

Geographic patterns of population longevity and reproductive longevity in Sardinia

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Introduction

In Europe, the highest frequency of centenarians has been observed among the Sardinian population: their numbers are remarkably higher than elsewhere (Poulain 2004, Caselli et al, 2005). This finding has been associated with the geographic and historical conditions of isolation and strong cultural traditions that largely determined the genetic structure, and epidemiological and demographic features of the area. Genetic studies (Deiana et al. 1999) have suggested a connection between the large number of centenarians and genetic markers that protect against ageing in Sardinia. From a demographic point of view, in the past the island was characterized by a scenario of traditionally advanced age at marriage and at reproduction for both parents.

Throughout the developed world the trend towards delaying maternity and paternity is well established, leading to an increase in high-risk pregnancies. Ageing of both parents at childbearing has been reported to be a risk factor for infertility or sub-fertility, miscarriage, pregnancy complications and adverse reproductive outcomes (Astolfi et al, 2004; Astolfi et al, 2005a; Astolfi et al 2005b).

As for longevity, Sardinia is an isolated example in Italy with regard to reproductive history. Women are older on average at delivery, yet the risk at birth is reduced with respect to the rest of the country (Astolfi et al, 2002; Astolfi et al, 2005c). It is under investigation whether the geographic variation observed in human longevity is similar to that regarding fertility at advanced age. It is hypothesized that the geography of these phenomena is shaped by a series of common factors: demo-socio-economic factors on the one hand, and genetic characteristic on the other.

Theoretical focus

Our purpose is to verify whether the genetic systems resulting in longevity in Sardinia also help to reduce the risk at birth in aged parents through reduced susceptibility to age associated diseases.

In Sardinia the genetic and environmental conditions favourable to an extended lifespan, along with the tradition of high endogamy, late marriage and reproduction, might represent a favourable scenario for a reduced risk of childbearing at advanced age. Longevity in reproduction is investigated by comparing Sardinia, where parents are hypothesized to be protected against the adverse affects of childbearing at advanced age, and the overall country, where the risk linked to late childbearing has been proved.

The ability of childbearing in late reproductive age and the reduced impact of ageing on the baby survival and health might be markers for slow ageing and an extended life span.

Our aim is to compare geographical longevity and late fertility maps and to investigate possible common determinants for population longevity and reproduction longevity.

Data and research methods

Mortality data are available for each geographical level (by municipality, province and region), by single age and calendar year since 1975. Complete life tables were constructed up to the age of 99 years, for the four Sardinian provinces for 1975-77, 1978-80, 1981-83, 1984-86, 1987-89, 1990-92, 1993-95 and 1996-97, 1998-2000. Regarding the 377 municipalities reference is made to standardised rates (SMR for over 80-year olds) for 1981-89 and 1990-1994. Mortality by cause refers to deaths for 1975 to 2000.

Methodology regards how life tables were constructed, with a particular focus on mortality probabilities for the oldest old (estimated by the Kannisto variant logistic function, KVLf), on the mortality and survival indicators used in the analysis and spatial analysis methods used to define homogenous geographic areas for mortality among the oldest old (Kernel method).

To study the differences in the impact of late reproduction between Sardinia and the rest of the country total 1990-98 Italian birth records (4.8 million) were used, assuming stillbirth, very preterm (<32 weeks of gestation) birth and very low weight (<1.5 Kg) at birth, as indicative of an adverse pregnancy outcome. Data are from the Italian Institute of Statistics.

The impact of parental ageing is evaluated after classification of maternal and parental age into three (20-29, 30-34 and ≥ 35 years) and four age classes (20-29, 30-34, 35-39, ≥ 40) respectively. Analyses were carried out using logistic regression models with the adverse pregnancy outcomes, as response variables, and the couple's education and childbirth order, as covariates. The class of 20-29 years for maternal and parental age is taken as reference for the relative risk estimate.

Preliminary results and expected findings

Population longevity

The underlying reasons for the high number of centenarians in Sardinia have been recently reported as part of an international research on the bio-demographic features of Sardinian centenarians (Caselli et al., 2005). This research located an inland area, more or less equivalent to the province of Nuoro, with a remarkably high number of centenarians (Poulain et al., 2004).

Biologists and geneticists agree that municipalities in Nuoro with the largest number of centenarians are those where low mortality after 80 years is due to a relatively low mortality for cardiovascular diseases, and particularly non ischemic diseases, and for certain cancers. Equally important is that elderly mortality for cardiovascular diseases is lower in Sardinia than in the rest of Italy (Caselli et al., 2005).

Reproductive longevity

In Sardinia aged parents seem to enjoy a selective advantage, here stressed by a reduced risk in reproduction at advanced age: with respect to young (<30 years) parents, mothers ≥ 35 years and fathers ≥ 40 run a decreased risk of stillbirth (Sardinia OR=1.6 vs rest of Italy OR=1.9), of very preterm birth (Sardinia OR=1.8 vs rest of Italy OR=2.7), and of very low birthweight (Sardinia OR=1.7 vs rest of Italy OR=2.6).

Discussion and speculation will be made in this section on the results obtained, with reference to the initial hypotheses that bio-demographic determinants, along with socio-demographic, epidemiological and genetic factors, as well as cultural conditions interacted and determined a selective pressure toward similar geographical patterns of population longevity and reproductive longevity.

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