Journal of Biosocial Science (2022), 54: 4, 545–557
doi:10.1017/S0021932021000389

CAMBRIDGE UNIVERSITY PRESS

RESEARCH ARTICLE

Surnames and population structure in the Doctrine of Belén, Altos de Arica, Viceroyalty of Peru (1750–1813)

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(Received 24 September 2020; revised 23 May 2021; accepted 24 May 2021; first published online 26 July 2021)

Abstract

The analysis of multiple population structures (biodemographic, genetic and socio-cultural) and their interrelations contribute to a deeper understanding of population structure and population dynamics. Genetically, the population structure corresponds to the deviation of random mating conditioned by a limited number of ancestors, by restricted migration in the social or geographic space, or by preference for certain consanguineous unions. Through the isonymic method, surname frequency and distribution across the population can supply quantitative information on the structure of a human population, as they constitute universal socio-cultural variables. Using documentary sources to undertake the Doctrine of Belén's (Altos de Arica, Chile) historical demography reconstruction between 1763 and 1820, this study identified an indigenous population with stable patronymics. The availability of complete marriage, baptism and death records, low rates of migration and the significant percentage of individuals registered and constantly present in this population favoured the application of the isonymic method. The aim of this work was to use given names and surnames recorded in these documentary sources to reconstruct the population structure and migration pattern of the Doctrine of Belén between 1750 and 1813 through the isonymic method. The results of the study were consistent with the ethno-historical data of this ethnic space, where social cohesion was, in multiple ways, related to the regulation of daily life in colonial Andean societies.

Keywords: Surnames; Inbreeding; Historical records

Introduction

The Doctrine of Belén was settled in 1777 by splitting off from the Doctrine of Codpa, which was divided by Manuel de Abad Yllan, both under the authority of the Codpa Chiefdom (*cacicazgo* in Spanish) (Hidalgo & Durston, 2004). It is located in the Altos de Arica (current Chilean territory), which can be divided into five distinct ecological zones: Puna (Bolivian altiplano), the *sierra* (2000–3500 m.a.s.l.), valley headwaters (˜2000 m.a.s.l.), the valley (< 2000 m.a.s.l.) and the Pacific coast. Ten settlements or localities were under its jurisdiction, including Belen, the seat of the doctrine's ecclesiastical administration, Socoroma, Putre, Pachama, Parinacota, Caquena Choquelimpe, Guallatiri, Sora and Churiña. Figure 1 shows the locations of these settlements, along with others belonging to the Doctrine of Codpa: Codpa, Esquiña, Pachica, Timar, Ticnamar, Saxamar, Umagata and Livilcar (Inostroza, 2017).

The socio-demographic and economic features of the Altos de Arica area distinguish it from the rest of the Andean Aymara region. Around this area, the silver and quicksilver trade expanded to and from Potosí, which had a significant influence on the way of life of local indigenous people

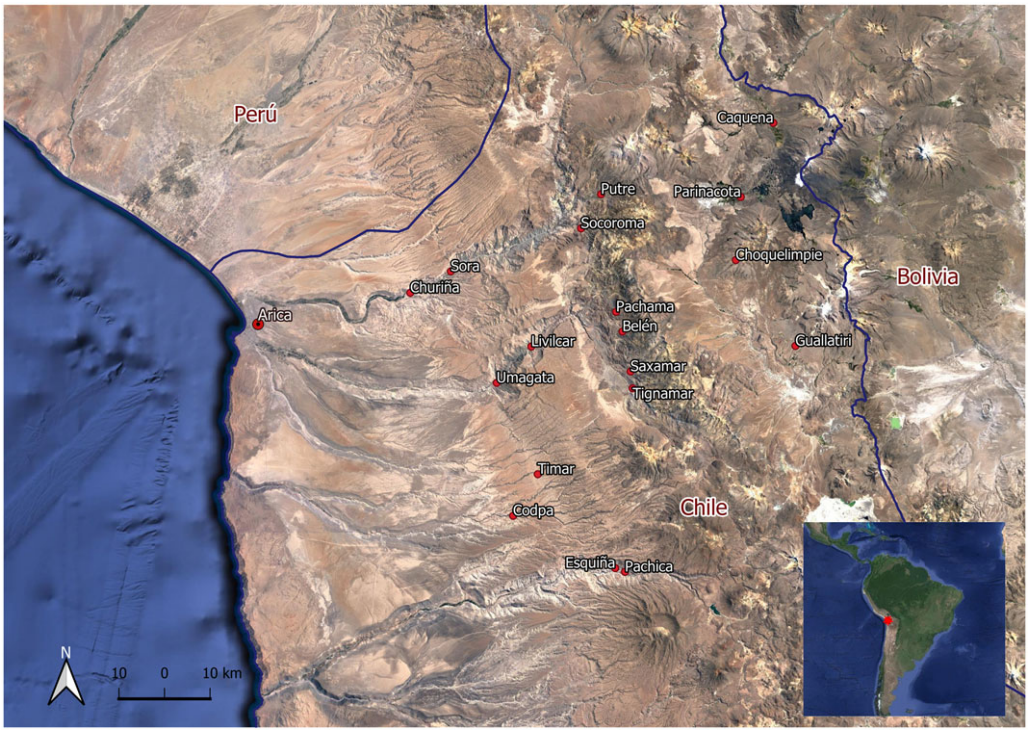

Figure 1. Localities of the Doctrine of Belén. Current borders of Chile, Peru and Bolivia. Source: authors' elaboration based on *Google Earth* satellite photo, versión 9.140.0.4 (2021). URL: https://earth.google.com/web/@-18.79454398,-69.76675868,2146.19084742a,464229.77881908d,30y,0h,0t,0r/data=MicKJQojCiExYTNZWVo2UmtJV2hreld4OUstZlBZZ0lRYmo3UV9lM1U6AwoBMA?authuser=0.

and their circulation from different areas along the Andean coastal trade route (Hidalgo, 1987; Dagnino, 2016; Inostroza, 2019). Local enterprises included agriculture, stockbreeding and horseback transportation. Since the Andean peoples in Altos de Arica were exempted from the Potosí *mita,* migrating to the Doctrine of Belén was an attractive prospect for many foreigners to escape from the pressure of the *mita* and potentially gain access to lands suitable for settlement (Hidalgo, 1986, 1987; Inostroza, 2019).

Archaeological research has confirmed that this area has been inhabited since pre-Hispanic times, first as part of the Altiplano kingdoms (Lupaca and Pacajes) and later, under Inka rule (Santoro *et al.*, 1987; Hidalgo & Focacci, 2004; Chacama 2005, 2009, among others). In the 18th century, the valley of Belén presented a diverse, multi-ethnic landscape where indigenous communal lands co-existed alongside estates owned by *criollos* (i.e. people of European ancestry born in America) (Marsilli & Hidalgo, 1992; Hidalgo *et al.*, 2004; Inostroza, 2017).

The demographic structure of the Doctrine of Belén at the turn of the 19th century has been described in detail by Hidalgo (1986), Inostroza (2019) and Hidalgo and Inostroza (2019) based on diverse documentary sources. The old *Corregimiento* of Arica extended over 58073 km^2 with 12,690 people in the mid-18th century (Hidalgo, 1986). In 1792, the province of Arica had a total of 18,711 inhabitants, 30% of whom were located in Tacna (currently Perú) and 20.9% in the Codpa Chiefdom. Approximately 83% of the total population was indigenous, and over 70% was subject to tribute (Hidalgo & Inostroza, 2019). According to census data, the Doctrine of Belén's population grew by 2.03% between 1750 and 1792 and fell by 2.17% between 1792 and 1813. Between 1750 and 1813, 50% of all men were under 19 years of age, while 50% of all women were under 24 years old and under 29 years old in 1772 and 1813, respectively.

https://doi.org/10.1017/S0021932021000389 Published online by Cambridge University Press

Among women, the average age of marriage at the turn of the 19th century was 23 years. Most of them got married as single women (79%) while others as widows (21%). Also, most of the children with recorded baptism were born to legitimate marriages (85.98%), with the rest born out of wedlock (Inostroza, 2019). The method for reconstructing family structure employed by Inostroza (2016) suggests that ca. 1787 the Doctrine of Belén was mainly composed of nuclear families (65%), followed by women-headed households (widows, single women or otherwise alone) (20%) and 15% by composite families (Inostroza, 2016).

The isonymic method and historical documents

The concept of biodemographic structure refers to the overall number of individuals, their distribution by sex and age and the frequency of births, deaths and migrations. These factors determine gene dispersion over time and space – and among or within populations, which conditions population size (Cavalli-Sforza & Bodmer, 1981; Fuster, 2005). In turn, the genetic structure of a population is shaped by a wide range of factors, such as age, kinship and religion, among others, which constrain partner selection and limit random mating, as well as social or physical barriers (or lack thereof), which shape migration dynamics (Fuster, 2003).

Besides demography and genetics, populations are also structured by the geography determining the distribution of a population's settlements, including soil conditions, weather, hydrologic and orographic characteristics, political boundaries and settlement preferences (Haggett & Ferrer, 1994). Together, these factors define a geographic hierarchical population structure where increasing complexity is observed, depending on the organizational mechanisms implemented. Over time, less-complex groups are modified by migratory movements that are subject to social, cultural and economic factors, shaping the geographic, demographic and genetic structure of the population (Haggett & Ferrer, 1994).

Consequently, the study of population structure is not a simple task. It involves careful consideration of all the elements that have contributed to said structure and their complex correlations. Thus, building an accurate model of the studied phenomena requires integrating a wide range of information sources and methodological approaches that consider as many factors as possible.

To this end, surname analysis becomes a valuable tool since surnames are a socio-cultural variable that can be easily related to biological features, enabling the study of diverse issues related to population structure (Lasker, 1980). Surnames can be evaluated in terms of ethnic adscription. Also, they reveal identity and biological kinship and can be traced through time, which makes surname analysis a significant methodological resource for bioanthropology and human population genetics. Assuming that two people holding the same surname belong to the same lineage, surnames can be considered equivalent to genetic markers. Therefore, their frequency and distribution in a population supply valuable quantitative data on the genetic structure of human populations.

The isonymic method and the concept of isonymy, defined as the occurrence of an identical surname in two different individuals (Rawling, 1973) or the proportion in which this phenomenon occurs (Lasker, 1985), were initially proposed by Darwin (1875) and later revived by Crow and Mange (1965). Darwin (1875) suggested using the proportion of isonymous unions to estimate the frequency of first-cousin marriages. Based on the same principle, Crow and Mange (1965) developed and expanded the isonymic method to study consanguinity in the population as a whole – not limited to first cousins – under the assumption that all individuals that share a surname have inherited it from a common ancestor. Crow and Mange's approach (1965) provided a way to overcome methodological challenges to estimate consanguinity in populations whose genetic or genealogical data were incomplete or not available.

Studies using the isonymic method to analyse population structure have extracted surname information from diverse documentary sources, such as parochial birth, marriage and death registers and census data (Roberts & Rawling, 1974; Pollitzer *et al.*, 1988; Lasker, 1980, 1985; MacRaild & Smith, 2009). In the Andean region, the method has been frequently applied in the study of historical

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population structure. Dipierri and colleagues (1991) analysed the isonymic structure in the Quebrada de Humahuaca based on parochial baptismal records (1734–1810) and observed increased consanguinity over time, with intermediate values for first cousins and second cousins once removed. A similar approach has been used to study the historical populations in the Jujenean Puna, particularly in Casabindo and Cochinoca, and in San Pedro de Atacama in Northern Chile (Costa Junqueira *et al.*, 2000; Alfaro *et al.*, 1998, 1999; Alfaro, 2010; Peña Aguilera, 2016).

The documentary sources used to reconstruct historical demography in the Doctrine of Belén (Altos de Arica) between 1763 and 1820 are notable for their stable patronymics, complete marriage, baptism and death records and low migration rates (Inostroza, 2019). Besides, a substantial percentage of individuals repeatedly appear in these records, indicating stable residence in the doctrine. When applying the isonymic method, such conditions constitute a significant advantage.

Given these favourable biodemographic and documentary conditions, the research objective of this study was to reconstruct historical population structure and migration patterns for the Doctrine of Belén's population between 1750 and 1813 by analysing names and surnames through the isonymic method.

Methods

Documentary sources

Name and surname data were collected from two types of documentary sources. The first were tax rolls from the Doctrine of Belén dated 1750 (Hidalgo, 1978), 1772/1773 (Hidalgo *et al.*, 2004) and 1813 (Hidalgo *et al.*, 1988). The former two included the total Andean population that was tributary to the Chiefdom of Codpa. Only the ten villages or towns that constitute the Doctrine of Belén were included in this study: Belén, Socoroma, Putre, Pachama, Parinacota, Caquena, Choquelimpe, Guallatiri, Sora and Churiña. The second documentary source was parochial marriage, baptism and death records between 1763 and 1834 (Inostroza, 2019). The period's tax list (*Lista de revisitas* in Spanish) had a population coverage comparable to that of a census and was consistent with parochial data, especially the names and surnames of the doctrine residents and their nuclear families (Inostroza & Hidalgo, 2015). The census records contained information on age, sex, category, married status and, in some cases, political or religious appointment.

Surnames were grouped by similar phonetics or spelling. Children were assigned the paternal surname, in the case of nuclear families, or the maternal surname, for single mothers, since the review of parochial records revealed that this was how surnames were inherited (Inostroza, 2019). The analysis considered only the first one when an individual had more than one name or surname.

Surnames as ethnic markers

The anthroponyms recorded in these documentary sources were classified according to their geographic-linguistic origin into:

a) Autochthonous: surnames with the phonetic or graphic influence of extant or extinct native languages, as suggested by documentary sources: catalogues, dictionaries, toponyms, electoral rolls, among others (Erdman, 1964; Albeck *et al.*, 2017; Inostroza, 2019);
b) Foreign: surnames that originated in other continents;
c) Autochthonous/foreign: surnames that could fall into either category;
d) Undetermined: surnames that could not fall into any of the preceding categories.

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Isonymic analysis

Based on the distribution of surnames within each period, the expected random isonymy (I_{ii}) was calculated assuming random mating within a population k, following Rodríguez-Larralde and Casique (1993):

$$I_{ii} = \Sigma n_{ik} \frac{(n_{ik} - 1)}{N_i(N_i - 1)} = \Sigma\left(n_{ik}/N_i\right)^2 - 1/N_i$$

Here, n_{ik} is the absolute frequency of surname k in population i; N_i is the total number of individuals in the same population (Σn_{ik}).

Consanguinity was estimated as an expression of the random isonymy (F_{ST}) and calculated according to Relethford (1988) using the following formula:

$$F_{ST} = I_{ns}/4$$

where I_{ns} is non-biased isonymy.

Other statistics derived from these indicators were used to describe population structure:

Surname diversity or Fisher's α

This indicator was first proposed by Fisher *et al.* (1943) to estimate the abundance of animal species representative of a sample. Piazza *et al.* (1987) proposed its use to analyse migration rates from the distribution of surnames by estimating the existing number of surnames in a population. It measures the effective number of surnames in a population and is analogous to gene drift (Barrai *et al.*, 1992). Fisher's α was calculated according to the following formula:

$$\alpha = 1/I_{ns}$$

Recent immigration or Karlin–McGregor's ν

Since surnames are considered as multiple alleles of the same locus (Piazza *et al.*, 1987), they can be analysed using the Karlin and McGregor (1967) theory, which predicts that dead individuals are replaced by others bearing the same surname, externally and with a rate ν, by mutations of surnames and by the introduction of other surnames through immigration. Since the Karlin–MacGregor ν equals the sum of the mutated surnames, a rare phenomenon in societies with a regular transmission of patronymics, plus the much more frequent immigration rate, it is reasonably assumed that ν equals this rate (Zei *et al.*, 1983; Piazza *et al.*, 1987). It was calculated according to Zei *et al.* (1983) with the following formula:

$$\nu = (1 - I_s)/[I_s(N_i - 1)]$$

where I_s is biased isonymy.

The actual number of migrants (N_{em})

Wright's Island Model (1951) allows the estimation of the definite number of migrants in a population from F_{ST} using the following equation (Yasuda & Furusho, 1971):

$$N_{em} = (1 - F_{ST})/4F_{ST}$$

The following indicators of isolation and sedentarism were also determined (Rodríguez Larralde, 1990).

i. Indicator A: Percentage of the population with unique surnames, i.e. surnames held by only one individual in the population. This indicator can also be considered an indicator of migration (Rodríguez Larralde & Barrai, 1997, 1998).

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ii. Indicator B: Percentage of the population that held the seven more frequent surnames. It is an indicator of relative isolation (Rodríguez Larralde & Barrai, 1997, 1998), as larger B values correspond to high isolation and sedentarism of a population.

The parameters I_{ii}, F_{ST}, ν and α were calculated using the DISTRIBU, ORMANOS and ISONIMIA programs developed and kindly shared by Dr Italo Barrai and Alvaro Rodriguez Larralde for the DBXL database processor.

Results

Geographic-linguistic origin of surnames

The 1750 document recorded 1306 individuals and 176 different surnames, of which 54% were foreign, 33.5% autochthonous, 6.8% could be either foreign or autochthonous (A/F) and 5.7% were undetermined. The 1772/1773 document listed 1717 individuals and 178 surnames, of which 59% were foreign, 30.9% were autochthonous, 6.2% were A/F and 3.9% were undetermined. The 1813 document showed a decrease in population size, recording 1445 people and 159 different surnames with similar origin distributions to those of 1772: most were foreign (59.7%), followed by autochthonous (29.6%), A/F (6.9%) and undetermined (3.1%) (Table 1). Although most individuals carried foreign surnames in all the considered records, the seven most frequent surnames in 1750 and 1772/1773 were all autochthonous. Not until 1813 did the foreign surname 'Flores' became one of the seven most frequent (n=42).

The contrast between the distribution of surnames by origin (i.e. mainly foreign) and the seven most frequent surnames (i.e. all or mainly autochthonous) is due to the number and origin of unique surnames. In the three periods considered, 56.9%, 63.5% and 60.0% of unique surnames had a foreign root, respectively.

Isonymic parameters

Table 2 presents the distribution of isonymic parameters, which had a slight variation over time. Population size increased between 1750 and 1772 but fell again in 1813. The number of distinct surnames was nearly the same in the first two periods, decreasing in the third one.

Random isonymy (F_{ST}) values suggested that the population's consanguinity rate remained stable through time. Surname diversity or abundance (α) did not vary significantly between periods. Moreover, in 1772/1773 there was an increase in population size, but α had the lowest value of the three studied periods, indicating that the increased number of individuals did not imply an inflow of new surnames. The recent immigration indicator (ν), which presents its lowest value in 1772, supports the claim that this rise was not a consequence of the arrival of immigrants with new surnames to the Doctrine of Belén but was given by the people within the existing surname set.

Indicator A dropped by nearly 50% between 1750 and 1813, implying a sharp decrease in immigration to the Doctrine of Belén, while indicator B suggested significant population sedentarism across the three periods since over 25% of the population had the same seven surnames. Similarly, there was no significant variability in the effective number of migrants (N_{em}) through time, which implies low population mobility in all periods considered.

Discussion

Given the limitations of the isonymic method previously mentioned above, the results must be considered as relative rather than absolute measures of biological affinity within and between

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Table 1. Doctrine of Belén population size and absolute and relative frequencies of surname types by period

Characteristic		1750		1772		1813	
		n	%	*n*	%	*n*	%
Individuals		1306		1717		1445	
Different surnames		176		178		159	
Autochthonous surnames (A)		59	33.5	55	30.9	47	29.6
Foreign surnames (F)		95	54.0	105	59.0	95	59.7
Autochthonous/Foreign surnames (A/F)		12	6.8	11	6.2	11	6.9
Undetermined surnames		10	5.7	7	3.9	5	3.1
Unique surnames		72	40.9	52	29.2	40	25.2
Unique autochthonous surnames (A)		22	30.6*	15	28.8*	13	32.5*
Unique foreign surnames (F)		41	56.9 *	33	63.5*	24	60.0*
Unique autochthonous/foreign surnames (A/F)		1	1.4	1	1.9	1	2.5
Unique undetermined surnames		8	11.1	3	5.8	2	5.0
Seven most frequent surnames	Surname	*n*	Surname	*n*	Surname		*n*
	Mamani	73	Mamani	103	Guanca		80
	Guanca	56	Choque	80	Mamani		75
	Choque	52	Guanca	76	Choque		68
	Larba	51	Larba	67	Yugra		45
	Yugra	46	Yugra	58	Condori		43
	Umiri	38	Condori	58	Flores		42
	Alanoca	35	Cutipa	51	Choqueguanca		41

*Percentage of total unique surnames.

Table 2. Isonymic parameters of the Doctrine of Belén population by period

Isonymic parameter	1750	1772	1813
No. individuals	1306	1717	1445
No. distinct surnames	176	178	159
No. unique surnames	72	52	40
Random isonymy (F_{ST})	0.0049±0.0003	0.0051±0.0003	0.0050±0.0003
α	53±3	50±3	52±3
v	0.038±0.003	0.028±0.002	0.034±0.002
N_{em}	51	49	50
Indicator A (%)	5.5	3.03	2.77
Indicator B (%)	26.9	28.7	27.3

populations when interpreting population structure based on a population's anthroponymy. In the Doctrine of Belén, the results indicated a relative homogeneity between periods, in terms of both the population structure by geographic–linguistic origin of surnames and isonymic structure.

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Consanguinity by random isonymy (F_{ST}) and indicator B (sedentariness) values were conditioned by the people's origin, the persistence of the traditional *ayllu* structure and marriage preferences within the Doctrine of Belén. According to parochial records (1763–1853), 73% of the population were natives, i.e. born within the doctrine. However, this percentage could have been even higher, considering that another administrative category (7.3%) was a neighbour (*vecinos* in Spanish), which included Spaniards or *mestizos* (mixed) that had settled in the doctrine's towns (Inostroza, 2019).

There is documentary evidence of the traditional Andean social structure known as *ayllu* in the area (Hidalgo *et al.*, 2004; Inostroza, 2016). The *Revisita de Codpa* of 1773 states that the town of Belén was divided into two *ayllus*, Mancasaya and Aransaya (Hidalgo *et al.*, 2004; Inostroza, 2016). In the most historical version of the Andean model of social and territorial organization, all the *ayllu* members were considered to share a common ancestor, belonging to the same lineage. In other words, an *ayllu* was composed of a group of nuclear families, bound to a specific territory and connected by kinship ties. They shared a common language and participated in collective labour, which favoured consanguinity and endogamy (Dipierri *et al.*, 2015). From Belen's 1787 tithe payer list, the origin of spouse was identified, indicating that 62% of all marriages were between individuals from the *ayllus* Mancasaya and Aransaya, and therefore, endogamous. Only 2.1% of all unions involved individuals from other doctrines (Inostroza, 2016). Such precedents endorse the great degree of sedentariness among the Doctrine's population found in this study.

In general, low values in indicator A and high values in indicator B usually represent high levels of isolation and sedentism. In the Doctrine of Belén, this was probably the result of isolation due to social factors, such as the a*yllu* structure, rather than geographic ones. Today, these towns are considered relatively isolated due to their high altitude (>3500 m.a.s.l.), close to the Andean massif, and routes that are mainly regional, primary, winding and unpaved. In the 1970s, the province of Parinacota was legally classified as an 'isolated territory' due to its extreme physical environment and historical settlement patterns, which are distinguished and asymmetric as compared to the rest of the country (Subsecretaría de Desarrollo Regional y Administrativo, 1999; Sánchez, 2009). During the colonial period, and despite its significant role within the Andean trade network, isolation conditions in the doctrine was assuredly even more pronounced, thus promoting endogamy and sedentism. The indicators of evolutionary dynamics coincide with those analysed so far since both ν (recent immigration) and α (surname diversity) indicate a high degree of stability in the population.

Historical demography studies suggest that the fluctuations in population size observed in the Doctrine of Belén were the result of migration dynamics rather than natural growth (Hidalgo & Inostroza, 2019). In 1750, there were 1497 individuals in the doctrine's records; by 1772/3, there were 1818; and 20 years later, 2023. Afterwards, the population size decreased; there were 1533 individuals recorded in 1804 and 1495 in 1813. These changes in population size are partially related to the behaviour of Karlin–McGregor's ν and indicator A. Both decreased between 1750 and 1772 and increased again between 1772 and 1813. Despite such population increase between 1750 and 1772, migration was driven by familial bonds or kinship networks enhanced by *compadrazgo* and marital alliances (Inostroza, 2019). These prevented the introduction of different surnames to the population, as observed in the number of new surnames among periods (176 vs 178). Another possible explanation is that these immigrants had the same surnames as the doctrine locals because these surnames were also highly prevalent in the neighbouring doctrines. Historical biodemography indicates that most of these immigration flows came from the Bishoprics of Charcas and La Paz, in what is now the Plurinational State of Bolivia, and that the most prevalent surnames among these foreigners were Mamani, Choque and Calle, which were already very frequent in the Doctrine of Belén (Table 1).

In terms of surname origin, autochthonous surnames represented over 30% of the total surnames recorded in each of the three documents. Meanwhile, individuals bearing these surnames decreased from 55.6% in 1750 to 49.3% in 1813, as expected from doctrines or Indian towns

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(Inostroza, 2019). However, they do differ from those presented by other contemporary Andean populations. After a long period of acculturation, in 1786, only a third of Oruro's inhabitants held an autochthonous surname (Sánchez Albornoz, 1974). The Humahuaca Parish expressed similar percentages between 1734 and 1810 (Dipierri *et al.*, 1991). In contrast, 65% of the surnames recorded in Casabindo were autochthonous in the early 19th century, representing 92% of the local population (Alfaro 2010), while in Cochinoca, between 1778 and 1806, these figures were 45% and 62–66%, respectively (Peña Aguilera, 2016). The fact that approximately half of Belén's population held an autochthonous surname suggests that the disruption of Andean onomastics caused by Christian evangelization in this area was not as drastic as in other Andean communities. This feature of local anthroponyms also promoted stability in the isonymic structure of the Doctrine of Belén over, at least, 63 years.

The relatively high prevalence of foreign surnames – over 50% of overall surnames – indicates that the replacement of autochthonous names with foreign appellatives took place relatively early in the Doctrine of Belén, which is evidence of a greater degree of social transformation, compared with Casabindo and Cochinoca. The observed difference with these populations from the central Jujuy's Puna could be explained by the fact that Casabindos and Cochinocas were reduced and put in an *encomienda*. Indeed, they were a particular group that did not share the fate of other native populations from neighbouring areas which, as a result of differential fragmentation or 'de-structuring' (Lorandi, 1997), had begun a process of colonial integration that led to the disappearance of native onomastics and replacement by European ones (Dipierri, 2004).

There are a few comparable studies of nearby Andean populations regarding the same time frame and analogous documentary sources that ponder the magnitude of consanguinity in the Doctrine of Belén. Among them, Dipierri *et al.* (1991) estimated consanguinity by isonymy in the historical population of Humahuaca from surname data from baptismal registers (1734–1810). Costa-Junqueira and colleagues (2000) analysed the evolution of consanguinity and kinship in the Puna de Atacama between 1800 and 1950 by applying the isonymic method to surnames in death registers of Susques (Argentina), San Pedro de Atacama and Toconao (Chile). These studies determined the coefficient of consanguinity by random isonymy, the immigration indicator ν (Karlin–McGregor's), the surname diversity or Fisher's α and the isolation indicator B. Overall, the region presented an early stage of considerable population mobility, followed by progressive isolation of populations located on both sides of the Andes range. Of all the localities considered, Susques presented the highest consanguinity and sedentism levels.

Table 3 presents the values for consanguinity by random isonymy, surname diversity (α) and the recent immigration indicator (ν) for these populations, which are very close to those observed in the Doctrine of Belen. As the table shows, consanguinity by random isonymy and surname diversity was nearly constant from the mid-18th century and early 19th in all the study locations. Such consanguinity values allow the identification of three groups. Susques, Toconao and Casabindo presented the highest consanguinity, followed by Cochinoca with intermediate values. The third group comprises the Doctrine of Belén, San Pedro de Atacama and Humahuaca, with significantly lower consanguinity values. As expected, surname diversity had the opposite behaviour and was highest among populations with low consanguinity, with a maximum value in San Pedro de Atacama (α=75) and minimum in Casabindo and Susques (α=23–24) (Table 3). The consanguinity levels described in this study are comparable to those found by Dipierri and colleagues (1991) in the Humahuaca Parish from 1734 to 1810. These authors used marital isonymy to estimate consanguinity, concluding that the native population of Humahuaca behaved as a single panmictic unit, where there are no deviations from random mating.

Differences in magnitude between the various estimates were due to the characteristics of each of the populations analysed and the methodology followed in each study. Casabindo was a closed population with no foreigners, governed and maintained in a restricted geographic area by the *encomendero* (Alfaro, 2010), while the Humahuaca Parish population included natives, Spaniards and Mulattoes. For Humahuaca, the estimates were given by marital isonymy among

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Table 3. Isonymy parameters in different Andean colonial populations

Population	Period	F_{ST}	α	ν	Document source	Reference
Doctrine of Belén	1750	0.0049±0.0003	53	0.038±0.003		
	1772	0.0051±0.0003	50	0.028±0.002		
	1813	0.0050±0.0003	52	0.034±0.002		
Humahuaca	1734–1772	0.002			Baptismal registers	Dipierri *et al.* (1991)
	1773–1810	0.003				
Casabindo	1778	0.011±0.0007	23	0.021±0.002	Viceroy population census	Alfaro (2010)
	1786	0.010±0.0006	24	0.016±0.001	Tax rolls	
Cochinoca	1778	0.008±0.0006	32	0.027±0.002	Viceroy population census	Peña Aguilera (2016)
	1786	0.007±0.0005	34	0.019±0.001	Tax rolls	
	1806	0.008±0.0005	32	0.021±0.0015		
San Pedro de Atacama	1800–1850	0.004±0.01	75	0.25±0.05	Death registers	Costa Junqueira *et al.* (2000)
Toconao	1800–1850	0.012±0.004	31	0.36±0.13		
Susques	1800–1850	0.012±0.003	23	0.15±0.03		

effectively constituted couples, while the rest of the studies estimated consanguinity by random isonymy (Costa Junqueira *et al.*, 2000; Alfaro, 2010; Peña Aguilera, 2016). Besides methodological differences, data sources also differ among the cited works. Including baptismal (Dipierri *et al.*, 1991) and death records (Costa Junqueira *et al.*, 2000), information was provided by ecclesiastical officials on one case and by population census, and tax rolls carried out by governmental representatives on the other (Alfaro, 2010; Peña Aguilera, 2016).

The use of surnames to estimate consanguinity, isolation and migration intensity and direction enables the analysis of isonymic structure as a transversal element, indicative of other population structures (i.e. demographic and genetic) to shed light on the biodemographic, historical, sociocultural and economic factors that shaped these structures from a multidisciplinary perspective. Despite evidence that population growth in the Doctrine of Belén was due to the immigration of 'foreign' individuals, isonymic analysis showed that it did not involve a change in surname patterns. Instead, the incoming population held similar surnames to the ones already part of the local pool. Therefore, it is reasonable to conclude that this population mobility, with people moving to the doctrine's area from the (currently) Bolivian Altiplano, was an expression of traditional mobility as per Murra's (1975) 'vertical archipelago' model. Colonial conditions might have given renewed impulse to this ancestral mobility pattern, driving people to leave their hometowns and settle in places with lighter tax burdens. Thus, this migrating population categorized as 'foreign' in colonial records were populations from a macro-zone connected by traditional mobility circuits. Another noteworthy aspect of this process was the relative homogeneity among surnames in the local and immigrant individuals.

In conclusion, consanguinity values by random isonymy (F_{ST}) suggest that intra-population kinship was relatively constant through time (1750–1813) in the study population. For instance, both ν (recent immigration) and α (surname diversity) displayed high stability among the population. Moreover, certain aspects of this analysis, such as indicator B (the seven most frequent surnames) and population mobility (which was constant) indicated high sedentariness throughout the entire analysed period. Together, these features are manifestations of a highly 'closed'

https://doi.org/10.1017/S0021932021000389 Published online by Cambridge University Press

community, in a social sense, where migrations occurred according to family or kinship networks enhanced by *compadrazgo* and matrimonial unions that did not bring new surnames into the local population.

The present study population structure and isonymic analysis indicate that the Doctrina de Belén was a partially closed, sedentary population with high consanguinity, low diversity of surnames and particular migratory movements. This structure did not change substantially between 1750 and 1813. Indeed, the results are consistent with ethno-historical and biodemographic studies that characterized the Doctrine of Belén as a stable, rural indigenous population within the colonial framework, including limited, mostly temporary, and culturally homogenous migration dynamics. Such features were frequent among many other populations of the Andean historical and geographic setting.

Funding. This research received no specific grant from any funding agency, commercial entity or not-for-profit organization.

Conflicts of Interest. The authors have no conflicts of interest to declare.

Ethical Approval. The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

References

Albeck ME, Alfaro EL, Dipierri JE and Chaves ER. (2017) Los apellidos en Salta origen, diversidad y frecuencia. *Revista Andes* **28** (2), 1–20.

Alfaro El (2010) Dinámica Antroponímica y Estructura Demogenética en Casabindo Siglos XVI al XXI. Doctoral dissertation, Univerdad Nacional de La Plata, Argentina. URL: http//sedici.unlp.edu.ar/handle/10915/5329. (accessed 17th June 2020).

Alfaro El, Dipierri JE, Albeck ME and Morales J (1998) Estructura genética por isonimia en poblaciones históricas de la Puna Jujeña. Paper presented at the *V Congress of the Latin American Association of Biological Anthropology, VI Symposium of Physical Anthropology "Luis Montané", La Habana, Cuba.*

Alfaro El, Dipierri JE, Albeck ME and Morales A (1999) Consanguinidad e identidad en el Casabindo colonial. Paper presented at the *IV National Conference on Biological Anthropology, San Salvador de Jujuy. Argentina.*

Barrai I, Formica G, Scapoli C, Beretta M, Volinia S, Barale R, Ambrosino P and Fontana F (1992) Microevolution in Ferrara isonymy 1890–1990. *Annals of Human Biology* **19**, 371–385.

Cavalli-Sforza LL and Bodmer WF (1981) *Genética de las Poblaciones Humanas.* Omega, Barcelona

Chacama J (2005) Patrón de asentamiento y uso del espacio. Precordillera de Arica, extremo norte de Chile, siglos X-XV. *Bulletin de l'Institut Français d' Etudes Andines* **34**(3), 357–378.

Chacama J (2009) De aldeas nativas a poblados coloniales. Dinámicas en el uso del espacio en la precordillera de Arica, Norte de Chile siglos X–XVIII. In Chiavazza H and Ceruti N (eds) *Arqueología de ciudades americanas del siglo XVI*, 101–124. UNCuyo, Mendoza.

Costa Junqueira M, Martínez-Campos M, Dipierri J, Bejarano I and Alfaro EL (2000) Evolución de la consanguinidad y parentesco por isonímia en La Puna de Atacama. *Revista Española de Antropología Biológica* **21**, 21–28.

Crow J and Mange A (1965) Measurements of inbreeding from the frequency of marriages between persons of the same surnames. *Eugenics Quarterly* **12**, 190–203.

Dagnino V (2016) *El Corregimiento de Arica 1535–1784*. Ruz Zagal R and Pizarro Pizarro E (eds). Ediciones Universidad de Tarapacá, Arica.

Darwin G (1875) Marriages between first cousins in England and their effects. *Journal of the Statistical Society* **38**, 153–184.

Dipierri JE (2004) Apellidos del Noroeste Argentino Distribución, Isonimia, Estructura y Dinámica Poblacional. Master's dissertation, Universidad Nacional de Jujuy, Argentina.

Dipierri JE, Alfaro EL, Cháves ER, Albeck ME and Rodríguez A (2015) Consaguinidad por insonimia en poblaciones Aymaras Bolivianas. In Montero P *et al.* (eds) *Poblaciones Humanas, Genética, Ambiente y Alimentación.* UAM-Sociedad Española de Antropología Fisica, pp. 311–324.

Dipierri JE, Ocampo S and Russo A (1991) An estimation of inbreeding from isonymy in the historical (1734–1810) population of Quebrada de Humahuaca. *Journal of Biosocial Science* **23**(1), 23–31.

Erdman L (1964) Patronimia del Noroeste Argentino. *Revista del Instituto de Antropología* **3**, 121.

Fisher R, Corbet S and Williams C (1943) The relation between the number of species and the number of individuals in a random sample of an animal population. *Journal of Animal Ecology* **12**(1), 42–58.

Fuster V (2003) Los estudios sobre consanguinidad en España una revisión. In Malgosa Morera A, Nogués RM and Aluja MP (eds) *Antropología y Biodiversidad.* Ediciones Bellaterra, Spain, pp. 272–279.

Fuster V (2005) Biodemografía. In Rebato E, Susanne C and Chiarelli B (eds) *Para comprender La Antropología Biológica. Evolución y Biología Humana*. Editorial Verbo Divino, Navarra, Spain.

Haggett P and Ferrer RM (1994) *Geografía una Síntesis Moderna*. Ediciones Omega, Barcelona.

Hidalgo J (1978) Revisita a los Altos de Arica Efectuada por el Oficial Real Don Joaquín de Cárdenas 1750. *Chungara, Revista de Antropología Chilena* **36**(1), 103.204.

Hidalgo J (1986) Indian Society in Arica, Tarapacá and Atacama, 1750–1793, and its response to the rebellion of Tupac Amaru. Doctoral dissertation, University of London.

Hidalgo J (1987) Tierras, exacciones fiscales y mercado en las sociedades de Arica, Tarapacá y Atacama, 1750–1790. In Harris O, Larson B and Tandeter E (eds) *La participación indígena en los Mercados Surandinos. Estrategias y reproducción social. Siglos XVI a XX*. Centro de Estudios de la Realidad Económica y Social (CERES), La Paz, pp. 193–231.

Hidalgo J, Arévalo P, Marsilli M and Santoro C (1988) Padrón de la Doctrina de Belén en 1813: Un caso de complementariedad tardía. *Documento de Trabajo* **4**, 9–122.

Hidalgo J, Castro N and González S (2004) La Revisita de Codpa (Altos de Arica) de 1772–73 efectuada por el corregidor Demetrio Egan. *Chungara* **36**(1), 103–204.

Hidalgo J and Durston A (2004) Reconstitución étnica colonial en la sierra de Arica El cacicazgo de Codpa, 1650–1780. In Hidalgo J (ed) *Historia Andina en Chile*. Editorial Universitaria, Santiago, pp. 507–534.

Hidalgo J, Farías A, Guzmán L and Arévalo P (2004) La mita de Azapa, 1680–1752 Un nuevo caso de mita local. In Hidalgo J (ed) *Historia Andina en Chile*. Editorial Universitaria, Santiago, pp. 627–642.

Hidalgo J and Focacci G (2004) Multietnicidad en Arica, siglo XVI. Evidencias etnohistóricas y arqueológicas. In Hidalgo J (ed) *Historia Andina en Chile*. Editorial Universitaria, Santiago, pp. 417–430.

Hidalgo J and Inostroza X (2019) Dinámicas demográficas de población indígena. Originarios y forasteros en Arica y Tarapacá (1750–1813). *Revista Chilena de Antropología* **40**, 255–270.

Inostroza X (2016) Familias y ayllus alianzas, riqueza y prestigio. Belén 1787 (Altos de Arica). *Surandino Monográfico* **1**, 6–23.

Inostroza X (2017) Familia y vida cotidiana en poblados indígenas rurales. Cacicazgo de Codpa (1774–1820). *MERIDIONAL Revista Chilena de Estudios Latinoamericanos* **8**, 873–896.

Inostroza X (2019) *Parroquia de Belén. Población, familia y comunidad de una doctrina aimara. Altos de Arica 1763–1820*. Ediciones Biblioteca Nacional, Santiago.

Inostroza X and Hidalgo J (2015) Parroquia de Belén familias, archivos, memorias. *Diálogo Andino* **46**, 95–105.

Karlin S and McGregor J (1967) The number of mutant forms maintained in a population. *Proceedings of the Fifth Berkeley Symposium on Mathematics, Statistic and Probability* **4**, 415–438.

Lasker G (1980) Surnames in the study of human biology. *American Anthropologist* **82**, 525–538.

Lasker G (1985) *Surnames and Genetic Structure. Cambridge Studies in Biological Anthropology*, Cambridge University Press.

Lorandi AM (1997) *El Tucumán Colonial y Charcas*. Universidad de Buenos Aires, Facultad de Filosofía y Letras, Buenos Aires.

MacRaild D and Smith M (2009) The origins of the Irish in northern England: an isonymic analysis of data from the 1881 Census. *Journal of Immigrants & Minorities Historical Studies in Ethnicity, Migration and Diaspora.* **27**(2–3), 152–177.

Marsilli M and Hidalgo J (1992) Hacienda y comunidades andinas en los valles costeros del norte de Chile siglos XVIII y XIX. In Orellana M and Muños J (eds) *Comunidades indígenas y su entorno*. Universidad de Santiago de Chile, Santiago, pp. 67–91

Murra J (1975) El control vertical de un máximo de pisos ecológicos en la economía de las sociedades andinas. In Murra J (ed) *Formaciones económicas y políticas del mundo andino*. Instituto de Estudios Peruanos, Lima, pp. 59–116.

Peña Aguilera DC (2016) Apellidos y estructura poblacional en Cochinoca (Puna de Jujuy) entre los siglos XVII y XXI. Degree dissertation, Universidad Nacional de Jujuy, Argentina.

Piazza A, Rendine N, Zei G Moroni A and Cavalli-Sforza L (1987) Migration rate of human populations from surname distributions. *Nature* **329**, 714–716.

Pollitzer W, Smith M and Williams W (1988) A study of isonymic relationships in Fylingdales Parish from marriage records from 1654 through 1916. *Human Biology* **60**(3), 363–382.

Rawling C (1973) A study of isonymy. In Roberts D and Sunderland E (eds) *Genetic Variation in Britain*. Taylor & Francis, London.

Relethford JH (1988) Comparison of observed and expected levels of genetic diversity based on surname frequencies: an example from historical Massachusetts. *American Journal of Physical Anthropology* **163**(1). 200–204.

Roberts D and Rawling C (1974) Secular trends in genetic structure an isonymic analysis of Northumberland parish records. *Annals of Human Biology* **1**(4), 393–410.

Rodríguez-Larralde A (1990) Distribución de los apellidos y su uso en la estimación de aislamiento y sedentarismo en los municipios del estado Lara, Venezuela. *Acta Científica Venezolana* **41**, 163–170.

Rodríguez-Larralde A and Barrai I (1997) Estructura genética por isonimia de los Estados Anzoátegui y Trujillo, Venezuela. *Revista Española de Antropología Biológica* **18**, 39–56.

Rodríguez-Larralde A and Barrai I (1998) Estudio genético demográfico del Estado Zulia, Venezuela, a través de isonimia. *Acta Científica Venezolana* **49**, 134–143.

Rodríguez-Larralde A and Casique J (1993) Estructura genético demográfica del estado Aragua, Venezuela, estimada a través de apellidos. *Acta Científica Venezolana* **44**, 224–232.

Sánchez Albornoz N (1974) La dénomination des personnes en Amérique espagnole. In Henry L (ed.) *Noms et prénoms. Aperçu historique sur la dénomination des personnes en divers pays*. Ordina, Dolhain, pp. 15–20.

Sánchez R (2009) Las nuevas regiones de Arica y Parinacota y de Los Ríos, Chile. Algunos antecedentes sobre su estructura y funcionamiento. *Revista Geográfica Venezolana* **50**(1), 87–107.

Santoro C, Hidalgo J and Osorio A (1987) El Estado Inka y los grupos étnicos en el sistema de riego de Socoroma. *Chungará* **19**, 71–92.

Subsecretaría de Desarrollo Regional y Administrativo (SUBDERE) (1999) *Integración de Territorios Aislados. Diagnóstico y Propuestas. Subsecretaría de Desarrollo Regional y Administrativo*. Santiago de Chile.

Wright S (1951) The genetical structure of populations. *Annals of Eugenics* **15**, 323–354.

Yasuda N and Furusho T (1971) Random and non-random inbreeding revealed from isonymy study. I. Small cities in Japan. *American Journal of Human Genetics* **23**, 303–316.

Zei G, Guglielmino R, Siri E, Moroni A and Cavalli-Sforza L (1983) Surnames in Sardinia. I. Frequency distribution for neutral alleles and genetic population structure. *Annals of Human Genetics* **47**, 329–352.

Cite this article: Alfaro E, Inostroza X, Dipierri JE, Peña Aguilera D, Hidalgo J, and Albeck ME (2022). Surnames and population structure in the Doctrine of Belén, Altos de Arica, Viceroyalty of Peru (1750–1813). *Journal of Biosocial Science* **54**, 545–557. https://doi.org/10.1017/S0021932021000389