Published in final edited form as:
J Am Geriatr Soc. 2006 August ; 54(8): 1237–1240. doi:10.1111/j.1532-5415.2006.00826.x.

Characteristics of 32 Supercentenarians

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Abstract

OBJECTIVES—To report phenotypic characteristics of 32 age-validated supercentenarians.

DESIGN—Case series.

SETTING—U.S.-based recruitment effort.

PARTICIPANTS—Thirty-two supercentenarians.

MEASUREMENTS—Multiple forms of proof were used to validate age claims. Sociodemographic, activities of daily living, and medical history data were collected.

RESULTS—Age range was 110 to 119. Fifty-nine percent had Barthel Index scores in the partially to totally dependent range, whereas 41% required minimal assistance or were independent. Few subjects had a history of clinically evident vascular-related diseases, including myocardial infarction (n = 2, 6%) and stroke (n = 4, 13%). Twenty-two percent (n = 7) were taking medications for hypertension. Twenty-five percent (n = 8) had a history of cancer (all cured). Diabetes mellitus (n = 1, 3%) and Parkinson's disease (n = 1, 3%) were rare. Osteoporosis (n = 14, 44%) and cataract history (n = 28, 88%) were common.

CONCLUSION—Data collected thus far suggest that supercentenarians markedly delay and even escape clinical expression of vascular disease toward the end of their exceptionally long lives. A surprisingly substantial proportion of these individuals were still functionally independent or required minimal assistance.

Keywords

supercentenarian; centenarian; longevity

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Author Contributions: Dr. Perls played key roles in all aspects of the preparation of this manuscript. Emily Schoenhofen played key roles in study concept and design, subject acquisition and data analysis. Dr. Wyszynski played a key role in data analysis and interpretation. Stacy Andersen played key roles in subject recruitment and enrollment and data collection, analysis, and interpretation. Robert Young played key roles in subject recruitment, ascertainment of demographic data, and age validation. JaeMi Pennington played key roles in subject recruitment and enrollment and data collection. Dr. Terry played key roles in study concept and design, data interpretation, and preparation of the manuscript.

The remarkable growth in the number of centenarians (aged ≥ 100) has garnered significant attention over the past 20 or so years. Consequently, a number of centenarian studies have emerged, ranging in emphasis from demographic to genetic. Recently, an even more extreme group, supercentenarians, or people aged 110 and older, has begun to yield sufficient numbers to warrant descriptive studies.

Great effort and diligence is required to locate living supercentenarians and validate their age claims. Claims of ages beyond that of the oldest well-accepted age of 122 years (Madame Jeanne Calment) regularly surface in the media, but these are invariably unsubstantiated.[1–3] The U.S. census listed 1,400 supercentenarians in 2000 (about 1 per 200,000),[4] but an e-mail based effort facilitated by the Gerontology Research Group (GRG, www.grg.org) that monitors and validates claims of age 110 and older estimates the number of living supercentenarians in the United States to be approximately 60 to 70 (or approximately 1 supercentenarian per 6 million people) and 250 to 300 worldwide. One study reported Medicare data indicating that, in 2000, there were 32,920 centenarians and that, of these, 105 (0.3%) were age 110 and older.[5] One study estimated that seven in 1,000 people born at the turn of the last century lived to become centenarians and that one in 100,000 lived to be 110 or older.[6]

Because of the efforts of the GRG and the International Database on Longevity (www.supercentenarians.org), it has become possible to go beyond single anecdotal case descriptions to formal case series. Reports of supercentenarians have only examined the demography, identification, and age-verification of these individuals.[7–10] Here, the first phenotypic characterization of a case series of 32 supercentenarians is reported.

Centenarians have been found to exhibit marked delays in functional decline and in most cases age-related lethal diseases such as heart disease, cancer, and stroke.[11] Compression of functional decline toward the relative end of their long lives might be a prerequisite or at least a marker of the ability to live to 100. In a sample of 105 centenarians, 88% were functionally independent at a mean age of 92.[12] Such compression of disability is even more pronounced in male centenarians.[13] Early experience with supercentenarians has led to the hypothesis that such a delay must be extended at least through age 100 for a person to survive to age 110 or older.

METHODS

From 1997 through 2005, supercentenarians were found through the surveillance efforts of the New England Centenarian Study (NECS) staff and Robert Young, a volunteer member of the GRG, who monitored the Internet and the media for news of supercentenarians, as well as through family and other interested individuals who contacted the NECS or GRG about a supercentenarian. Individuals included in this report were enrolled in the NECS using protocols approved by the Beth Israel Deaconess Medical Center (1997–2002) and Boston University Medical Center (2002 to present) institutional review boards. In accordance with the recommendations of the National Institute on Aging Panel on the Characterization of Participants in Studies of Exceptional Survival in Humans, age verification of centenarians began with obtaining subjects' birth certificates.[14] In the case of rarer and potentially sensationalized ages, such as claims of 110 and older, additional forms of proof that indicated ages at different times in the person's life were obtained. Such forms of proof included census records, school report card with age, military record, marriage license, employment record, old passport, and parental age on child's birth certificate. Dates of death for subjects who had died were confirmed using death certificates, the Social Security Death Index, or when these were unavailable, cemetery or funeral home records. The familial reconstitution method was also employed to determine whether the ages of parents, grandparents, siblings, and children were

reasonable in relation to that of the supercentenarian.[15] Such stringent requirements for age verification were deemed necessary, because according to the GRG's experience, the majority of claims of age 115 and older are false.

Collected phenotypic data included sociodemographic, pedigree (first-degree relatives), activities of daily living (ADLs) and medical history variables. The Barthel Index was used to categorize functional status based upon ADL variables.[16] In all cases, family, nursing home and medical staff or both provided data. In addition, available medical records were obtained and reviewed. When the cognitive status of the subject allowed, data were also obtained from the subject.

RESULTS

Thirty-nine subjects with claims of age 110 and older were enrolled during 1997 through 2005. Two individuals did not meet the age validation criteria, and five died after consent was received but before data could be collected. Thus, demographic and phenotypic data are reported for 32 subjects. Regarding the two claims that could not be validated, one subject believed to be 111 years old lived in Germany for most of his life, and birth records or age-verifying documents were unavailable. A second subject did not have any documents to substantiate (or contradict) her claimed age of 110.

For 32 supercentenarians, the age range was 110 to 119. The 119-year-old female participant was the oldest living person in the world at the time of her enrollment. The sources of age validation for these 32 subjects are summarized in Table 1.

As revealed in Table 2, medical history was remarkable for few subjects having a history of vascular-related diseases, including myocardial infarction (n = 2, 6%) and stroke (n = 4, 13%), despite their long lives. Seven (22%) were taking medication to treat hypertension. Eight (25%) had a history of cancer, all cases of which had been successfully treated, and none of which were active. Diabetes mellitus (n = 1, 3%) and Parkinson's disease (n = 1, 3%) were rare. Osteoporosis (n = 14, 44%) and cataract history (n = 28, 88%) were common.

DISCUSSION

This report of basic sociodemographic and medical characteristics of supercentenarians is the first of its kind. Although the sample size of 32 is small, it represents half the number of supercentenarians living in the United States at any one time. There were expected and surprising findings. As expected, the vast majority of participants were female. The proportion of men (16%) was statistically similar to that published in a previous study (1 male per 10.8 women, or 9%; $P = .27$), the latter probably more accurately reflecting the proportion of men in industrialized nations.[7] That study, citing data collected from the Max Planck Institute for Demographic Research-based international research effort known as the International Database on Longevity (www.supercentenarians.org), indicated that the numbers of supercentenarians can be so small in individual countries that the prevalence of these individuals in different parts of the world and the sex ratio can vary wildly at different times.[8] One must still be wary of sex bias in studies such as these. It has been previously shown that male centenarians, although fewer in number, tend to be more functionally fit and therefore may be more likely to participate in studies. Additionally, it is possible that male prevalence increases relative to female at these extreme ages because of demographic selection, the phenomenon of the frail dying off, leaving behind a cohort of healthier individuals with a greater propensity for survival.

Regarding age validation, only two of the purported supercentenarians in the sample were found not to have adequate substantiating evidence of their ages. This is an unusually high

validation success rate, although it is understandable, because most of the subjects enrolled had already gone through an age validity check via the GRG's efforts. High rates of inaccurate age reports emerge from national databases in which people assumed to be alive are actually dead. Errors also emerge from inadequate data entry, such as including only the last two digits of a birth year. Some age misreporting may be intentional. At a younger age, some people might have exaggerated their age (e.g., to get married or to join or to be excluded from the military), and this exaggeration is maintained for the rest of their lives. Others or their family members might claim to be aged 110 and older for secondary gain such as media attention and monetary incentives. One study noted a significant disparity in age validation rates for claims of age of 110 and older between Caucasians and African Americans, particularly in the southern United States.[17]

Two groups have reported a 50% annual mortality rate in supercentenarians.[18] One study found that the 50% mortality rate observed at age 110 to 114 may not continue to increase at even older ages and might even plateau.[8] When one is dealing with such small samples that just a few individuals can so dramatically affect mortality rates for the group in question, the validity of these observations may not be generalizable for different birth cohorts; only time, and perhaps larger samples, will tell.[19]

Not surprisingly, more than 50% of the cohort had 8 or fewer years of education. In 1900, the average highest grade attained was eighth grade. Not until 1915 did states begin advocating for at least 12 years of education. Given that longevity has been associated with years of education, the change in years of required education, in combination with improved public health and medical interventions, will likely contribute to the increasingly higher prevalence of centenarians and supercentenarians in the future.

Reported cardiovascular disease and stroke were rare among the supercentenarians, more than likely because these diseases would otherwise prevent survival to extreme age. It was previously reported that more than 80% of centenarians delay diseases that are normally associated with significant mortality, cardiovascular disease and stroke, beyond the age of 80 or escape them entirely.[11] It would be expected that supercentenarians would experience the same survival advantage but at a correspondingly older age. Also similar to experience with centenarians generally, Parkinson's disease was nearly nonexistent, and approximately 25% had a history of treated cancer.[20]

Fifty-nine percent of the subjects had Barthel Index scores in the partially to totally dependent range, although remarkably, the remaining 41%, despite their extreme age, required minimal assistance or were independent. The sample of men was too small to make sex-specific observations. It has previously been reported that centenarians compress the time they experience disability toward the end of their long lives, in part, because disability in the extreme old is likely a potent predictor of mortality.[12] The same would likely be true for supercentenarians, although this has yet to be demonstrated with longitudinal data.

Although this is a small sample for a case series, it is large given the rarity of supercentenarians. Given that "all comers" were enrolled in the study, ascertainment bias is likely minimal, although the absence of minorities from the sample is obvious, and the findings may not be generalizable to other racial groups or other geographic regions. As interest in this exceptional group of people continues to grow, additional studies are sure to emerge that will be able to put these findings into perspective and to expand upon them.

Older people are well known for their heterogeneity across a broad spectrum of genetic and environmental variables known to effect longevity. However, it is likely that supercentenarians might be more homogeneous with regard to phenotypic presentation and genetic and environmental characteristics that play significant roles in the ability to achieve such

exceptional old age. Reported or clinically significant cardiovascular disease and stroke were rare in the supercentenarians, perhaps because these diseases prevent survival to extreme age. By virtue of their likely ability to markedly delay or escape age-related illnesses and frailty and their probable sharing of traits that enable such exceptional survival, supercentenarians are likely to be an important resource for discovering environmental, behavioral, and genetic factors that predispose to longevity and decreased susceptibility to vascular and other lethal diseases associated with aging.

Acknowledgments

Financial Disclosure: Support was received from National Institute on Aging (NIA) Grants U01-AG-023755 (TTP, DFW), K24 AG25727 (TTP), K08AG22785 (DFT), K23 AG026754—Paul Beeson Physician Faculty Scholar in Aging Award (DFT)

Sponsor's Role: The NIA played no role in the design, methods, subject recruitment, data collection, analysis, or preparation of the manuscript.

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Table 1

Age-Validating Documents for 35 Supercentenarians

Document	n (%)
Birth certificate	14 (40)
Census record	25 (71)
Baptismal record	5 (14)
Marriage certificate/license	11 (31)
Passport	1 (3)

Table 2

Sociodemographic, Medical, and Functional Characteristics of 32 Supercentenarians

Characteristic	Value
Age, mean ± SD (range)	111 ± 2 (110–119)
Sex, n (%)	
Female	27 (84)
Male	5 (16)
Education, years, n (%)	
≤8	17 (53)
9–12	8 (25)
13–17	7 (19)
≥18	0 (0)
Education, years, mean ± SD	10 ± 4 (0)
Race, n (%)	
Caucasian	28 (88)
Other	4 (12)
Place of birth, n (%)	
Australia	2 (7)
Canada (Prince Edward Island)	1 (3)
Germany	1 (3)
Ireland	1 (3)
Morocco	1 (3)
United States	26 (81)
Grandparents' ethnicity, n (%)	
Danish	1 (3)
English	10 (31)
English/Dutch	1 (3)
English/German	1 (3)
English/Irish/Scottish	1 (3)
English/French	1 (3)
French	1 (3)
German	4 (12)
German/Spanish	1 (3)
Irish	1 (3)
Irish/German	1 (3)
Irish/Canadian/French	1 (3)
Norwegian/German	1 (3)
Scottish	1 (3)
Scottish/English	1 (3)
Spanish	1 (3)
Unknown	4 (12)
Living situation, n (%)	
With family	5 (17)

Characteristic	Value
Assisted living	5 (17)
Nursing home	19 (65)
Missing data	3 (1)
Medical history, n (%)	
Myocardial infarction	2 (6)
Cardiac arrhythmia	1 (3)
Pacemaker inserted	0 (0)
Angina pectoris	0 (0)
Stroke	4 (13)
Treated hypertension	7 (22)
Adult-onset diabetes mellitus	1 (3)
Chronic obstructive pulmonary disease	0 (0)
Hypothyroidism	5 (16)
Other thyroid condition	2 (6)
Osteoporosis	14 (44)
Cataract	28 (88)
Parkinson’s disease	1 (3)
Cancer	8 (25)
Bladder	1 (3)
Breast	2 (6)
Colon	2 (6)
Skin	2 (6)
Unknown	1 (3)
Functional status (Barthel Index score), n (%)	
Totally dependent (<20)	3 (9)
Very dependent (20–39)	10 (31)
Partially dependent (40–59)	6 (19)
Requires minimal assistance (60–79)	8 (25)
Independent (80–100)	5 (16)