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Genealogy of centenarians and their relatives: A study of 12 families

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Abstract

The longevity is a complex phenomenon in which specific genetic properties seem to play a role. The present study intended to reconstruct the genealogical tree of 12 subjects, being residents of one Northern and one Southern province of Italy, in order to establish the longevity of the ancestors. Detailed studies have been performed in the registry offices and the historic archives. The research method started from the identification of the centenarians on the basis of the documentation of the relevant birth document, it was continued by identifying the documents of birth, marriages and death of the parents of the centenarians. This way we proceeded systematically backwards in time. In addition, we verified the medium life span of the Italian population in the given periods of time, when the centenarians and their ascending lines had lived. These results offer clear historic-statistical evidences for the genetic basis of longevity.

Keywords

Genealogical tree of centenarians; Medium life span of the Italian population; Genetic basis of longevity

1. Introduction

One of the most important phenomena, especially in the industrialized countries, is the increase of the medium life span and a consequent aging of the population (Gavrilov and Heuveline, 2003). The increased longevity is related with complex phenomena, which may be listed as follows:

- i. Decrease of the negative environmental factors, such as the bad hygienic conditions, the infectious diseases, the undernutrition, bad socio-economical situations and increase of the positive environmental conditions (a better socio-sanitary assistance,

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better nutritional state, higher level of hygiene, decreased morbidities, etc.) (NRC, 2001).

- ii. Interventions on the genetic factors being responsible for pathological conditions, which would be able to reduce the human survival, such as familial hyperlipoproteinemia, thalassemia, genetic diseases, etc. (Balistreri et al., 2002).
- iii. Absence of genetic factors, which would be able to interfere with the development of various diseased states like diabetes, dementia, cardiopathies, etc. (Wienke et al., 2005).
- iv. The presence of several genes, which have an essential effect on the capacity to reach longevity (De Benedictis et al., 1999; Puca et al., 2001).
- v. Alterations of both the specific and natural properties of the immune system which have an impact on the higher incidence of infections, immune pathologies, several types of hemopathies, tumors and chronic inflammatory diseases, like atherosclerosis, Alzheimer disease and diabetes of type 2 (Pawelec et al., 2002).
- vi. Stochastic and occasional factors which are able to influence directly the life span (Perls et al., 2002).

Previous studies have described that the relatives of centenarians had a clearly longer survival than the general population (IMUSCE, 1995). Those studies document that the longevity is of familiar character, pointing out, however, to the fact that these declarations were made by the contemporary family members. In addition, it has not been clarified in those studies, to what extent the longevity is determined by the genetic factors, or by the environmental (Perls et al., 2002).

In the frame of our research on centenarians, we could identify 12 families in which we were able to identify with certainty the dates of birth and death backward up to the fourth generation, i.e., we could determine the effective length of their survival. These data were then compared with the medium survival of the general population in the periods when the studied subjects were living.

2. Case reports

Our studies involved a pool of 144 centenarians in two cities (Catania and Pavia) in South and North of Italy, respectively. These subjects were covered also by the IMUSCE (1995) studies, in which it was possible to conduct precise investigations of the historic archives and in the registry offices. The complex and detailed research allowed us to identify 12 centenarians (11 females and 1 male), subjects of our present studies, who had precise data on the survival of their antecedents up to the fourth generation (Table 1). At the same time, it was also possible to establish the medium life span of the general population in the periods in which the studied subjects were living.

3. Results

The safely identified subjects represented 95.8% the second generation (i.e., parents of 23 centenarians out of 24). They belonged in 91.7% to the third generation (i.e., grandparents of 44 centenarians out of 48), and in 53.1% to the fourth generations (grand-grandparents of 51 centenarians out of 96). As shown by Figs. 1 and 2, the medium life span of the second, third and fourth generations was 73.0, 69.5 and 60.9 years, respectively.

We have established the date of birth for all four generations in chronological decades. From this analysis, the first generation was born in the period of 1890–1900, when the expected

medium life span at birth was 42.6 years for males and 43.0 for the females, while the same parameter was 54.6 years for both sexes in the same decade, if excluding the early mortality up to 5 years of age (ISTAT, 1965).

Subjects of the second generation were born between 1860 and 1870. In this period, the medium life span expected at birth in Italy was 35.2 and 35.7 years for males and females, respectively (ISTAT, 1965; Golini, 1991), while after excluding the mortality up to 5 years of age, the life expectancy was 50.3 and 49.6 years for the males and females, respectively (ISTAT, 1965; Golini, 1991). The subjects of the third generation were born in the decade 1830–1840, those of the fourth generation born between 1800 and 1810, i.e., during the first half of the 19th century. The data preceding 1861 (the year of the first census in Italy) should be considered as approximate ones. For several European countries, data from the same period are more reliable, therefore, the life expectancy for Italy can be considered to be analogous with that of the other European countries (Livi Bacci, 1988). Thus, the life expectancy at birth for the third and fourth generations in Italy was taken as 35 and 30 years, respectively, while if detracting the mortality up to 5 years of age, this parameter can be considered certainly below 50 years (ISTAT, 1965).

4. Discussion

Based on these results, one can admit that the longevity may have a genetic-hereditary component. Otherwise, we could not explain the great difference observed between the medium life span of the antecedents of the centenarians and the contemporary life expectancy values, even if we detract the mortality of the early childhood. As a matter of fact, the life span of the second generation was 73.0 against the medium 35.0 years of the average population, i.e., was 108.6% longer, while the same differences were 98.6% (69.5 against 35.0 years) and 103.0% (60.9 against 30.0 years) in the third and fourth generations, respectively.

The possibility of the presence of a hereditary-familial component is supported also by the documentation regarding the brothers and sisters of the centenarians: we have observed on 1571 siblings referred to on the questionnaires, a medium life span of 70.7 ± 25.3 years, while the life expectancy for the general population born in the same period of our centenarians was only 42.8 years (Pawelec et al., 2002). All these facts confirm the possibility of the existence of genetic factors, being able to overcome the directly non-lethal environmental effects.

Therefore, we conclude that in centenarians there may exist some longevity-determining genetic factors, even if those have not been identified in all details.

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Fig. 1.
The genealogical tree of 12 centenarians: the medium life span of them and of their antecedents.

Fig. 2.

The genealogical tree of the most important family studied, having three centenarians: the numbers indicate the ages of family members at death.

Table 1

The basic data (age in years at death, and sex) of the antecedents of centenarians studied

Period of birth	Centenarian 1890–1900	Second generation 1860–1870	Third generation 1830–1840	Fourth generation 1800–1810
Pavia				
B.M.F.	101	94 F, 100 M	63 F, 80 M 61 F, 51 M	39 M 69 M 70 M
P.L.	101	43 M	77 M 91 M	45 M 88 F
P.L.	102	71 M, 76 F	77 M, 77 F 61 M, 76 F	64 M 46 M
M.R.N.	103	85 M, 85 F	71 M, 80 F	51 M, 64 F 56 M, 68 F
C.G. (alive 07.11.99)	105	76 M, 81 F	82 M, 81 F 84 M, 83 F	—
D.M.M. (alive 11.03.99)	103	93 M, 74 F	88 M, 84 F 79 M, 83 F	—
Catania				
S.A.	101	83 M, 83 F	90 M	—
V.D.	100	34 M, 46 F	53 M, 81 F 90 M, 75 F	88 M, 81 F 74 M
V.R.	100	72 M, 78 F	68 M	—
R.G.	101	75 M, 71 F	77 M, 42 F	81 M, 77 F 77 F
G.N.	103	67 M, 77 F	55 M, 76 F	—
S.G.	103	55 M, 60 F	80 M, 80 F 90 M, 90 F	—

M, male, F, female.