins- and C33 -second cousins relationships.

stability as in La Cabrera. In the period studied, two sharp increases were recorded – in 1910-19 (α_3 rises from 0.00412 to 0.00791) and in 1930-39 (α_3 rises from 0.00279 to 0.00412) – together with equally marked two decreases: in 1920-29 (α_3 falls from 0.00791 to 0.00279) and in 1950-59 (α_3 falls from 0.00340 to 0.00203). Similarly, the trajectory of the C22/C33 ratio (Figure 3) along the time analysed is marked by strong oscillations, with two maxima, (1910-19: C22/C33=0.75; 1930-39; C22/C33=0.67), and a minimum (1940-49: C22/C33=0.00).

The results obtained from the isonymy calculations remained equal, regardless of whether one or the other pair of surnames was used (1°-1°, 1°-2°, 2°-1° y 2°-2°) or the mean of all couples (Figure 4).

The study was performed at two levels for the entire period (Figure 4). Considering the region as a reproductive unit, it was seen that the values of total consanguinity (F_t=0.02016 in La Cabrera and F_t=0.01418 in Fuentes Carrionas) are far higher than those of the random component (F_r=0.00551 and F_r=0.00626, respectively). Nonetheless, at parish level the values of total consanguinity (F_t=0.02065 in La Cabrera and F_t=0.01270 in Fuentes Carrionas) are very similar to those of the random component (F_r=0.01932 y F_r=0.01589, respectively).

In detail (Figure 5), it may be seen that in La Cabrera between 1880 and 1979 the total value of consanguinity (F_t) and random consanguinity (F_r) is very similar and greater than non-random consanguinity (the F_n value is far lower than those of F_t and F_r). It is only during the 1950-79 period that the value of total consanguinity decreases (F_t=0.01769) and, coinciding with this decline, the non-random component (F_n=–0.00211) has negative values for the first time. In contrast, in Fuentes Car-

TABLE 2
REPEATED PAIRS

	N° de matr.	RP	RPr	(RP-RPr)/ RPr
La Cabrera (Region)	5716	0.0008	0.0005	0.63
La Cabrera (Parish)	5716	0.0082	0.0077	0.06
Fuentes Carrionas (Region)	1243	0.0010	0.0007	0.47
Fuentes Carrionas (Parish)	1243	0.0045	0.0044	0.10

RP – repeated pairs observed (RP)
RPr – repeated pairs expected

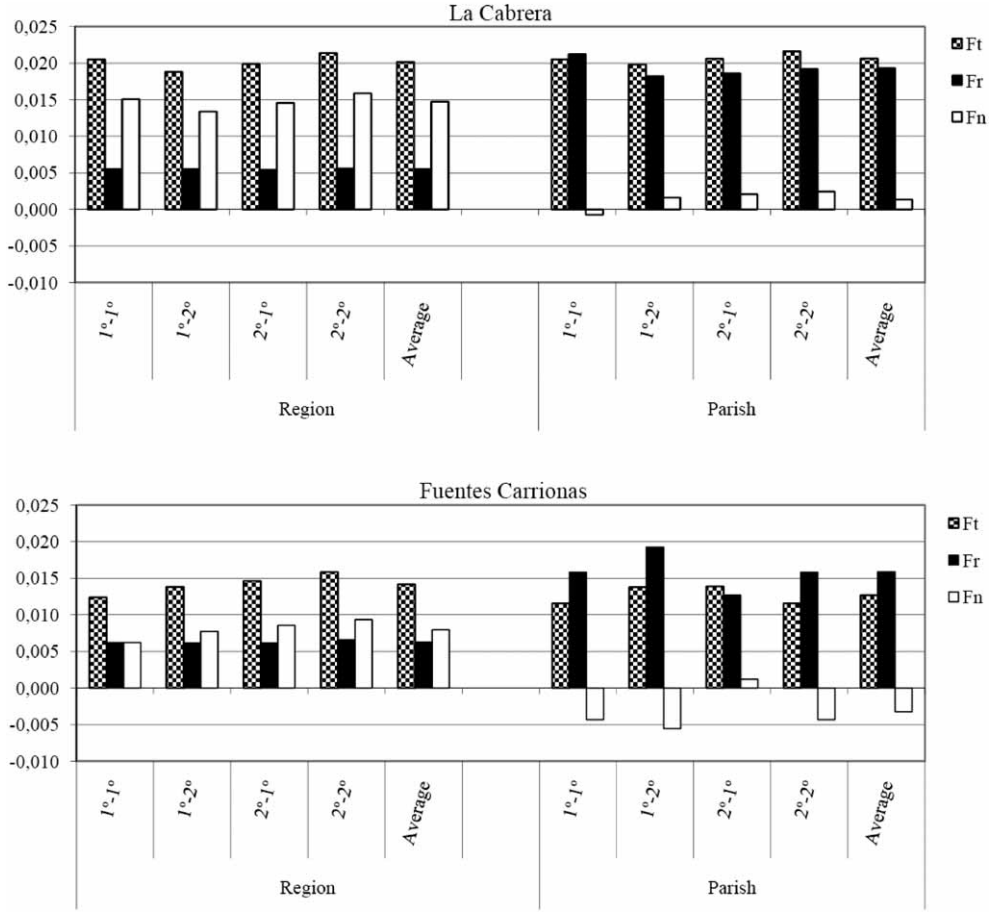

Fig. 4. Consanguinity by isonymy -Ft=Total Isonymy, Fr=Random Inbreeding, Fn=Non-Random Inbreeding.

rionas the total consanguinity throughout the period analysed is lower than the random component and the non- random component has negative values, which persist along the period.

The analysis of repeated pairs was carried out using the two levels of region and parish (Table 2). At regional level, the proportional difference between the observed values (RP) and those expected (RPr) are higher ((RP-RPr)/RPr)=0.63 in La Cabrera and (RP-RPr)/RPr)=0.47 in Fuentes Carrionas) than at parish level ((RP-RPr)/RPr=0.06 in La Cabrera and (RP-RPr)/RPr=0.10 in Fuentes Carrionas).

Discussion

La Cabrera and Fuentes Carrionas have consanguinity values situated among the highest recorded for Spain and Europe[7,8,12,23] which are sustained in high percent-

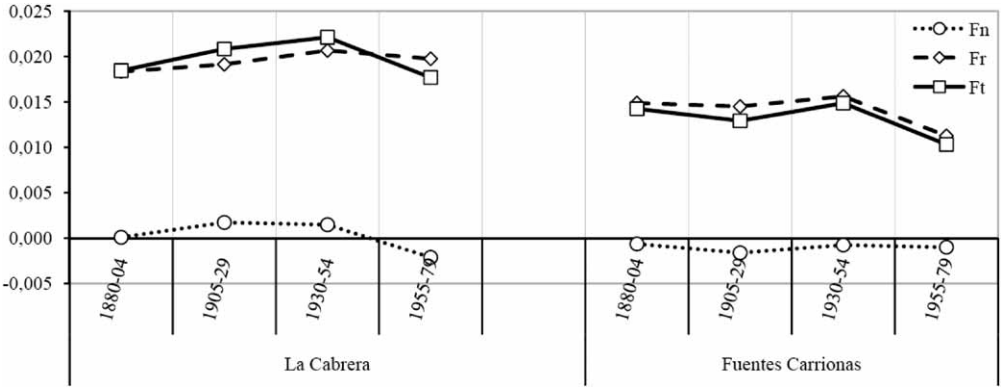

Fig. 5. Evolution of consanguinity by isonymy.

ages of unions between relatives. This differs from what has been observed in other regions of the North of Spain, where moderate percentages of marriages among relatives are reflected in high indices of consanguinity[7,10], probably as a consequence of the strong isolation to which these two regions have been subjected, a degree of isolation whose most evident expression is the high frequency of endogamous marriages.

Furthermore, the average proportion estimated between first cousins (C22) and second cousins (C33) is higher than the expected random value. This suggests that in both regions there may have been a preferential attitude toward the celebration of marriages between close relatives (Figure 3)[12,13]. This behaviour is typical rural regions with a subsistence economy, such as those studied here, where the trend is to favour marriages between first cousins with a view to preventing the breakage of family inheritances[5,6]. Nevertheless, this preference is lower (the values of the C22/C33 ratio are lower) than that observed in other regions[5,10] of the North of Spain, although it appears that in some of them such percentages could be based on high levels of illegitimacy[10], a circumstance which has not occurred either in La Cabrera or in Fuentes Carrionas.

From a geographic and economic point of view, La Cabrera and Fuentes Carrionas have very similar profiles. Because of their peculiar reliefs, both have been isolated from surrounding territories and – until recently- have maintained a subsistence economy. Calculation of he average values and structure of the consanguinity estimated from dispensations (a of Berstein and principal relationships) also afforded very similar results. It is therefore possible to argue an identical reasoning for both populations, assuming that their high consanguinity values would have been generated as a consequence of a geographical factor responsible for isolation and would have reduced the proportion of unrelated potential partners 7, to which a cultural factor could be added in the sense that related couples are preferred for economic reasons.

Nevertheless, detailed observation of the temporal trend of both parameters (Figures 1 and 2) suggests substantial differences between the two regions. Whereas in La Cabrera consanguinity and the ratio of C22/C33 marriages have remained stable, in Fuentes Carrionas the sharp fluctuations have persisted in the evolution of both parameters.

In our view, this irregularity could reflect more than a merely preferential attitude of the population: a tolerance for unions among relatives at times in which exceptional socio-demographic situations could have reduced the number of potential partners[5]. Thus, while we failed to find any satisfactory explanation, neither demographic nor socio-cultural, for the first maximum (1910-19), we believe that the descents in consanguinity observed for 1920-29 and 1950-59 would have been the result of a greater availability of unrelated partners owing to the arrival of manual labour for the construction of the Camporredondo reservoir (1916-30) first, and that of Compuerto (1949-60) later. In contrast, the scarcity of partners due to deaths in the Spanish Civil War could be determinant in the increase in consanguinity observed for the 1930-39 period. From 1939 onwards, growing industrialisation and improvements in communications[5,6,8,14] would have been responsible for the decreasing tendency in consanguinity observed throughout Spain[5,9]. Similarly, in 1940-49, the C22/C33 ratio shows the minimum value, coinciding with the return to the rural environment at the end of the war[18].

The analysis of the surnames by isonymy has allowed us to examine more closely the different pressures that the environmental and socio-cultural factors have exerted on the levels of consanguinity in a population[15]. In this sense, in terms of region, both at La Cabrera and Fuentes Carrionas, higher levels of total consanguinity (F_t) were obtained than would have been expected if such consanguinity had only derived from environmental influence and both communities had been homogeneous reproductive units (F_r), which is not the case at parish level (Figure 4). Therefore, it may be inferred that the social unit (at least in regard to the search for a partner) in both populations was a minor subunit (the parish), within which marriages between relatives occurred almost exclusively on a random basis[1]. The analysis of repeated pairs ratifies this deduction, with the observation of a greater proportional difference ((RP-RPr)/RPr) between the observed value and that expected at the level of region than at the level of parish (Table 2)[22]. This type of internal subdivision is known as the Wahlund effect[20] It is a phenomenon widely observed in other populations[6,11,12,22,24] and has important consequences in the genetic variability of a population[14,22]. Thus the parish is the reproductive unit and hence the level of reference. The choice of this level is of vital importance for the interpretation of the rest of the results[6,12].

In La Cabrera, the analysis of the isonymy shows that the total consanguinity (Figure 4) is mainly due to environmental causes (F_t and F_r are very similar), derived from isolation and, although to a lesser extent, to a preferential attitude of the population towards a certain type of relationship (F_n). This mixture of environmental and socio-cultural factors has maintained the values of consanguinity very high in spite of the passage of time (Figure 5)[7,9]. Indeed, the consanguinity only is only reduced when the preference for marriages among relatives disappears (F_n is negative in 1955-79).

In contrast, in Fuentes Carrionas the total consanguinity (Figure 4) is only due to environmental causes (the value of F_t is smaller than that of F_r) and persisted at identical levels throughout the study (Figure 5). Thus, it seems to indicate an attitude, although not one of rejection, that is at least non-preferential as regards unions among relatives (F_n is always negative).

This circumstance differentiates the region of Fuentes Carrionas from other populations in which the F_n values reported between the end of the 19th century and the 20th century have always been positive[4,8,24,12], demonstrating a preference towards unions among relatives;

this is infrequent behaviour, but similar to other models in which mechanisms of social control of consanguinity exist[1], or at least do not show preference for consanguineous marriages[7].

Conclusions

From the present results it may be deduced that the use of two complementary methods (dispensations and isonymy) permits a more accurate examination of the nature of consanguinity and allows us to conclude that both in La Cabrera and in Fuentes Carrionas the levels of consanguinity recorded are among the highest in Spain and Europe.

In La Cabrera, two types of factor have been determinant. On the one hand, environmental pressure in the form of strong isolation, both from outside the region and among the populations of the interior; on the other, a socio-cultural factor that tends to favour unions among relatives.

In contrast, in Fuentes Carrionas the unions among related individuals are not a preferential option; it is only environmental pressure, again in the form of geographical isolation the high levels of consanguinity recorded in the region in certain decades.

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KONSANGVINITET U DVIJE ŠPANJOLSKE REGIJE – LA CABRERA I FUENTES CARRIONAS

S A Ž E T A K

Ovaj rad istražuje razinu i strukturu konsangviniteta u dvije ruralne regije u Španjolskoj, sličnih geografskih i orografskih karakteristika, za period 1880. – 1979. godine, koristeći dvije različite metodologije. Procjene prema prvoj metodi pokazuju da je opća razina (α_4=0,00552 u La Cabreri i 0,00405 u Fuentes Carrionasu) i struktura (C22/C33=0,43 and 0,34) konsangviniteta slična u obje regije, no da se razvila na različite načine. Dok su u La Cabreri oba parametra bila stabilna, u Fuentes Carrionasu su oni fluktuirali kroz analizirani period. Proučavajući strukturu konsangviniteta detaljnije korištenjem metode izonomije, uočeno je da se u La Cabreri ukupni konsangvinitet (F_t=0,0206) može pripisati najviše utjecaju okolinskih čimbenika (F_r=0,0193), a manje sociokulturnim faktorima (F_n=0,0013). Za razliku od toga, u Fuentes Carrionasu na konsangvinitet najviše i gotovo isključivo utječu sociokulturni faktori (F_t=0,01270; F_r=0,01589; F_n=–0,00325).