

# The Health effects of wine: The case of longevity in Sardinia

Graziella Benedetto<sup>1</sup> and Donatella Carboni<sup>2</sup>

<sup>1</sup>Department of Agriculture, University of Sassari, 07100 Via E. De Nicola 1, Italy

<sup>2</sup>Department of Humanities and Social Sciences, University of Sassari, 07100 Via Roma 151, Italy

**Abstract.** This work explores the relationship between nutrition and health: specifically, it focuses attention on the aspect of longevity. From this point of view, the analysis is deepened through a Case Study Analysis that takes the case of Sardinia (Italy) as a reference. The Island is a privileged observation point since, as amply demonstrated in the literature it is one of the five rural areas geographically identified and referred to as Blu Zone, in which there is a lifestyle and a common environment that “explain” the longevity of the populations that inhabit them. The reasons certainly include nutrition: specifically, we refer to the Mediterranean Diet which, as brought into vogue by Keys, represents a fundamental dietary model for ensuring a correct state of health. UNESCO in 2010 included it among the intangible assets of humanity, as a culture that has its roots in the peasant economy and has a unique dimension in the world. Our goal is to highlight the correspondence between the Blu Zone of Sardinia and the concentration of the production and consumption of wine both Cannonau (red wine), as evidenced mainly by the scientific literature, and Vermentino (white wine) which represents the emblem of the viticultural economy of Sardinia. It is considered of particular importance in this historical moment, to focus attention on the health aspects of wine that can help promote a conscious consumption and to an extent corresponding to adequate dietary models and also favor the enotourist development of areas in which the correlation “wine and health” is clear.

## 1 Introduction

The phenomenon of longevity has now assumed international relevance both in the scientific and popular literature (journalistic reports, television broadcasts, and within the YouTube social networks) and in the various reports and statistical analyzes. The scientific studies present in the international and national literature have aimed on the one hand to identify and characterize long-lived populations in the world, and on the other to research the reasons and/or the main factors related to longevity. The term “longevity” itself has in turn been defined according to different levels of depth and detail. This study is part of the panorama of international scientific literature with the aim of studying and deepening the link between longevity and nutrition and the lifestyle of long-lived/centennial people. This is still an exploratory study, which aims to collect the pieces of a “puzzle” (ie the scientific articles present at international level) also with the aid of cartography, aimed at preparing the basis for an investigation in the field, aimed to the places where the concentration of the centenarian and/or long-lived population is greatest, as reported by authoritative sources [1-4].

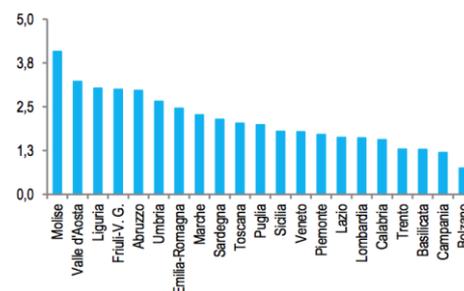
In fact, a first look at the statistical data published by Istat, which since 2008 has conducted a survey aimed at monitoring the resident population aged 105 and over, [5, 6] allows us to highlight that Italy, together with France, holds the record for the number of over-100-year-olds in Europe and the majority (about 90% as of January 1, 2021) as it is known is made up of women.

In the last ten years, after a steady growth until 2015, the superlongeva population has been reduced due to structural reasons according to Istat: the cohorts, less numerous than the previous ones, have entered this age group, as they are represented by those born in correspondence with the first conflict world. As a result

of the increase in the initial contingents of the cohorts born at the end of the first post-war period, a new growth of the longest-lived survivors is observed starting from 2020.

At the regional level in 2021, most centenarians reside in Northern Italy: among those over 105 years old, 284 reside in the North-West, 243 in the North-East, 225 in the Center, 238 in the South and 121 in the Islands.

The region with the highest incidence of centenarians is Molise (4.1 per 100 thousand) (Fig. 1), followed by Valle d'Aosta (3.2 per 100 thousand), Friuli Venezia Giulia, Liguria and Abruzzo (3 per 100 thousand) compared to a national average of 1.9 per 100 thousand.



**Figure 1.** Ratio between population aged 105 and + and total resident population, by region as of 1.1.2021 (Values per 100 thousand residents) (Source: Istat, 1 gennaio 2021).

More in-depth analyzes [1-3], using a specific indicator (ELI – Extreme Longevity Index<sup>1</sup>), have identified five geographic areas with high longevity internationally now known as “Blue Zones”: Loma Linda (USA, California), Nicoya (Costa Rica), Ikaria (Greece),

<sup>1</sup>ELI compares the number of centenarians born in a given place with the number of persons born in that place a century ago, wherever these centenarians are living. The main advantage is that it limits biases due to migration compared to the centenarian’s prevalence [3].

Okinawa (Japan) and Sardinia (Italy). In these areas, people reach the age of 100 at a rate 10 times higher than the United States average.

[4] have identified 9 evidence-based common denominators among the world's centenarians that are believed to slow this aging process.

**Move naturally.** The world's longest-lived people do not pump iron, run marathons, or join gyms. Instead, they live in environments that constantly nudge them into moving without thinking about it. They grow gardens and do not have mechanical conveniences for house and yard work.

**Purpose.** The Okinawans call it *Ikigai* and the Nicoyans call it *plan de vida*; for both, it translates to "why I wake up in the morning." Knowing your sense of purpose is worth up to 7 years of extra life expectancy.

**Downshift.** Even people in the Blue Zones experience stress. Stress leads to chronic inflammation, associated with every major age-related disease. What the world's longest-lived people have that others do not are routines to shed that stress. Okinawans take a few moments each day to remember their ancestors; Adventists pray; Ikarians take a nap; and Sardinians do happy hour.

**80% Rule.** *Hara hachi bu*—the Okinawan 2500-year old Confucian mantra said before meals reminds them to stop eating when their stomachs are 80% full. The 20% gap between not being hungry and feeling full could be the difference between losing weight or gaining it. People in the Blue Zones eat their smallest meal in the late afternoon or early evening, and then, they do not eat any more the rest of the day.

**Plant slant.** Beans, including fava, black, soy, and lentils, are the cornerstone of most centenarian diets. Meat—mostly pork—is eaten on average only 5 times per month. Serving sizes are 3 to 4 oz, about the size of a deck of cards.

**Wine @ 5.** People in all Blue Zones (except Adventists) drink alcohol moderately and regularly. Moderate drinkers outlive nondrinkers. The trick is to drink 1 to 2 glasses per day (preferably Sardinian Cannonau wine), with friends and/or with food. And no, you cannot save up all week and have 14 drinks on Saturday.

**Belong.** All but 5 of the 263 centenarians interviewed belonged to some faith-based community. Denomination does not seem to matter. Research shows that attending faith-based services 4 times per month will add 4 to 14 years of life expectancy.

**Loved ones first.** Successful centenarians in the Blue Zones put their families first. This means keeping aging parents and grandparents nearby or in the home (it lowers disease and mortality rates of children in the home too.). They commit to a life partner (which can add up to 3 years of life expectancy) and invest in their children with time and love. (They'll be more likely to care for aging parents when the time comes.)

**Right tribe.** The world's longest lived people chose—or were born into—social circles that supported healthy behaviors, Okinawans created *moais*—groups of 5 friends that committed to each other for life. Research

from the Framingham Studies<sup>2</sup> shows that smoking, obesity, happiness, and even loneliness are contagious. So the social networks of long-lived people have favorably shaped their health behaviors." [4, pp. 318-319].

In addition to [2], who remains the main international reference, numerous other scientific articles are focused on the study of the correlation between longevity and nutrition [2, 3, 7, 8].

Our analysis aims to gather information on the relationship between longevity and wine consumption using Sardinia as a case study. The latter was indicated by [4] as "the home to the world's longest-lived men" (p. 319). We are well aware that a single element does not alone explain the phenomenon of longevity, because it is certainly, as has already been shown in the literature, a mix of factors that together produce people's resilience.

However, we want to investigate the studies carried out that have highlighted this aspect, and then proceed in a subsequent *step* of the research to carry out field surveys and direct interviews to the population of centenarians of Sardinia.

## 2 Methodology

This is a survey of the scientific literature and available data aimed at cartographically representing the distribution of the long-lived/centenarians of Sardinia distributed over the regional territory, first calculating the geographical location by municipalities and then the rate of incidence on the single municipal population. At the same time we collected material on the distribution of vineyard areas, with particular reference to the two most important cultivars in the panorama of regional viticulture used for the production of Cannonau wine (red wine) and Vermentino wine (white wine). As far as wine consumption is concerned, we did not find data on wine consumption at the municipal level, but only for large aggregates and for large centers. While we have as a reference a study developed in the 40s that can be taken as a reference and that we want to reproduce and update in perspective. An objective of the study, in fact, is to detect the consumption of wine among the population of centenarians of Sardinia, and of the blue areas, with the aim of also verifying the type and quantity of wine consumed.

As regards the identification of the long-lived population, reference was made to Eurostat data of 2022 on life expectancy in 2021: the general data indicates an age of 83 (81 for men and 85 for women).

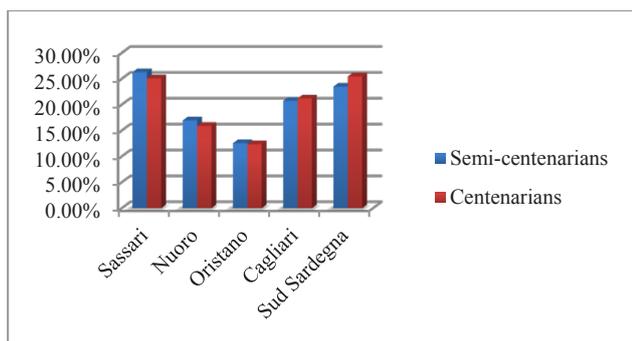
For this reason, in the search for analytical data on the state of longevity in Sardinia, and by municipality, it was chosen to use the lower limit of 95 years as a starting point for identifying semi-centenarians. We then worked out the distribution of semi-centenarians on the regional territory and then calculated the incidence of super-long-lived and centenarians (100 years and older) on the total resident population per municipality.

The results of the various processing and data collection are reported and discussed below.

### 3 Results and Discussion

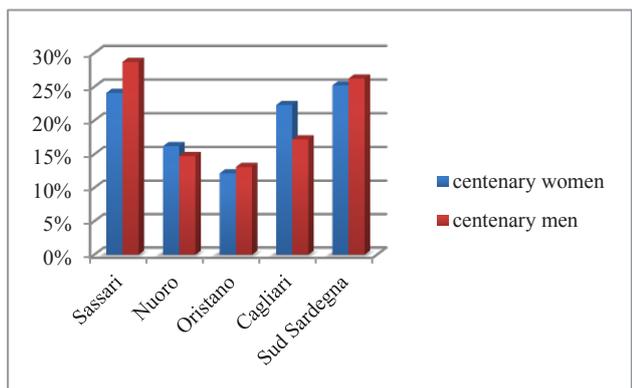
#### 3.1 Distribution of long-lived and centenarians in Sardinia

In this work we distinguish the centenarians (those who have reached the age of 100 years and +) from the long-lived semi-centenarians, i.e. those who have well exceeded the average of 83 years as a life expectancy indicated by Eurostat [9], and who represent the class of age starting from 95 to 100 years and +. The analysis of geographical location, for this class of population, was carried out using Istat data [10] and photographing the situation in 2021, municipality by municipality and then by province and regionally.



**Figure 2.** Incidence of centenarians and semi-centenarians by province compared to the same regional data (our elaboration on Istat data, January 1, 2021).

As you can see, the centenarians are distributed throughout the region, with a greater location in the provinces of Sassari and South Sardinia. Considering gender, there is a deviation from the national average (90%) because women represent 78% of the total centenarian population of Sardinia and males the remaining 22%, with a ratio of approximately 4:1.

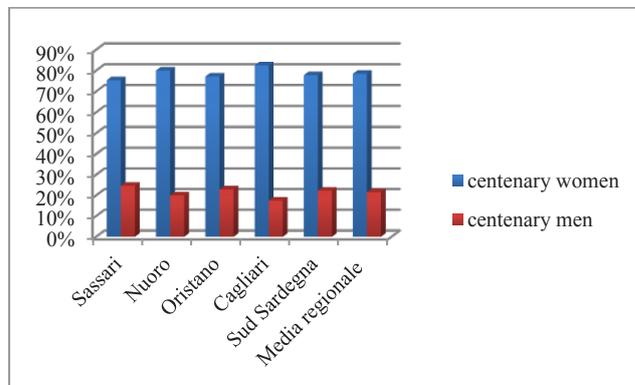


**Figure 3.** Incidence of centenarians by gender and by province on the same data regional (our elaboration on Istat data, 1 January 2021).

Figure 3 highlights the gender distribution of centenarians by province: the greatest localization of male centenarians is recorded in the provinces of Sassari and South Sardinia, followed by the provinces of Cagliari and Nuoro where the proportions are reversed.

By calculating the incidence of the centenarian population divided between females and males in the

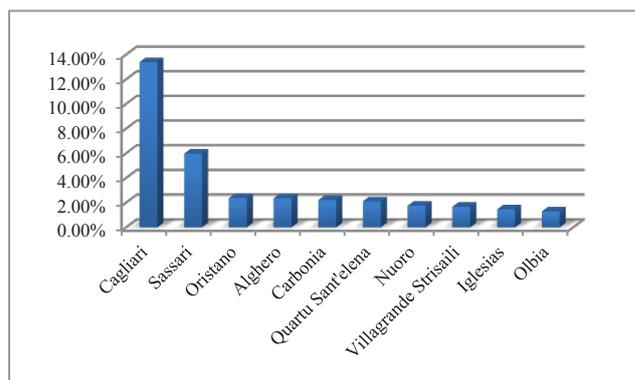
province (Fig. 4), a different composition is observed with respect to the regional average: in the provinces of Nuoro and Cagliari the incidence of centenarian women is higher than the regional average (80% and 83% respectively); in Sassari it is lower (75%) while the other two provinces are in line with the regional figure (78%).



**Figure 4.** Incidence of centenarians by gender compared to the total of centenarians in the province (our elaboration on Istat data, as of January 1, 2021).

Still processing the Istat 2021 data [10], we calculated the distribution and location of semi-centenarians and centenarians within the 377 municipalities into which Sardinia is divided (92 in the province of Sassari, 74 in the province of Nuoro, 87 in the province of Oristano, 17 in the province of Cagliari and 107 in the province of South Sardinia).

Figure 5 shows the municipalities with the highest incidence of semi-centenarians: these are municipalities that have a very variable population size and pass through urban centers, such as Cagliari and Sassari, with a number of inhabitants varying between 120 thousand and 150 thousand, and urban centers like Quartu Sant'Elena and Olbia (over 68 thousand and 60 thousand inhabitants) up to villages like Villagrande Strisaili which has about 3 thousand inhabitants.

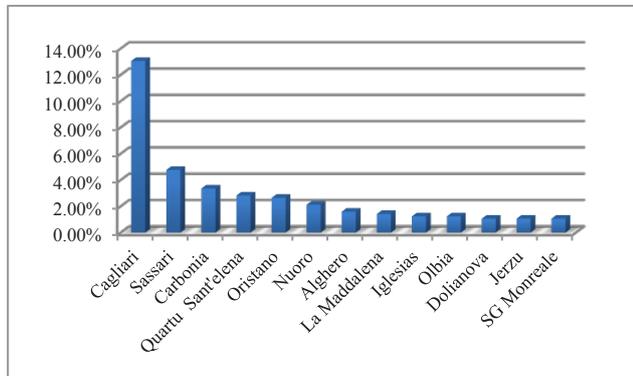


**Figure 5.** Incidence of semi-centenarians per municipality compared to the total of semi-centenarians in Sardinia (our elaboration on Istat data, as of 1 January 2021).

Villagrande Strisaili is one of the most attentive and mentioned centers in the literature as regards the concentration of long-lived (semi-centenarians for us) in Sardinia [1, 2]. If we normalize the population with respect to the number of inhabitants (3000 by 2021)

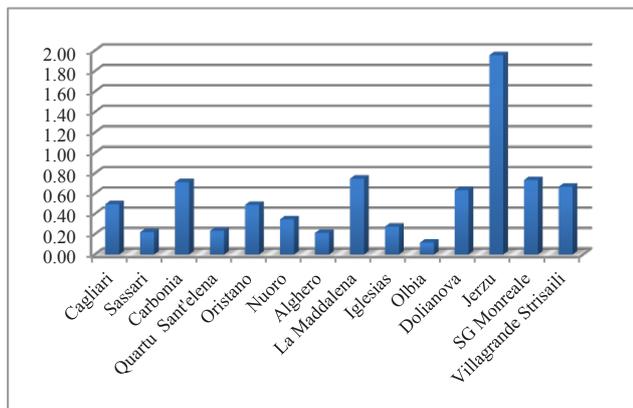
of Villagrande Strisaili, we note that there is a surprising gap between the number of long-lived (80 by 2021) and those present in the other municipalities: Cagliari 13, Sassari 7, Oristano 11, Alghero 8, Carbonia 12, Quartu Sant'Elena 4, Nuoro 7, Iglesias 8, and Olbia 3.

If we consider the distribution of centenarians (100 years and +) in Sardinia, the list of municipalities at the top of the ranking changes partially (Fig. 6).



**Figure 6.** Incidence of centenarians by municipality compared to the total of centenarians in Sardinia (our elaboration on Istat data, as of January 1, 2021).

In addition to the municipalities listed in the previous graph, also: La Maddalena (with a population of 10722 inhabitants), Dolianova (with a population of 9473 inhabitants), Jerzu (with a population of 3069 inhabitants) and San Gavino Monreale (with a population of 8189 inhabitants) rank among the municipalities with the highest number of centenarians.

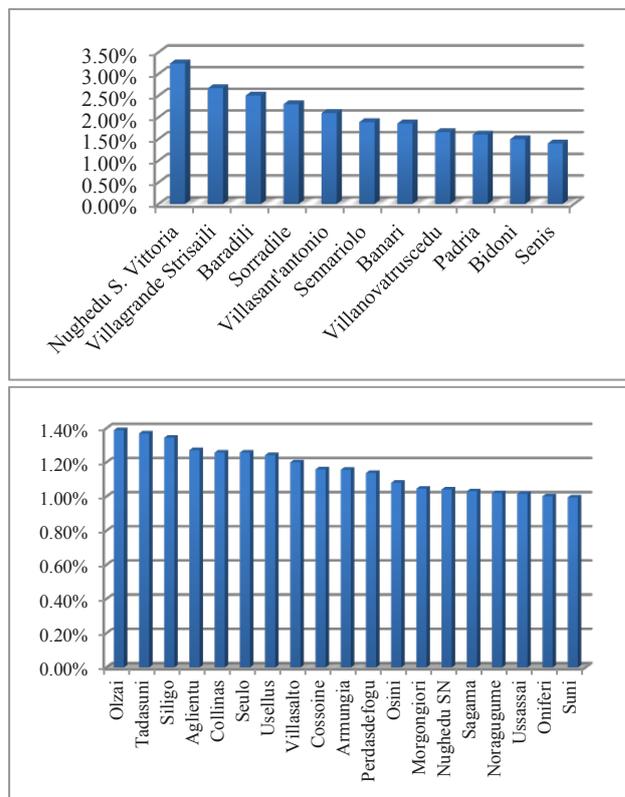


**Figure 7.** Number of centenarians per municipality and per 1000 inhabitants in reference to Fig. 6 (our elaborations on Istat data, as of January 1, 2021).

Calculating the data per 1,000 inhabitants (Fig. 7), within which we have also included the municipality of Villagrande Strisaili for comparison with the previous performance, it is observed that the longest-lived municipality is represented by Jerzu, with 1.96 centenarians/1000 inhabitants, followed by La Maddalena (0.75), San Gavino Monreale (0.73), Carbonia (0.71) and Villagrande Strisaili with 0.67 centenarians per 1000 inhabitants.

The result obtained from the analysis of the relationship between the number of semi-centenarians per municipality and the number of inhabitants per

municipality (Fig. 8) is interesting, because there are other municipalities that include a noteworthy concentration of semi-centenarians.



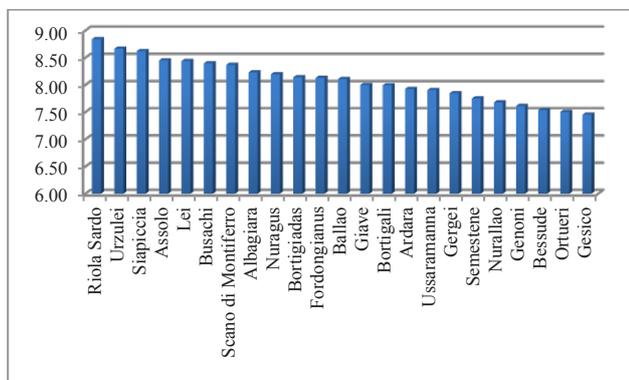
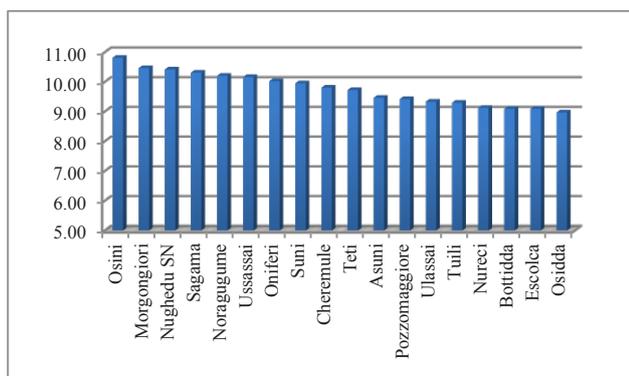
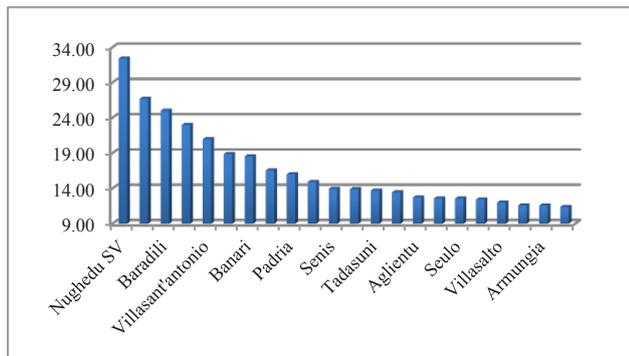
**Figure 8.** Incidence of semi-centenarians per municipality compared to the number of inhabitants per municipality (our elaboration on Istat data, as of January 1, 2021).

The semi-centenarians are distributed in the province of Oristano with 13 municipalities (Nughedu S.Vittoria, Baradili, Sorradile, Villa Sant'Antonio, Sennariolo, Villanovatrusedu, Bidoni, Senis, Tadasuni, Usellus, Morgongiori, Sagama, Suni), in the province of Nuoro with 7 municipalities (Villagrande Strisaili, Olzai, Perdasdefogu, Osini, Noragugume, Ussassai, Oniferi), in the province of Sassari with 6 municipalities (Banari, Padria, Siligo, Aglientu, Cossoine, Nughedu S. Nicolò) and in the province of Southern Sardinia with 4 municipalities (Collinas, Seulo, Villasalto and Armungia).

By calculating the number of semi-centenarians per 1,000 inhabitants (Fig. 9) we noted that the municipality of Nughedu Santa Vittoria (Oristano, 463 inhabitants) also maintains its position in the regional panorama with 32 long-lived per 1,000 inhabitants as well as when calculating the centenarians per 1,000 inhabitants occupying first place with 11 centenarians per 1,000 inhabitants.

The municipalities that include up to 11 semi-centenarians per 1,000 inhabitants are collected in the first part of the graph (a) and mainly belong to the province of Oristano with 11 municipalities (Nughedu S. Vittoria, Baradili, Sorradile, Villa Sant'Antonio, Sennariolo, Villanovatrusedu, Bidoni, Senis, Tadasuni, Usellus, Morgongiori and Sagama), to the province of Nuoro with 7 municipalities (Villagrande Strisaili, Olzai,

Perdasdefogu, Osini, Noragugume, Ussassai and Oniferi), to the province of Sassari with 6 municipalities (Padria, Siligo, Aglientu, Cossoine, Nughedu S. Nicolo) and to the southern Sardinia province with 3 municipalities (Collinas, Seulo and Villasalto).



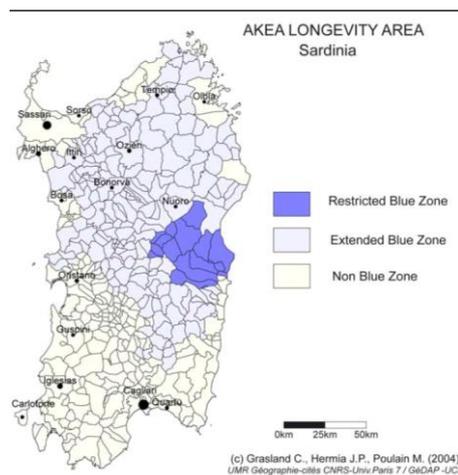
**Figure 9.** (a, b, c) - Number of semi-centenarians per municipality and per 1,000 inhabitants in Sardinia (our elaboration on Istat data, as of 1 January 2021).

The geographical location of the municipalities with the highest concentration of semi-centenarians in 2021 falls within the extended “Blue Zones” as identified by [1] (Fig. 10).

The hypothesis tested by [1] has shown, in fact, that through the ELI calculation the municipalities with a high and a low ELI were organized in clusters and that in the high ELI cluster all the municipalities with ELI higher than the average ELI for Sardinia were spatially adjacent to cover a specific territory, named “Blue Zones”.

According to our elaboration of 2021 only Villagrande Strisaili (Fig. 11), falls within the “Restricted Blue Zones” and some municipalities that fall within the “Extended Blue Zones” are relatively close to the

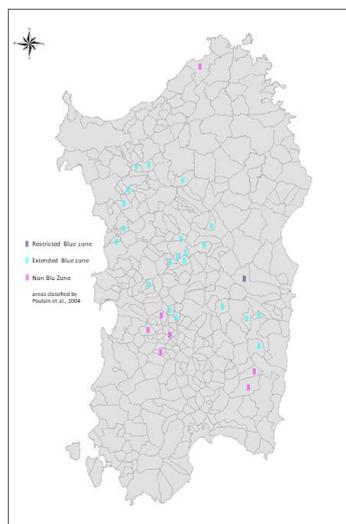
restricted areas such as Nughedu Santa Vittoria, Olzai, Seulo, Ussassai and Osini.



**Figure 10.** Cartographic representation of the “Blue areas” or “extended Blue areas” identified by calculating the ELI indicator (Source: [1], p. 1426).

Figure 11 highlights our results presented on the graph (Fig. 8 a and b) within the map of Sardinia: this is a very first elaboration that takes into account only the longest-lived municipalities of the island (from 32 to 11 semi-centenarians per 1,000 inhabitants and per municipality).

What we want to investigate now is how wine has been treated in the literature among the factors that contribute to “explain” longevity in Sardinia.



**Figure 11.** Cartographic representation of the municipalities with semi-centenarians per 1,000 inhabitants (our elaboration on Istat data, 1 January 2021) compared to the “blue zones” identified by [1].

### 3.2 Wine and longevity in Sardinia

As mentioned earlier, there are several contributions in recent literature aimed at investigating the factors of longevity. Scientific research shows that only 25% of longevity is explained by genetics while the remaining 75% is related to lifestyle and daily choices [2]. Nutrition

plays a fundamental role within the lifestyle. The Mediterranean Diet which, as brought into vogue by Keys, represents a fundamental dietary model for ensuring a correct state of health. UNESCO in 2010 included it among the intangible assets of humanity, as a culture that has its roots in the peasant economy and has a unique dimension in the world.

Nutrition in Sardinia, which is currently being studied for its effects on longevity, has always been closely linked to the lifestyle led by shepherds and farmers, the result of uninterrupted poverty, and is exceptionally summarized, “its frugality is extraordinary even for a Mediterranean country” [11 p. 282]. It is worth recalling what happened then (at the beginning of the last century), when these researches were published, to understand the current situation (studying the past to understand the present). *“Bread is by far the main food. The farmer leaves in the morning for the fields with a kilo of bread in his saddlebag. There are few villages where he takes a very strong coffee before going out. At noon his meal is made up solely of bread, with a side dish that is cheese only in the wealthiest families, while most of the workers are satisfied with an onion, a little fennel or a bunch of radishes. In the evening, the reunited family eats the only consistent meal of the day, made above all of a soup in which the richest put pasta. In the fields, few peasants drink wine; most drink it only at the evening meal, and at most a quarter”* [11 p. 282].

Although at present the economic conditions on the island have changed, the eating habits of the current centenarians or semi-centenarians are more or less the same. Numerous interviews, also found as a result of the media interest that the phenomenon of longevity of Sardinians has received internationally, show that the composition of the diet of centenarians has not substantially changed.

The role of wine remains a constant in daily consumption as revealed by interviews also released by centenarians who lived off the island [12].

Recent scientific literature [13-18] has highlighted the health properties of red wines especially with reference to moderate consumption: a beneficial measure known since the time of Hippocrates [16] and recognized in subsequent biochemical studies [19-23].

From the results of these studies, it emerges that wine has antioxidant and vasodilatory properties in the case of red wine (due to the ethanol content), which is also considered responsible for reducing the risk of cardiovascular diseases, increasing the level of high lipoproteins density (HDL) and decreasing that of low density lipoprotein (LDL); physiological and anti-inflammatory properties with chemopreventive health benefits associated with the presence of resveratrol were also found [24]; moreover it was found that the moderate consumption of wine augments the expression of the key genes associated with longevity, and no unwanted secondary effects were observed [17].

Several studies have taken into consideration the relationship between the properties of wine and its consumption and the longevity of the observed populations. [7] for example highlighted that the longevity of Sardinia as noted by [1] and that of the

populations of men (over 75 years) of the department of Gers (who assumed an unusual patterns compared to other areas in France where mortality due to coronary heart disease was very marked) in southeastern France was associated with the consumption of wines that had 2 or 4 fold more biological activity and oligomeric procyanidins (OPCs) than other wines. They argue that grape seeds are the main source of OPCs but poor solubility, combined with oenological and viticultural factors, influence the amount of OPCs in wine. And this concentration is due to the way wine is produced in these regions of France and ensures that high quantities of OPCs are extracted, which makes up a large proportion of grapes used to produce local wines in the Gers area but is rarely grown elsewhere.

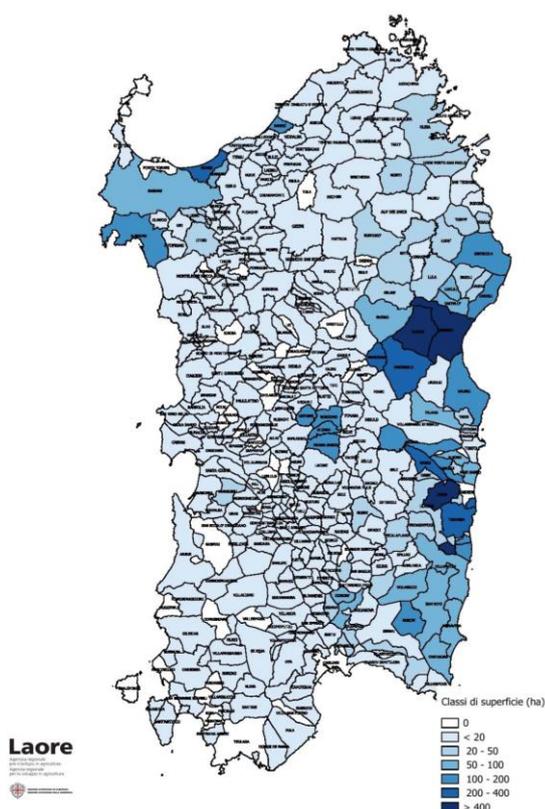
Already in the past [20] had highlighted the French paradox, according to which in the face of the consumption of foods with a high content of saturated fatty acids (e.g. cheeses, meats, sweets), the relative mortality index cardiovascular disease was lower than in other similar dietary countries, particularly the USA. This fact was associated with the constant and moderate consumption of red wine by the French population which, thanks to wines rich in antioxidant polyphenols, is thus protected from cardio-circulatory diseases.

And this would explain how the low incidence of cardiovascular disorders in France.

Cannonau is the first vine by area cultivated in Sardinia (over 27% of the regional vineyard area) equal to 7,385 Ha by 2020 [25], followed by the Vermentino vine with a total area of 4,850 Ha by 2020 (18% of the surface regional vineyard).

Compared to 2010, these percentages have slightly changed [26] but the cultivation of Cannonau remains concentrated in some specific areas (Fig. 12). As we have already commented on another occasion, Cannonau can certainly be considered as an expression of the local culture: this grape is cultivated practically everywhere in Sardinia, but there are areas with greater concentration specialized in the cultivation of this grape and the production of its relative wine represented by Oliena, Dorgali, Jerzu, Tertenia, Mamoiada, and in the minor areas (such as Gairo or Irgoli) where the Cannonau is more than the 97% of cultivated grapes. Even in some municipalities with very low wine-growing density (Gavoi, Loceri, Lotzorai, Olzai), the cultivation is clearly mono-varietal.

If we compare the areas with the highest concentration of surfaces in Cannonau and the areas with the highest concentration of semi-centenarians we observe that Oliena (592 hectares), Orgosolo and Mamoiada (239 and 251 hectares respectively), Arzana and Baunei (101 and 110 respectively) Talana (76 hectares) fall within the “BZ Restricted”; the other municipalities belonging to this cluster have smaller surface classes such as Lotzorai and Triei (between 20 and 50 hectares), while the other Fonni, Villagrande Strisaili, Seulo, Urzulei, Ovodda, Tiana all have an area of less than 20 hectares, as do most of the neighboring municipalities or close to and falling within the “BZ extended”.



**Figure 12.** Surface planted with Cannonau in 2020.

At first glance, the distribution and extension of the municipal area in Cannonau may not have any relationship with the location of the centenarians and the consumption of wine itself. However, a more in-depth analysis of the characteristics of the viticultural economy in these areas, and the role that viticulture has played in the development of these territories may suggest some thought.

The spatial concentration of Cannonau in the two homogeneous areas of Dorgali and Jerzu-Mandrolisai along the eastern ridge, separated by the Gulf of Orosei, is the direct consequence of the history and activity of local populations.

In this territory there are two important realities of the viticultural cooperation of Sardinia, the Cantine Sociali di Dorgali and Jerzu (the latter one of the oldest built in 1929), around which 220 members are currently gathered in the first case and 430 members in the according to. The certified production of Cannonau in Sardinia reached 67 thousand hectoliters in 2020 (about 6,000 in 1990) and comes mainly from the province of Nuoro as well as the bottled wine that exceeds 80 thousand hectoliters (as production of single cellars and cooperative cellars). However, the form of sale of bulk wine is still very widespread, as is the small production for family self-consumption represented in areas where the concentration of surfaces is much less than 20 hectares. In reality, the cultivation of vines has an ancient tradition in these areas: in fact, while the vine has always been a characterizing element of the structure of the villages, since the Roman era, in order to guarantee survival: a more or less wide band of closed vineyards around the village has remained so for a long time and in some cases up to the present

day. As [11] recalls, "there was no Sardinian village that did not have a few hectares of vines, producers of delicious wines or indefinable but always jealously cultivated wines" (p. 237). Even the village of Fonni, the highest in Sardinia (1000 m above sea level) had 5 hectares of vineyards. From a simple heritage of the village, the vine subsequently gave space to the cultivation of the vineyard (not before the last quarter of the 19th century, without completely erasing the old vines of the village, because "the Sardinian likes to drink the wine from the vineyard he owns" [11, p. 237]. But among the vineyards that have formed in Sardinia with patches of considerable importance there is precisely that of the Ogliastra hills, from Lanusei to Jerzu and a smaller one between Nuoro and Oliena: viticulture production in these areas therefore boasts an ancient age and tradition. The evolution of viticulture in the area has, as we have seen, subsequently given rise to a viticultural economy, aimed at the market and no longer subsistence, but the cultivation of the vine also remains in plots of numerous very small owners who have only a few tens of ares and who always produce for family self-consumption. In these areas the vine is rarely planted alone but is associated with 'Olive and almond trees and only in the Jerzu area do the vines form a single block without interruption (300 hectares).

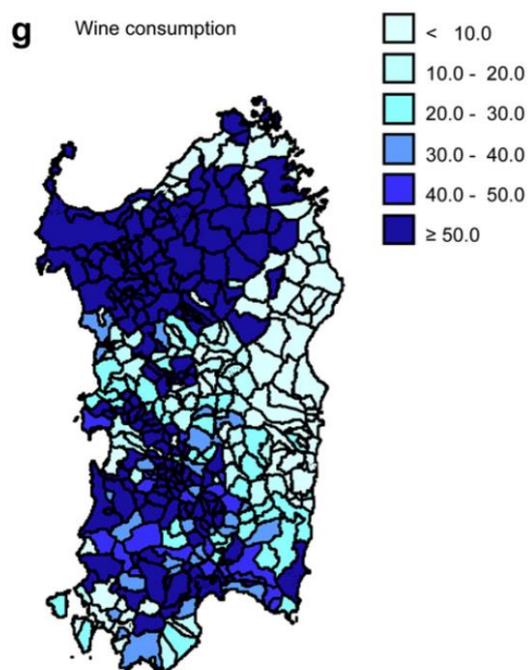
Therefore, the overlap between the cultivation dimension of Cannonau, production for family self-consumption and constant and moderate consumption of red wine is well associated with the location of the semi-centenarians in these areas.

On the other hand, it was not possible to estimate the per capita consumption of wine for each municipality because there are no data with this level of disaggregation. The available Istat data were collected for different purposes and aimed at measuring and controlling alcohol abuse and in any case do not allow us to get to the municipal detail but only for large aggregates and for the number of inhabitants over the age of 11.

In the literature [3] a work from 1932 [27] has been recalled which had detected, among other variables, the consumption of wine in liters per person and per year: the map reproduced using [27] data (Fig. 13) highlights that in the areas of our interest as regards the concentration of semi-centenarians, wine consumption is moderate and less than 10 liters per capita per year.

Regarding the consumption of wine mainly practiced in the plain villages of Sardinia, it is worth mentioning the practice of traditional small and distant transhumance, following which the saltus of Barbagia, an area of long-lived and centenarians, become depopulated; the flocks from the mountains go to spend the winter in the plain to escape the cold, while the animals of the plain stay there both in summer and in winter [11]. Following the guidelines of transhumance [11] it is observed that from Talana and Villagrande the flocks with small transhumance move towards the sea, towards Tortoli (east coast) where consumption is always moderate; from Arzana and Jerzu, they move with long transhumance towards the Quirra jump, where consumption becomes partly higher, from Seulo, in the same way with long

transhumance the flocks descend towards the plain of Cagliari, where consumption increases again; another route moves the flocks to the province of Oristano, in particular from Tiana and Fonni, for example, to Fordongianus and the plain of Oristano, on the west coast, where consumption is high. Therefore we can consider the fact that the consumption recorded in the lowland areas is not to be attributed only to the sedentary populations, but probably also to the transhumant populations.



**Figure 13.** Cartographic reproduction [3] of wine consumption by municipality as recorded by [28].

To set up the continuation of this research, a small sample survey was carried out on some semi-centenarians distributed throughout the region to detect wine consumption: it can be confirmed that wine consumption is still practiced in moderate quantities (1 or two glasses during main meals) and does not only concern Cannonau but also Vermentino.

Our goal will therefore be to proceed with the administration of a reasoned and complete questionnaire aimed at detecting eating habits, the composition of the diet, current and past, and the consumption of wine by type and quantity.

#### 4 Some concluding remarks

In light of this exploratory analysis on Sardinian longevity, and different localization areas of semi-centenarians (from 95 years and +), on the relationships studied in the literature between wine consumption and longevity, it is considered of particular interest not only to deepen the analysis geographical area of long-lived populations (updating the data in the literature), but also check and deepen nutritional factors studied [28, 29] and specifically the wine consumption of a representative

sample of semi-centenarians and centenarians distributed throughout the region by area, starting from the municipalities that have a number of centenarians and semi-centenarians per 1,000 inhabitants higher. In addition to the quantity, it seems interesting also the detection of the type of wine consumed.

#### References

1. M. Poulain, G.M. Pes, C. Grasland, C. Carru, L. Ferrucci, G. Baggio, et al, *Exp. Gerontol.* **39**, 1423 (2004)
2. D. Buettner, *Lezioni di lunga vita Le zone Blu, I segreti delle popolazioni ultracentenarie*, National Geographic (2008)
3. G.M. Pes, F. Tolu, M. Poulain, A. Errigo, S.Masala, A. Pietrobelli, N.C. Battistini, M. Maioli, *Nutr. Metab. Cardiovasc. Dis.* **23**, 212 (2011)
4. D. Buettner, S. Skemp, *Am. J. Lifestyle Med.* **10**, 318 (2016) doi: 10.1177/1559827616637066
5. Istat, Cent'anni e non sentirli, *indagineperiodica*
6. Istat, [https://www.istat.it/it/files//2022/06/STAT-TODAY\\_CENTENARI-2021.pdf](https://www.istat.it/it/files//2022/06/STAT-TODAY_CENTENARI-2021.pdf), (2022)
7. R. Corder, W. Mullen, N.Q. Khan, S.C. Marks, E.G. Wood, M.J. Carrier, A. Crozier, Red wine procyanidins and vascular health, *Nature* **444**, 566 (2006) ([www.nature.com/bca](http://www.nature.com/bca))
8. A. Nieddu, L. Vindas, A. Errigo, J. Vindas, G.M. Pes, M.P. Dore, *Nutrients* **12**, 1621 (2020)
9. [ec.europa.eu/Eurostat](http://ec.europa.eu/Eurostat)
10. [demo.istat.it](http://demo.istat.it) (popolazione residente anno 2021)
11. M. Le Lannou, *Pastori e contadini di Sardegna*, Ed. La Torre, 1941, prima edizione italiana Cagliari (1979)
12. <https://www.winebiowine.com/blog/l-elisir-lunga-vita-cannonau/>
13. L. Di Renzo, A. Carraro, R. Valente, L. Iacopino, C. Colica, A. De Lorenzo, *Oxidative Medicine and Cellular Longevity* **2014**, 1 (2014)
14. E. Pavlidou, M. Mantzourou, A. Fasoulas, C. Tryfonos, D. Petridis, C. Giaginis, *Diseases* **73**, 1 (2018)
15. L. Castaldo, A. Navarez, L. Izzo, G. Graziani, A. Gaspari, G. Di Minno, A. Ritieni, *Molecules* **24**, 3626 (2019)
16. J. Gambini, L. Gimeno-Mallench, G. Olaso-Gonzalez, A. Mastaloudis, M.G. Traber, D. Monleon, C. Borrás, J. Vina, *Antioxidant* **10**, 301 (2021)
17. J. Gambini, K. Stromsnes, *Red wine and longevity*, Science & Wine (2021)
18. R. Meccariello, S. D'Angelo, *Antioxidants* **10**, 507 (2021) doi: 10.3390/antiox10040507
19. R. Patay, G. Danon, *Bull. Acad. Natl. Med.* **146**, 62 (1962)
20. S. Renaud, M. de Lorgeril, *Lancet* **339**, 1523 (1992)
21. A. Lavyet al, *Ann. Nutr. Metab.* **38**, 287 (1994)
22. S. Gorelik, M. Ligumsky, R. Kohen, J. Kanner, *FASEB J.* **22**, 41 (2008)
23. S.R. Weaver, C. Rendeiro, H.M. McGettrick, A. Philp, S.J. Lucas, *Eur. J. Nutr.* **60**, 1 (2021)

24. D.K. Das, S. Mukherjee, D. Ray, *Heart Fail Rev.* **16**, 425 (2011)
25. Laore, *Rapporto di Analisi 2021, La Filieravitivinicola Scenario regionale*
26. G. Benedetto, D. Carboni, G.L. Corinto, *BIO Web of Conferences* **3**, 03011 (2014) <http://dx.doi.org/10.1051/bioconf/20140303011>
27. C. Fermi (eds) *Decadenza, risanamento e spesa. Tipografia*, vol. 1-3, Sardegna: Regioni malariche (1932)
28. G. Pes, M. Poulain, *La Longevità in Ogliastra. Un viaggio attraverso i geni, il cibo e l'ambiente*, in *Studi Ogliastrini* **13**(2017), 139-155
29. G.M. Pes, A. Errigo, *Fattori alimentari e longevità in Sardegna* (nd)