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Why are supercentenarians so frequently found in French Overseas Departments? The cases of Guadeloupe and Martinique

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Abstract

Many more cases of supercentenarians are observed in the French *Départements d'Outre-Mer* (DOM) than in metropolitan France. A first possible explanation is that the standard French protocol for validating age does not sufficiently cover DOMs. However, if additional checks can confirm the verity of this phenomenon, forming explanatory hypotheses can be relevant and quite interesting. Thanks to an INED research funding, a special protocol of deep age checking has been established to be applied to the two DOMs where the phenomenon is the most pronounced: Guadeloupe and Martinique. First results not only show that combining several additional checks does not leave much room for further doubting the ages of supercentenarians but they also support some arguments in favor of a possible fundamental explanation: genetic selection due to the extreme severity of mortality inflicted on their slave ancestors.

Introduction

For a couple of decades, demographic research is giving more and more attention to those people who live more than 110 years, the so-called supercentenarians. In the frame of the lasting debate between researchers, like Jay Olshansky, thinking that we are to the eve of reaching the limit of human life expectancy increase (Olshansky, Carnes Bruce, & Christine, 1990) and those, led by James Vaupel, believing that we must be much more optimistic about the possibilities of pushing far away that limit, if it exists (Vaupel James & Carey James, 1993; Vaupel James et al., 1998), it is crucial to get precise data about mortality and survival at very old age. One of the main issues for that controversy is to know more about the way mortality rates change at very old ages. According to the Gompertz law, all along adult ages, mortality increases with age exponentially (Gompertz, 1825). Some studies, however, opened the door to a certain inflexion of that law at very old ages. For a few researchers, not only the pace of mortality increase is slowing down at extreme ages, but also it could even reach a plateau (Barbi, Lagona, Marsili, Vaupel, & Wachter, 2018). The main question here is that is very difficult to measure mortality risks precisely at very old age. Not only so few people reach such ages that rates are less and less reliable but also the actual age of

very old people is often subject to over estimation which make uneasy to simply gather realistic data to give a solid basis of population estimates and death statistics to computes reliable death rates.

In the early 2000s, an international research group was founded by James Vaupel to collect solid sets of data about supercentenarians in a dozen of countries with high-quality vital statistics, including Belgium, France, Italy, Nordic countries, Quebec, the UK, and the USA. A first book has been published in 2010 to present the data gathered on people surviving or dying at ages over 110 and the subsequent International Database on Longevity (IDL, <https://www.supercentenarians.org/>) as well as first analyses by countries and, over all, a first analysis of all data pooled internationally (Maier, Jutta, Jeune, Robine, & Vaupel, 2010). The idea was that pooling national statistics would be easier to reach significant results. This first step ends with not only quite interesting findings but also with the main conclusion that it was necessary to continue gathering more and more data on supercentenarians to get definitive results.

Ten years later, a second international monograph on supercentenarians is forthcoming (Maier, Jeune, Robine, & Vaupel, 2020). The chapter specifically devoted to France in this book (Ouellette, Meslé, Vallin, & Robine, 2020) is based on a complete list of all observed cases of death at age 110 and above from 1988 to 2016, which was provided by INSEE (Institut national de la statistique et des enquêtes économiques). For each case, age was checked in accordance with the highest standard of validation process proposed by the IDL for inclusion in the international database (matching death certificate and birth certificate). Although all cases were officially validated in this way, the chapter considers only cases observed in metropolitan France because the number of cases observed in the overseas territories proved to be too high to not suspect any age overestimation. This is particularly true for the French Départements d'Outre-Mer (DOM), despite these territories' use of high-quality civil registration system for more than a century and a half. Nevertheless, relative to the population, the number of supercentenarians in these DOMs was found to be three times higher than in metropolitan France. Even more striking, the two DOMs of Guadeloupe and Martinique were, respectively, 7 and 8 times higher¹.

However, suspicion is not evidence. And if suspicion can be eliminated, finding an explanation for such an astonishing fact would prove to be quite interesting.

Because age was strictly validated in all cases on the French list by comparing the death and birth certificates, the only possible reason for any suspicion emerges from the hypothesis that, at some point in his/her life, the alleged supercentenarian took the identity of another individual who was to some extent older. While the probability of such a substitution is quite negligible in metropolitan France², the socioeconomic context of French DOMs at the end of the nineteenth century and beginning of the twentieth century could leave room for doubt. In particular, in these regions at the time, families living in poor remote rural places could find travel to the civil registration bureau to be prohibitively costly (in terms of both money and lost work). Consequently, as

¹The ratio of supercentenarian deaths observed from 1980 to 2016 to the total population of metropolitan France was 2.98 per 1,000,000 inhabitants, while it was 20.9 in Guadeloupe and 24.7 in Martinique. More precisely, these two Caribbean DOMs were far above the range of variation observed among metropolitan French *départements* (from 0 in a dozen *départements* to 11 in Haute-Corse and 10 in Deux-Sèvres).

²Even in the case of Jeanne Calment, who died at above age 122 in 1997, the recent vigorous dispute regarding her true age was proven to be completely unfounded (Robine, Allard, Herrmann & Jeune 2019).

what occurs in some modern-day developing countries, it may be that when a previous young child of a pregnant mother dies, the parents do not declare the death and instead give the new child the identity of the previously dead sibling. Other types of substitution are less likely at older ages, but it is of some interest to also check for these as far as possible. Thus, the first step in this research was to confirm, to the extent possible, that the initial validation process was not compromised by any substitution.

The second step is to provide possible explanations for why supercentenarians occur so much more frequently in Guadeloupe and Martinique than anywhere else in metropolitan France.

Data and methods

The basic data for this study came from the exhaustive list of supercentenarians who died in Guadeloupe and Martinique from 1988 to 2016. This was provided by INSEE and then validated by the French IDL team by matching birth and death certificates: eight deaths occurred in Guadeloupe, all born there; and nine deaths occurred in Martinique, eight of whom were born there and one in Guadeloupe. Interestingly, all these cases are female deaths.

The present study has adopted two lines of investigation for removing suspicion of age substitution as much as possible. One highly efficient way to eliminate the risk of substitution in infancy is to look at the birth history of the supercentenarian's mother, as this allows computing birth intervals. We can then check that the intervals are small enough to remove any risk of identity exchange between newborns. Indeed, it is of utmost importance to check that the interval between the births of the supercentenarian and the next child is low enough to determine that no other child could have been born between the two. It is also quite useful to ascertain the interval with the previous child and, finally, to rebuild the mother's entire birth history to obtain even stronger proof that will provide precise insight into the regularity of successive birth intervals. Naturally, the source for this is the civil registration system. On the one hand, this work is conveniently facilitated by the website ANOM (*Archives numérisées d'Outre-Mer*, <http://anom.archivesnationales.culture.gouv.fr/caomec2/recherche.php>), which is publicly accessible and allows everybody to investigate marriage, birth, and death registries. However, this is possible only for events occurring before the early 1900s³. All events after that time frame require physically going to the civil registration bureaus. On the other hand, such work can encounter great difficulty due to the sociocultural specificities of the French Antilles, where many women have children from different men out of wedlock. This often greatly impedes establishing a complete list of children bearing various unknown patronyms. Needless to say, this task requires much patience.

In the end, we of course cannot demand that all supercentenarians fit with the requirement of a short birth interval. When this is not the case, we therefore must develop arguments strong enough to explain longer intervals before rejecting the substitution hypothesis.

To remove other types of possible substitution, the method used here was to identify and precisely date as many events as possible that occurred during the supercentenarian's entire life, and the way to do this is twofold. As mentioned above, the first

³The limit varies from 1900 to 1907 according to the *commune*.

approach is to consult civil registries to follow the marriage and birth histories of the supercentenarians themselves. However, additional life events must obviously be confirmed by other sources for the post-fertile period. Unfortunately, routine administrative sources are largely missing (especially censuses). The primary way to overcome this was to find one or several still-living individuals who knew the supercentenarian well enough to recount her whole life (or at least the post-fertile part of it), followed by confirming all specific reported events as much as possible.

To date, all this work has been systematically performed in Guadeloupe during two successive field campaigns. The data for Martinique has only been collected through ANOM while the fieldwork still lies ahead.

At this stage, no real suspicion persists in regard to the completely reviewed cases, and it seems highly unlikely that the remaining cases will be subject to any strong doubts, such that it is possible to divide the total number of cases by 7 or 8. Thus, it is already time to think of a convincing explanatory hypothesis. In my view, only a genetic hypothesis can explain such an extreme prevalence of supercentenarians: the tremendous health selection effect of slavery, as explained below. Of course, the current survey cannot provide sufficient evidence for this, although at least one essential step can be completed here: confirming how many observed cases actually have slave origins. To do this, I used the ANOM website once again and reconstructed the ascendant genealogies for each of the 17 validated supercentenarians. Additional information was provided by the Anchoukaj website (http://www.anchoukaj.org/recherche_avancee.php), which makes accessible data from the special registration performed at the time when slavery was abolished.

Assessing the actual age of supercentenarians

Checking birth intervals

Table 1 gives an example of the birth history details for Louise Francius, the mother of one Guadeloupean supercentenarian named Marie Cayol. Once the necessary pieces of information are gathered, the case appears to be remarkably conclusive. Indeed, gathering data was facilitated by the fact that Louise Francius married Joseph Cayol on

Table 1 Birth history of Louise Francius, the mother of Marie Cayol

Birth rank	Surname	Birth date	Interval in days	Interval in years
1	Joséphine	22/9/1883	726	1.99
2	Théophane	18/9/1885	672	1.84
3	Marguerite	20/7/1887	727	1.99
4	Benoisine	17/7/1889	708	1.94
5	Jeanne	25/6/1891	691	1.89
6	Honoré	16/5/1893	686	1.88
7	François	2/4/1895	604	1.65
8	Marie	1/12/1896	742	2.03
9	Lucain	13/12/1898	646	1.77
10	Luciana	19/9/1900	699	1.92
11	Hélène	18/8/1902		
Mean interval				1.89

February 17, 1887 and their first two children were “legitimated” by marriage. It was then quite easy to find their subsequent children, who were all born in the same place before the end of the period made accessible on the Internet by ANOM. Indeed, the couple had children on a very regular basis of nearly every 2 years, although sometimes a bit less, with a mean interval of 1.89 years. In particular, the interval between the births of Marie and her immediate follower Lucain was 2.03 years. It is very clear that there is no room for suspecting any identity substitution in her infancy.

Of course, not all cases are so simple. Table 2 provides a summary of all cases: first, for Guadeloupe, where the field work is almost completed; then for Martinique in the second part of the table.

In Guadeloupe, the results for five of the eight studied supercentenarians are quite similar to those of the exemplary case of Marie Cayol, with the “following” intervals being very close to 2 years in four cases and even much less for the fifth. However, three cases need more attention for two different reasons: the following interval for Ismène Jean-Charles is much too large; and a following interval is missing for Mathilde Tafna and Ferdeline Vergelas due to their last positions in the birth order.

The birth interval between Ismène Jean-Charles and her young brother Stéphane is seven and a half years, much longer than the previously observed regular intervals. This leaves enough room for the death of another girl who could have died without registration and thus had her identity given to a younger sister born 2 or 3 years later. However, several arguments can be made for another interpretation of this large interval. First of all, Ismène is the eighth of a nine-child family. At the time of her birth, her mother was already 35 years old, an age when fertility begins to decline and the risk of

Table 2 Mother’s births of each supercentenarian and some indicators of interval length

Name of the supercentenarian	Number of mother’s births	Birth order	Mean interval	Previous interval	Following interval
Guadeloupe					
Marie CAYOL	11	8	1.89	1.65	2.03
Annoncia CYRIL	7	4	2.50	3.72	2.31
Marceline FAVIERE	10	6	2.67	2.19	2.01
Ismène JEAN-CHARLES	9	8	2.70	2.05	7.46
Julie MOYSAN	10	5	2.47	2.40	2.23
Camille REPIR	9	8	2.25	5.93	1.59
Mathilde TAFNA	2	2	2.42	2.42	-
Ferdeline VERGELAS	5	5	3.04	4.20	-
Martinique					
Félicité AJAX	8	1	2.55		2.64
Véronique BERNADINE	(2)*	1	4.22		4.22
Marelle CELICA	5	1	2.19		2.19
Irénise LERMAIN	(1)*	1			
Luce MACED	7	2	3.33	5.23	2.91
Angèle MARC	6	5	3.58	2.39	7.44
Angèle NITHARUM	(1)*	1			
Louise PICRODE	(4)*	2	5.03	8.01	2.53
Marie RAMY	(4)*	1	2.07		1.87

*The last birth observed is very close to the last year available on ANOM and the birth history is incomplete

miscarriage increases. Biologically, longer birth intervals are quite plausible, and this is coherent with the fact that Stephane is the last child born to the couple. However, there is also a social reason to believe that the non-registration of a death and birth is highly improbable. I interviewed one of Ismène Jean-Charles' daughters, who was born in 1937 and knew her maternal grandmother until she died in 1947. The whole family lived close to each other, and this daughter told me various stories about her family. In particular, she shared that both her mother and father worked at the city hall, where her father was responsible for civil registration and—even more importantly—her grandfather, Saint-Eloi Jean-Charles, Ismène's father, had himself been chief of the civil registration bureau. It is unimaginable that the latter could have omitted declaring the death of her daughter and the birth of a subsequent one.

The cases of Mathilde Tafna and Ferdeline Vergelas are different, with the problem being that they had no younger brother or sister.

Brice Tafna and Noémie Soleil, the parents of Mathilde Tafna, definitively had only two children together (Mathilde in 1895 and her older brother Frumence in 1892). Brice Tafna later had another girl named Eclariste, born in 1905 from another woman named Marie Gravillon; then in 1906, he married a third woman named Clothilde Guinga. Given these events, it is quite certain that the relationship between Noémie Soleil and Brice Tafna ended quite soon after the birth of Mathilde. In spite of exhaustive searches in the civil registries, I was unable to find any marriage to Noémie Soleil or any other births declared by her under her own name, although it remains possible that she had additional children from other men. Unfortunately, the only family member I could meet was Fritz Tafna, Mathilde's great-nephew. Born in 1968, he was far too young to know very many things about Mathilde's mother. However, he declared to have never heard anything about the existence of any additional brothers or sisters to Mathilde. My conclusion is that Noémie Soleil probably had only two children. Thus, there is no strong suspicion for the existence of early identity substitution.

Emilienne Tamarin was 37 years old in 1903 when she gave birth to Ferdeline Vergelas, whose father Auguste Vergelas had two additional children in 1906 and 1908 by another woman named Foransia Rubens. Emilienne Tamarin had previously had four children from her first partner, Casimir Tassot, who abandoned her soon after the birth of the fourth child. It is very plausible that Emilienne, who was nearly 40 and had already been left by two men, had no further partners or children. The absence of a new child after Ferdeline does not leave room for identity substitution.

The investigations remain incomplete for the Martiniquan supercentenarians. Fieldwork is necessary for obtaining entire birth histories of the mothers to Véronique Bernadine, Irénise Lermain, and Angèle Nitharum; while the large interval between Angèle Marc and her young brother Isidore could be understood by conducting only complementary field investigation. Nevertheless, the data available on the ANOM website were sufficient to check all birth intervals for the five other cases, leading to the conclusion that there is no room for identity substitution. This is true even for the cases of Louise Picrodé and Marie Ramy, despite the still incomplete birth histories of their mother, since they are early births with short intervals to the next ones.

From the 17 cases, small intervals with the next child provide evidence that identity substitution in infancy was impossible for five Guadeloupeans and five Martiniquans. For the three other Guadeloupeans, the excessively large intervals and absence of

younger children can be explained by specific circumstances, while further fieldwork is still necessary for the remaining four Martiniquans before making any conclusions. Finally, I have so far found no evidence of early identity substitution, and it is probable that the forthcoming fieldwork will not change that conclusion. Questions remain about the risk of substitution at older ages.

Interviewing proxies

It was not easy to find people able to recount the whole life of each supercentenarian. Fortunately, thanks to either funeral services, a person in the civil registration bureau, or some indication given by the death certificate, it has been possible to interview at least one proxy for each of the eight dead supercentenarians in Guadeloupe. Similar efforts in Martinique will be the main task of the forthcoming fieldwork (Table 3).

Marriages and childbirths are proof of existence at very precise dates that can be confirmed in the civil registries. Consequently, the birth histories of each supercentenarian have been systematically investigated in Guadeloupe, which will also be done in Martinique. Such efforts provide solid reference points throughout the period of fertility. Unfortunately, marriages are not so frequent, and supercentenarians prove to have rather low fertility. Proxy interviews cover the later part of life better and provide much information on various aspects. However, these additional reference points are rarely dated with great precision and are often difficult to check. Nevertheless, these different pieces of information taken altogether appear to be coherent enough to preclude any solid hypothesis of age overestimation for the studied supercentenarians.

Side-findings from the checks

Collecting data for the above checks resulted in some interesting secondary findings, at least for fieldwork completed in Guadeloupe.

Table 3 Supercentenarian proxies interviewed in Guadeloupe

Supercentenarian	Proxy interviewed
Marie CAYOL	1. The director of the "Accueil familial" Cherini-Laaland 2. A granddaughter of the supercentenarian (SC) 3. A grandson of the SC
Annoncia CYRIL	1. Two great-nieces of the SC (interviewed together) 2. A third great-niece of the SC (who took care of her at the end of her life)
Marceline FAVIERE	1. Two great-nieces of the SC (interviewed together)
Ismène JEAN-CHARLES	1. A daughter of the SC
Julie MOYSAN	1. A niece of the SC 1. A great-niece of the SC, city councilor in the SC's place of birth
Camille REPIR	1. A daughter-in-law of the SC
Mathilde TAFNA	1. The former director of the Geriatric Hospital of Pointe-à-Pitre 2. A great-nephew of the SC
Ferdeline VERGELAS	1. A daughter of the SC

Fertility is very high in the supercentenarians' mothers but surprisingly low in supercentenarians themselves

With the exception of Mathilde Tafna's mother, who had only two children, the number of children ever born from mothers of supercentenarians appears quite high: from 5 to 11 (Table 4). The mean total fertility rate is thus almost eight children per mother of the eight Guadeloupean supercentenarians. It should also be acknowledged that this constitutes a minimum, since it is possible that some births escaped our investigation on the ANOM website and/or in the more recent civil registries.

Unfortunately, no fertility statistics exist for the corresponding cohorts at the level of all Guadeloupe; and cross-sectional computations are available for only the most recent decades. However, Henri Leridon's (1970) study on the fertility transition of Martinique (which was certainly not very different from that of Guadeloupe) showed that fertility was not very high before beginning to decline in the 1960s (see also Péron, 1966). In 1948–1949, the first period for which the total fertility rate (TFR) has been computed, TFR was 5.6. This is in fact about the same as in France during the late eighteenth century, before the fertility decline began. According to Jean-Louis Rallu (1997), TFR in Guadeloupe was 5.3 in 1967.

Obviously, supercentenarians' mothers had at least one child, what excludes unfertile women, and they necessarily had higher fertility than the mean. However, the gap between 5.6 and 8 seems too large to be fully explained in this way.

It is even more striking that supercentenarians themselves had much lower fertility than expected, although they had children at a time when the fertility decline had not yet started. Only two supercentenarians had large families (seven for Ismène Jean-Charles and eight for Ferdeline Vergelas), while five of them had only one or two children, and two even had none. On average, their TFR is only 3. This is much less than the pre-transitional fertility level of 5.6, even though all these births occurred before the 1960s. Could this be due to underestimating the numbers of observed births? It is not impossible that some births escaped my investigations, but this is much less probable than for the mothers' fertility because in the case of supercentenarians themselves researching births in the civil registries was made more powerful by interviewing proxies who knew the supercentenarians better than they knew their mothers. It is highly probable that the low fertility of supercentenarians is true, and the contrast with their mothers' fertility is quite surprising. This implies

Table 4 Children ever born from mothers of Guadeloupean supercentenarians and from supercentenarians themselves

Name of the supercentenarian	Number of births to the supercentenarian's mother			Number of births to the supercentenarian		
	Males	Females	Total	Males	Females	Total
Marie CAYOL	4	7	11	5	0	5
Annoncia CYRIL	3	4	7	1	1	2
Marceline FAVIERE	5	5	10	0	0	0
Ismène JEAN-CHARLES	5	4	9	3	4	7
Julie MOYSAN	8	2	10	0	1	1
Camille RÉPIR	5	4	9	1		1
Mathilde TAFNA	1	1	2	0	0	0
Ferdeline VERGELAS	4	1	5	3	5	8
Total births	35	28	63	13	11	24
TFR			7.9			3

complex biological and/or sociological relationships between fertility and longevity, a phenomenon that would merit deeper investigation.

Supercentenarians' siblings live longer than the mean

A less surprising observation, but one quite important for suggesting a genetic explanation for the high prevalence of supercentenarians in Guadeloupe, is that the children of supercentenarians' mothers seem to live longer than the general population. Table 5 provides the example of the Ismène Jean-Charles' siblings. By chance, it was possible to gather precise dates for the births and deaths of all family members. We see that not only did Ismène become a supercentenarian, but one of her sisters, Savinie, lived past age 100 and two other siblings lived more than 80 years. On the other hand, only one sibling died at less than 1 year of age. The mean age at death of the whole sibship is 66.1.

Full information is also available for another supercentenarian, Annoncia Cyril. However, it has unfortunately not yet been possible to gather this for the six other cases. While all birth dates are available, death dates are missing for one or two siblings in each of the other sibships. It is therefore possible to obtain the mean age at death for only those whose age at death is known. Table 6 summarizes the situation through several indicators of longevity.

Out of 63 siblings, death dates are missing for a total of 10. Mean age at death was computed for 53 people. Depending on the sibship, the range of lifespan varies from 51.8 to 85.7 after excluding the supercentenarian herself. The mean lifespan was 61.6 among Repir's sibship and 88.9 among Favière's. Tafna's sibship has been left out, as only the age of Mathilde is known.

To compare the durations of life to those of the general population, it would be necessary to look at cohort data, which do not exist for Guadeloupe. However, it is possible to compare them with metropolitan French data, although, admittedly, life expectancy was very probably lower in Guadeloupe than in metropolitan France. According to their birth dates, all siblings belong to cohorts born from 1880 to 1914. Using French cohort life tables (Vallin & Meslé, 2001, updated) weighted by the numbers of siblings born the same year, I use the life expectancies at birth of these cohorts as a reference. The average life expectancy is 48.85 years. That is 14 years less than the 63.5 years observed in the eight sibships studied here. Even after excluding the

Table 5 Lifespans of children born to Ismène Jean-Charles' mother

	Name	Birth date	Death date	Length of life
1	Fabius	24/8/1884	5/6/1967	82.78
2	Victor	3/2/1887	10/4/1946	59.18
3	Cassius	1/12/1888	5/5/1960	71.44
4	Savinie	8/12/1890	26/1/1994	103.15
5	Thégnie	17/9/1892	28/5/1893	0.70
6	Prudencine	2/7/1894	11/6/1982	87.94
7	Gaston	4/10/1896	16/12/1901	5.20
8	Ismène	24/10/1898	4/3/2009	110.37
9	Stéphane	6/4/1906	6/8/1980	74.33
Mean age at death of the full sibship				66.12
Mean age of Ismène's siblings				60.59

Table 6 Lifespan indicators in the sibship of the eight Guadeloupean supercentenarians

Supercentenarian	Number of siblings	Missing death dates	Mean age at death		Number of siblings aged	
			All	The SC excluded	100–109	90–99
Marie CAYOL	11	1	67.68	62.87		3
Annoncia CYRIL	7	0	61.82	53.66		
Marceline FAVIERE	10	2	88.88	85.71	2	2
Ismène JEAN-CHARLES	9	0	66.12	60.59	1	
Julie MOYSAN	10	2	78.08	73.51		3
Camille REPIR	9	3	53.94	39.73		
Mathilde TAFNA	2	1	112.12			
Ferdeline VERGELAS	5	1	69.62	56.09		
Total	63	10			3	8
Mean age at death			62.90	55.53		

supercentenarians themselves, the mean duration of life for their siblings is still 7 years higher. Clearly, the supercentenarian's siblings have a higher longevity than the general population.

Another interesting fact is that among supercentenarian sibships, it is rather common to find several others with very long lives: 4 siblings lived between 100 and 110 years and another 8 between 90 and 99 years. A very impressive case is the siblinghood of Germaine Favière: 1 supercentenarian, 2 centenarian siblings, and 2 others aged more than 98. It is difficult to not consider that longevity genes play a role and that, if so, these genes underwent selection by means of a major historical event.

An extraordinary case still to be explored further

The case of the Martiniquan Félicité Ajax could lead to revising any conclusions about the very low fertility of supercentenarians. She had nine children with her first partner, Louis Servule Montabord⁴, who married her in 1929 and died a few years later. She then married for the second time to Jules Jandia in 1935, followed by possibly a third marriage somewhat later. Although these facts still need to be confirmed by fieldwork, what is most extraordinary here is that Félicité's first daughter, Herménégilde Montabord (born on April 17, 1906), celebrated her 113th birthday before dying in July 2019. Félicité Ajax was thus the supercentenarian mother of a supercentenarian daughter. This is of course one more argument favoring the genetic transmission of longevity genes and possible gene selection.

The slavery selection

The hypothesis

The validation work remains to be completed. It can still be improved upon in Guadeloupe and the fieldwork is pending in Martinique. However, it is already certain that additional investigations will not be able to bridge the gap between 3 supercentenarians per 1 million people observed in metropolitan France versus 21 in Guadeloupe and 24 in Martinique. Undoubtedly, the extreme prevalence of supercentenarians in the two French Caribbean islands is real, and it is not too soon to seek explanations. Although such a huge task obviously cannot be completed here, it is at least possible to

⁴Louis Servule Montabord himself had previously fathered at least nine children with another woman.

discuss some hypotheses and hopefully inform their probability by means of some observations.

When speaking with experts in the field of longevity research, many ascribe long life-spans to either climate or dietary habits. Indeed, this type of explanation is often given for cases like Okinawa in Japan, Crete in Greece, and the so-called blue zones identified in various other places by Michel Poulaïn (Poulaïn, Herm & Pes, 2016). However, genetic reasons are also sometimes suspected, such as in Sardinia (Poulaïn et al., 2004). As explained by Thomas Pearl (2008), lacking genetic variations that predispose to disease as well as having variations that confer disease resistance (longevity enabling genes) are probably both important to achieving exceptional old age. It seems to me that the cases of Guadeloupe and Martinique require paying particular attention to genetic causes. First, the extreme prevalence is much higher than in any other cases, and it is difficult to imagine that only environmental factors could explain such a gap from "normality." However, the historical settlement of these territories also opens the door to a reasonable hypothesis for strong genetic factors. The current populations in Guadeloupe and Martinique are largely descendants of slaves. Indeed, at the time of abolition (in 1848), the proportion of slaves and freedmen was more than 90% compared to less than 10% "whites." Today, proportions for the descendants of these two populations is unknown, but it very likely has not changed much, due to low immigration and high fertility among black people compared to white. Thus, one can assume that the majority of the population has inherited the genetic characteristics of former populations who were strongly selected by the very severe over-mortality experienced by their slave ancestors. In particular, their capture, confinement before deportation, and crossing of the Atlantic were extremely deadly. Then, upon arrival in the Antilles, these usually quite young people were subjected to forced labor and brutal treatment. Many still died before having children. The entire process produced severe selection of the strongest individuals, who were the only ones that managed to have children. If there is a link between robustness and longevity, this could be sufficient in explaining the extreme prevalence of supercentenarians there today.

A first argument for such an explanation can be found in a comparison with La Réunion. La Réunion is another DOM, but situated in the Indian Ocean close to Madagascar. On this island of 870,000 inhabitants, only one death above the age of 110 occurred between 1988 and 2016. That is 1.15 per 1 million inhabitants, much less than the 21 and 24 Guadeloupeans and Martiniquans, and even less than the metropolitan France ratio of 3. Such a low ratio can simply be the result of a much too small number of cases (only one) as it was for a dozen of French metropolitan *départements* (0 case in ten of them), but it could also be due to less healthy life conditions than in France, which are much more probable than the presumably more healthy conditions sometimes considered as an explanation for Antilles' high longevity. However, this still would not justify an outright rejection of the slavery selection hypothesis.

La Réunion certainly practised slavery in the past just as Guadeloupe and Martinique did, but at least three main differences can explain the contrast in longevity. First, slavery was much more massive in Antilles than in La Réunion. Only 60% of the latter population were slaves at the time of abolition, compared to 90% of the former. Second, while all the slaves in Guadeloupe and Martinique came from Africa, those in La

Réunion came mainly from Madagascar and did not endure the terrible Atlantic crossing. Third, for two centuries, Antilles practiced a quasi-monoculture of sugar cane, which imposed awful conditions on the working slaves. This type of work did not occur for as long and was never so massive in La Réunion. Furthermore, slave emancipation took place more frequently, as well as extensive immigration of non-slave workers from India and other countries. On balance, the high slave mortality was not only less extreme in comparison, but it affected fewer people and did not last as long. It is very possible that the much later consequences on populations today cannot be discerned.

Of course, that argument does not sufficiently prove anything. Only genetic studies can provide definitive evidence, which is not possible in the framework of this study. However, it is at least possible to inquire into historical civil registries to verify the extent to which these observed supercentenarians descended from slave ancestors.

The slave status of supercentenarians' ancestors

To the extent possible, the ancestral slave status of the eight deceased supercentenarians in Guadeloupe was confirmed via the Internet and complementary fieldwork. Internet confirmation is nearly complete for Martinique.

Side bar 1 summarizes the example of Marie Cayol's genealogy back to her first slave ancestors. In this case, the genealogical work was rather easy because her parents and grandparents were married and slavery was in effect as recently as her grandparents' generation.

Side bar 1: Marie Cayol's ancestors

Marie Françoise CAYOL, born on December 1, 1896 at Pointe-Noire, from Joseph Isidore CAYOL and Marie Louise FRANCIUS; she died on November 11, 2007 at Le Gosier.

Parents

Father: Joseph Isidore CAYOL, born at Pointe-Noire on May 15, 1859, from Joseph Célicourt CAYOL and Rosalie DAMINER.

Mother: Marie Louise FRANCIUS, born RADJOUKI at Pointe-Noire on December 8, 1863 and recognized later by her father, from Sainte-Luce Déodat FRANCIUS and Julie RADJOUKI.

Joseph Isidore CAYOL and Marie Louise FRANCIUS married on February 19, 1887 at Pointe-Noire.

Grandparents

Paternal Grandfather: Joseph Célicourt CAYOL, born about 1830 « *d'après un extrait de l'arrêté du gouverneur du premier septembre 1832 qu'il nous a présenté* » (certificate of marriage, n°14), natural son of Francillette CAYOL; died on November 22, 1885 at Pointe-Noire. (NB: the mention of the governor's act indicates that he was born a slave).

Paternal Grandmother: Rosalie DAMINER, born about 1839 (according to her « *acte d'inscription à l'état civil n° 355 du 6 11 1848* »), from Athanase Petit-Frère DAMINER and Rose AMIREILLE. (NB: the mention of the inscription bill indicates that she was born a slave).

Joseph Célicourt CAYOL and Rosalie DAMINER married on May 18, 1858 at Pointe Noire.

Maternal grandfather: Sainte-Luce Déodat FRANCIUS, born about 1841, natural son of Euranie FRANCIUS and unknown father.

Maternal grandmother: Julie RADJOUKI, born about 1846 or 1847.

Sainte-Luce Francius and Julie Radjouki married on April 25, 1871 at Pointe-Noire. Both of them were born slaves, since their bill of marriage refers to their "actes de liberté" delivered in 1849).

Great-Grandparents

Great-Grandfather 1: unknown

Great-Grandmother 1: Francillette CAYOL

Great-Grandfather 2: Athanase Petit-Frère DAMINER

Great-Grandmother 2: Rose AMIREILLE

Great-Grandfather 3: Unknown

Great-Grandmother 3: Euranie FRANCIUS, born about 1819 at Pointe-Noire, natural daughter of Rosiette FRANCIUS (source Anchoukaj, from slave registers).

Great-Grandfather 4: Anicet Séverin RADJOUKI

Great-Grandmother 4: Jeannette ZABETH was probably born a slave, since several slave women called ZABETH are listed by Anchoukaj as living in the GOSSE DEBLAINE & PIERRE dwelling.

Such an exhaustive example points toward slave origins, since all four grandparents were born slaves. This does not exclude interbreeding, although we can suspect this in the previous generation because several great-grandfathers are unknown while one is possibly the owner of the great-grandmother. However, interbreeding can only be marginal.

After conducting the same investigation on ANOM and Anchoukaj, sometimes with the help of fieldwork, I was able to build genealogical trees for all seven of the remaining Guadeloupean cases. This has also been partially done for the nine Martiniquan cases. Table 7 summarizes the results of confirming their slave ancestry.

Further investigations are still needed to complete the table, especially in Martinique, but it is already clear that all supercentenarians had slave origins, with the exception of only one Martiniquan for whom no information was found. In some cases, we have proof that all four grandparents were born slaves while for others this is true for at least the maternal grandparents. In two cases, however, it is necessary to go as far back as the great-grandparents to find slave origins. Further investigation will undoubtedly complete the table. However, Table 7 already gives us the strong impression that each time slave origins are not proven, it is only because the origins are unknown. It is most often the case that unknown origins are because the father did not recognize a birth. While the father most probably had the same status as the mother, it could also be that in some cases, the father was a family member to the owner of the slave mother or was even the owner himself. Such cases are perhaps not exceptional, but they are certainly rare. In any case, supercentenarians are widely the heirs of genes selected by the slave for overcoming mortality.

The surprising exception of Saint-Barthélemy

Saint-Barthélemy is a very small Caribbean island situated north of Guadeloupe, beyond Montserrat, Antigua, Barbuda, and St. Kitts and Nevis. Formerly a part of Guadeloupe, this island today is an independent French “Collectivité territoriale d’Outre-Mer” together with nearby Saint-Martin island. Although very small (25 km²) and with a very small population (9600 in 2018), the INSEE list of supercentenarian deaths for the period 1988–2016 identified one as having occurred there, giving this small island an extraordinary supercentenarian rating of 104 per 1 million (compared to the 21 and 25 of Guadeloupe and Martinique). Of course, such a rating has no significance at all, being based on such small numbers. However, my slave hypothesis is called into question by the existence of Anne Eugenie Blanchard, who was born in Saint-Barthélemy on February 15, 1896 and died on November 4, 2010 at nearly 115 years of age. It is true that she came from a very fertile mother (11 children) and that some of her siblings seem to have lived long lives. Furthermore, she did not have any

Table 7 Slave origins of the supercentenarians

Supercentenarian	Gandparents' status	Remarks
Guadeloupe		
Marie CAYOL	All grandparents born slaves	
Annancia CYRIL	PGF born a slave, PGM's parents born slaves, MGF « mestive » origins MGM unknown origins	« Mestive » is interbreeding of black with native population Survey still ongoing
Marceline FAVIERE	PGF, PGM, MGM born slaves MGF probably born a slave	Survey still ongoing
Ismène JEAN-CHARLES	2 MGP born slaves 2 PGP	
Julie MOYSAN	All grandparents born slaves	
Camille REPIR	All grandparents born slaves	
Mathilde TAFNA	All grandparents born slaves	4 great-grandmothers born slaves 2 great-grandfathers unknown
Ferdeline VERGELAS	2 MGP born slaves 2 PGP unknown	Survey still ongoing
Martinique		
Félicité AJAX	2 PGP unknown 2 MGP born slaves	Father unknown Survey still ongoing
Véronique BERNADINE	2 PGP unknown 2 MGP born slaves	Father unknown Survey still ongoing
Marelle CELICA	PGF unknown PGM born a slave MGF unknown MGM's origin unknown	Survey still ongoing
Irénise LERMAIN	2 PGP unknown 2 MGP born slaves	Survey still ongoing
Luce MACED	2 PGP unknown 2 MGP born slaves	The father himself was born a slave, the reason why his father is unknown
Angèle MARC	Information not available	Survey still ongoing
Angèle NITHARUM	2 PGP unknown 2 MGP born slaves	
Louise PICRODE	MGM born a slave	All Great-Grandparents born slaves or unknown
Marie RAMY	MGM born a slave	All Great-Grandparents born slaves or unknown

PGF Paternal grandfather, PGM Paternal grandmother, MGF Maternal grandfather, MGM Maternal grandmother, PGP Paternal grandparents, MGP Maternal grandparents

children (being a nun), all of which conform to previous observations. However, the genealogical study failed to identify any slave ancestors, which challenges my explanatory hypothesis. The question is not at all settled by the socio-political context of Saint-Barthélemy being quite different from that of Guadeloupe and Martinique (much less massive slavery and completely different political history).

Nevertheless, the case itself is also still debatable. When she was about 25 years old, Anne Eugenia Blanchard migrated to Curaçao to become a nun. She changed her name to "Sister Syria" and lived in that congregation for 33 years. When she returned to Saint-Barthélemy, she had completely forgotten the French language and generally never managed to recover it well. Obviously, the case requires in-depth research to confirm her age, which remains to be done. In particular, it is necessary to inquire rigorously into the 33 years she spent in Curaçao in order to obtain proof that the 60-

year-old woman who returned from Curaçao is actually the young one who left Saint-Barthélemy.

Conclusion

The very high prevalence of supercentenarian deaths observed in Guadeloupe and Martinique between 1988 and 2016 are, respectively, 7 and 8 times higher than those in metropolitan France. Such a disparity compelled an extensive inquiry to confirm these alleged ages, one that went beyond the classical comparison of birth and death certificates. This is the objective of an ongoing research project, which to date has been completed for Guadeloupe and is in progress for Martinique. The first results confirm that the ages at death were as reported upon their inclusion in the IDL database. In particular, the birth histories of each supercentenarian's mother were reconstructed in order to check all birth intervals, especially the interval between the supercentenarian and the birth of her next sibling. This eliminated the primary source of suspicion. Furthermore, following research conducted at the civil registration services and a series of interviews conducted with various proxies of the supercentenarians, I was left with a strong impression of coherence among all the reported events.

This extensive validation provided an opportunity to look at several demographic characteristics that were somewhat surprising. First, the supercentenarians belong to large families born of mothers whose fertility was higher than that of the general population. In contrast, the fertility of the supercentenarians themselves (all are women) is much lower than that of the general population. Finally, the mean age at death of all the supercentenarians' siblings is much higher than the mean life expectancy for the same birth cohorts in the general population.

The last observation could fit quite well with our main explanatory hypothesis: the high prevalence of supercentenarians can be a present-day consequence of the strong health selection effect from the very high mortality inflicted by slavery on their ancestors. Until evidence can be gathered from a genetic research project, we can at least consider this solid preliminary finding: all the observed Guadeloupean and Martiniquan supercentenarians are confirmed to be descendants of slaves, and none have been found to have non-slave ancestors born before the abolition of slavery.

While it is true that this study relies on quite a small number of cases (17), its findings sufficiently validate the very high prevalence of supercentenarians observed in the French Antilles and additionally motivate more extensive research into the proposed explanatory hypothesis. It can also serve as an argument in favor of the great number of supercentenarians observed in the southeastern states of the USA, despite the lack of civil registration there for validating many birth dates.

Naturally, completing the current fieldwork is also urgently required. In particular, it will be important to learn more about the extraordinary case of the Martiniquan supercentenarian mother of another supercentenarian, as well as about the surprising Saint-Bathélémyenne who lived almost 115 years but had no slave ancestors.

Abbreviations

ANOM: Archives numérisées d'Outre-Mer (Digitalized Archives of Overseas Territories); CHG: Centre hospitalier gérontologique; CHU: Centre hospitalier universitaire; DOM: Département d'Outre-Mer (Overseas Department); IDL: International Database on Longevity; INED: d'études démographiques (National Institute for Population Studies); INSEE: Institut national de la statistique et des enquêtes économiques (National Institute for Statistics and Economical Surveys); MGF: Maternal grandfather; MGM: Maternal grandmother; MGP: Maternal grandparents; PGF: Paternal

grandfather; PGM: Paternal grandmother; PGP: Paternal grandparents; SC: Supercentenarian; TFR: Total fertility rate; USA: United States of America

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I do not see any competing interest

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