The growth of high ages in England and Wales, 1635-2106

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Abstract. In England and Wales there were many historical claims of extreme longevity—ranging up to 152 years, said to have been reached in 1635—but it is impossible to verify any of them. A modern approach suggests that it is unlikely that genuine centenarians reached the age of 100 before about 1700. Later, the number of centenarians recorded in censuses was found to be greatly exaggerated. Much more reliable estimates of numbers of centenarians can be derived from the data on registered deaths, which provide a continuous series from 1911 to the present. Details are given of a very well-documented supercentenarian who reached the age of 110 in 1930, and also of the verified supercentenarian deaths since 1968. From 1911 until the 1940s, there were only one or two hundred centenarians, but from the 1950s, the numbers started to increase rapidly. The identified reasons for this are summarized. The numbers have already reached an estimated 8,500. According to the official projections, if trends continue the number of centenarians may reach 486,000 in 2076, and perhaps double that number by 2106; provided, presumably, that there will be enough carers to look after so many. The highest age is expected to rise.

1 The first centenarian

As a prologue, we shall begin by mentioning what is known about the date of the first centenarian in England and Wales, a kind of milestone which was passed before the days of modern statistics.

There has always been intense public interest in reported cases of extreme longevity. Countries and areas and experts vied with each other to find older and older cases, but the idea that extreme ages needed to be verified with extreme rigor was not recognized. A celebrated example was Thomas Parr, who died in 1635 at the reported age of 152. A post-mortem examination was made by William Harvey, who was famous for

H. Maier et al. (eds.), *Supercentenarians*, Demographic Research Monographs,
DOI 10.1007/978-3-642-11520-2_11,

discovering the circulation of the blood. The case naturally attracted considerable publicity. Harvey described in detail the state of Parr's body, but did not make any attempt to check his age. Peter Laslett, the founder of the Cambridge Group for the history of population and social structures, was very critical of this claim, and, indeed, all the other reported very high ages in England and Wales. Laslett and his assistant, Julia Hynes, set out to verify, by the most rigorous methods, as many cases of high ages as they could, but they found that this was not an easy task.

Thatcher (1999a) compared some of the verified ages with the highest ages one might have expected to find in theory, in historical cohorts of sizes which were known at least roughly, and with probabilities of dying which could also be estimated by using a model. The details are in the paper. The method predicted that the longest-living members of cohorts born in the medieval period were likely to have died in their nineties. There were certainly medieval people who were believed by their contemporaries to be over 90 years old, but it is difficult to validate individual cases by modern methods.

However, by the time we reach the cohort born in 1600, the cohorts were larger and the death rates were lower. The theory then suggested that the highest attained age would probably be above 100 years, though whether this could be identified and verified was another matter. This age would not, of course, be reached until 100 years later. Julia Hynes found the case of Sir John Holland (1603-1701), who certainly reached age 97, and whose documentation is described as indisputable. There were also several possible centenarians who died between 1700 and 1800. The presumption is that, in England and Wales at least, one genuine centenarian will have reached the age of 100 in this period.

2 Registration of births and deaths

Soon after the Church of England was established, its clergymen were instructed (in 1538) to keep registers of all the baptisms, weddings, and burials which they had conducted in their parishes. After the Reformation, the registers were confined to members of the Church of England, and did not include Roman Catholics, Nonconformists, Jews, or Quakers. Only the Church of England registers were recognized in law in cases of dispute about inheritance. They remain to this day a source of invaluable information about family history. However, there is no guarantee that all the high ages recorded at death are always accurate.

The compulsory civil registration of all births, marriages, and deaths was introduced in 1837. Moreover, the 1841 census of population was deliberately designed so that the age groups, areas, and occupations of those living could be matched up with the information recorded in the registers of deaths. Thus, the census would provide the numbers at risk to go with the deaths, so that death rates could be calculated by age, area, and occupation. This brilliant idea produced wonderful results, with immediate applications to health policy.

However, for the much more limited purpose of research on longevity, as described in this article, there proved to be a problem. Not all the very high ages recorded in the census were accurate, so the numbers at risk could not be trusted. Methods of great ingenuity were used to overcome this difficulty, as will be described.

3 The census problem

Thatcher (1981) assembled all the statistical data on centenarians which were available at that time—more than had ever been available before—and immediately encountered the census problem in an acute form. The 1971 census had shown 2,320 centenarians, compared with only 479 in 1961. However, the 2,320 who were centenarians in 1971 must have been the survivors of those who were recorded as aged 90 and over in 1961, and it had been expected that there would be only 1,145 such survivors. Thus, there appeared to be twice as many centenarians in 1971 as would be expected.

A major investigation followed. The number described as centenarians in the census was found to be double the number of centenarians who were claiming state pensions. It was seriously unlikely that a genuine centenarian would not be drawing a pension. Also, the centenarians in the census were found to include people who had given very different dates of birth for themselves on official records on previous occasions. Many of the differences were round numbers, like ten years. It only needed such errors by a small proportion of old people to produce the faulty figure for centenarians in the census.

4 The method of extinct cohorts

It had already been recognized by Vincent (1951) that estimates of numbers at risk could be made, at least retrospectively, entirely from data on deaths, without having to use dubious census data. This could

be done by classifying deaths according to the year of birth, and then following through the members of a given birth cohort, year by year, at least from some high age onwards, until they had all died. Working backwards, one could then determine how many were alive at each previous date. In its original form, though, the method could only be applied retrospectively, once the cohort had become "extinct," with all its members dead. However, various improvements were added, first by Depoid, and then by Kannisto and Thatcher, in constructing their database on old age mortality, so that provisional estimates of numbers at risk could be made at an earlier stage.

In the rest of this note, the estimates of numbers and death rates high ages are made by using these modifications of the method of extinct cohorts, and do not depend on census data. Although it cannot be claimed that all the ages recorded at death are completely accurate, they are certainly much more accurate than the very high ages which appear in censuses.

5 The "explosion" of centenarians

From 1911 until the 1940s, there were only one or two hundred centenarians in England and Wales, and these were more objects of curiosity than anything else. Then, from the 1950s, the numbers started to grow, roughly doubling every ten years. This produced what was described as an "explosion," with the number reaching 4,062 in 1991, and an estimated 8,513 as of January 1, 2006. The increase from 1911 onwards is shown for selected years in Table 1, and illustrated in Figure 1.

It has been possible to identify the demographic reasons for this increase in considerable detail (Thatcher, 1999b, 2001). The rise in centenarian numbers was, in part, due to an increase in births between 1850 and 1895; in part, to the improvement in survival between birth and age 80; in very large part, to the improvement in survival between age 80 and age 100; and, in small part, to longer survival above age 100. Against these increases, there were reductions in the numbers reaching 100 due to war deaths and net migration.

6 Supercentenarians

Those who reach the age of 110 are known as supercentenarians. Only a few deaths were recorded at ages 110 and over before the year 1969, and there were some doubts about their accuracy. However, from 1969

Table 1. Numbers of centenarians in England and Wales

Year	**1911**	**1921**	**1931**	**1941**	**1951**	**1961**
Males	26	35	25	33	48	85
Females	76	103	145	141	247	472
Total	102	138	170	174	295	557

Year	**1971**	**1981**	**1991**	**2001**	**2005**	**2006**
Males	164	281	455	649	916	1024
Females	1,022	1957	3607	5742	7157	7489
Total	1,186	2238	4062	6391	8073	8513

Note: 1. Estimated numbers aged 100 and over at 1st January in selected years.
2. Numbers from 1991 onwards are not yet final.

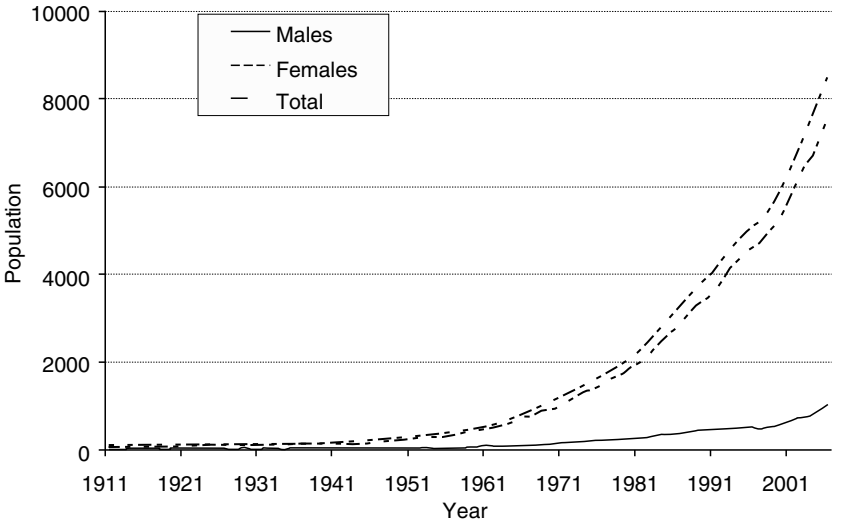

Fig. 1. Numbers of centenarians in England & Wales. (Population aged 100 years and over on 1st January, England & Wales, 1911 to 2006)

onwards all the entries in the registers showing deaths at ages 110 and over were checked systematically, to see whether it was possible to trace a corresponding entry in the birth register 110 years before. If such an entry was found, giving the correct name, date of birth, and place of birth, then the case was described as "verified." It must be remembered, though, that if a supercentenarian death was not verified by this procedure, this did not mean that it was necessarily incorrect. For example, immigrants from other countries would not have had their births recorded in the registers of births in England and Wales, and so could not be verified, even if they had genuinely reached 110 years.

The first list of names of verified supercentenarians in England and Wales showed two males and 19 females, who died between 1968 and 1990. The two males, whose names keep recurring, were John Moseley Turner (1856-1968) and John Evans (1877-1990). The names of all the 21 supercentenarians were published in the paper by Thatcher (1992), which appeared in the research journal *Population Studies*. There was a reason for this. The Office of Population Censuses and Surveys (OPCS), which, in principle, might have published the names itself in one of its official publications, was a statistical organization. It took pride in producing statistics in ways which preserved confidentiality and revealed no information about individuals. On the other hand, the information in the registers of births, marriages, and deaths was not confidential. In fact, under English law, since 1836 any member of the public has been able to obtain a copy of any entry in the registers on payment of a fee. A compromise was easily reached. OPCS did not object to the names being published in a research journal, provided they did not appear in one of its official statistical publications. For the same reason, the second list of names was published in the research journal *Population* (Thatcher, 2001).

By the time of the second list, there were still the same two verified male supercentenarians, but the number of females had grown to 44. The latest list (with deaths up to 2006) still shows the same two males, but now with 64 females. It is possible that the probability that a person who reaches age 100 will die before reaching age 110 may be slightly higher for males than for females, but the numbers are still small, and war deaths in 1914-18 may be relevant. Be that as it may, the cumulative total number of supercentenarians in England and Wales continues to grow. This can be seen from Table 2.

A recent development is that the Office for National Statistics (ONS), which incorporates the former OPCS, now produces frequency

Table 2. Verified cases of supercentenarians

Period	Number of verified cases	Highest verified age
1968-1972	2	111
1973-1977	2	112
1978-1982	7	112
1983-1987	3	114
1988-1992	7	113
1993-1997	17	115
1998-2002	15	115
2003-2006	13	112

Note: Verified cases of deaths at ages 110 and over, England and Wales

distributions for the causes of death of supercentenarians, though not linked to names.

7 A very early supercentenarian

We have described the publication of the names of validated cases of supercentenarians who died in England and Wales from 1969 onwards. There was, however, a much earlier supercentenarian who has been most carefully validated. Her name was Katherine Plunket. She was born on November 20, 1820, and died on October 14, 1932, at the age of 111. She therefore became a supercentenarian in 1930.

She was born and died in Ireland, where she owned a house, but she also owned a house in London. She therefore had at least a partial connection with England and Wales.

Katherine Plunket was a member of the Anglo-Irish aristrocracy. Her grandfather was a Lord Chancellor of Ireland. Her father became a Bishop and inherited the title of Baron Plunket. Her cousins included three titled members of the aristocracy. She was the eldest of six children, but she never married and all her sisters predeceased her. In her later years, she lived alone with her servants, but she traveled extensively and was very well known. At the age of 109, she received congratulations from King George V. She had obituary notices in both the Irish and London newspapers.

There is no shortage of documentation about the entire life of Katherine Plunket. However, perhaps her most important demographic entries appear right at the beginning. She was baptized on December

13, 1820, and was then recorded with her family in the Census of Ireland in 1821.

The year 1930 is very early for the appearance of a genuine supercentenarian in any country. However, Katherine Plunket had near-contemporaries in England and Wales who reached ages 107, 108 and 109, and she lived only two years longer than this. The example of Mme Calment has shown how contemporaries can be outlived.

The documents on Katherine Plunket were traced and assembled by Julia Hynes. For full details, see Thatcher (1999c).

8 Probabilities of dying and the limit to life

We are interested not only in the numbers of people who reach ages 100 and 110, but also in how long they survive. We use the standard terminology. If a number of people reach the exact age x, then the proportion of them who die before reaching age $x + 1$ is denoted by $q(x)$, and this is often described as the probability of dying (within 12 months).

It is not so long ago since it was widely believed that there is a fixed biological limit to the lifespan of the human species, which cannot be exceeded. If this were so, the probability of dying $q(x)$ would start to rise towards 100% as the limit of life is approached. It used to be very difficult to measure these probabilities, but, with the recent explosion in numbers at very high ages, combined with the use of the method of extinct cohorts, it is now much easier.

To cut a long story short, $q(x)$ so far shows no sign of reaching anywhere near 100%. There has been theoretical work on the "trajectory" of mortality, which expresses the force of mortality as a function of age. This work has been based on data for many countries and current theories suggest that $q(x)$ will not exceed a ceiling (asymptote) of about 0.6. There is no firm evidence that this value has been reached in any country (Kannisto, contribution to the discussion on Thatcher, 1999a).

Table 3 shows the official estimates of $q(x)$ for centenarians in England and Wales in 1985-1995, and in 1995-2005. The table does not extend above age 104 for males, and 106 for females, because at ages higher than these there were fewer than 100 deaths in either decade, so that any estimates based directly on the data for deaths will have high standard errors. However, it is notable that the estimates given in Table 3 show no fall in $q(x)$ between the two decades.

The observed values of $q(x)$, at least in England and Wales in 1985-1995, were still less than 0.48, at least up to age 106 for females, and

Table 3. Probability of dying within 12 months $q(x)$

	Males		Females	
Age	1985-1995	1995-2005	1985-1995	1995-2005
100	0.38	0.38	0.35	0.35
101	0.40	0.41	0.37	0.37
102	0.41	0.43	0.38	0.39
103	0.42	0.41	0.39	0.42
104	0.43	0.44	0.43	0.44
105			0.45	0.45
106			0.44	0.48
107				
108				

104 for males. Even at these very high ages, a person chosen at random will still have a better-than-equal chance of living for at least one more year.

9 Prospects for the future

We have described how the number of centenarians in England and Wales, once fewer than 300 until the 1950s, then started to "explode," and reached about 8,513 on January 1, 2006. Projections for the future are published by the Office for National Statistics. Table 4 gives the latest official (2006-based) projection which reaches 486,000 in 2076. Figure 2 illustrates this, and also shows an unpublished continuation (assuming no changes in trends) which reaches about a million centenarians in 2106. Although views on future trends may change, any revisions seem unlikely to change the prospect that a huge further increase in the number of centenarians is to be expected; provided, presumably, that there will be enough carers to look after so many.

Table 4. Projected numbers of centenarians

Year	2008	2026	2046	2066	2076
Official principal projection	10,000	32,000	167,000	403,000	486,000

Note: Projected number of centenarians in England & Wales in selected years (1 Jan).
Source: Data derived from 2006-based principal population projections for England and Wales

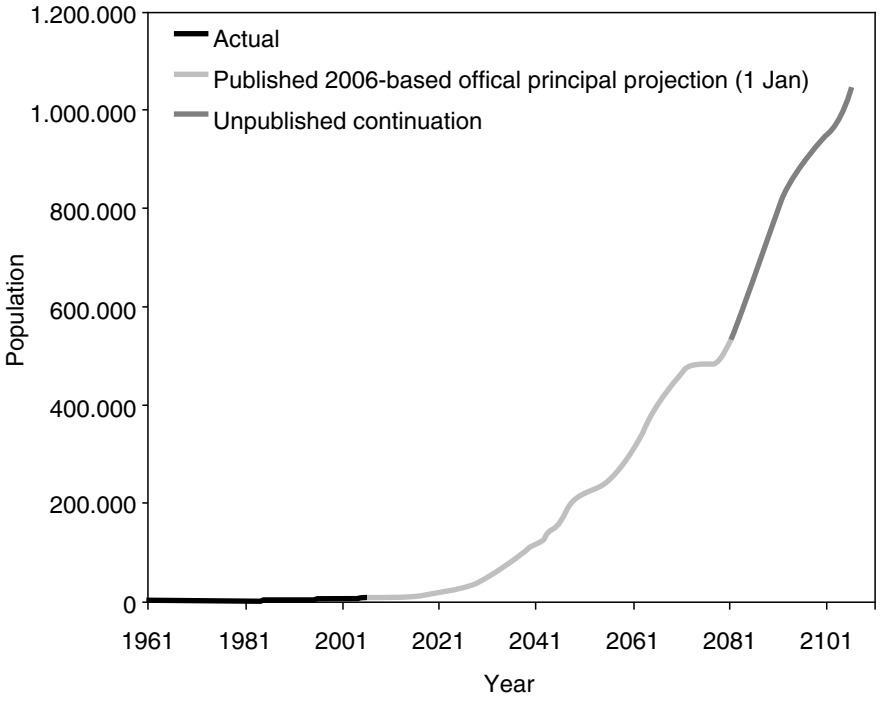

Fig. 2. Actual and projected number of centenarians in England & Wales

Note: Population aged 100 years and over on 1st January, England and Wales, 1961 to 2106

This large impending increase in the number of centenarians means that the record for the highest age can be expected to rise. According to the theory of the highest attained age (see Thatcher, 1999a), the highest age depends not only on the death rates, but also on the numbers. A record age is more likely to happen in a large population than in a small one. Put another way, if only one person reaches (say) 115, then nobody may reach 116. On the other hand, if numbers grow so that several reach 115, we shall not be so surprised if one of them reaches 116. This is how the record age can increase.

The highest age at death in a calendar year varies from year to year, within a range of about six years of age. The highest age recorded so far in England and Wales is 115 years. As the century advances, and if the number of centenarians increases as projected, this highest age can be expected to rise to at least 119 years, and may possibly even exceed the age of 122 years that has already been reached by Mme Calment in France.

Some fairly high ages are to be expected when the large cohort born in 1966 reaches the relevant age range, around the year 2080. This may sound like a long way ahead, but the people born in 1966 are already aged 42.

Acknowledgement

The author is much indebted to the Office for National Statistics for providing the latest tables and figures.

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