The Mortality of Two Groups of Infants in Spanish Rural Region

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ABSTRACT

In this study the structure of the mortality of two groups of infants settled in the same environmental context is analysed: the comarca (a typical Spanish sub-division of territory) of La Cabrera (province of León, Spain) between the years 1880 and 1932. In this geographical region of the northwest of Spain two communities of infants from different origins are found in this time period. On the one hand, an autochthonous infant population from the births of the legitimately constituted families settled in this territory. On the other, an infant population represented by a group of children who were abandoned in a foundling hospital situated in a nearby city (Ponferrada) and who were sent to this rural »comarca« to be breast-fed by wet-nurses being paid certain quantities of money. The mortality rates and the seasonality of the deaths have been analysed for both the autochthonous and non-autochthonous children. Thus we have been able to test whether differences in the structure of mortality exist. Throughout the study, the possibility that these differences in mortality could be attributed to discriminative cultural factors, expressed through preferential care and/or attention and which show in the different models of infant mortality, is considered.

***Key words**: infant mortality, foundling children, environmental conditions, Spain*

Introduction

In the biological analysis of human populations, mortality is one of the most widely studied demographic parameters and one that arouses greatest interest. Especially, mortality during the first years of life has been the object of privileged attention, on the one hand, because until very recently it has had very elevated dimensions and, on the other, because of the great number of variables which have been demonstrated to be related with its levels.

Only citing some of the works published in the last decade, it should be emphasised that some biological variables such as the inbreeding degree between the couple[17]; the intervals between births and the maternal age[15,33] the practice of breast-feeding[3] or even the precedent of a sibling death[4], have been shown to be determinant when establishing differences between the levels of infant mortality between some families and others. These differences become even more notably evident when the biological variables become biosocial ones on being described, taking into account the economic status of the family[2,19,28,31,36,47,48] the educational level of the parents[32] or the absence of paternal recognition making the child illegitimate, with all the related implications[1,27].

The simple variability of mortality in relation to environmental conditions as evident as the type of inhabited areas: rural or urban[3,29,34]; the density of settlement or natural disasters (such as hurricanes or periods of epidemic) must be borne in mind, which are more important at times than the biological variables[11].

In Spain, the important historical recession in the levels of infant mortality recorded since the end of the 19th century, thanks to the control of exogenous mortality, has also been widely studied. Great regional differences have been demonstrated, associated with a wide amalgam of factors, such as the economic structure, standard of living, climatology, the development of public infrastructures, hygiene and sanitary measures, or rural or urban habitat, among others[7,24,35,37–41]. Some biosocial variables, as important as illegitimacy or pre-marital conceptions[20–22], must also be taken into account.

All these studies, both within and outside Spain, analyse the relationships existing between infant mor-

tality and a group of variables of different nature, biological, environmental, socio-economic status. Nevertheless, there are still great questions regarding some other aspects, which is why some studies[42,43,49] have shown the necessity of examining the explicative models of the differences existing between some populations and others in greater detail. One of the least known, given that it is not easy to evaluate, is the care and attention of children in the first months of life, a period in which the risk of death is very high. It is extremely complicated to carry out a comparative study of this cultural variable, since in different populations this care and attention can be different, but, obviously, all the previously cited factors can also be different.

On few occasions the circumstance arises that in one selfsame territory the coexistence of two infant groups of different origin are faithfully recorded. This work offers the possibility of studying the characteristics of mortality during the first year of life in two different series of infants, but who live in an identical rural environmental context. One autochthonous infant series, constituted by children born into legitimately constituted families resident in a region of north-west Spain; the other, an infant series, represented by a group of foundling children taken to that region to be cared for by families resident there. The question arises whether there are differences between the patterns of infant mortality of the legitimate children and the fostered children. To answer this question we have analysed the rates of mortality and the seasonality of death, carrying out a comparative study of both parameters in both series of children.

Material

The autochthonous infant series

The autochthonous infant series is represented by children who were born and died in the rural *comarca* of La Cabrera (province of León, Spain), situated in the north-west of the Iberian Peninsula and approximately 30 Km. from the city of Ponferrada (Figure 1). »*Comarca*« is a very common level of geographical subdivision in Spain constituted by an association of geographically limited municipalities that share similar terrain, climate and vegetation, as well as identical cultural patterns[50].

La Cabrera has a total surface of 784 km², over which its 37 parishes grouped in four different municipalities are distributed. The families resident in two of them (Castrillo and Benuza), certainly because of their better accessibility and communication with the city of Ponferrada, received the more important contingent of abandoned children from the foundling hospital of that city.

A wider study made of this population[8] details the infant deaths of the autochthonous children recorded in the ecclesiastical archives of the different parishes that received the foundlings. In this way, sex, day, month and year of birth and death and the place and cause of death (where reported) were verified.

The foundling infant series

This infant series came from a foundling hospital situated in the city of Ponferrada. This institution, of a beneficial-assistential character, received new-born children abandoned by their progenitors. It was attended by the religious order of the Hermanas de la Caridad (Sisters of Charity). Although its date of opening is not known exactly, the oldest references to its existence go back to the year 1826. The institution closed in 1932.

Its organisation was based on the norm applicable to the Establishments of Beneficence of the epoch (hospices, foundling hospitals). Thus, according to the »Regulation for interior government and administration of the establishments of beneficence of León province (1880)«, this institution had, in its dependencies, fixed wet-nurses among its personnel, responsible for the care of the children »*in situ*«. These gave the children the essential care after the moment of abandonment and, unless they were ill on reception, or became ill in the institution and died, they were immediately moved to different zones of León to be looked after by external wet-nurses who were breast-feeding mothers that formed part of legally constituted families.

In an earlier study[9] it was demonstrated that abandoned children were always only a few days old and only stayed in the foundling hospital for a very short time (several days) until the external wet-nurse came to the institution to collect the child, who was taken to be cared for in her home in exchange for certain quantities of money. This, therefore, implied the movement of the children from the foundling hospital to other more or less distant localities to be received in families who undertook their care and attention.

The distribution of the foundling children was not random, but directed in a preferential way towards surrounding rural zones, whether because of custom, proximity or tradition. This caused the concentration of foundlings to be very high in some parishes. To be precise, one of the rural areas that received a greater number of abandoned children was the *comarca* of La Cabrera. Between the years 1880 and 1932 (the date of closure of the institution) 3217 children were abandoned in the foundling hospital, of which 614 were moved to two municipalities of this rural *comarca* (Castrillo and Benuza).

Each abandoned child in the foundling hospital was registered systematically and in detail in the Books of Entrances. Consulting them allowed the extraction of the data of the foundlings (sex, date of entrance, exact or approximate age), those related to the child's possible death (date, age and place) as well as the data of the wet-nurse responsible.

With the objective of making the two population groups comparable only the infant deaths of autochthonous children who had died at more than eight days were taken into account, since in La Cabrera only the deaths of children from the foundling hospital with this

age are recorded. It is evident that this period of time was the minimum detected between birth, abandonment and the later reception by a family of the *comarca* of reception.

Furthermore, in the two cited populations of La Cabrera, and between the years 1880 and 1932, a total of 7503 births and 663 deaths of children who died between the eighth day of life and twelve months are registered. During the same period 614 children were taken from the foundling hospital in Ponferrada and of these the deaths of 117 with ages inferior to one year were registered.

Methods

The rates of infant mortality have been calculated taking into account the years of birth and death of the children who died during the first year of life, applying the equation indicated by Henry[25]:

$$I = q_x / n_x + q_{x-1} / n_{x-1}$$

in which: q_x – number of children who were born and died in the year x, q_{x-1} – number of children who died in the year x but were born in x–1, n_x – total number of births in the year x, n_{x-1} – total number of births in the year x–1.

In the case of the foster children: q_x – number of children who were born and died in the year x; q_{x-1} – number of children who died in year x but were born in x–1, all of them from the group abandoned in the foundling hospital who were taken to La Cabrera; n_x – total number of foundlings taken to La Cabrera in year x; n_{x-1} – idem, in year x–1. The annual rate of foundlings has been calculated with the following $(n_x/n_{x-1})* 100$.

We have used the graphic method designed by Bourgeois-Pichat[10] to estimate infant mortality.

To determine the relationship between the season of birth and death we have elaborated a table of contingency for each infant series (autochthonous and foster children). We have applied the analysis of correspondences[6] to each of them. By the said graphic method the level of association that exists between seasonality (birth and death) is expressed with the proximity between the points represented.

Following the indications of Calafell and Hernández[13], each of the tables of contingency has been considered as a square matrix (i x j) in which each of the elements represents the number of children born in the season i and who had died in season j. This has been transformed into a Probabilistic Matrix on which the Euclidean distance to the square has been estimated, with which the dissimilarity existing in the relative contribution of the different season of the year to the deaths of each annual period can be measured.

Finally, through the application of Mantel's test[30] we have been able to compare the two matrices of dissimilarity (foundlings and autochthonous), which allows us to check the identity between both models.

Results

Regarding the tendency of the rate of infant mortality throughout the time, represented by its mobile averages each five years (Figure 1) it is noteworthy that its value in the autochthonous children remains high, but very regular in its levels, in contrast to a great irregularity observed in the foundling children, doubtless associated to the smaller number of them. It is evident that among these latter mortality was superior throughout the whole of the period studied and that only in some years, between the years 1889 and 1899, the situation was inverted.

It can be observed, therefore, that during practically the totality of the study period analysed, infant mortality of the children from the foundling hospital is greater, two entirely different temporal spaces can be distinguished in its trajectory. One first period, between 1880 and 1903, in which the foundling mortality is marked by
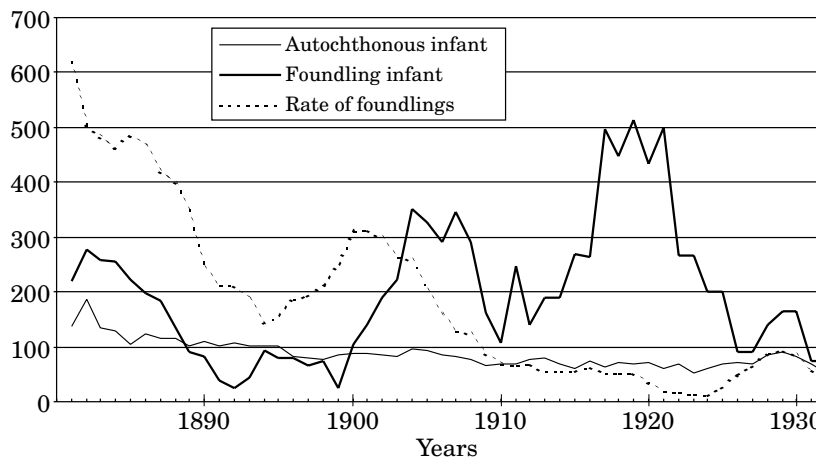

Fig. 1. Temporal evolution of the infant mortality of the autochthonous and foundling children and of the entry of foundlings in La Cabrera.

the oscillations due to the number of entrances. The year 1903 marks a point of inflection, where the trajectory of mortality of the foundling children does not systematically follow the same norm as in the former period. It always remains far above that recorded for the autochthonous children, presenting striking irregularities associated to a great scarcity of registers.

Taking as a base the graphic method of Bourgeois-Pichat[10] for the estimation of infant mortality, we have determined the lineal distribution of accumulated mortality according to the age at death expressed as the $log^3(x+1)$ for the series considered. In Figure 2 the lines of regression obtained for the two groups of infants are presented. In the case of the autochthonous series two considerations have been made: on the one hand, including all the infant deaths and, on the other, excluding those who died at less than eight days. It can be observed that the lineal adjustment is very high, slightly inferior for the autochthonous children (r^2=0.990 both if those who died in the first week are included and if they are not included), in comparison to the foundlings r^2= 0.994 (Table 1).

Once the accumulated frequencies have been corrected, whether by the number of births or by the number of foundlings taken to the *comarca*, it can be seen that the mortality of the foundling children is notably higher than that of the autochthonous ones from two months of life (Figure 3). As can be observed, only in the first month of life is the mortality of the autochthonous children slightly higher.

Finally, we have attempted to determine the existence of association between the season of birth and that
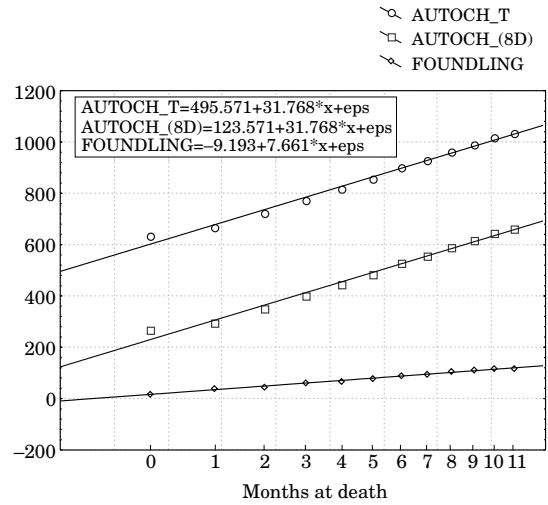

Fig. 2. Lineal regression of mortality accumulated in accordance with age of death expressed as $log^3 (x+1)$, considering: the total autochthonous infant population (AUTOCH_T); the autochthonous infant population excluding those who died at less than 9 days (AUTOCH_8D); and the foundling infant population (FOUNDLING).
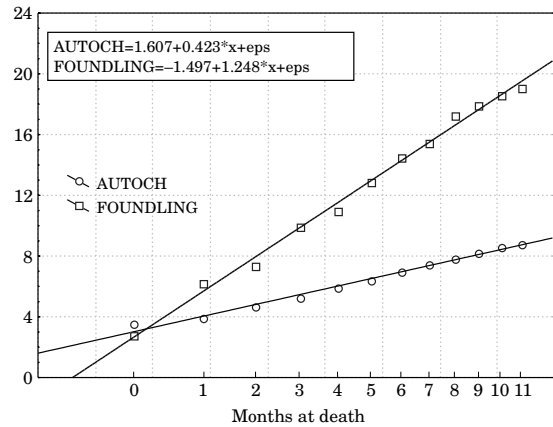

Fig. 3. Lineal regression of the mortality accumulated according to age at death expressed as $log^3 (x+1)$; autochthonous infant population, excluding those who died at less than 9 days corrected with the number of births (AUTOCH) and the foundling infant population corrected with the number of entries (FOUNDLING).

of death, (Table 2), expressing graphically the relationship of dependence between both variables by a factorial analysis of correspondences[6]. This allows us to demonstrate a very interesting fact: on choosing the season of birth as a reference we are associating common climatic and environmental conditioners to this group of children, independently of whether their birthplace is La Cabrera or another place in León, since all the inhabitants of the zone are ruled by those same factors.

The relationship between seasonality (birth/death) is statistically significant when the analysis with the autochthonous children is performed (χ^2=115.55, p<0.001,

TABLE 1
INFANT DEATHS ACCUMULATED IN THE AUTOCHTHONOUS AND FOUNDLING CHILDREN OF LA CABRERA

Months at death	Autochthonous children		Foundling children
	Total	Excluding (> 8 days)	
0	636	264	17
1	666	294	38
2	723	351	45
3	771	399	61
4	815	443	67
5	853	481	79
6	900	528	89
7	929	557	95
8	961	589	106
9	987	615	110
10	1018	646	114
11	1035	663	117
	Number of births = 7503		Number of foundlings = 614
r^2	0.990	0.990	0.994

TABLE 2
SEASONALITY BIRTH/DEATH IN AUTOCHTHONOUS INFANT AND FOUNDLING INFANT

Births			Deaths		
Autochthonous infant	Spring	Summer	Autumn	Winter	Total
Spring	80	45	35	11	171
Summer	9	52	49	30	140
Autumn	14	10	49	14	87
Winter	92	40	37	96	265
Total	195	147	170	151	663
Foundling infant	Spring	Summer	Autumn	Winter	Total
Spring	12	15	11	2	40
Summer	4	11	9	4	28
Autumn	4	3	11	7	25
Winter	8	5	6	5	24
Total	28	34	37	18	117

df=9) (Figure 4), which implies that the season of the deaths and of the births are linked to climatic and epidemiological factors peculiar to each annual season and fundamentally conditioned by them. In contrast, with the children who were taken from outside the *comarca* there is no significance (χ^2=15.93 p>0.06, df=9) (Figure 5), which is why we consider that the number of deaths in each season is not determined, at least exclusively, as in the autochthonous population, by the environmental conditioners proper to each annual period and, therefore, that in the independence recorded between both variables substantial qualitative differences are evident in the model of mortality between the autochthonous population and the foundlings.

The lack of identity between both models of seasonality was corroborated, in turn, by Mantel's test (r=0.073, p=0.16) applied to the tables of contingency previously transformed into matrices of distances, in accordance with Calafell and Hernández[13].

Discussion

The estimates of the rates of mortality on the foundling population present grave methodological complications: on the one hand, there is no consensus among the authors regarding which is the most adequate method to measure it; on the other, the difficulty of finding a reference population to confront the normality of their rates. Nevertheless, whatever the methodology employed, there is an important point of agreement: there are real and substantial differences regarding survival between abandoned children and those brought up at home[46].

Fildes[18] calculates, in different European hospitals during the 17th century, that between 34 and 100% of abandoned children ended dying; Sherwood[45] reported, for the foundling hospital of Madrid, a range between 75 and 85%; Smith and Lima[46] in the Azores (Portugal) situates this value at 50% with temporal oscillations
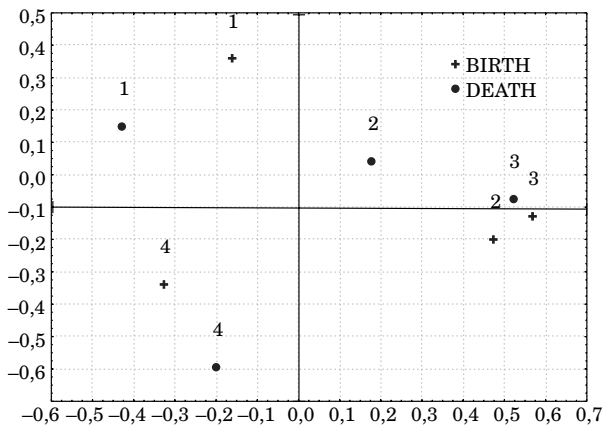

Fig. 4. Analysis of correspondences utilising the season of birth and death in the autochthonous infant series.
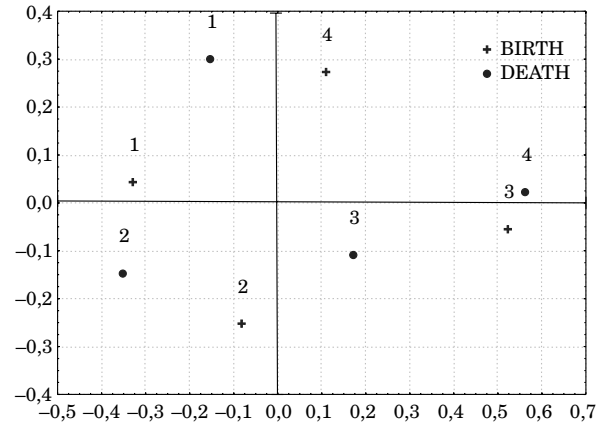

Fig. 5. Analysis of correspondences utilising the season of birth and death in the foundling infant series.

which even reach 72%. Nonetheless, all these studies were performed only on a collective of children abandoned in foundling hospitals, where the rates of mortality refer to the percentages of deaths, only taking into account the number of children abandoned in each year.

We do not know of any study in which, over an identical territorial context, two infant series of different origins are identified. Therefore, this *comarca* of the study represents an authentic experimental laboratory in which we can distinguish two perfectly differentiated groups of infants. Applying identical methodology in both infant series for the calculation of the mortality rates[25] we have been able to prove that the foundling children present a higher mortality, on average, throughout the study period 152% (1880–1932).

This higher mortality rate is maintained, practically, throughout the whole period of study analysed, however, we can distinguish two stages that the following considerations could affect. A first period, between 1880 and 1903, where the foundling mortality is marked by the oscillations of the number of entries and is maintained very high, since it is 24% greater than that of the autochthonous children. During this period the number of children admitted into the foundling hospital and sent to the *comarca* is very high (487) given that it was a social moment of extreme moral rigidity, in which the abandonment in the foundling hospital was a resource accepted by the society[5,14].

Furthermore, within this temporal space an exceptional period exists. During the decade of the 1890's, coinciding with the inversion of the rates of mortality between both series, an economic depression took place in the whole region, motivated by one of the economic pillars of the region, the cultivation of vines, suffering as a consequence of the phylloxera plague. This disease unleashed disastrous consequences for the economy of the region[23] and its repercussions were felt in the maximum number of abandonments in the foundling hospital in the city of Ponferrada[9], which did not result in a greater number of children displaced to the *comarca* of La Cabrera to be cared for; probably because this economic crisis had such a strong impact on the families of this community that they could not accept new children in their surroundings, not even in exchange for money.

From the year 1903, the mortality of the foundling children is maintained above that of the autochthonous ones, but presents great irregularity in its trajectory derived from a lower number of registers. We must remember that, at the beginning of the 20th century, recovery from the economic recession of the previous period starts and the relative, but real, improvements in living conditions in the general context of the Spanish population limit the number of poor families who utilise the beneficence to care for those children they cannot feed.

The analysis of the variability of infant mortality frequently tends to be described evaluating three great aspects: the biological cause, the degree of parental competence and the environment of abandonment[26]. The first of the aspects is evaluated through the endogenous

mortality, that which occurs during the first month of life. Nonetheless, the interpretation of its values is not so simple if we take into account that during this vital period infant deaths obey a double nature, in one part those that have a genetic cause and those others derived from the risks of birth and infectious illnesses.

The application of the graphic method of Bourgeois-Pichat allowed us to separate the infant mortality into its two components: endogenous and exogenous in both infant series. The endogenous mortality in autochthonous children is significantly high, which is perfectly logical, since those deaths provoked directly or indirectly by birth are associated to it. Thus, there are only two relevant actions that diminish the risk of an excessively high mortality during this first period of life; preventive action on the mothers before and during pregnancy and an immediate curative action of the children after birth[10]. Until relatively recently, in almost all the rural regions, such as the one we describe in this work, both actions were carried out according to popular wisdom and, therefore, the existing deficient sanitary system was irrelevant. A series of repetitive conduct, in relation to some deeply rooted cultural patterns, represented all the assistance that could be counted on during and after pregnancy and likewise at the moment of birth. Without forgetting, obviously, that in a spatial and temporal context such as the one we describe, the weight of the infectious illnesses is so important that it minimises that of a strictly genetic cause[16].

It is also very probable that the mortality derived from the risks of birth would be very high in the foundling series, but impossible to quantify. These children come from unwanted pregnancies and illegitimate conceptions, in an environment of strict moral rigidity, which, very probably, gravely prejudices the maternal health. Nevertheless, a child abandoned in the foundling hospital has survived the initial risk and in the case of any symptom of illness would not leave the hospital.

Therefore, we suppose that the foundling children enjoyed, an optimum state of health that would guarantee them the journey and the later integration into a new family surrounding.

It is precisely from this moment, when the two infant series, autochthonous and foundling, can be considered as homogeneous groups, with relation to the variables that affect them. From the moment that the child from the hospital is integrated in a family unit, its survival is going to depend, uniquely, on the same variables relative to the family and environment (climatic, epidemiological) as the children from the autochthonous series. With relation to the first aspect, we are conscious of the heterogeneity of the family environment regarding the maternal abilities in basic care[16]; the differences in the nutritional status[12]; the health of the mother herself and the care of the health of the children[31] introduce a great variability in the rates of infant death. Nevertheless, we believe that both infant series share the same variability and, therefore, far from being a discriminating factor is a homogeniser.

A priori, we consider that these children should not have received worse care than the legitimate children. We must not forget that this practice was repeated since many years before in this community; that it generated a very important source of income for the receiving families and that to be paid it was necessary for the foundling to survive. With all these coincident premises it can be supposed that the pattern of mortality of these children should not differ from the pattern of mortality of those born in the *comarca* in the bosom of legally constituted families. We have, however, been able to prove that there is a higher mortality rate in the foundling children which is clearly expressed from the second month of life and that therefore must be associated to the exogenous mortality.

Similarly, we could also prove that between both series of infants, not only are there quantitative differences, but also these appear qualitatively. And thus, whereas in the autochthonous children the environmental and epidemiological factors proper to each annual season are linked to the season of the deaths and births, in the case of the foundling children, the distribution of the deaths is random.

We would like, at this point in the work, to be able to decipher a group of solid variables that could justify the differences recorded in the patterns of mortality between both series of infants. Nevertheless, this is not so. Having discarded epidemiological and/or environmental variables, which are common, only care in the receiving home can be questioned to explain this variability in survival. We must not forget that the foundling series of infants was taken to La Cabrera to be breast-fed by wet-nurses. The wet-nurse is, at the same time, a breast-feeding mother who feeds her legitimate child and, moreover, the foster child. We can therefore ask ourselves, »Do both children enjoy the same quality of nutrition or, on the contrary, does the mother give priority to the feeding of her own child with regard to that of the child received in the home?«.

As the quality of breast-feeding is one of the most determining factors in infant survival[3,44] it would not be absurd to suppose the existence of nutritional differences between them which could justify the variability existing in the pattern of mortality.

Acknowledgements

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MORTALITET DVIJE GRUPE NOVOROĐENČADI U REGIJI RURALNE ŠPANJOLSKE

S A Ž E T A K

U ovom istraživanju analizira se struktura mortaliteta dvije grupe novorođenčadi istog okolišnog konteksta: »comarce« (tipična španjolska potpodjela teritorija) u La Cabreri (provincija Leon, Španjolska) u periodu od 1880. do 1932. U ovom periodu i ovoj geografskoj regiji sjeverozapadne Španjolske pronađene su dvije populacije novorođenčadi različitog podrijetla. Prva grupa sastojala se od autohtone populacije novorođenčadi rođene iz legitimno uspostavljenih obitelji koje naseljavaju ovo područje. Drugu grupu činila je populacija napuštene djece iz doma na nahočad koja se nalazi u obližnjem gradu (Ponferrada). Ova djeca bila su poslana u ruralnu »comarcu« kako bi ih dojile plaćene dojilje. Analizirane su stope mortaliteta i vremena smrti za autohtonu i neautohtonu djecu. Na taj način bilo je moguće ispitati da li postoje razlike u strukturi mortaliteta. U tijeku istraživanja uzeta je u obzir mogućnost da se ove razlike u mortalitetu mogu pripisati diskriminirajućim kulturnim čimbenicima izraženima kroz povlaštenu brigu i pažnju, a koji dovode do različitih modela mortaliteta novorođenčadi.