J. biosoc. Sci. (1998) **30**, 521–528

BIODEMOGRAPHY IN SIENA, ITALY

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Summary. Data were obtained on surnames of the parents and places of birth of the parents and grandparents of children in Siena, Italy. Isonymy and total inbreeding coefficient, and their random and non-random components, are 0·005, 0·00125, 0·00019 and 0·00106, respectively. Isonymy and inbreeding figures are similar to those of other medium-sized Italian towns, while higher values have been reported for Italian villages and Italian ethnic minorities. City endogamy, and endogamy of *Contrada* for grandparents have the same values (44·1 and 44·8%, respectively), but for parents, endogamy of *Contrada* is lower than city endogamy (15·2 and 33·4%, respectively). The difference between the extent of *Contrada* endogamy expected at random and observed in the parents' generation does not seem to affect the genetic structure of the present population. However, the bulk of marriage migration (more than 70%) is short range, with people coming from Tuscany. There is no statistical difference in marital migration between males and females.

Introduction

Marital migration (producing gene flow) and inbreeding are the main factors affecting the genetic structure of human populations, and are easily estimated from non-biochemical data. Migration matrices have been employed in many studies on marital movements (Bodmer & Cavalli-Sforza, 1968). The matrices are based on the birthplace of husband and wife (matrimonial) or parents and offspring (father–offspring and mother–offspring). To calculate the equilibrium genetic structure, two main assumptions must be made: that the pattern of migration remains constant for the considered period, and that migration is only influenced by the immediately preceding state (Mielke & Swedlund, 1993).

Besides demographic variables, during the last three decades surnames have been included in studies of the ways in which cultural and behavioural mechanisms are involved in biological changes of human societies. In many societies surnames are transmitted by the male line, and so behave like Y chromosome alleles. Surnames can be used to examine the genetic effects of mating patterns, through the estimate of the total inbreeding coefficient and its random and non-random components, and can be usefully employed in evaluating relationships among populations or subpopulations.

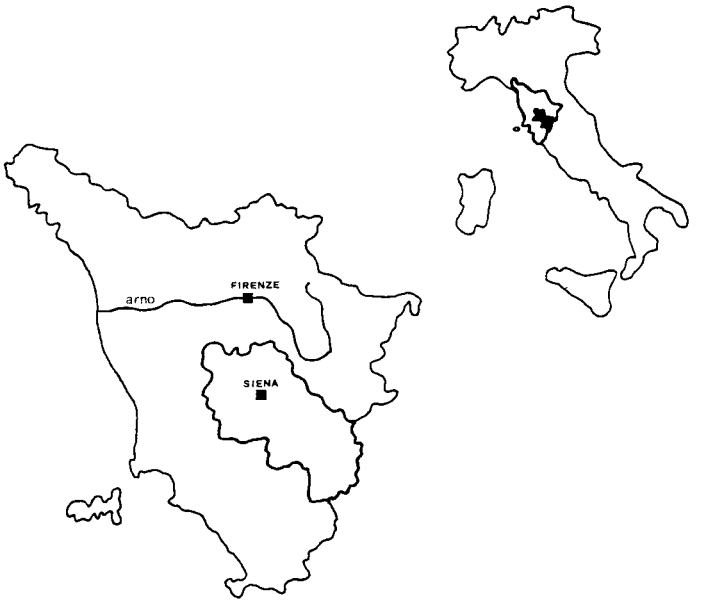

Fig. 1. Tuscany and the province of Siena.

Again, assumptions must be made: that surnames do not have multiple origin, that the degree of relationship along the male line is also representative of the female line, and that both sexes are represented among migrants (Lasker, 1985).

The aim of the present study is to clarify the biological role of the peculiar social organization of the Sienese population, which is almost without parallel in Italy and Europe.

Data and methods

The Italian city of Siena is situated in the centre of Tuscany (Fig. 1). It is the chief city of the homonymous province, with a resident population of 56,518 (ISTAT, 1995).

The urban and social tissue of the city is traditionally divided into *Contrade* (districts of the city). The first historical data about their existence are traceable in a document of 1265; the organization into *Contrade* met the requirements of a topographical, military and administrative arrangement of the city (Cecchini, 1982). The present subdivision of the city into 17 *Contrade* – grouped into three *Terzi* (Fig. 2) – was defined in 1729 by Princess Violante Beatrice of Bavaria, governor of Siena, who enacted a law describing the territory of each *Contrada* (Falassi, 1982).

Since such subdivision is emotionally shared at all social and cultural levels by the population of the city, and the feeling of belonging to their own *Contrada* is strong in all Sienese people, the population of the *Contrada* is a unique social structure. It is a small independent motherland, a city within the city, in accordance with a model – partly real, partly idealized – of the ancient city-states of Tuscany (Falassi, 1982).

Demographic data were obtained from 1200 families through questionnaires given

https://doi.org/10.1017/S0021932098005215 Published online by Cambridge University Press

Fig. 2. Present subdivision of the city of Siena into seventeen *Contrade*, grouped into three *Terzi*.

to the children of Sienese primary state schools (11–13 year olds). Each informant (610 males and 590 females) was asked to state the birthplaces of their parents and grandparents and their parents' surnames. People born in the city of Siena were asked in which *Contrada* they were born. When more than one child from the same family attended school, care was taken to ensure that the family was only included once. The sample, collected during the school year 1991–1992, represents more than 90% of the Sienese scholastic population for this type of school.

Using these data, the total inbreeding coefficient (F_t) and its random (F_r) and non-random (F_n) components were estimated from marital isonymy (I) according to the B method of Crow (1980). Thus marital isonymy (I) is the frequency of pairs in which both the spouses have the same surname. Random inbreeding (F_r) is calculated as:

$$F_r = \Sigma S_{i1} S_{i2} / 4 N_1 N_2,$$

in which S_{i2} is the number of husbands of the ith surname and S_{i2} is the number of wives of the same surname, and N_1 and N_2 are ΣS_{i1} and ΣS_{i2} respectively. Non-random inbreeding (F_n) is calculated as:

$$F_n = (I - \Sigma S_{i1} S_{i2} / N_1 N_2) / 4(1 - \Sigma S_{i1} S_{i2} / N_1 N_2).$$

https://doi.org/10.1017/S0021932098005215 Published online by Cambridge University Press

Table 1. Marriages, surnames and inbreeding coefficients of the Sienese population

Variable	Frequency
Total sample	
Number of marriages	1200
Total number of surnames	2400
Number of different surnames	1525
Number of surnames that occur only once	1117
Number of isonymous marriages	6
I	0·005
F_r	0·00019
F_n	0·00106
F_t	0·00125
Couples with one partner born in Siena	
Number of marriages	715
Total number of surnames	1430
Number of different surnames	944
Number of surnames that occur only once	686
Number of isonymous marriages	3
I	0·00420
F_r	0·00024
F_n	0·00081
F_t	0·00105

Total inbreeding (F_t) is calculated as:

$$F_t = F_r(1 - F_n) + F_n.$$

The geographic mobility and partner choice in the Sienese population were analysed using the birthplaces of spouses (children's parents and grandparents). Marriages were subdivided into groups according to the birthplaces of mates as follows: both partners born in Siena (for computing city endogamy), only one partner born in Siena (for computing city exogamy), and neither born in Siena (for computing immigration rate). When both partners were born in Siena, and *Contrada* of birth was reported, and the endogamy and exogamy of *Contrada* were calculated as well.

The distances between Siena and other birthplaces were calculated using a map measurer, the road route on the IGDA map of Italy (1988), and the TCI map of Tuscany (1989).

Results

As the percentage of immigrant couples in the examined sample is very high (40%) isonymy and inbreeding were evaluated both in the total sample and the couples with at least one partner born in Siena. Table 1 shows the values of isonymy and inbreeding coefficients of the Sienese population. The proportion of isonymous relationships in the

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Table 2. Immigration rate of the Sienese population

Generation	Examined couples	Immigration rate: HO–WO	
		N	%
Parents	1200	485	40·4
Paternal grandparents	808	467	57·8
Maternal grandparents	848	504	59·4
Grandparents	1656	971	58.6

HO = husband born outside Siena; WO = wife born outside Siena.

Table 3. City endogamy and exogamy of the Sienese population

Generation	*N**	City endogamy		City exogamy					
		HS–WS		HS–WO		HO–WS		Total	
		N	%	*N*	%	*N*	%	*N*	%
Parents	715	239	33·4	240	33·6	236	33·0	476	66·6
Paternal grandparents	341	146	42·8	114	33·4	81	23·8	195	57·2
Maternal grandparents	344	156	45·3	98	28·5	90	26·2	188	54·7
Grandparents	685	302	44·1	212	30·9	171	25·0	383	55·9

*Total couples with at least one partner born in Siena (examined couples minus immigrant couples in Table 2). HS = husband born in Siena; WS = wife born in Siena; HO = husband born outside Siena; WO = wife born outside Siena.

total sample (i.e. total inbreeding) is similar to the figure reported for Ferrara, another medium-sized Italian town ($I = 0{\cdot}0037$, $F_t = 0{\cdot}0009$; Barrai *et al.*, 1987). By contrast, the proportion is only one-fifth to one-tenth of those reported for Italian villages and Italian ethnic minorities (Biondi *et al.*, 1990, 1993; Pettener, 1990). The random component of the inbreeding coefficient is an estimate of commonality of surnames between husbands and wives in the population and only accounts for about 15% of inbreeding. The non-random component is correspondingly larger, which includes the effect of locality differences. When only couples with at least one partner born in Siena were considered, the figures remained similar.

The number and percentage of immigrant couples in Siena (Table 2) show that the immigration rate decreases from 58·6% in the grandparental generation to 40·4% in the parental generation. There is no statistically significant difference between paternal and maternal grandparent immigration ($\chi_1^2 = 0{\cdot}46$, $p = 0{\cdot}498$). Endogamy and exogamy are

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Table 4. *Contrada* endogamy and exogamy of the Sienese population

Generation	Examined couples	Endogamy of *Contrada*: H–WSC		Exogamy of *Contrada*: H–WDC	
		N	%	*N*	%
Parents	158	24 (13·7)*	15·2	134	84·8
Paternal grandparents	106	42	39·6	64	60.4
Maternal grandparents	117	58	49·6	59	50·4
Grandparents	223	100 (22·3)*	44·8	123	55·2

H–WSC = husband and wife born in the same *Contrada*; H–WDC = husband and wife born in different *Contrada*.
*Figures in parentheses are extent of *Contrada* endogamy.

Table 5. Estimates of geographic mobility for partner choice of the Sienese population

Place	Parents				Paternal grandparents				Maternal grandparents			
	HS–WO		HO–WS		HS–WO		HO–WS		HS–WO		HO–WS	
	N	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
Tuscany	171	71·3	170	72·0	97	85·1	63	77·8	82	83·7	59	65·5
Northern Italy	8	3·3	10	4·2	6	5·2	6	7·4	7	7·2	12	13·3
Central Italy	17	7·1	22	9·3	5	4·3	6	7.4	4	4.1	5	5·6
Southern Italy	21	8·7	22	9·3	2	1·8	4	5.0	1	1·0	6	6·7
Sicily	3	1·3	8	3·4	1	0·9	1	1·2	2	2·0	5	5·6
Sardinia	5	2·1	2	0·9	1	0·9	1	1·2	2	2·0	0	0·0
Abroad*	15	6·2	2	0·9	2	1·8	0	0·0	0	0·0	3	3·3

HS = husband born in Siena; WS = wife born in Siena; HO = husband born outside Siena; WO = wife born outside Siena.
*Parents' generation: fifteen females (nine from Europe, five from the Americas and one from Africa), two males (one from Europe and one from Africa); grandparents' generation: two females in paternal grandparents from Europe; three males in maternal grandparents (two from Europe and one from the Americas).

shown in Table 3. 'City endogamy', where both partners are born in Siena, and 'city exogamy', where one partner is from outside Siena, were calculated after exclusion of the couples where both partners were from outside (immigration rate). Endogamy decreases from grandparents to parents, the percentage of unions being respectively 44·1 and 33·4%. Obviously, the opposite trend between grandparents and parents appears in the rate of exogamy; the percentage in grandparents is 55·9%, and in the parental generation 66·6%. Neither the endogamy nor the exogamy rate shows a

https://doi.org/10.1017/S0021932098005215 Published online by Cambridge University Press

statistically significant difference between paternal and maternal grandparents ($\chi^2_1 = 0{\cdot}44$, $p = 0{\cdot}507$). It seems that both sexes make the same contribution to immigration for marriage. In fact, when exogamy is divided between couples in which husband or wife were born outside of Siena (HS–WO and HO–WS) no statistically significant difference is observed (paternal grandparents versus maternal grandparents: $\chi^2_1 = 1{\cdot}57$, $p = 0{\cdot}210$). Besides, the difference between parents and grandparents disappears too ($\chi^2_1 = 2{\cdot}08$, $p = 0{\cdot}149$).

In Table 4 the marriage structure of the Sienese population according to *Contrada* of birth is reported. The grandparental generation shows the same proportion of endogamy and exogamy as the population of the city as a whole (see Table 3). No statistically significant difference exists between paternal and maternal grandparents ($\chi^2_1 = 2{\cdot}20$, $p = 0{\cdot}138$). On the other hand, in the parental generation *Contrada* endogamy is less than half city endogamy (15·2 and 33·4%, respectively), a highly significant difference. Obviously, the opposite trend is shown by exogamy (84·8 and 66·6%, respectively). The extent of the difference between *Contrada* endogamy expected at random and observed consistently decreases from the grandparents' to the parents' generation.

In Table 5 the geographic subdivision of exogamy is shown. The bulk of marriage migration comes from Tuscany: 71·6% in parents and 78·6% in grandparents, and the difference between the two generations is statistically significant ($\chi^2_1 = 5{\cdot}47$, $p = 0{\cdot}019$). By contrast, the percentage of partners coming from abroad is very low, especially in the grandparental generation (3·6% in parents and 1·3% in grandparents). When migration from other Italian regions is considered, grandparents show higher percentages from Central–Northern Italy while parents show higher percentages from Central–Southern Italy; the proportion of migration in grandparents and parents, respectively, is: 8·1 and 3·8% from the north, 5·2 and 8·2% from central regions, and 3·4 and 9·0% from the south. Excluding people born abroad, differences between males and females are not statistically significant in parents and paternal grandparents ($\chi^2_5 = 4{\cdot}27$, $p = 0{\cdot}511$; $\chi^2_5 = 3{\cdot}08$, $p = 0{\cdot}688$); while maternal grandparents show a statistically significant difference, mainly due to an excess of males coming from Southern Italy against females ($\chi^2_5 = 11{\cdot}42$, $p = 0{\cdot}044$).

Discussion

One should be cautious when estimating inbreeding by isonymy. However, when the purpose is to estimate deviations from random mating in populations of the same culture, region and period, difficulties tend to be minimal, even if values may be inflated by polyphyletic names (Roberts, 1980). Social barriers, like the organization of the town of Siena into *Contrade*, may cause deviations from panmixia with subsequent subdivision of the population into endogamous groups. The level of inbreeding in Siena is comparable to that of other Italian urban populations. The isolation that the peculiar social organization might have caused, as expected in the parent's generation (see Table 4), was not extreme, so that there is a low value of inbreeding.

Within the limits of the generations considered, and therefore at least with reference to the second part of the 20th century, *Contrade* have influenced partner choice less and less. The proportion of partners chosen in the same *Contrada* decreases from

https://doi.org/10.1017/S0021932098005215 Published online by Cambridge University Press

grandparents to parents. One may interpret this tendency as being related to the great influence that *Contrade* had on the social life of Siena until about the last post-war period. The geographic marriage mobility from outside Siena is mainly short range: that is migration within Tuscany. So exogamy does not seem likely to have greatly affected the genetic structure of the Sienese population.

The current biodemographic history of Siena is similar to that of any other Italian town. At the present time, the social subdivision of the town into *Contrade*, and the strong feeling of the Sienese population of belonging to their own *Contrada*, remain as a splendid cultural and historical institution that has no comparison in Italy and Europe. Yet it does not seem to have had any prominent biological effect on the population, in particular its genetic structure.

Acknowledgments

Thanks are due to the Local Director of Education and to headmasters and teachers of the schools of Siena, and to the students and their families for their cooperation. The authors are also very grateful to Professor D. F. Roberts for his helpful suggestions and encouragement. Financial support was provided to A.V. by MURST–Italian ('Dottorato di Ricerca, VI ciclo') and to G.B. by CNR–Italian (grant n.93.04258.CT04).

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