THE DEMOGRAPHY OF SUPER SURVIVORS IN ENGLAND & WALES

LA DEMOGRAFÍA DE LOS SÚPER SOBREVIVIENTES EN INGLATERRA Y GALES.

George W. Leeson
University of Oxford, Oxford, Inglaterra
ORCID: https://orcid.org/0000-0002-4720-791X
E-mail:george.leeson@ageing.ox.ac.uk

Trabalho enviado em 11 de maio de 2022 e aceito em 09 de julho de 2022

ABSTRACT

Against a backdrop of population ageing and an increasing number of centenarians in England & Wales after the 2nd World War, this paper analyses the expected length of life of super survivors at different ages in 1956, 2016 and 2050. In particular, the paper highlights the development in the gender divide in respect of expected total length of life for both the super survivors and the general population, and the analyses reveal that this aspect of gender inequality has declined over the 60 year period from 1956 to 2016, and is expected to continue to decline to the middle of the 21st century, falling to less than 1 year for the super survivors.

Key words Population ageing, expected total length of life, life expectancy, super survivors.

RESUMO

Tendo como pano de fundo o envelhecimento da população e um número crescente de centenários na Inglaterra e no País de Gales após a 2ª Guerra Mundial, este artigo analisa a expectativa de vida dos super-sobreviventes em diferentes idades em 1956, 2016 e 2050. Em particular, o artigo destaca o desenvolvimento na divisão de gênero em relação à expectativa de vida total tanto para os super-sobreviventes quanto para a população em geral, e as análises revelam que esse aspecto da desigualdade de gênero diminuiu ao longo do período de 60 anos de 1956 a 2016, e espera-se que continue a declinar até meados do século XXI, caindo para menos de 1 ano para os super-sobreviventes.

Palavras-chave: Envelhecimento da população, expectativa de vida total, expectativa de vida, super-sobreviventes.

INTRODUCTION

The world is ageing both at an individual and population level (Leeson 2016) and the population of England & Wales is already *demographically mature* (Harper 2006) with a larger proportion of the mid-2016 population aged 60 years and over (23.3 per cent) than aged under 15 years (17.9 per cent) (Office for National Statistics 2017).

It is the development in fertility and mortality together that brings about the ageing of the population. In England & Wales, as elsewhere, the 20th century saw a dramatic transformation of the population's age structure as the changes in fertility, and in early life and then later life mortality passed into and through the age structure of the population. This is a continual demographic process for any population and the population structure of the future will reflect the increasing longevity predicted for males and females as well as modest increases in fertility.

So, for example, according to data from the Human Mortality Database, in 1925, the proportion of the population in England & Wales aged under 15 years was 26.4 per cent. By mid-2016, this had declined to 17.9 per cent (Office for National Statistics 2017). As a consequence of the ageing of the population, the proportions aged over 65 years have in the same period increased from 6.4 per cent to 18 per cent respectively. The age pyramid for England & Wales is expected to continue to change dramatically moving forward to 2050 with the proportions in younger age groups continuing to decline and those in later-life age groups in particular increasing. By 2050, the proportion aged under 15 years will have declined further to 16.5 per cent whilst the proportion aged over 65 years will increase to 25.2 per cent (Office for National Statistics 2017a).

Mortality: The first driver of population ageing is that of mortality. Life expectancies across the whole of the United Kingdom, including England & Wales, have been increasing at birth and at age 65 years since the mid-20th century (Leeson 2016a). The time taken for ten-year incremental increases in life expectancy at birth for both males and females corresponds to increases of around 2 years per decade. More specifically, in England & Wales, male life expectancy at birth increased over a period of 60 years by more than 13 years from 67.6 years in 1956 to 79.9 years in 2016, and female life expectancy increased from 72.9 to 83.4 years in the same time period (Office for National Statistics 2015). This rate of increase has decreased significantly since the early 20th century when it took only around 20 years for females and 25 years for males to increase their life expectancies by 10 years. This reflects in part what Bongaarts (2006) termed the transition from juvenile to senescent mortality. The difference in absolute terms between male and female life expectancy at birth also exhibits an interesting development in recent decades. In the late 19th century, female life expectancy at birth exceeded male life expectancy at birth by approximately 2 years but by the 1960s this difference had increased to 6 years. By the 1990s, however, the life expectancies began to converge, the difference falling to approximately 5 years in the 1990s and to approximately 3-4 years by the 2010s (Leeson 2016a).

Thus, the 20th century saw a shift in mortality declines in England & Wales from younger to older age groups, reflecting the demographic reversal of the previous conviction that mortality at older ages is intractable (Wilmoth 1997; Vaupel 1998). The latter part of the 20th and the early part of the 21st centuries are reliant on mortality declines in later life and even in extreme old age to drive continued increases in life expectancy at birth. Declines in mortality among the extreme aged have already been striking (Vaupel 1998) and the age-specific mortality rate for females aged 80 in England & Wales has declined from around 70 per 1000 population in the early 1980s to less than 40 by 2016. For females at age 90 years, the decline in the same period has been from around 170 to around 130 per 1000 population. Similar order of magnitude improvements have occurred in that period for older males declining from around 110 to 50 per 1000 at age 80 years and from around 215 to 165 per 1000 at age 90 years (Office for National Statistics 2017b).

At age 65 years, it is interesting to note that while life expectancy at birth increased steadily over the last 170 years or so, life expectancy at age 65 years was slow in beginning to increase. Indeed from the mid-18th to the early 20th century, it remained more or less the same, and the difference between male and female life expectancy at age 65 years was less than 1 year. The turn of the 20th century saw life expectancy at age 65 years begin to increase steadily – particularly for females, and with this came a divergence of male and female life expectancies, mirroring the development to some extent for life expectancies at birth. Post 2nd World War, life expectancy at age 65 years for females continued to increase while for males there are signs of stagnation, which led to an increase in the male-female difference in life expectancies at age 65years to around 4 years in the 1960s. By the end of the 20th century, however, male life expectancy at age 65 years had increased and reduced this difference to around 2.5 years.

Fertility: In the mid-18th century, total fertility in England and Wales was at around 3.75 – 4.5, from where it rose to around 5.75 in the early 1800s (Woods 2000). Fertility declines saw fertility levels fall towards replacement level in the continued fertility decline of the demographic transition (for example, Kirk 1996; Hobcraft 1996) and then to below replacement in the second demographic transition (van de Kaa 1987), leaving England & Wales in the first 17 years of the 21st century still in a low fertility cycle after almost 40 years of below replacement fertility.

Levels of fertility subsequently increased from an all-time low of 1.63 in 2001-2 to around 1.9 in 2008-12 after which they have declined to 1.82 in 2014. There is no single explanation to these increasing levels of fertility in the early years of the 21st century (Office for National Statistics 2013) and such low levels of fertility remain a matter of concern among demographers and policy makers (Sobotka 2008).

Against a backdrop of population ageing in England & Wales after the 2nd World War, this paper will analyse the life expectancies of super survivors – the 10% longest surviving of different cohorts – compared with population life expectancies and the development of these since the mid-1950s to the present day and beyond to 2050.

PURPOSE, AIMS AND BACKGROUND

As discussed in Leeson (2016a), living long lives is not just a phenomenon experienced in our recent demographic history. Some evidence of centenarians and super centenarians exists for populations more than 1500 years ago. The Greek philosopher Democritus of Abdera is referenced by Diogenes Laertius in 250AD as *assuredly* having lived 109 years. By the 19th century, with improving and more universal records of deaths in many countries, evidence of centenarians becomes more reliable. In fact in Norway, there seems to be evidence of centenarians before 1800 (Kjaergaard 1995). The verified oldest person ever to have lived is Jeanne Calment, who died in France in 1997 aged 122 years 164 days. The verified oldest person still alive (as of January 31st 2018) is Nabi Tajima of Japan – born on August 4th 1900 and aged 117 years and 181 days at the time. The oldest verified person in England & Wales is Bessie Camm, born on June 20th 1904 and aged113 years and 225 days.

While we may not all live into our 100s, Leeson (2016a) suggests there will indeed be significantly more centenarians in England & Wales as we move deeper into the 21st century. The number of centenarians in England and Wales increased from around 160 in 1922 (Human Mortality Database) to around 18,000 by (Office for National Statistics 2011 & 2011a). By 2100, the number of centenarians in England & Wales is expected to reach around 1.4 million. However, if predicted mortality for those aged 55 years and over was to decrease by an additional 5% every 5 years until

2100, then the number of centenarians in England and Wales would reach around 1.8 million by the end of the century (Leeson 2016a).

It is against this backdrop of population ageing in England & Wales after the 2nd World War that this paper will analyse the life expectancies and expected total length of life of super survivors – the 10% longest surviving of different cohorts – compared with population life expectancies and length of life and the development of these since the mid-1950s to the present day and beyond to 2050.

METHODS

Data sources: In this paper's analyses of super survivors and their age-specific counterparts in the population, we utilized life table data for males and females respectively in England & Wales published by the Office for National Statistics covering the period 1841-2064 (Office for National Statistics 2015). The historical tables pre 1961 are not published National Statistics and the life tables for 2015 to 2064 are based on projected mortality rates from the 2014-based National Population projections (principal assumption).

Super survivors: as mentioned above, super survivors are defined as the longest surviving 10% of the life table cohort at the selected age. In these analyses we consider males and females separately and at ages 25, 35, 45, 55 and 65 years. This 10% will have survived to a certain age, and it is the life expectancy at that age we then consider. At age x, in the life table there will be l(x) survivors and so the super survivors of these would amount to l(x)/10 who attain age y, say, at which age life expectancy is e(y). e(y) is then calculated from the life table assuming a uniform distribution of deaths and life expectancy around age y. If age y is between age z and z+1 in the life table,

$$l(y) = l(x)/10$$

and the super survivor age y is given by

$$y = z + 1 - ((l(y) - l(z+1))/((l(z) - l(z+1)))$$

while life expectancy at super survivor age y is given by

DOI: 10.12957/rqi.2022.67157

$$e(y) = e(z) - (e(z) - e(z+1)) \,.\, (1 - ((l(y) - l(z+1))/((l(z) - l(z+1))))).$$

The expected total length of life for the super survivors of those aged x, say long(x), is then

$$long(x) = y + e(y).$$

Analytic strategy: The analyses carried out are both retrospective and prospective. Retrospectively, life table data for England & Wales have been analysed for 1956 and 2016 to compare the life expectancies and expected total length of life for male and female super survivors respectively from the life table cohorts aged 25, 35, 45, 55 and 65 years. These data are compared with data for the general population of males and females in the respective life tables and for the respective ages. The prospective analyses have considered how projected mortality in England & Wales will impact on the life expectancies and expected total length of life of the same groups moving forward to 2050.

The published life table for 2050 for females (Office for National Statistics 2015) ends at 100 years with an estimated number of survivors l(100) equal to 13236. At each of the selected ages, the super survivors survive to an age beyond the tabulated 100 years. For example, the super survivors of the cohort of females in 2050 aged 25 amount to 9962. The estimation of the life expectancy for the super survivors needs therefore first of all to continue the life table survivors beyond 100 years. This is done by using the survivorship beyond age 100 given by the Human Mortality Database for England & Wales for 2014, which then enables us to estimate that 8875 females aged 25 years would survive to age 101. The same process can then be completed for each group of super survivors to give the final set of data used in the analyses.

RESULTS

It is something of a truism that the longer we live, the longer we can expect to live, but it is informative to consider just how life expectancies in later life relate to the life expectancies at birth and how these themselves relate to the achievements of super survivors at different points in time – in this analysis 1956, 2016 and 2050. To begin the analysis, Table 1 presents life expectancies and the corresponding expected total length of life (age x + life expectancy at age x) in England & Wales in 1956 for males and females respectively at ages 0, 25, 35, 45, 55 and 65 years. In 1956, it was expected that the longer we lived, the longer we could expect to live. So for males, life expectancy at age 25 years in 1956 would have taken them to age 70.5 years. And life expectancy at age 65 years in 1956 would have taken them to 76.8 years. The pattern and picture is similar for females, albeit with longer life expectancies and expected total length of life at all ages.

Table 1. Life expectancies and expected total length of life for those aged 25, 35, 45, 55 and 65 years for males and females, England & Wales, 1956.

Age x	0	25	35	45	55	65
			Males			
Life exp. at age x	67.6	45.5	36.0	26.8	18.5	11.8
Exp. total life	67.6	70.5	71.0	71.8	73.5	76.8
			Females			
Life exp. at age x	73.0	50.3	40.7	31.4	22.7	14.8
Exp. total life	73.0	75.3	75.7	76.4	77.7	79.8

Source: Office for National Statistics (2015)

The data for these life expectancies and expected total length of life reveal a number of interesting elements about each gender but also about the gender divide in terms of life expectancy. For example, over a survival of 65 years, females in 1956 were expected to gain almost 7 years in expected total length of life compared with just over 9 years for males. And while the life expectancy gender gap was 5.4 years in favour of females at birth, this had reduced to 3 years at age 65 years.

Using this same life table (Office for National Statistics 2015), we can consider the life expectancies and expected total length of life for what we shall term *super survivors* – super survivors are defined as the longest surviving 10% of the life table cohort at the selected age. The results for the 1956 data are shown in Table 2.

Table 2. Life expectancies and expected total length of life for super survivors of each cohort aged 25, 35, 45, 55 and 65 years for males and females, England & Wales, 1956.

Age x	25	35	45	55	65
		Males			
Life exp. at age x	63.4	53.5	43.7	33.9	24.7
Exp. total life	88.4	88.5	88.7	88.9	89.7
		Females			
Life exp. at age x	67.4	57.4	47.5	37.6	28.1
Exp. total life	92.4	92.4	92.5	92.6	93.1

Source: Own calculations from data from Office for National Statistics (2015)

The data for 1956 reveal that the super survivors of the male cohorts considered had an expected total length of life between 12 and 18 years longer than the general male population at these ages, while the gains for super surviving females were between 13 and just over 17 years.

Some 60 years ago, the super survivors of the 65 year old cohort were expected to live for around another 25-28 years and all cohorts had life expectancies for the super survivors which would take them into their late 80s (males) or early 90s (females). The gender gap for super survivors is smaller than for the general population at each tabulated age. At age 25, the gap is 4 years compared with 4.8 years, falling to 3.4 years at age 65 years compared with 3 years. So, while gains in life expectancy for the super survivors are quite significant the gender gap is reduced modestly.

Let us consider now how these life expectancies and expected total length of life changed in the period 1956-2016. Table 3 provides the general population data based on the 2016 life tables (Office for National Statistics 2015) and these data reveal some interesting changes over the course of 60 years or so. For example, in absolute terms, over a survival of 65 years, both males and females are expected to gain less than their age-counterparts some 60 years earlier. The gain now is around 3 years in expected total length of life for females (down from 7 years in 1956) and around 4 years for males (down from 9 years in 1956). However, the increases in overall life expectancies at the different ages are noteworthy. At birth, life expectancies have increased by almost 13 years for males and just over 10 years for females, thereby decreasing the gender divide in life expectancy. And at age 65 years, males can expect to live around 7 years more than their age counterparts in 1956 and for females the gain is similar. This is a reflection of the continued move to senescent rather than juvenile mortality after the middle of the 20th century.

Table 3. Life expectancies and expected total length of life for those aged 0, 25, 35, 45, 55 and 65 years for males and females, England & Wales, 2016.

Age x	0	25	35	45	55	65
		Males				
Life exp. at age x	80.1	55.8	46.1	36.7	27.6	19.2
Exp. total life	80.1	80.8	81.1	81.7	82.6	84.2
		Females				
Life exp. at age x	83.6	59.1	49.3	39.7	30.3	21.5
Exp. total life	83.6	84.1	84.3	84.7	85.3	86.5

Source: Office for National Statistics (2015)

Let us now consider the 2016 life table data for super survivors in England & Wales shown in Table 4.

Table 4. Life expectancies and expected total length of life for super survivors of each cohort aged 25, 35, 45, 55 and 65 years for males and females, England & Wales, 2016.

Age x	25	35	45	55	65
Males					
Life exp. at age x	72.3	62.3	52.3	42.4	32.6
Exp. total life	97.3	97.3	97.3	97.4	97.6
Females					
Life exp. at age x	74.4	64.4	54.4	44.5	34.6
Exp. total life	99.4	99.4	99.4	99.5	99.6

Source: Own calculations from data from Office for National Statistics (2015)

When compared with the data in Table 3, these data reveal that the super survivors of the male cohorts in 2016 have an expected total length of life of between 13 and 17 years longer than the general male population at these ages, while the gains for females are between 13 and 16 years. The super survivors of the 65 year old cohort can expect to live for at least another 30 years, and for all cohorts, life expectancies for the super survivors take them into their late 90s, with females reaching almost 100 years in expected total length of life. From 1956 to 2016, it is estimated that the super survivors of those aged 65 years added 6.5 to 8 years to their life expectancies, the greatest improvement being for males. This is a significant increase at this age.

With the survival curve for both males and females becoming rectangularised (Fries 1980), the data reveal both for the general populations and the super survivors that increases in life expectancies have been possible by increasing survival and extending lives in later life, in contradiction of the conviction that mortality at older ages is intractable (Wilmoth 1997; Vaupel 1998; Leeson 2014 & 2014a).

Population ageing in England & Wales is expected to continue well into the 21st century, so let us consider the predicted development in the life expectancies and expected total length of life to 2050 (Table 5).

Table 5. Life expectancies and expected total length of life for those aged 0, 25, 35, 45, 55 and 65 years for males and females, England & Wales, 2050.

Age x	0	25	35	45	55	65
	Males					
Life exp. at age x	85.7	61.1	51.3	41.7	32.3	23.5
Exp. total life	85.7	86.1	86.3	86.7	87.3	88.5
	Females					
Life exp. at age x	88.4	63.7	53.8	44.1	34.5	25.4
Exp. total life	88.4	88.7	88.8	89.1	89.5	90.4

Source: Office for National Statistics (2015)

To the middle of the 21st century (at least), the observed increases in life expectancy at all ages are predicted to continue, and over the course of almost 100 years from 1956 to 2050, life expectancy at age 25, for example, will have increased by almost 16 years for males and by more than 13 years for females. Life expectancy at birth by 2050 will be approaching 90 years for both males and females.

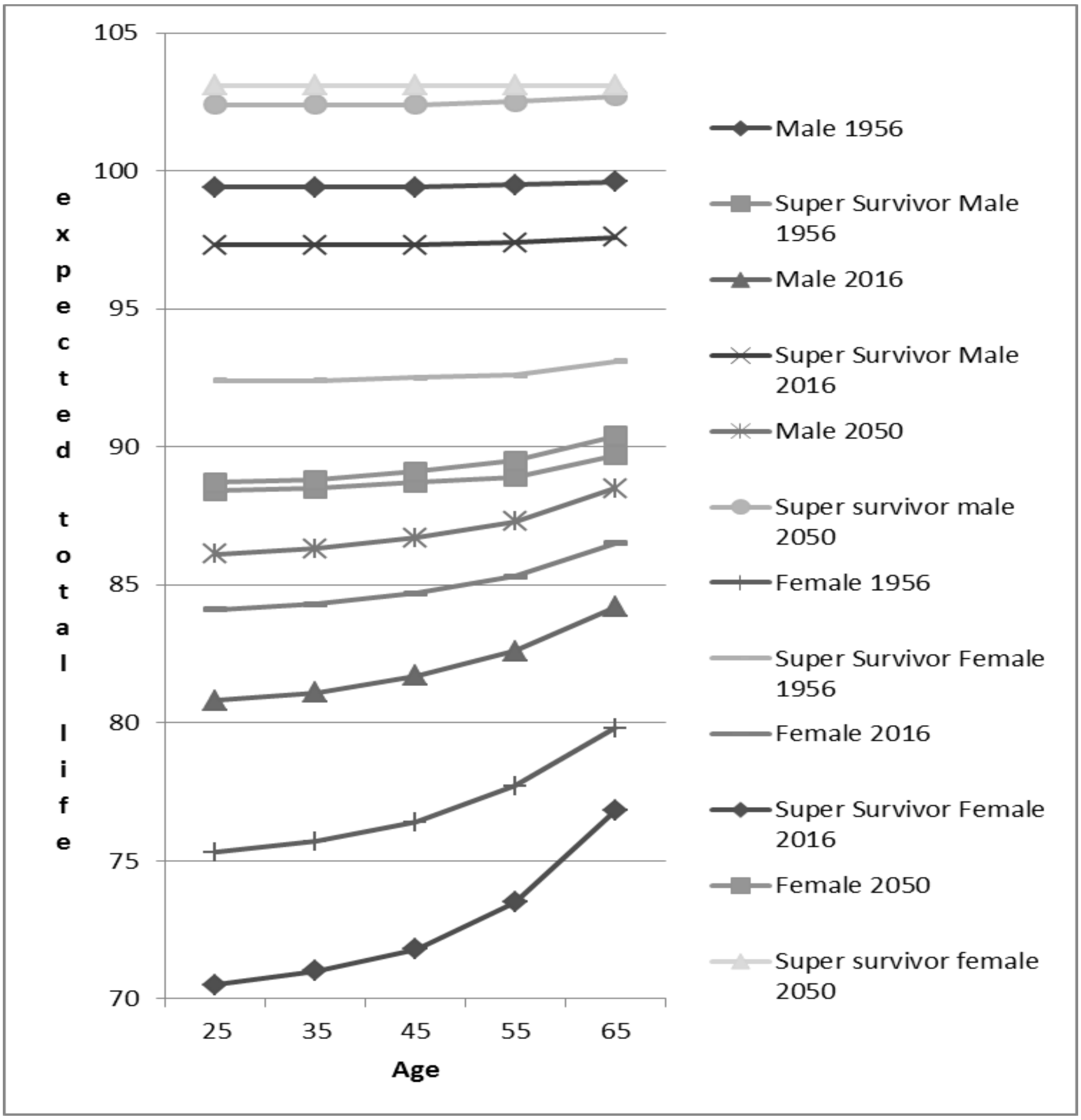
The life expectancies and estimated expected total length of life for super survivors from the 2050 life table are shown in Table 6. There is already a substantial body of evidence which suggests that lives will continue to be extended (Bongaarts 2006; Thatcher 1999, 2001; Olshanky et al. 2001; Robine, Saito & Jagger 2003; Wilmoth & Robine 2003; Christensen et al. 2009; Vaupel 2010; Leeson 2014) and these data for England & Wales to the middle of the 21st century support this suggestion. The expected total length of life for all cohorts, both male and female, according to the 2050 life table for England & Wales is more than 100 years, and the super survivors' expected length of life is up to around 15 years longer than their general population counterparts.

Table 6. Life expectancies and expected total length of life for super survivors of each cohort aged 25, 35, 45, 55 and 65 years for males and females, England & Wales, 2050.

Age x	25	35	45	55	65
	Males				
Life exp. at age x	77.4	67.4	57.4	47.5	37.7
Exp. total life	102.4	102.4	102.4	102.5	102.7
	Females				
Life exp. at age x	78.1	68.1	58.1	48.1	38.1
Exp. total life	103.1	103.1	103.1	103.1	103.1

Source: Own calculations from data from Office for National Statistics (2015)

Figure 1. Expected total life for cohorts aged 25, 35, 45, 55 and 65 years for all and for super survivors in England & Wales, 1956, 2016 and 2050, males and females.



DOI: 10.12957/rqi.2022.67157

Figure 1 illustrates the expected total length of life for the different cohorts and for males and females in 1956, 2016 and 2050, both super survivors and the general population. In absolute terms, the expected total length of life for super survivors has remained at around 15 years greater than the expected total length of life for the equivalently aged general population in the period from 1956 to 2050. It is interesting to note that the gender divide for super survivor expected total length of life decreases over time, having been at 3.5 to 4 years in 1956, falling to 2 to 2.1 years in 2016, and to just 0.4 to 0.7 years by 2050. The same is true of the gender divide for expected total length of life for the general population, although the divide is at all times greater than for the super survivors, namely 3 to 5.5 years in 1956, 2.3 to 3.5 years in 2016 and 1.9 to 2.7 years in 2050.

While it is implicitly clear from the analyses thus far that increasing numbers of people in England & Wales will be living to extreme old age, it is possible to gain a more clear insight into the actual numbers of extremely long-lived persons. Data from the Office for National Statistics for the United Kingdom reveal that in 2017, only 9 persons were aged 110 years or over, with not a single person aged 115 years or over. By 2050, almost 1900 persons are expected to be alive aged 110 years or over, with 21 aged 115 years or over. At the end of the 21st century, more than 81,000 persons will be aged 110 years or over; almost 8000 will be aged 115 years or over; and almost 400 will be aged 120 years or over.

In other words, by the end of the 21st century, there will be around 5 times as many people aged 110 years and over as there currently are aged 100 years and over. The verified oldest person ever to have lived is Jeanne Calment, who died in France in 1997 aged 122 years 164 days. In 2100, in the United Kingdom, it is estimated that there will be 10 people alive at age 125 years (Office for National Statistics 2013a).

This is in no uncertain terms, a tale of super survivors – and many of them.

CONCLUDING REMARKS AND DISCUSSION

Against a backdrop of population ageing and an increasing number of centenarians in England & Wales after the 2nd World War, this paper has analysed the expected length of life of super survivors at different ages in 1956, 2016 and 2050. In particular, the paper highlights the development in the gender divide in respect of expected total length of life for both the super survivors and the general population, and the analyses reveal that this aspect of gender inequality has declined over the 60 year period from 1956 to 2016, and is expected to continue to decline to the middle of the 21st century, falling to less than 1 year for the super survivors.

One of the greatest achievements of humankind has to be that as many people as possible are living as long as possible. Not just in England & Wales as witnessed in this paper, but around the world, new generations can expect to live longer than previous generations. However, with the on-going success of longer and longer lives come questions for individuals, families, communities and societies. A key question relates to the development of national policies which will maintain well-being for all citizens across increasingly long lives as well as address inequalities between and within generations. Another key question relates to the way in which technological development will change our lives. The digital revolution of the 21st century threatens low- and perhaps even middle-skilled jobs on the one hand but offers opportunities to develop new methods of providing health and social care for an ageing population.

The demography demands political attention in its own right. The demographic trends outlined in this paper, are a natural consequence of on-going demographic change in England and Wales and elsewhere. In the recent past, European populations experienced fundamental changes brought about by the ageing of their populations. Human longevity exceeded expectations and mid- and late-life mortality declined as the prevention and treatment of life style diseases such as cardiovascular diseases improved. The future will be one of a continued significant increase in length of life and the numbers achieving these long lives.

While this paper has England and Wales as its focus, increasing length of life and increasing numbers of citizens achieving these long lives will be at least equally challenging elsewhere in both the developed and the emerging economies of the world. Regardless of location, the trend has fundamental consequences for the way in which individuals view and live these extending lives, but also for the way in which societal infrastructures (education, workplace, housing, transport, health and social care) will need to be adapted to the needs of these populations of the future. At the individual level, these developments present a challenge to life course planning. Family dynamics will be challenged by the survival of these extreme aged generations delaying intergenerational succession and inheritance and depending on smaller families for support in frail and dependent old age. The prospect of declining population size as well as this demography of super survivors also raises workplace issues as traditionally defined workforces contract, technologies increase and individuals look to continue working for many years past traditional retirement – both because of a desire to continue to contribute and a need to continue in order to remain financially secure into such great old age (Leeson & Harper 2007, 2008).

ACKNOWLEDGEMENT

This research is part of the *Demographic Forecasting* programme at the Oxford Institute of Population Ageing, supported by the Oxford Martin School at the University of Oxford.

REFERENCES

Bongaarts, J. (2006) How long will we live? *Population and Development Review*, Vol. 32 (4), pp. 605-628.

Christensen, K., Doblhammer, G. & Vaupel, J. (2009) Ageing populations: the challenges ahead, *Lancet*, Vol. 374 (9696), pp. 1196-1208.

Fries, J.F. (1980) Aging, natural death and the compression of morbidity, *The New England Journal of Medicine*, Vol. 303 (3), pp. 130-135.

Harper, S. (2006) *Ageing Societies*, Hodder Arnold, New York.

Hobcraft, J. (1996) Fertility in England and Wales: a fifty year perspective, *Population Studies*, Vol. 50 (3), pp. 485-524.

Kirk, D. (1996) Demographic transition theory, *Population Studies*, Vol. 50 (3), pp. 361-387.

Kjaeregaard, T. (1995) Alleged Danish centenarians before 1800. In: Jeune, B. & Vaupel, J.W., editors, *Exceptional longevity: from prehistory to present*, Odense Monographs on Population Ageing 2, Odense University Press.

Leeson, G.W. (2014) Future prospects for longevity, *Post Reproductive Health*, Vol. 20 (1), pp. 17-21.

Leeson, G.W. (2014a) Increasing longevity and the new demography of death, *International Journal of Population Research*, Article ID 521523, 7 pages, doi:10.1155/2014/521523.

Leeson, GW (2016) Environment, Health and Ageing, in *Environmental Gerontology in Europe and Latin America – Policies and Perspectives on Environment and Aging* (eds. Diego Sanchez-Gonzales & Vicente Rodriguez-Rodriguez), pp. 93-104, Springer International Publishing, Switzerland.

Leeson, GW (2016a) The impact of mortality development on the number of centenarians in England and Wales, *Journal of Population Research,* Springer, 23 September 2016, pp. 1-15, DOI 10.1007/s12546-016-9178-8.

Leeson, G.W. & Harper, S. (2007) The Global Ageing Survey (GLAS) - Ageing and later life, United Kingdom and Europe, Research report 107, Oxford Institute of Ageing, University of Oxford, Oxford.

Leeson, G.W. & Harper, S. (2008) Some descriptive findings from the Global Ageing Survey (GLAS) – Investing in later life, Research report 108, Oxford Institute of Ageing, University of Oxford, Oxford.

Office for National Statistics (2011) 2010-based National Population Projections, Principal Projection England, ONS, London.

Office for National Statistics (2011a) 2010-based National Population Projections, Principal Projection Wales, ONS, London.

Office for National Statistics (2013) Why has the fertility rate risen over the last decade in England and Wales? Part of Birth Summary Tables - England and Wales, 2011 (Final) Release, Released: 17 June 2013.

Office for National Statistics (2013a) 2012-based National Population Projections, Principal Projection United Kingdom, ONS, London.

Office for National Statistics (2015) 2014-based National Population Projections Life table, England and Wales 1841-2064, ONS, London.

Office for National Statistics (2017) Population estimates for the United Kingdom, England and Wales, Scotland and Northern Ireland: mid-2016, ONS, London.

Office for National Statistics (2017a) 2016-based National Population Projections, ONS, London.

Office for National Statistics (2017b) Past and projected mortality rates from the 2016-based England & Wales life tables, principal projection, ONS, London.

Olshansky, J., Carnes, B.A. & Desesquelles, A. (2001) Prospects for human longevity, *Science*, Vol. 291 (5508), pp. 1491-92.

Robine, J-M., Saito, Y. & Jagger, C. (2003) The emergence of extremely old people: the case of Japan, *Experimental Gerontology*, Vol. 38, pp. 735-739.

Sobotka, T. (2008) Does persistent low fertility threaten the future of European populations? In "Demographic Challenges for the 21st Century" (eds. Surkyn, J., Debrosere, P. & Van Bavel, J.), pp. 27-90, Brussels University Press.

Thatcher, R. (1999) The demography of centenarians in England and Wales, *Population Trends*, 96, Office for National Statistics, London.

Thatcher, R. (2001) The demography of centenarians in England and Wales, *Population; An English Section*, Vol. 13 (1), pp. 139-156.

Van de Kaa, D.J. (1987) Europe's second demographic transition, *Population Bulletin*, Vol. 42 (1), pp. 3-57.

Vaupel, J. (1998) Demographic analysis of aging and longevity, *The American Economic Review*, Vol. 88 (2), pp. 242-247.

Vaupel, J. (2010) Biodemography of human ageing, *Nature*, Vol. 464, pp. 536-542.

Wilmoth, J.R. (1997) In search of limits: what do demographic trends suggest about the future of human longevity, in *Between Zeus and the Salmon* (eds. Wachter, K.W. & Finch, C.E.), National Academy Press, Washington DC, pp. 38-64.

Wilmoth, J.R. & Robine, J-M. (2003) The world trend in maximum life span, *Population and Development Review*, Vol. 29, pp. 239-257.

Woods, R. (2000) *The Demographics of Victorian England and Wales*, Cambridge University Press, Cambridge, UK.

Sobre o autor:

George W. Leeson
University of Oxford, Oxford, Inglaterra
ORCID: https://orcid.org/0000-0002-4720-791X
E-mail:george.leeson@ageing.ox.ac.uk