

Does living in a retirement village extend life expectancy? The case of Whiteley Village

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Foreword

The dramatic increases in average life expectancies witnessed throughout the 20th and early 21st centuries is one of our society's greatest achievements. However, this achievement has too often been overshadowed by the stark disparity in life expectancy between the highest and lowest socio-economic groups; life expectancy at birth for men living in the least deprived parts of England is nearly eight years higher than in the most deprived areas.

The increasing number of people we expect will require residential care at some point in their lives provides a new impetus to examine how retirement village communities can cater for the needs of their residents. This report is particularly commendable because it examines the records of residents of Whiteley Village, covering 100 years of its existence including their longevity experience.

It finds that Villagers, particularly females, live longer than the average for England & Wales and this advantage was especially pronounced when pensioner poverty was higher than it is today. This is particularly remarkable since eligibility to become a resident of Whiteley, usually at around normal retirement age, is based on having limited financial means i.e. people who would be expected to die sooner on average.

This advantage continues today if one compares the longevity of Whiteley Villagers with the poorest 20% of pensioners in England & Wales. The key message therefore is that as well as increasing quality of life, housing with care communities such as Whiteley Village can also extend life expectancy.

As the residential care sector continues to respond to the needs of our rapidly ageing society, I hope that policymakers and the social care sector can take heart in knowing that, whilst socio-economic inequalities in life expectancy sadly still exist, the right housing with care community might just be able to ameliorate the effects of deprivation and address those inequalities in later life.

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Executive Summary

The benefits or otherwise of communal living in later life are of considerable interest in the context of a growing and increasingly elderly population because of the continuously rising cost pressures on health and social care and the need to provide more suitable accommodation. Such establishments have the capacity to provide in one location all the needs of residents whilst providing a stimulating and high quality living environment which insulates residents from the day-to-day problems of growing old. Whiteley Village, currently celebrating its 100th anniversary, is one of the main forerunners of this kind of retirement living anywhere in the world. The aim of this study is to investigate the possible benefits of retirement village life with respect to life expectancy i.e. whether Villagers live longer on average than the general population. Our results show that there is strong statistical evidence that female residents, in particular, receive a substantial boost to their longevity when compared to the wider population – at one point in time reaching close to five years. Whiteley's longevity advantage is even greater once we take account of the fact that the resident population is drawn from the poorest pensioners, who would be expected to experience higher mortality rates. Although we were unable to find sufficient statistical evidence that the male residents of Whiteley outlive their counterparts in the wider population, there was certainly evidence that the majority lived at least as long on average (i.e. the effects of living at Whiteley appears to combat the inequalities caused by social deprivation).

Key words: Population aging – longevity – life expectancy – social deprivation – social care

Does living in a retirement village extend life expectancy? The case of Whiteley Village

1. Introduction

The UK population over age 65 is projected to increase by more than 40% during the next 17 years to over 16 million; while the number of people in the UK over age 85 is expected to double during the next 23 years to more than 3.4 million (ONS, 2015a). With the population ageing so rapidly, finding ways in which the older population can live their later lives in relative good health and comfort has become an increasingly important issue in the UK.

One relatively recent development is the emergence of retirement villages in the UK to house and care for the increasing numbers of older people who are attracted to this type of retirement living. The benefits or otherwise of communal living in later life are of considerable interest in the context of a growing and increasingly elderly population because of the continuously rising cost pressures on health and social care. Such establishments have the capacity to provide in one location all the needs of residents with the potential to offer services more cheaply and effectively. A typical retirement village comprises independent living units grouped around a central residential/nursing care complex with leisure and other opportunities to engage with others, increasing the enjoyment of the later years.

Whiteley Village, the subject of this study, can be considered as one of the main forerunners of this kind of retirement living anywhere in the world. The aim of the study is to investigate the possible benefits of retirement village life with respect to life expectancy i.e. whether Villagers live longer on average than the general population. To do this we analysed Whiteley Village records from the time it opened to the present day. Our study is also very timely since 2017 represents the centenary since the first resident at Whiteley was admitted.

Hitherto the focus of published research on retirement villages has generally involved two aspects – financial arrangements and the benefits to individuals. As far as financial aspects are concerned, there is an obvious commercial dimension in which the actuarial profession has made several important and ground-breaking contributions to put such establishments on a sustainable financial basis but we do not consider these here. We would refer those interested in this area to Cumming and Bluhm (1992), Jones (1995; 1997a; 1997b) and Humble and Ryan (1998).

As for the benefits to individuals from living in a retirement village, Beach (2015) identified four main advantages which such “extra care housing” can offer:

- Greater independence for the residents by having on-site amenities and care facilities easily available
- Greater choice for later life planning
- The potential to reduce social isolation by exposure to social interaction
- Enhanced quality of life

These features represent a qualitative assessment of retirement village life in which the potential benefits are obvious. However, despite the increasing popularity of retirement villages in the UK, we are not aware of any research that has been carried out up to now into the quantitative gains which might come from living in a retirement village i.e. that living in such a retirement community might, on average, extend an individual's life.

In the UK, most retirement villages are run on a commercial basis which means that residents must be self-funding and hence will tend to come from more affluent backgrounds. By contrast, a notable feature of Whiteley Village is that, in order to be admitted, an applicant must be deemed to have low financial means (i.e. possess a low level of income and assets). This means that they are likely to be drawn from a lower socio-economic group.

It is well established that a population classified as having a low socio-economic status tends to have a lower life expectancy than the general population (ONS, 2015b). It follows, therefore, that one would expect a tendency for the life expectancy of a Whiteley Village resident to be lower than the national average. One of the main results of our study is that we show that female residents of Whiteley Village actually receive a longevity boost from retirement village life, and that the life expectancy for males reaches the same level as that of the general population.

The basis for this boost is almost certainly due to a range of factors which act in combination and reinforce each other to strong effect. In a recent survey, Villagers emphasised friendship and happiness, a strong community spirit, the level of security and monitoring of personal safety, the high quality of accommodation and also being able to voice an opinion as some of the benefits of village life. Volunteering, help with shopping, excursions, benefits advice, education and physical exercise classes, handyman services, home adaptations and living in lovely surroundings all featured strongly in their feedback.

As mentioned above, we could not find any other research which similarly analysed life expectancy within a retirement village. However, we did find some research which examined life expectancy within another self-contained community. Winkler-Dworak and Kaden (2013) carried out an interesting study which compared the life expectancy of the members of a learned society, the Saxonian Academy of Science and Humanities in Leipzig, with that of the German population during the period 1846 to 2010.

This showed that the Saxonian academicians enjoyed a higher life expectancy than the general German population at age 60, and that this was attributable to the health advantage that being amongst the intellectually elite conferred. The situation is in stark contrast to the residents of Whiteley Village whose occupational and financial backgrounds suggest a totally different kind of population. Perhaps the only similarity is being part of a 'community' with all the benefits which that implies (in the academician's case no doubt these would have involved various types of benefits in kind as well as privileged status).

Our report is structured as follows:

- Section 2 provides a brief background to the history of Whiteley Village including the accommodation, amenities and services provided which includes nursing and end of life care
- Section 3 focuses on data collection and the extraction of historical and contemporary records of Villagers from the earliest incumbents to the present day
- Section 4 provides a detailed demographic analysis of Villagers – including changes to the age and gender structure over time
- Sections 5 and 6 compare the mortality experience in Whiteley Village with that of the wider population in England & Wales, including an analysis of the occupational histories and marital status of Villagers
- Section 7 analyses the longevity of Villagers compared with the wider population through a detailed examination of the life-spans of people that joined the Village in the decades from 1930 to 1980
- Section 8 provides a summary of our overall findings

2. Brief background to Whiteley Village

Whiteley Village is a charitable retirement community comprising just under 500 older people, most of whom have limited financial means. Set in 225 acres of Surrey woodland near Walton on Thames, the Village contains 262 grade II listed almshouses, 51 extra care apartments, a residential home and a nursing home. It is managed by The Whiteley Homes Trust, a registered charity, which sees its role as enabling Villagers to be as independent as possible and contribute as much as they can to village life.

Although not the first purpose-built community, (it was preceded by estates such as Bourneville, Port Sunlight and Saltaire), Whiteley Village is believed to be the first such *retirement* village in the UK. It was established in 1914 when building began at the bequest of entrepreneur and philanthropist William Whiteley, owner of the Bayswater department store founded in 1863.

The first resident was Miss Eliza Palmer who joined the village on 10th October 1917. Therefore, in 2017, Whiteley Village celebrates 100 years since its first resident was admitted.

2.1 Accommodation

Today, Whiteley Village offers home help, nursing and end-of-life support to residents, in addition to pastoral care, housing and benefit advice and property management. Staff work closely with other professionals such as general practitioners and local hospices, though there are no resident doctors on site. Residents are encouraged to go to the local surgery, though a local general practitioner (GP) visits the Village from time to time.

There are essentially three tiers of accommodation available at Whiteley: Almshouses, Extra Care Flats (Huntley House) and a Nursing Home (Whiteley House).

- Almshouses (or cottages) are intended for those who wish to, and are able to, live independently. Cottage residents receive limited support from the Trust – primarily this means information and advice designed to promote and prolong their independence. If they can continue to live independently, but require support for personal care, this can be assessed and funded through Social Services. Disabled applicants are considered as long as they are able to live independently. If Villagers fall ill or have an accident, the vast majority have a call button that they can use to summon assistance. A support worker will attend, or the call operative will contact an ambulance, depending on the severity of the problem. For less urgent health issues, Villagers make their own GP appointments, with support from Whiteley staff if necessary.
- Huntley House is an Extra-Care facility. It offers 51 self-contained, unfurnished, wheelchair-accessible apartments for one or two people. It is aimed at those who want to remain independent and retain their own space and belongings, but who need a little extra support in order to do so. It is staffed 24 hours a day and has an emergency call system. Each resident receives a minimum of three hours help a week, with the option of paying for more help as and when they need it. Huntley House has a number of communal areas including a dining room (with catering service), computer area and launderette, as well as assisted bathing facilities.
- Whiteley House is a residential and nursing home which provides person-centred residential care, through to nursing, palliative and end of life care. Residents are either self-funding, funded by Social Services or supported by the NHS through Continuing Health Care Funding. Family and friends can visit at any time, and can be involved in formulating individual care plans with their relatives.

If Whiteley residents need to go into hospital, the Trust stays in contact during their stay and helps plan for a discharge if and when required.

2.2 General Village Facilities

Whiteley Village offers a huge range of facilities, including a shop and post office; hairdressing salon; library; activities centre equipped with computers and technology, Wi-Fi access; garden allotments; hydrotherapy pool and social club complex with a café and licensed bar. In addition, there are over 20 clubs and societies run by the Villagers themselves, including Card and Board Games Club, Keep Fit, Line Dancing and Water Fitness Club.

2.3 Eligibility Criteria

2.3.1 Almshouses/Cottages

The original requirements for admission set down in William Whiteley's will over 100 years ago are as follows:

“The homes to be used and occupied by the aged poor persons of either sex; to be of good character and of sound mind, and not affected by any infectious or contagious disease and not having been convicted of any criminal offence; being of state pension age, preference shall be given to persons or the wives of persons who have been engaged in commercial or agricultural pursuits”.

This remains the case today, although it has since been updated and modernised with references to good character, sound-mind and contagious disease removed.

Applicants must be in sufficiently good health to meet the goal that Villagers should have several independent years of living in their cottage with minimal support. They must agree to their GP providing relevant medical data for review by the Trust if required and to the possibility of undergoing a full medical examination in either the Village or in nearby Hersham. This has been the case since the Village opened.

Whiteley staff have always helped to support people to live within the community for as long as possible. This is to preserve a sense of security, familiarity with daily life and lessen anxiety. This ethos makes it easier for those in the early stages of dementia to remain in the Village. On the few occasions where this has not been possible, and the person has needed specialist care due to the severity of their dementia, they have often had a period of care in the on-site nursing facility until they reached a stage where their needs required interventions which exceeded those available on-site.

In terms of financial status, applicants must be of limited means. There has been some flexibility applied to this requirement over the years, for example, when there was less demand for a place in the Village due to the cottages having become outdated and in need of refurbishment. However, given that the Village is once again heavily oversubscribed, with a current waiting list of between 70 and 80, 'limited financial means' is now applied by an admissions panel, which is managed by Trustees, as per The Alms House Association guidance. For most people this means that they only have an income from the State Pension and have no, or very limited savings, and are certainly not in a position to afford to rent or buy on the open market. While many applicants do qualify for housing benefit, this is not a requirement for admission; for example, if they have capital exceeding £16,000 they will not be eligible for housing benefit but could still meet the eligibility requirements for joining the Village.

Villagers do not pay rent as such but a monthly 'amenity charge' including a service charge, which is typically £893 for a 1-bedroom single cottage, or £1,025 for a 2-bedroom double cottage (assessed by the Fair Rent Office as market comparable in the area) plus an additional monthly Supporting People charge of £48. Many existing Villagers qualify for local authority-administered Housing Benefit and Supporting People funding which covers these charges in full.

2.3.2 Huntley House & Whiteley House

Pensioners can apply to go straight into either of Huntley House or Whiteley House, or they may progress there after initially living independently in the cottages. The same admissions criteria apply to Huntley House as to the cottages. Amenity charges for Huntley House vary from £950 per month to £1,140 per month. Whiteley House is different as it is a care home. People can move straight there if they have an assessed need and weekly fees range from £900 to £1,200 per week.

2.3.3 Privately-funded accommodation

For pensioners who would like to live in Whiteley Village and take advantage of its facilities but who do not satisfy the 'limited means' criteria, there is Ingram House (a residential home) and Coach House Mews (private housing). However, while such individuals would be considered part of the Village community, we have excluded them from our analysis since we are only investigating the benefits of retirement village life in respect of people with limited financial means.

3. Data collection

Our data collection focused solely on Villagers who had entered Whiteley to live independently (at least initially) in a cottage/almshouse. Those who went directly to Huntley House or Whiteley House, or entered private accommodation, were therefore not included.

Since its inception, Whiteley Village has kept typed or handwritten records of every Villager to have been admitted, assigning each person or couple a Villager Number. The information recorded has generally included: name, last address, marital status, date of birth, religion, occupation, health status, income details, parents' names, date of entry to the Village, name and address of nearest relative, guarantor, and sometimes, the date they died, or the date they left their cottage to move either to the residential care facility, to an external hospital or to other accommodation outside the Village.

Data was computerised around four years ago, though hard copies have also been maintained. All these records are contained in a total of eight ledgers and/or on index cards. One ledger has unfortunately gone missing but as there are also individual archived files on the vast majority of Villagers, records are believed to be largely complete. This assertion is supported by the data showing a stable population (see Figure 1).

Working from the oldest to the most recent ledger, from index cards, computerised records and individual files where necessary, every record available - a total of 2,614 - was entered on a spreadsheet (the last admission date recorded being 1 September 2015). The data collected was: Village Number, name, marital status, date of birth, health status, religion, occupation, date of entry to Village, date of exit, mode of exit, and date of death (where listed), as well as any additional comments where relevant.

There were a significant number of Villagers for whom no date of death was listed – usually because they had left Whiteley for alternative accommodation. In these cases, the date of death or whereabouts of such Villagers was sought using various genealogy and electoral roll websites, primarily Ancestry.com, FamilySearch.org, SearchElectoralRoll.co.uk and 192.com. This proved effective in most cases, though no trace or date of death could be found or confirmed for around 6% of all Villagers.

Having established the background of the Village and the data collection, we will now describe the demographic changes that have occurred over the history of the Village. It is important to emphasise that our analysis is only concerned with residents who first entered the Village as an active resident of an almshouse (i.e. people of reasonable health but low financial means). In other words, we have excluded anyone who entered directly any of Whiteley House, Huntley House or privately funded accommodation from our dataset.

4. Demographic history of Whiteley between 1917 and 2015

We now analyse the demographic changes that the Village has undergone from three viewpoints. Firstly, by looking at the composition of the Village population; secondly, by using summary statistics to capture broader trends; and finally, by considering the flows into the Village and associated residential care facilities.

4.1 Composition of the Village population

For Figures 1 to 3, we obtained the average number of people, broken down by gender and age, by counting the total days spent in the Village (cottages and residential care) and dividing this number by 365.25 to get the number of 'person years'. This total was then divided by the number of years of the sub-period under consideration. For example, the period 1917 to 1926 spans ten years, and we therefore would divide the calculated 'person years' by ten. In fact, all the sub-periods shown in the Figures 1-3 have a ten-year duration, apart from the period 2007 to 2015 which has nine years.

Figure 1 shows the total population broken down by gender over the last 100 years. It can be seen that the Village (Almshouses) reached a relatively stable population size of approximately 350 by the second decade.¹ We can also note that the number reduced over the last two decades.

Analysing our data further (as will be seen later in Figure 10), we observe that from 1995 the number of residents in the residential care facilities started to reduce which was due to extensive refurbishments. Since 2002 the numbers in the residential care facilities have been increasing and are now almost back to the previous highs.

¹ The total village population is actually larger with the addition of extra care apartments and the nursing and residential homes which take the total village population to approximately 500.

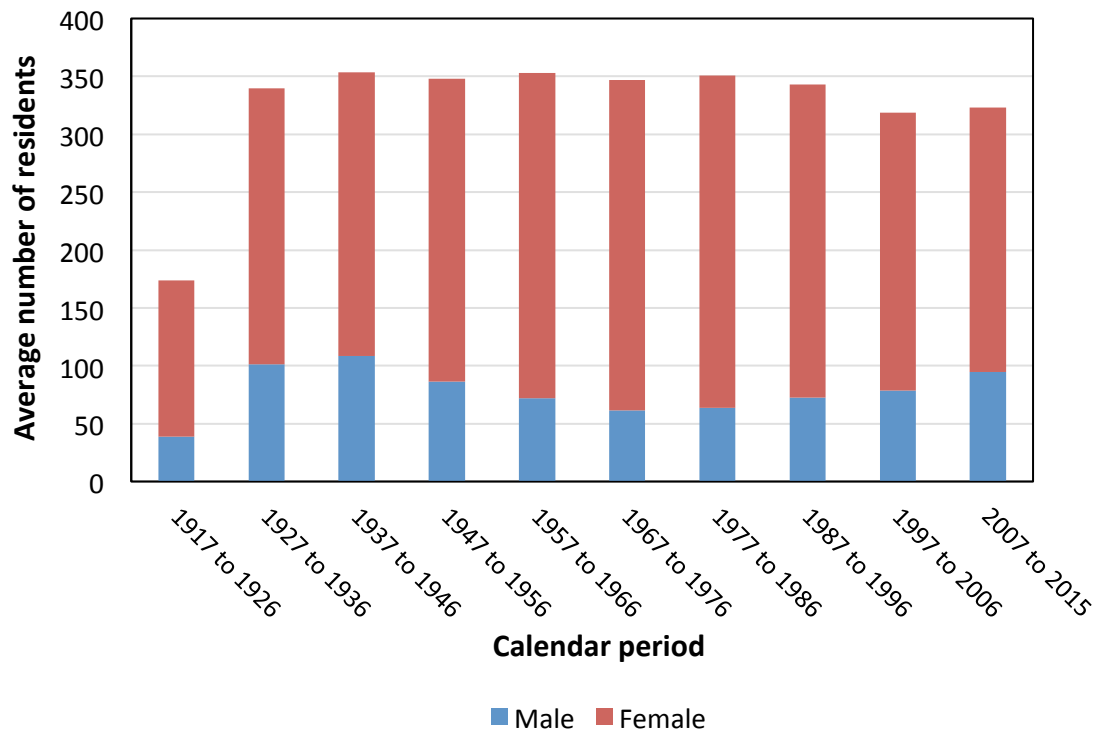


Figure 1: Gender breakdown of Whiteley population

We can note that the majority of the population has always been female, with the proportion being particularly high between 1967 and 1986. Figures 2 and 3 show the population by age for each gender separately.

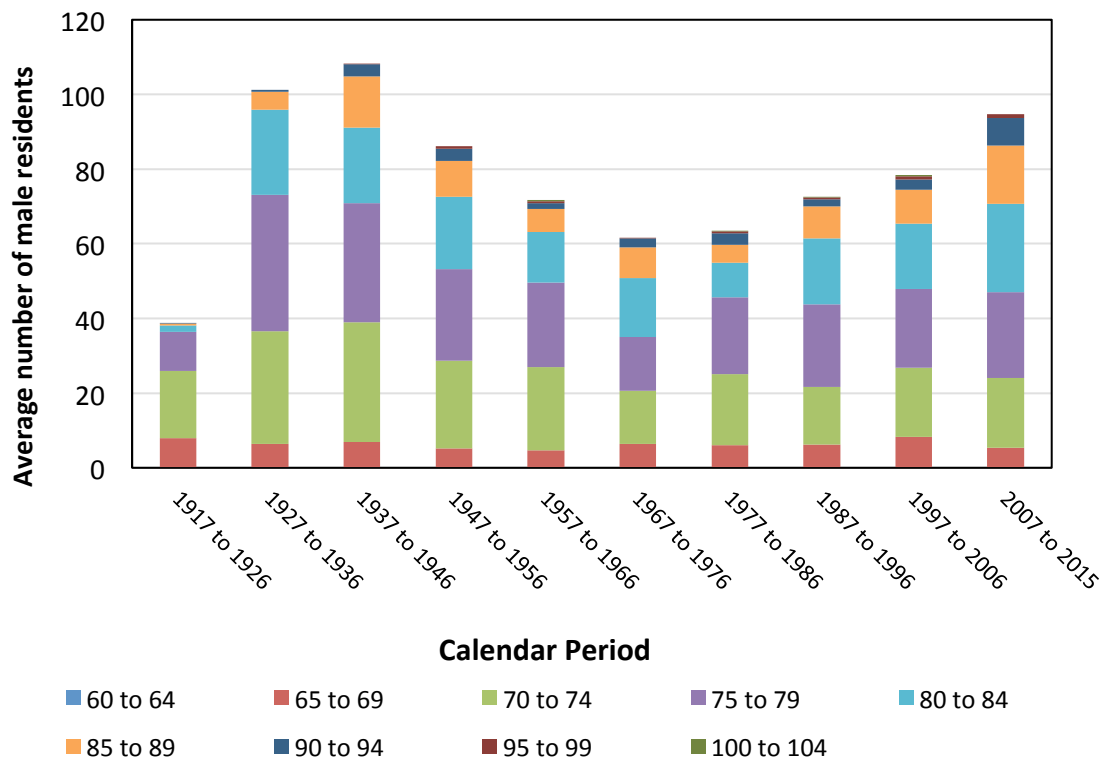


Figure 2: Age breakdown of male residents in Whiteley

Figure 2 shows the average number of male residents broken down into five-year age bands. Attention is drawn to three particularly interesting features:

- Figure 2 shows a cyclical past trend in the total number of male residents, reaching a peak during 1937-1946, reducing to a low in 1967-1976 from which point the number of male residents has increased in each ten-year period until the present time
- The age breakdown shows that the reduction in total male residents was led mainly by a diminution in the number of residents aged between 70-79
- Although the most recent sub-period shows that the total male population is almost back to its all-time high, one can see that there has been a considerable ageing of the male population of residents. For example, there has been a large reduction in the number of residents below age 74 and a significant increase in the number aged 80 and over

Figure 3 shows the average number of female residents broken down into the same five-year age bands as the males above. However, it should be noted that we have changed the scale for the y-axis due to the female population being around three times the size of the male population (see Figure 1).

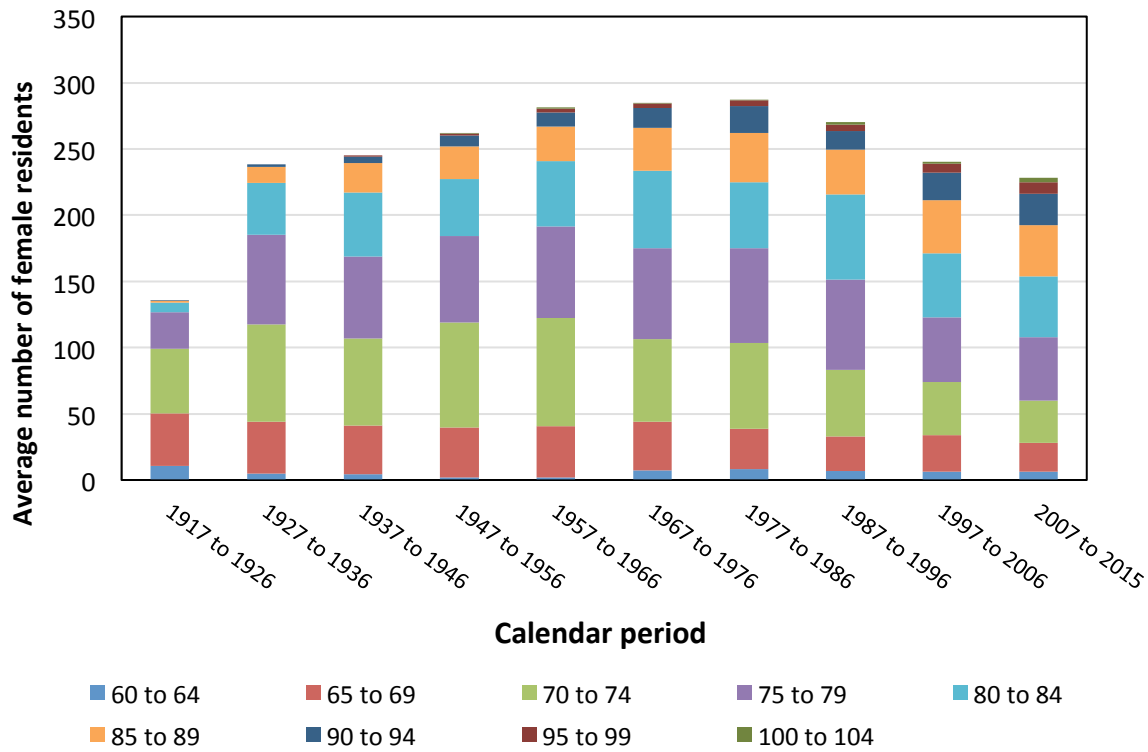


Figure 3: Age breakdown of female residents in Whiteley

Figure 3 shows that the trend in the total female population is the exact opposite to that of the males above. In Figure 1, we saw that the total population of the Village was relatively constant over the whole period; therefore, the increase in female population fully compensates for the fall in the male population.

As with the male population, we see a large reduction in the number of female residents below age 74. Similarly, the female population has been ageing but, compared to the males, this has occurred more at the very oldest age groups i.e. over age 90.

4.2 Summary statistics of the population

Figures 4 to 7 show the annual change in the average ages (mean, median and mode), the youngest age, the oldest age and also the age of the 90th percentile for both genders. These graphs include both residents in their almshouses and those who have moved from their almshouses into the residential care facilities.

The results displayed in Figure 4 show that, overall, the mean age of the male population has risen over time. However, this increase has not been continuous but has instead formed wave-like patterns.

The modal average is more erratic than the mean and it is interesting to note that the Village has large cohorts from time to time which can dominate for many years. For example, in 1940 there were a number of residents then aged 69 who remained the largest group until reaching age 82 in 1953.

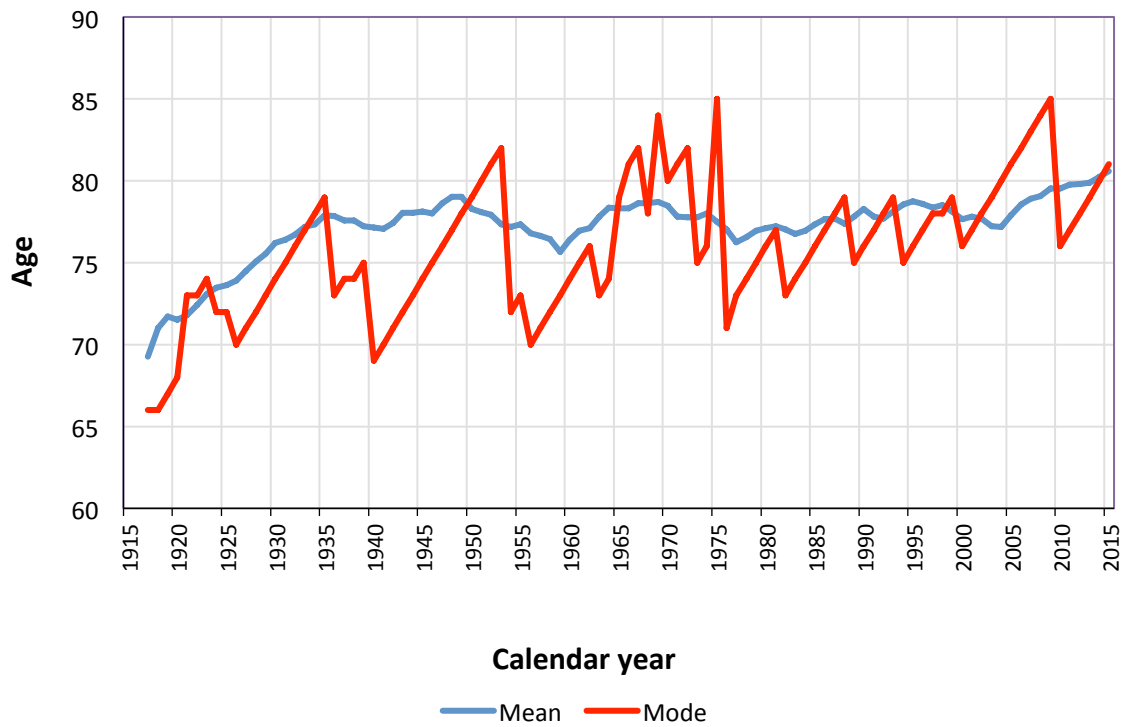


Figure 4: The mean and modal average ages for the male residents of Whiteley

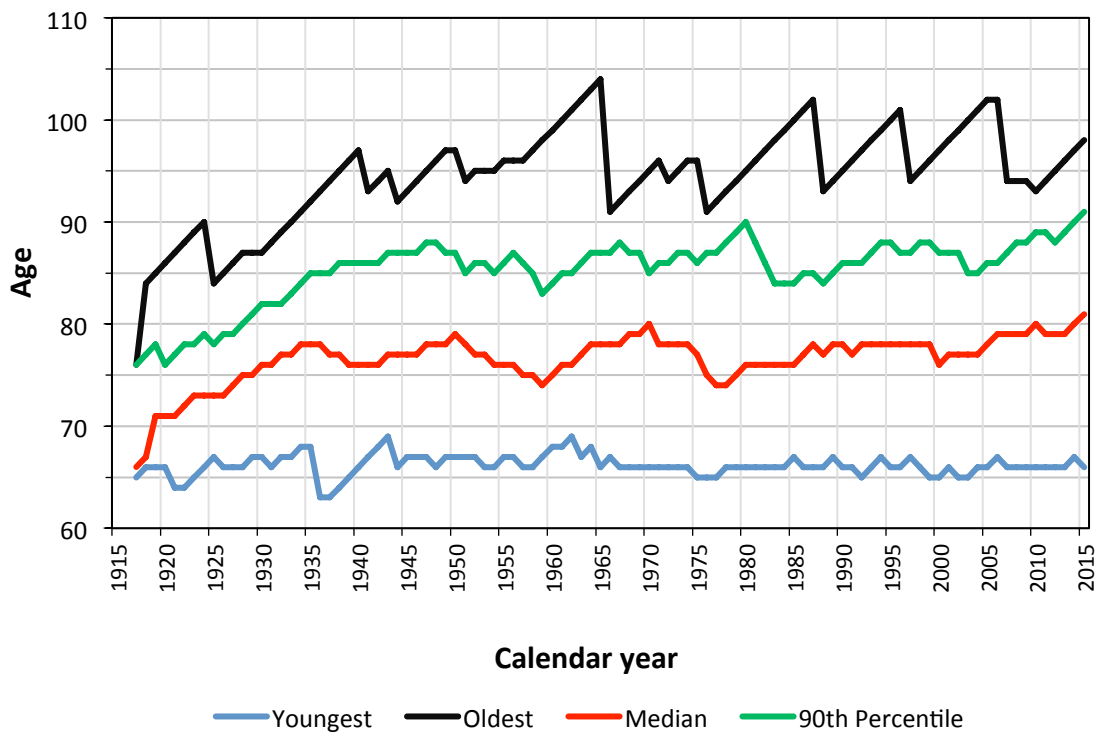


Figure 5: The youngest, oldest, median and 90th percentile ages for the male residents of Whiteley

Looking at the data in Figure 5, which represent specific percentiles of the male population, we see that the age of the youngest male in the Village at any point in time is actually quite stable, usually varying only between ages 66 and 68. This would be expected with a constant flow of new entrants into the Village (see Figure 10). The median average is very similar to the mean average above due to there never being a particularly skewed distribution of ages. The oldest age is dominated by certain individuals who survive into their early 100s, and we can see that from 1978 to 2005 it would appear that three long lived individuals held this position for three distinct blocks of time.

The 90th percentile can be seen as a less volatile measure of the possible ageing of the population as it should not be affected by specific individuals. The general shape is similar to the median but there are times when this gap widens noticeably e.g. between 1975 and 1980. This is likely to be due to the relatively small size of the male population.

Compared with the male mean age, the female mean age (shown in Figure 6) is a lot less volatile and so displays a clearer upward trend over the lifetime of Whiteley Village. This smoother average may be due to the larger female population (see Figure 1). The modal average shows the same cohort pattern as the males, though possibly with the cohorts not lasting as long on average (although the cohort in 1926 dominates for 14 years).

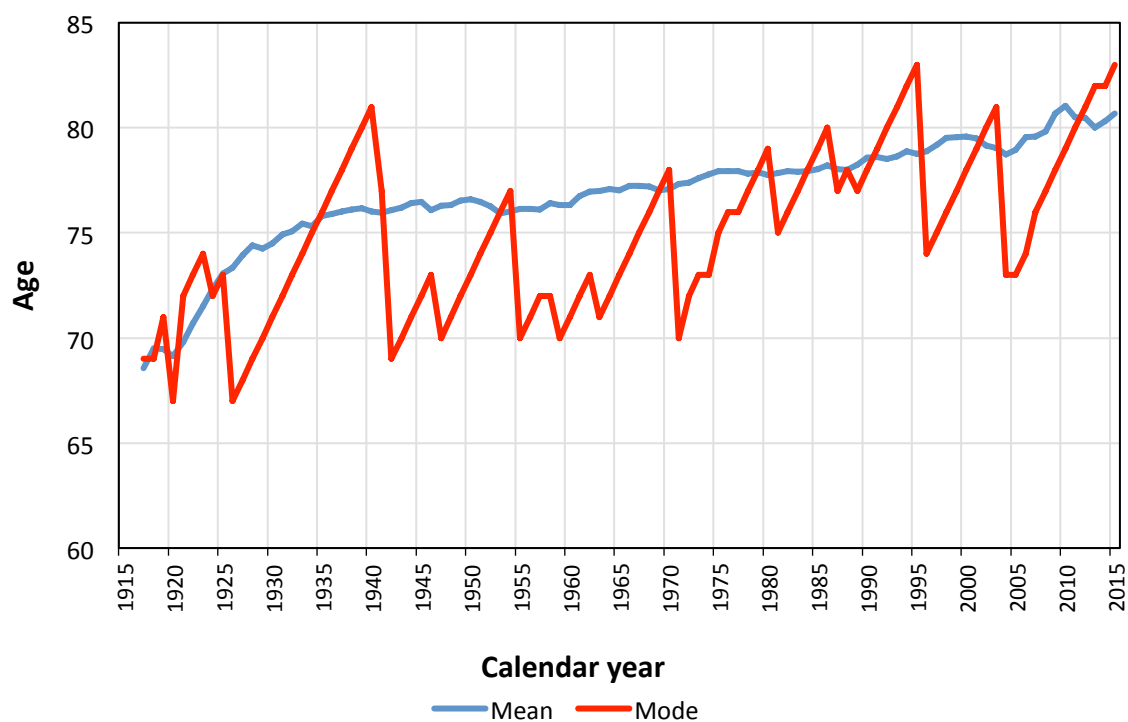


Figure 6: The mean and modal average ages for the female residents of Whiteley

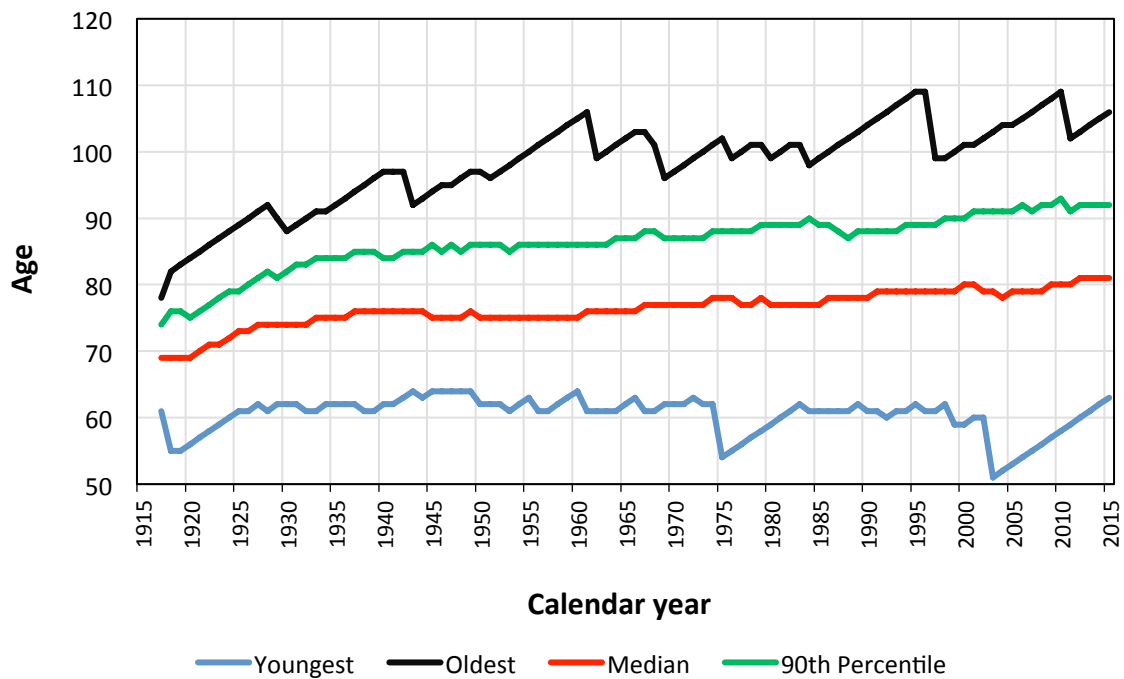


Figure 7: The youngest, oldest, median and 90th percentile ages for the female residents of Whiteley

Figure 7 shows that, in a similar way to the comparison of the mean ages discussed above, the median and the 90th percentile for the female population is a lot less volatile than that of the males. While again the oldest age is shaped by certain long lived individuals, in recent times it looks like the reduction in age to the next oldest when the current oldest dies is a lot less than for males. The only statistic which is more volatile for females compared to males is the age of the youngest resident; this is likely to be due to the fact that, on occasion, young wives (or possibly widows) enter the Village.

4.3 Numbers entering the Village

4.3.1 Age of entry

We analysed age of entry for all Villagers since Whiteley Village opened.

From Figure 8 it can be seen that the youngest men entered the Village at age 65 (the State Pension Age), but most men entered later, typically around age 70. From Figure 9 it is seen that the youngest women joined at age 60 (the State Pension Age up to 2010) but most joined between age 66 and age 70.

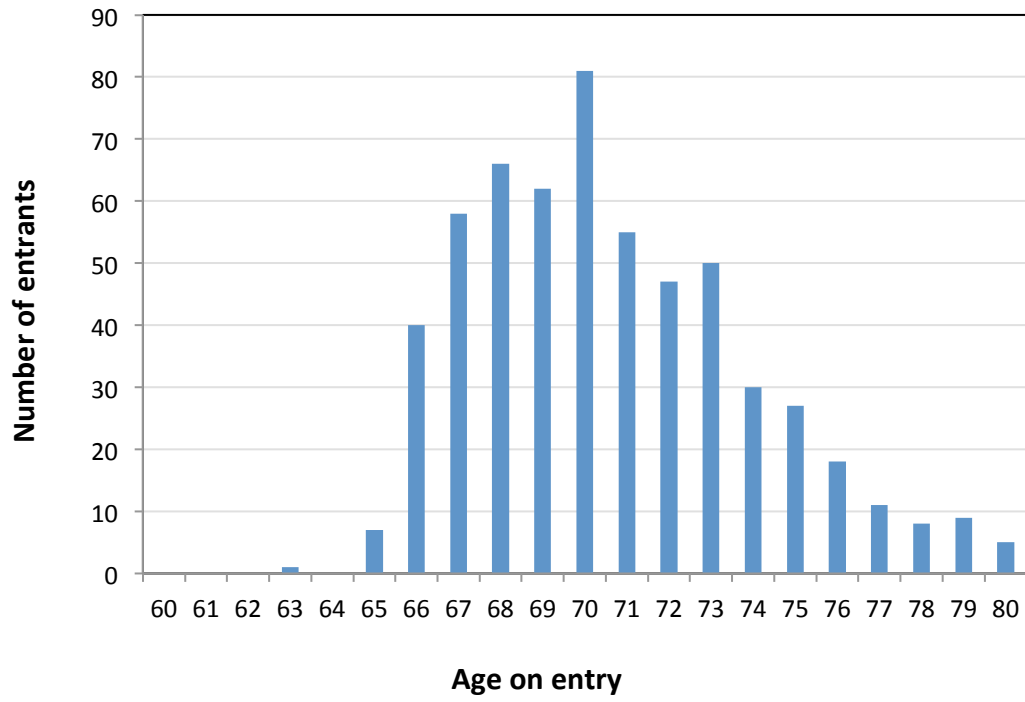


Figure 8: Age at entry to the Village: Males

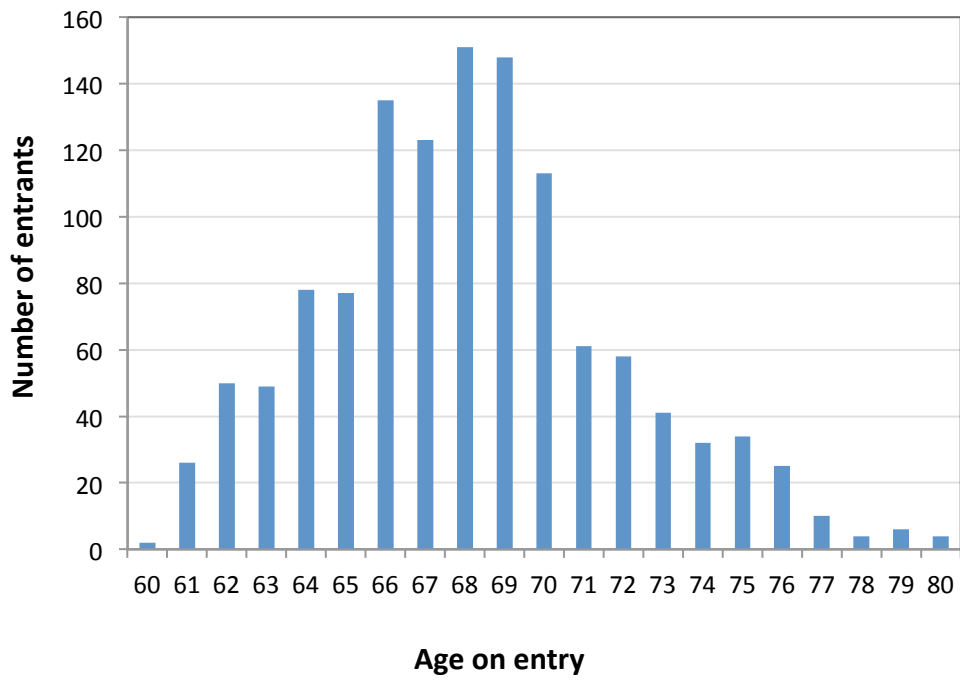


Figure 9: Age at entry to the Village: Females

Table 1 provides an overall summary based on different measures, and shows that, on average, men are older on entry than women.

	Men	Women
Average age at entry	70.5	68.1
Lower quartile age	67.5	64.9
Median age	69.7	67.5
Upper quartile age	72.7	70.4
Modal age at entry	70.0	68.0

Table 1: Summary statistics on age at entry to the Village

Table 2 breaks down average entry age by the same 10-year time periods as we used in our demographic analysis earlier. In Tables 3 and 4, this data is further broken down by marital status on entering the Village. The key features are as follows:

- The average age at entry for both genders remained constant up to 1996. It then increased between 1997 and 2006, with an even sharper increase between 2007 and 2015
- Surprisingly, we found that the marital status had little impact on the average entry age of the Villagers. In particular, widows and widowers were only marginally older, on average, than the other entrants

Time Period	Males		Females	
	Count	Mean	Count	Mean
1917 to 1926	90	69.09	223	66.63
1927 to 1936	119	70.85	172	67.07
1937 to 1946	87	69.22	168	66.43
1947 to 1956	71	68.69	194	66.46
1957 to 1966	63	69.13	171	66.35
1967 to 1976	59	68.81	160	66.00
1977 to 1986	71	69.97	191	68.20
1987 to 1996	67	69.76	180	68.36
1997 to 2006	91	70.54	180	69.31
2007 to 2015	90	72.40	167	71.68

Table 2: Number of new entrants and mean age for males and females by time period

Time Period	Married	Single	Widower	Sibling
1917 to 1926	69.13	68.43	69.38	N/A
1927 to 1936	70.47	69.50	72.27	N/A
1937 to 1946	69.68	68.00	69.00	N/A
1947 to 1956	68.53	67.80	70.38	N/A
1957 to 1966	68.88	68.50	70.67	N/A
1967 to 1976	68.18	68.40	72.22	N/A
1977 to 1986	69.72	68.75	71.38	N/A
1987 to 1996	69.88	70.54	68.71	N/A
1997 to 2006	70.65	69.72	71.15	N/A
2007 to 2015	72.54	70.80	72.87	N/A

Table 3: Mean age at entry for male residents by time period and marital status

Time Period	Married	Single	Widow	Sibling
1917 to 1926	66.89	66.17	67.07	67.00
1927 to 1936	67.78	66.39	67.23	66.80
1937 to 1946	67.58	65.60	66.30	66.11
1947 to 1956	66.31	66.25	66.82	66.33
1957 to 1966	66.75	65.97	66.40	N/A
1967 to 1976	65.44	65.86	66.39	65.00
1977 to 1986	67.20	67.51	69.18	N/A
1987 to 1996	67.49	66.65	68.93	N/A
1997 to 2006	68.46	67.06	70.18	N/A
2007 to 2015	70.21	67.26	73.88	N/A

Table 4: Mean age at entry for female residents by time period and marital status

With the State Pension Age due to increase to 67 between 2026 and 2028, the most likely effect will be to cause a further increase in the average entry age. Over the following decade or so this could continue to change the character of the Village since State Pension Age increases, coupled with rising life expectancy, will cause the Village population to age. We return to this point in Section 7.

Figure 10 breaks down the number of residents into those living in the Village and those residing in the residential care facilities. It also shows the number of new residents entering Whiteley each year. The difference between the values represented by the red (top) line and the black line is the number of people residing in the residential care facilities.

We can see from Figure 10 that for the first few years of Whiteley's existence there was a large number of new entrants to get the Village population up to full capacity quickly. However, it should also be noted that as the population was quite young at this point (see Figures 2 and 3) there were very few deaths. From 1925 onwards we can see that residents were moving into the residential care facilities and there are significant numbers from 1940 onwards, reaching a maximum of around 50 from 1970.

There was a reduction in the number of residents in the Village and residential care facilities starting in the late 1990s and this suppressed the total population for several years. This was the result of refurbishments carried out over a period, in both the almshouses and Whiteley House (the nursing care centre). To enable residents to remain within the community, occupancy rates were deliberately kept low so that residents could be transferred between different areas of the Village as the refurbishments took place. However, those needing intensive nursing care may have needed to receive their care in other locations instead.

4.3.2 Length of stay in Village

If village life has a positive impact on life expectancy, it is likely to depend on two factors: firstly an entrant's health and secondly how many years they spend in the Village. Village policy is that applicants must be in reasonable health on entering the Village since the intention is for the residents to have several independent years of living in their cottage with minimal support.

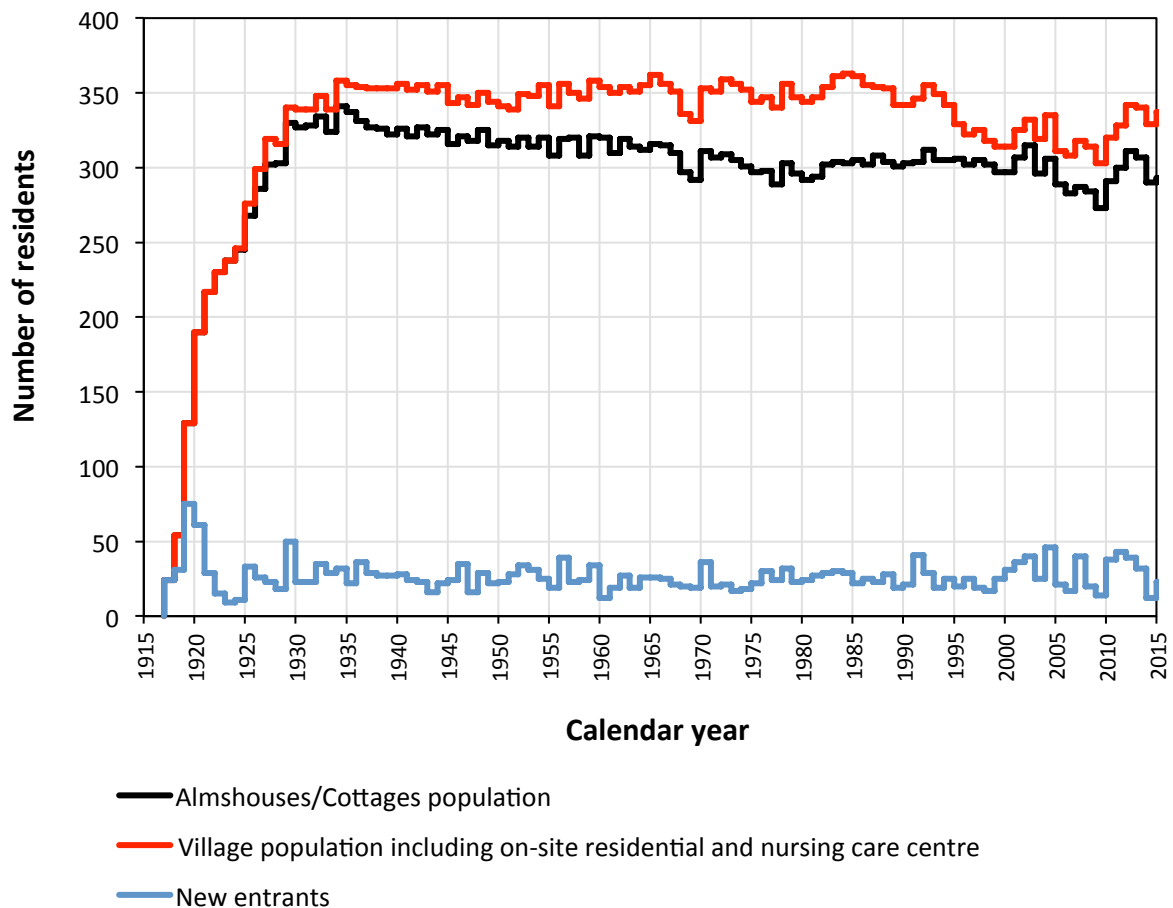


Figure 10: Changes in the Village (Almshouse) population over time and the pattern of new Village entrants (1915 to 2015)

However, if their time in the Village is only very short because they left soon after joining, or they were already very old when they entered, then any longevity effect will be harder to detect. Figures 11 and 12 show the length of time spent in the Village including any durations at the end of life spent in the Village hospital / nursing home as applicable. The figures also distinguish spells of time spent by people who decided to withdraw from the Village.

It can be seen that withdrawals are a relatively small proportion (~11%) of the total entrants with most withdrawals occurring within the first five years of arrival. Table 5 summarises the main features. It shows that:

- Women stay longer than men in the Village. The average stay based on deaths within the Village is 15.8 years for women versus 10.7 years for men (median values 15.4 and 10.0 years, respectively)
- Of the withdrawals, the median lengths of stay are very similar for both men and women at five to six years
- The upper quartile length of stay for a woman is 21.1 years and for a man 15.6 years with the difference reflecting partly differences in entry age and partly differences in their respective mortality
- The maximum length of stay for a woman is 44.9 years and for a man is 33.9 years

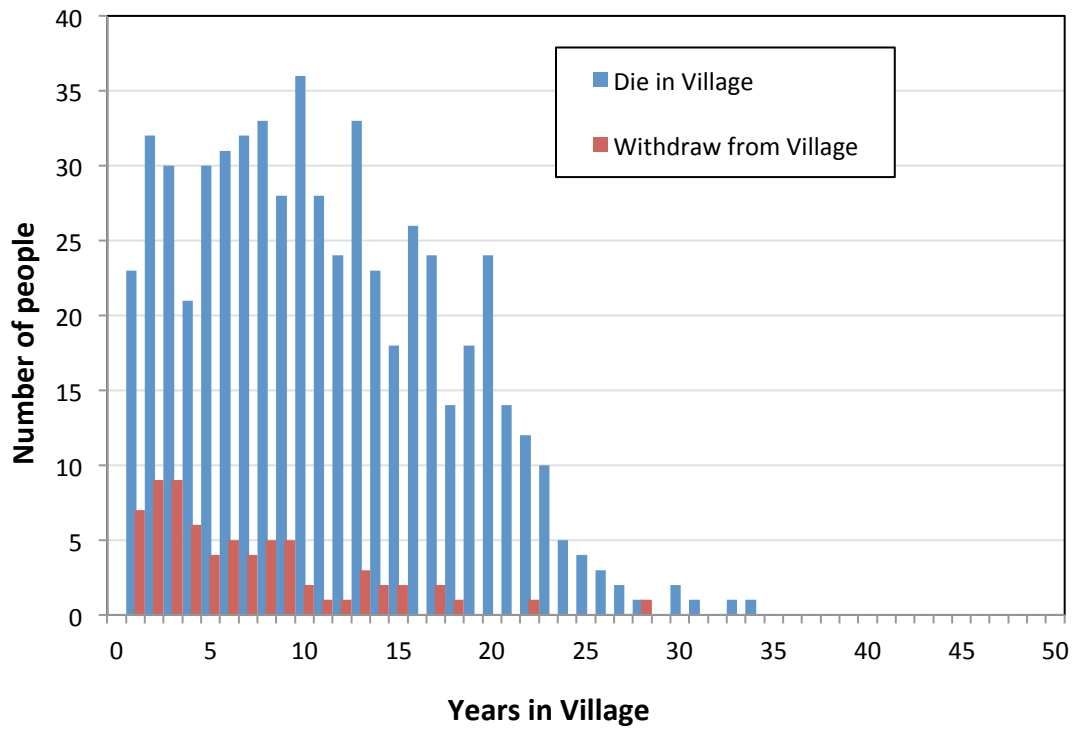


Figure 11: Lengths of Village stay: Men

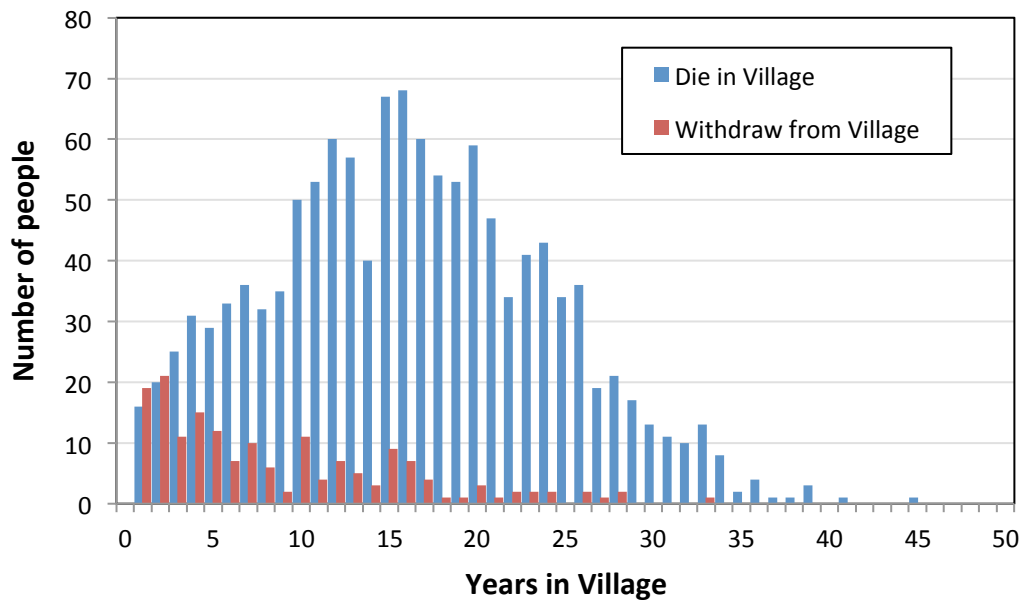


Figure 12: Lengths of Village stay: Women

Summary measure	Men		Women		Men and Women	
	Die in Village	Withdraw from Village	Die in Village	Withdraw from Village	Die in Village	Withdraw from Village
Average	10.7	6.4	15.8	8.1	14.1	7.6
Lower quartile	5.4	2.2	10.1	2.3	8.0	2.2
Median	10.0	5.1	15.4	6.0	13.8	5.6
Upper quartile	15.6	8.7	21.1	12.6	19.5	11.4
Mode	10.0	3.0	16.0	2.0	16.0	2.0
Max	33.9	27.3	44.9	32.5	44.9	32.5

N (valid cases)	584	70	1238	171	1822	241
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Table 5: Length of stay by Whiteley Villagers measured in years by gender and according to whether they die in the Village or withdraw before death

5. Mortality analysis

In this section we test the hypothesis that Whiteley Villagers live longer on average than similar members of the general population. Among the entry conditions to Whiteley are that entrants should have reached State Pension Age and that they should have low income and assets.

To carry out a mortality comparison we need to compare the Village population with a suitable external population. This means comparing by the corresponding age and gender and, ideally, the external data would be similar in terms of location and wealth as these factors also influence mortality rates. We have selected the general England & Wales population as being the most appropriate in terms of the location of the Villagers' previous residence. In terms of wealth, the Village population will have lower means than the majority of the general population. This would normally imply a higher mortality rate; however, this will be partly counter-balanced by the health criteria for entering the Village (i.e. the entrants should be mentally and physically capable of living independently).

Any health problems should be recorded on entry to the Village. Of the 7% of entrants where health issues have been recorded:

- 53% suffered from musculoskeletal problems (arthritis, rheumatism, etc.)
- 42% from some form of disability (deafness, partial sighted, amputees etc.)
- 13% had bronchial-related conditions suggesting smoking-related causes
- 7% some form of heart disease
- a few Villagers entered with 'other' conditions

We should add that the health data, such as it is, must be considered as partial for two reasons. Firstly, the sample of entrants with health details recorded is small and, secondly, without the benefit of full medical tests and modern diagnostics, it would not be possible to detect the underlying presence of life threatening illnesses such as cancer (for which we found only one mention).

The impact on mortality due to selection using the Whiteley Village health criteria is therefore not as strong as that of insurance underwriting. This is why it can be argued that the selection effect may not fully counter-balance the negative impact on mortality of being on low means. As a result, we would still expect that Whiteley Villagers would experience higher mortality rates than the general population.

We now discuss our approach to comparing the mortality experience of the two populations.

5.1 Methodology

Our initial methodology is to compare the actual percentages of the Village population that survive to different ages, based on a common entry age, with comparable survival percentages in England & Wales. We then test whether the number of observed Village deaths by specific ages is significantly different compared with the expected number of deaths.

For example, suppose that in the Village population 50% of men who entered the Village died by age 80, but in the wider male population 50% died by age 78; then this may indicate that male residents live longer than the general male population.

With this general concept, our testing procedure is as follows. For each gender, we need to select the appropriate entry age as this differs between the two genders (see Figures 8 and 9). For our general population, we can calculate the ages to which we expect to see a given a percentage of the population to survive. This would allow a comparison between the percentage of Whiteley residents who survive to these calculated ages, thus enabling us to analyse whether the differences are statistically significant. We can then draw conclusions about the possible extra longevity benefits of living in Whiteley Village.

However, a complication is that life expectancy of the wider population has been increasing steadily for both genders. Therefore, the comparison should take account of changes in mortality in the general population. In other words, the mortality 'goal posts' keep shifting.

For example, suppose it was the case that 50% of the general population had died by age 78 in year t , and by $t+10$ the age had increased to 79. This change would need to be reflected in our analysis because the benchmark for comparison purposes has itself changed during the ten-year period.

To facilitate the comparison of mortality rates, we adopted the following approach. To create a homogenous dataset, we decided to analyse only Villagers with similar entry ages so that village life would have approximately the same impact on them at each subsequent age.

Starting with women, we analysed those women entering the Village between exact age 65 and 69 with a midpoint age of 67. From our earlier analysis we saw that this was a typical entrant age range. This equates to 560 (or 45%) of all female entrants over the period, if we exclude those who subsequently withdrew (see Figure 9).

For male residents, the analysis was on those men entering the Village between exact age 68 and 72 with a midpoint age of 70. We use a higher age band since, as we saw earlier, male entrant ages are typically slightly older than for females (see Figure 8). This age bracket accounts for 245 (or 42%) of all male entrants over the period, if we exclude those who subsequently withdrew.

Our benchmark data on survival and life expectancy for males and females was extracted from the Human Mortality Database (HMD) for each year from 1912 to 2011 using data for England & Wales.

To determine the ages to which different population percentiles survive we used the l_x values set out in the life tables. These provide information on how many men or women are expected to survive to exact age x in the general population using a radix of 100,000 individuals at age 70 for males and age 67 for females based on the mortality rates in each year of the study.

For our purposes we wish to extract the exact ages to which a specified percentage of the population is expected to live. To obtain these values, we applied linear interpolation to estimate the exact ages to which 90%, 50%, 10% and 5% of the England & Wales population survived at annual intervals based on starting ages of 67 for women and 70 for men.

In this way we are able to compare the actual ages to which Villagers survive with the expected ages of survival to see if there is a material difference. Expressed differently, it is equivalent to comparing the ages at which 10%, 50%, 90% and 95% of Whiteley residents would have died if they had been subjected to the mortality rates experienced by the wider England & Wales population.

We recognise that these percentiles are based on period life tables rather than cohort tables which leads to some inconsistency in our comparison. However, we have chosen to do this because survival percentiles based on period life tables are more intuitive than those based on cohort tables. In addition, using survival percentiles based on period life tables will require stronger evidence to reject our null hypothesis. In other words, a significant result using period tables must imply an even more significant result if we had used cohort tables, due to improvements in mortality rates over the investigation period.

6. Initial results

Using the methodology described above, we now present our initial results below.

6.1 Females

Figure 13 shows the data for women entering the Village between age 65 and 69. On the vertical axis is the age at death and on the horizontal axis is the year of death. The data points represent the actual age of death for each of the 560 women in the sample who died in the Village between 1920 and 2015 (no deaths were recorded before 1920). As expected, wide differences were found in age of death, ranging from 66 (i.e. shortly after entry) to well over 100 years of age.

Superimposed on the chart is a black hatched line. This represents the ages by which 10% of the England & Wales female population would be expected to have died if they had entered the Village at age 67, based on the methodology described above. The line shows that at the start of the investigation, if the Whiteley Villagers had experienced the same mortality as the general population of England & Wales, then we would have expected 10% to have died by age 69.3 years. Due to improvements in mortality over the period, this age had increased by 5.2 years to age 74.5 years by 2011.

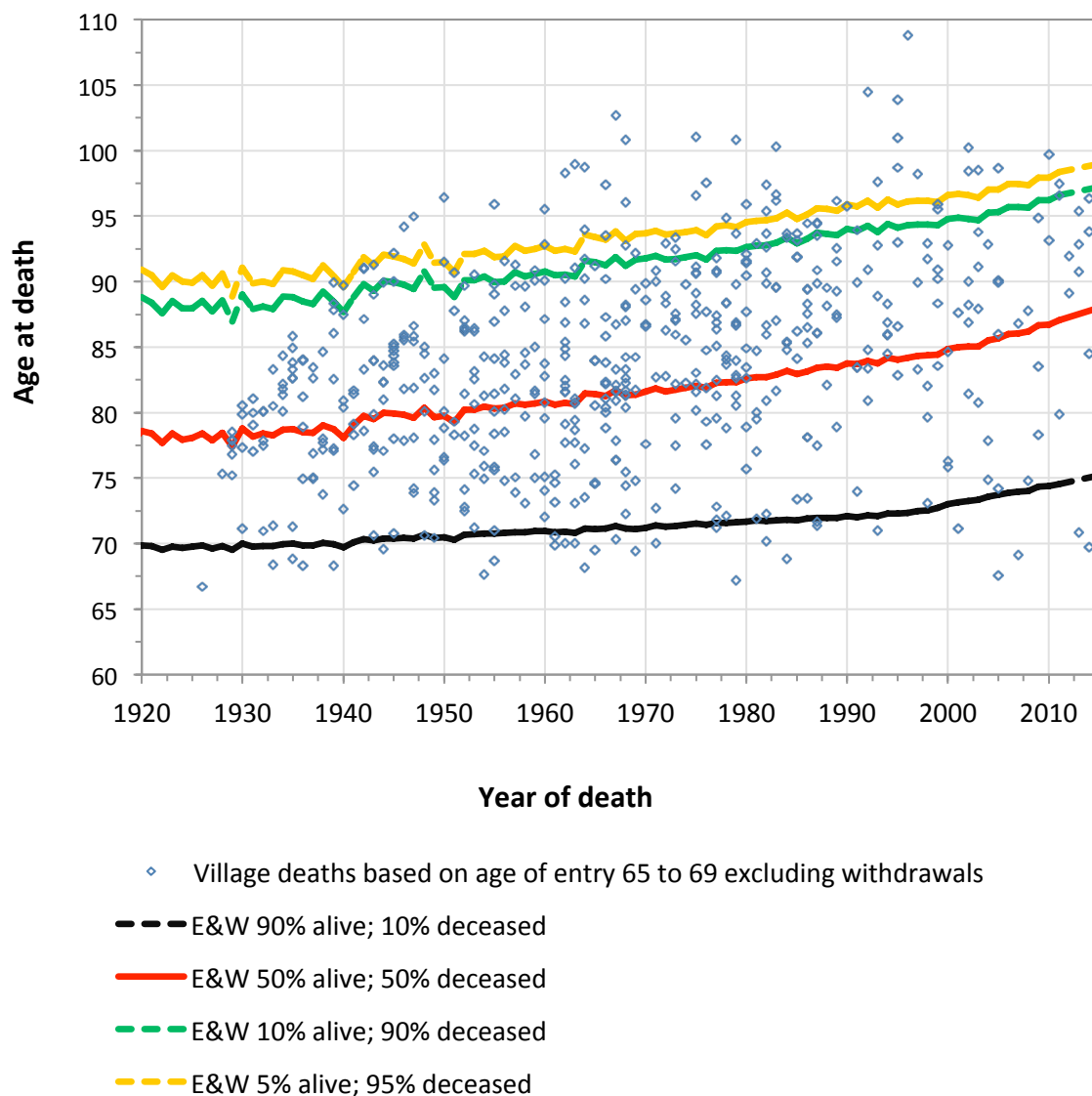


Figure 13: Age of death of female Villagers from 1920 onwards with hatched lines showing the expected ages of 10%, 50%, 90% and 95% of female deaths in the England & Wales population at age 67

The solid red line represents the age at which 50% of the England & Wales population would be expected to have died (i.e. median age of death); the green hatched line is for 90% and the amber hatched line is for 95%.

Percentage of deaths	10%	50%	90%	95%
Observed deaths	31	196	486	516
Expected deaths	56	280	504	532

N=560

p two-sided	0.0004	<0.0001	0.0112	0.0020
p one-sided	0.0002	<0.0001	0.0056	0.0010

Table 6: Observed versus expected number of female deaths for each percentile cut-off

Table 6 compares the observed number of female deaths in Whiteley with the expected number based on mortality rates in the wider population for each percentage cut-off. For example, if Whiteley residents had experienced the same mortality rates as the wider population then we would have expected 56 observed deaths on or below the black hatched line (i.e. 10% of the 560 sample size sample). Instead we observed 31 actual deaths in the Village population (or 5.5%). This suggests that Whiteley residents experienced lower mortality than the general population.

Similarly, we can consider the ages at which we would have expected only 5% of the residents to have survived. This can be done by looking at the ages by which we would have expected 95% of the Whiteley residents to have died if they had experienced the same mortality rates as the wider population (i.e. those whose age at death lies on or below the amber hatched line in Figure 13).

Here, we would have expected to have observed 532 deaths over the period (560×0.95), but instead we observed 516 actual deaths in the Village population. At each cut-off (10%, 50%, 90% and 95% of all deaths), we arrive at the important finding that there were fewer female deaths observed in the Whiteley Village population than we would have expected if the mortality rates had been the same as those of the wider population.

We therefore tested whether the higher survival rate (or lower mortality rate) among residents was statistically significant or simply due to chance. Specifically, we tested the null hypothesis that women living in the Village who entered between the ages of 65 and 69 do not die later, on average, than women who had attained age 67 in the wider population.

To test this, we initially assumed the Whiteley population to be a sample from the wider population i.e. Whiteley Villagers experience the same mortality rates as the wider population. We then investigated the likelihood that the proportion of observed deaths in the Village is consistent with this assumption, or whether there is sufficient evidence that Whiteley Villagers have different underlying mortality rates than the wider population.

This procedure was carried out as follows. If, for example, we consider the median age at death of the wider population then we know that, by definition, the probability that a member of the wider population died before reaching this age is 0.5.

If the Whiteley population (which is the sample in this test) is the same as the wider population then we would expect the proportion of Villagers to have died by this age to also be 0.5. We therefore investigated whether the difference in the observed proportion of the Whiteley population dying and the wider population dying by the specified age is due to sampling error or due to a genuine difference in the underlying survival rates.

Our main focus is to determine whether there is sufficient evidence to conclude that the mortality rates experienced by Whiteley Villagers are lower than those experienced by the wider population. For each percentile being considered, we construct a one-tailed hypothesis test which is formally defined as:

$$H_0 : p = p_0$$

$$H_a : p < p_0$$

where p = true underlying probability of a Whiteley resident dying before the specified cut-off age

p_0 = probability of a member of the wider population dying before the cut-off age

with a test statistic of:

$$z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0 \times (1 - p_0)}{n}}}$$

where \hat{p} is the observed proportion of deaths in Whiteley Village at the specified cut-off age.

The test statistic can then be compared to the normal distribution.

For example, to investigate whether there is evidence that a Whiteley resident has a lower probability than 50% of dying before reaching the median age of death of the wider population, the test statistic is calculated as follows:

$$H_0 : p = 0.5$$

$$H_a : p < 0.5$$

$$z = \frac{\frac{196}{560} - 0.5}{\sqrt{\frac{0.5 \times (1 - 0.5)}{560}}} = -7.0993$$

$$\Pr(Z < -7.0933) \approx 0$$

Because the probability of observing the test statistic is less than 5% we reject the null hypothesis. Therefore, we accept the alternative hypothesis that p (the probability of a Whiteley resident dying before reaching the median age of death of the wider population) is less than p_0 (which in this case is 50%). In other words, the probability of a Whiteley resident surviving beyond the median age of the England & Wales population is higher than 50%.

The bottom line of Table 6 shows the probabilities of the null hypotheses being correct for each percentile cut-off (i.e. that the Whiteley Villagers experience the same mortality as the wider population). It can be seen that the probability of this is less than 5% for each of the percentile cut-offs and hence there is very strong evidence that Whiteley Villagers experience lower mortality rates than the wider population.

The penultimate line of Table 6 shows the equivalent probabilities when using the two-tailed hypothesis i.e. testing whether the mortality rates of Whiteley Village are different to the wider population. To calculate the p -value for the two-tailed test we simply double the probability of the one-tailed test.

As mentioned above, the standard criterion for rejecting the null hypothesis is that the p -value must be 0.05 or less. Since the p -value is, in fact, always less than 0.01 based on the one-sided test, we have strong evidence to reject the null hypothesis that ages of deaths are broadly the same in the two populations and accept the alternative hypothesis that female residents live longer.

A key result is that the greatest difference in longevity is between the median age of death of residents and the median age of death in the wider population ($p < 0.0001$). In other words, for female entrants in this age group, the median age of death is higher than the equivalent median age of death in the wider population with a certainty exceeding 99.9%.

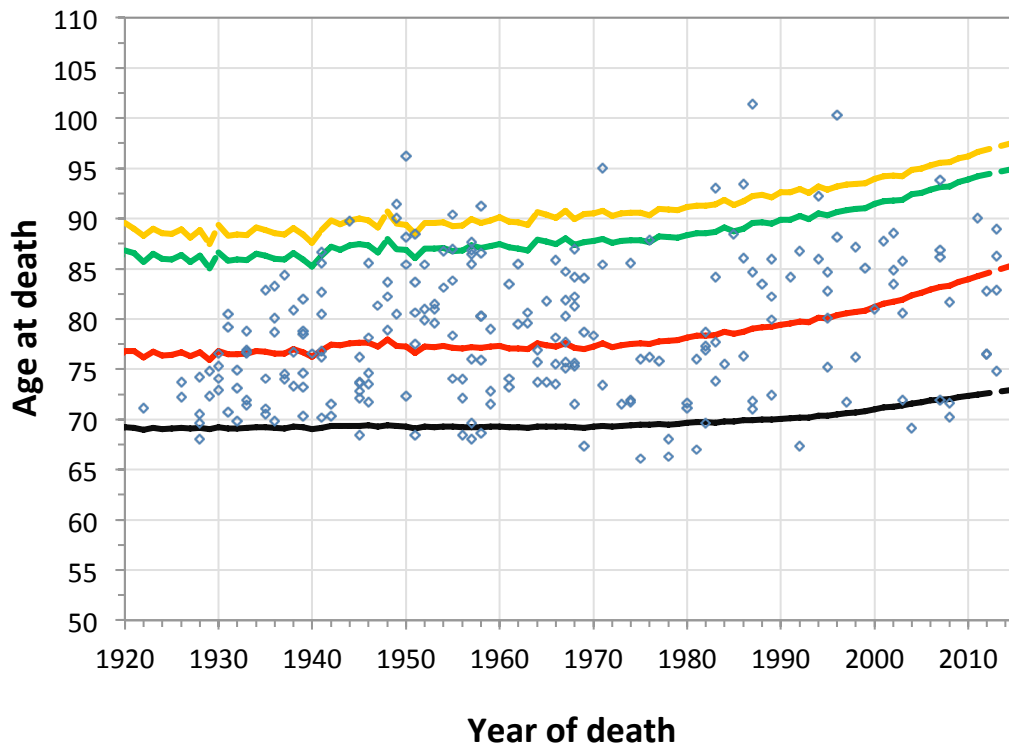
6.2 Males

Figure 14 shows the equivalent results for males using the same methodology as used for females. The data points represent the actual observed age of death for each of the 245 males in the sample dying in the Village between 1920 and 2015. As with Figure 13, the black hatched line represents the age by which we would have expected 10% of the male population to have died if they had entered the Village at age 70 and experienced the mortality rates of the wider population; green represents 90% and amber represents 95%. The solid red line represents 50% of all deaths (i.e. the median age of death).

Table 7 compares the observed number of male deaths in Whiteley with the expected number based on the mortality rates in the wider population for each cut-off. For example, 24.5 (or 10% of the of the 245 sample size) would be expected to have died if the mortality rates in the Village had been the same as in the wider population which compares with 30 actual observed deaths in the Village population (or 12.2%). We should note, therefore, that this implies that these shortest-lived residents have experienced higher mortality than the general population.

Looking at the 95% cut-off, we would expect 232.75 to have died over the period (245×0.95) as compared with 232 male residents who had actually died. At each cut-off (10%, 50%, 90% and 95% of all deaths), we arrive at the second important finding that there are only slight differences between the expected numbers of male deaths using the wider population mortality rates and the actual observed number of male deaths in Whiteley Village.

As before, we tested whether the number of deaths of male residents and the expected number of deaths were significantly different from one another. Specifically, we tested the null hypothesis that men living in the Village who entered between the ages of 68 and 72 do not die later, on average, than men who had attained age 70 in the wider population. Table 7 (bottom two lines) shows the probabilities of this hypothesis being correct for each cut-off.



- ◇ Village deaths based on age of entry 68 to 72 excluding withdrawals
- E&W 90% alive; 10% deceased
- E&W 50% alive; 50% deceased
- E&W 10% alive; 90% deceased
- E&W 5% alive; 95% deceased

Figure 14: Age of death of male Villagers from 1920 onwards with hatched lines showing the expected ages of 10%, 50%, 90% and 95% of male deaths in the England & Wales population at age 70

Percentage of deaths	10%	50%	90%	95%
Observed deaths	30	111	211	232
Expected deaths	24.5	122.5	220.5	232.75
N=245				
p two-sided	0.4397	0.1417	0.0431	0.8260
p one-sided	0.8793	0.0709	0.0215	0.4130

Table 7: Observed number of male deaths versus expected number of deaths for each percentile cut-off

As noted above, there are more observed deaths amongst the 10% shortest lived male residents than would have been expected if the mortality rates had been the same as in the general population. When we consider the median age at death of the general population, the reverse is true as we have observed fewer deaths than expected up to this age; however, the result falls just short of being statistically significant at the 5% level, with a p -value of 0.0709.

Further support for the argument that living in the Village gives the residents a longevity boost is provided by the test at the 90% cut-off where the test is statistically significant with a p -value of 0.0215. At the 95% cut-off, we find that the number of observed deaths is approximately the same as the number expected if the mortality rates had been the same as in the general population.

In conclusion, while there is some evidence that, for male residents, both the median age at death and the age at the 90% cut-off has increased compared to the general male population of England & Wales, any possible increase is much less pronounced than for females.

6.3 Discussion of initial mortality findings

The main purpose of the mortality analysis was to investigate whether men and women entering Whiteley Village tend to live longer than men and women in the wider England & Wales population. The findings show that women, in particular, seem to have received a longevity boost from living in the Village and are still improving. Men also seem to have benefited from retirement village life, but not to the same extent as the women.

We have found that if we compare a Whiteley Village female population at age 67 with the wider female population at the same age living in England & Wales then, at the age at which 50% of the wider population would have died, substantially more than 50% of the female Village population would still be alive. We also have strong statistical evidence that the same is true at the other cut-offs we have considered i.e. 10%, 90% and 95%.

This should be considered a noteworthy result and shows how community living with its opportunity for social interaction and access to health care services can make a difference to people's life expectancy. We checked the validity of this conclusion by undertaking the same analysis for female entrants aged 65. The results showed a comparable improvement, suggesting that the results are robust for a range of typical entry ages.

For men, we have concentrated our analysis on the entry age range of 68 to 72 (midpoint age 70) as this is when men have tended to enter the Village. The main finding here is that there is some evidence that male entrants aged 68 to 72 do live longer in general than men aged 70 in the wider population. However, at the age where we would have expected 10% of the population to have died (i.e. the shortest lived lives), the observed number of deaths in the Village was higher than expected.

At first glance, this would appear to be a relatively disappointing result when compared to the results obtained for females but, as we argued in Section 5, the target Village entrant will be of low financial means and so achieving life expectancy that is at least similar to that of the wider population should be seen as success. Coupled with this, we are using period-based percentiles and, had we used cohort-based percentiles, we may well have actually obtained a more positive result as regards longevity for males.

As Whiteley Village reaches its 100th anniversary in 2017, it is clear that the impact of the retirement village environment on longevity has been significantly better in the case of women than it has been for men. This could be due to several reasons which we now discuss.

We have already seen that men have tended to be older than women when they entered the Village so we might expect later entry to be one factor, as we have already proposed that the longevity boost from living in Whiteley may be cumulative.

Another possible reason is that, as we saw in Section 4, the Village has always had a much larger number of female residents than male residents. This may mean that the social activities and community spirit, which we believe to be one of the main reasons that retirement villages are so beneficial, will be stronger for female residents than males.

The above points focus on why the effect of social impact offered by the retirement village environment might be stronger for women than for men. However, in addition, there may be differences between the two genders in how beneficial this social interaction can be in extending longevity which we discuss below.

Table 8 gives the breakdown of entrants by marital status. We can see that the majority of males are married but that the largest percentage of females are widowed. However, when we investigated the age at entry into the Village (see Table 4) we found very little difference in the mean ages for women who were married compared to those who are widowed. If we assume that all residents of Whiteley are from the same target socio-economic group, and that widows usually enter the Village soon after their husband's death, then this implies that male members are subject to high mortality rates in their late 60s/early 70s.² This means that the males entering the Village are vulnerable to an early death (e.g. heart attack or stroke).

Gender	Married	Widowed	Single	Sibling	Total
Men	66.7	19.7	13.6	0.0	100.0
Women	29.7	40.9	27.5	1.9	100.0
All	41.1	34.4	23.3	1.3	100.0

Table 8: Percentage breakdown of marital status of male and female Village entrants

This assumption of high mortality rates for males when they enter the Village at around age 70 is consistent with our earlier statistical analysis where we noted that the observed number of early deaths in Whiteley Village were higher than expected (i.e. see the analysis of the 10% cut-off in Table 7).

² However, we do not have the precise data on the age at death of the deceased husbands of the widows entering the Village to investigate this conjecture.

In fact, if we postulate why a couple aged in their 60's might move into the Village then we can consider three main possibilities.

- The first is that, in the past, when people were employed in domestic service then they may simply have lost the dwelling that came as part of their occupation and would therefore have needed to find alternative accommodation. It is unclear how this would affect mortality
- Secondly, we may find that the couple is attracted to the social side of Whiteley Village. For these couples we would expect them both to benefit from living in Whiteley
- Thirdly, the couple may choose to move into the Village because they feel that the husband can no longer maintain the home they are living in due to his increasing frailty. For these couples, we may find that the wife fully embraces the social life in Whiteley and gets the resulting longevity boost. By contrast, the husband could be spending more time in their cottage and garden and hence will not get the full social benefit of living in Whiteley

A logical cause of the observed high male mortality rates and potential early frailty may be attributed to occupation. We investigated whether previous occupations appeared to play any role in explaining the differences between male and female life expectancy.

A wide range of occupations are included in the data. The fact that many of these have disappeared reflects wider changes in society both in terms of fashion and technology. Occupations such as domestic work, coachmen, ladies companion, domestic servant and butler are common among the early data, together with textile workers (e.g. lace workers) and office staff (e.g. shorthand typists and accounts clerks). However, other occupations are more familiar, at least in name, such as teachers and nurses.

To obtain a feel for whether occupational differences would throw more light on why male entrants did not seem to get the same longevity boost as females, we classified the recorded occupations according to whether we believed that they were sedentary, semi-manual or manual.

We should note that there was no evidence of male occupations being represented in the traditionally most hazardous occupations such as mining or other heavy industry which might have skewed the results towards earlier male deaths.

In general the results were inconclusive – to summarise, we found no correlation between occupation type and age of death for women and only a very small correlation for men, but none of which was statistically significant.

However, it is important to emphasise that the data often contained only one occupation, which we believe was the most recent one. Hence, we may only have a record of the occupation where the resident spent the last years of their working life which may well have needed to be relatively light due to the physical requirements of their main previous occupation. We are therefore not necessarily capturing the true toll that the resident's main occupation has taken on their health in our analysis.

Having found no statistically significant link between the recorded occupation and mortality rates, we need to consider other reasons why the retirement village environment appears to have little or no beneficial impact on the shortest-lived male lives.

If we consider the lifestyle of males coming from a lower socio-economic group, we would historically find that there is a high preponderance of heavy smoking, poor diet and high alcohol consumption as compared to the corresponding females. These lifestyle choices will lead to a higher number of early deaths from causes such as heart attack, stroke and cancer.

While residents were screened for health on entry, as discussed earlier, such screening will have focused on the ability of the resident to lead an independent life. Screening therefore may not have detected the underlying health indicators (e.g. high blood pressure) that could lead to early death. The beneficial social environment of the Village can do little to postpone such imminent deaths.

Once these unpreventable early deaths have occurred (i.e. deaths amongst the shortest-lived lives discussed earlier), there is evidence that the rest of the male Village population is living at least as long as the general population. Therefore, the retirement village environment is offsetting the usual detrimental impact on mortality of belonging to a lower socio-economic class.

It is interesting to consider how changes in the future demographics of Whiteley may impact on the currently observed benefits to longevity. For example, we have seen that the average age of new entrants has increased in the last 10-20 years and that the Village as a whole is ageing. If this is due to older people staying much more active for longer then we could argue that the level of social interaction in Whiteley will remain as it is at present, and hence the boost to longevity will continue at similar levels.

However, if the fact that the Village is ageing means that the social aspects of the Village life diminishes then the health dividend that the Village pays is likely to reduce in the future. This would suggest that a more active attempt should be made to attract younger entrants to counter-balance the ageing of the Village as people, particularly males, live longer lives.

7. Determining the longevity boost from living in Whiteley Village

Our initial results in Section 6 found that there is statistically strong evidence that female Villagers entering Whiteley between ages 65 and 69 received a substantial boost to their longevity when compared to the general population. While a possible similar effect for men was found to be only borderline statistically significant, there was evidence that the majority of male Villagers lived at least as long on average as males in the wider population.

While we have shown that female Villagers received a longevity boost, we did not quantify the actual size, nor whether it has changed over time. The purpose of this section is to calculate the size of any longevity boost in ten-year intervals centred on 1930 to 1980 i.e. to determine by how much average life expectancy differed over time. Subsequent cohorts for 1990, 2000 and 2010 have not been included because they are 'incomplete' i.e. there are Villagers still alive who entered in these years.

7.1 Methodology

To calculate the difference in longevity between Villagers and the general population our methodology entails a comparison of both average and median life expectancy among completed female Whiteley cohorts at ten-year intervals.

We did not carry out the corresponding analysis for male Villagers as the results shown in Section 6.2 indicated that there was little statistically significant difference between the male Whiteley population and the general male population of England & Wales in terms of age of death.

Therefore, returning to females, each cohort is compared with cohort life tables based on the England & Wales female population. Entrant ages are from age 65 to 69 centred on age 67 and are therefore consistent with the approach adopted in Section 6.1. For the 1930 cohort, entrant years range from 1925 to 1934, for 1940 from 1935 to 1944,...., and for 1980 from 1975 to 1984.

Sample sizes vary according to cohort. They range from 112 (highest) in 1950 to 45 (lowest) in 1980. We believe that there are two main reasons for this decline. The first is that there has been a propensity, in the later cohorts, for females to join the Village at ages outside the cohort age range of 65 to 69 i.e. there are fewer new entrants who meet our criteria for being included in the dataset.

The second reason is that the residential and nursing care facility, Whiteley House, operated at lower levels of occupancy from the late 1990s to the early 2000s. The reduced capacity of Whiteley House resulted in some elderly residents who required long term care having to leave the Village rather than being transferred to the nursing facility. As a result, their deaths took place outside the Village and were therefore not captured in our dataset. The impact of this meant that the results for 1980 may not be as statistically reliable as for other years. We return to this point in Section 7.2 below.

7.2 Results

Table 9 gives our key results for each female cohort. Columns (A) and (B) give the average (mean) duration to death in years (i.e. the standard definition of future life expectancy) for the female Whiteley cohorts and the general England & Wales female population, respectively. Column (C) shows the difference in mean duration between the two populations and is positive for each cohort. However, as mentioned earlier, the increase in life expectancy from living in Whiteley Village has reduced for the 1970 and 1980 cohorts.

Columns (D) and (E) show the median duration to death (i.e. the period of time by which 50% of the cohort has died) for both female Villagers and the female general population. Column (F) shows the difference in median duration between the two populations. We have provided the median duration as it is less prone to the distorting effect of outliers, particularly when small sample sizes are involved.

We should note that the differences in life expectancies - Columns (C) and (F) - are found by comparing the future lifetimes of Whiteley pensioners with those of the general population. While this indicates that living in Whiteley Village gives a longevity boost, we believe that it understates the full benefit to Villagers. This is because Village entrants are of lower economic means than the average pensioner and so we would expect them to live a shorter life on average.

			Average (mean) duration to death (years)			Median duration to death (years)		
Whiteley cohort centred on year	N	Average age on entry	(A)	(B)	(C)	(D)	(E)	(F)
			Whiteley Residents	E&W	Difference (A-B)	Whiteley Residents	E&W	Difference (D-E)
1930	80	66.9	16.2	12.2	4.0	16.1	11.4	4.7
1940	78	67.2	15.5	13.0	2.6	15.2	12.5	2.7
1950	112	67.0	16.9	13.8	3.1	15.6	13.5	2.1
1960	101	66.8	18.4	14.5	3.8	19.2	14.4	4.9
1970	55	67.0	17.7	15.5	2.2	18.4	15.5	2.9
1980	45	67.2	17.3	16.4	0.9	17.9	16.7	1.3

Table 9: Mean and median duration to death at age 67 for female Whiteley cohorts (N = sample size) and corresponding England & Wales female cohorts

Figure 15 shows the median female future durations of life at age 67 for the general female population and for Whiteley Villagers with 90% confidence intervals around the observed medians. As can be seen, for 1930, 1940, 1950, 1960 and 1970 we can be 90% certain that the longevity advantage is not caused by sampling error. Although the result for the 1980 cohort is not statistically significant, Villagers still appear to have received a noticeable benefit.

As mentioned previously, the reduction in the capacity at Whiteley House affected the 1980 cohort as residents who would ordinarily have opted to transfer there if nursing care were required may have transferred out of the Village. They would therefore not be included in our dataset and, in all likelihood, would have an age at death older than average. Including these lives would hence increase the median and mean life expectancies of the cohort.

Further analysis of Whiteley records led us to identify three additional female Villagers who met the entrant age criteria and, after withdrawing from the Village, survived for between one and two years. These lives were all aged over 85, and each had been in the Village for at least 19 years.

We investigated the impact on longevity had these deaths taken place inside the Village and hence would have been included in our data. Including these lives increases the mean and median durations of death from 17.3 years (Column (A), 6th row) to 17.7 years and from 17.9 years (Column (D), 6th row) to 18.5 years, respectively. In other words the results would have been on a par with 1970. Note that Figure 15 does not include these three extra Villagers.

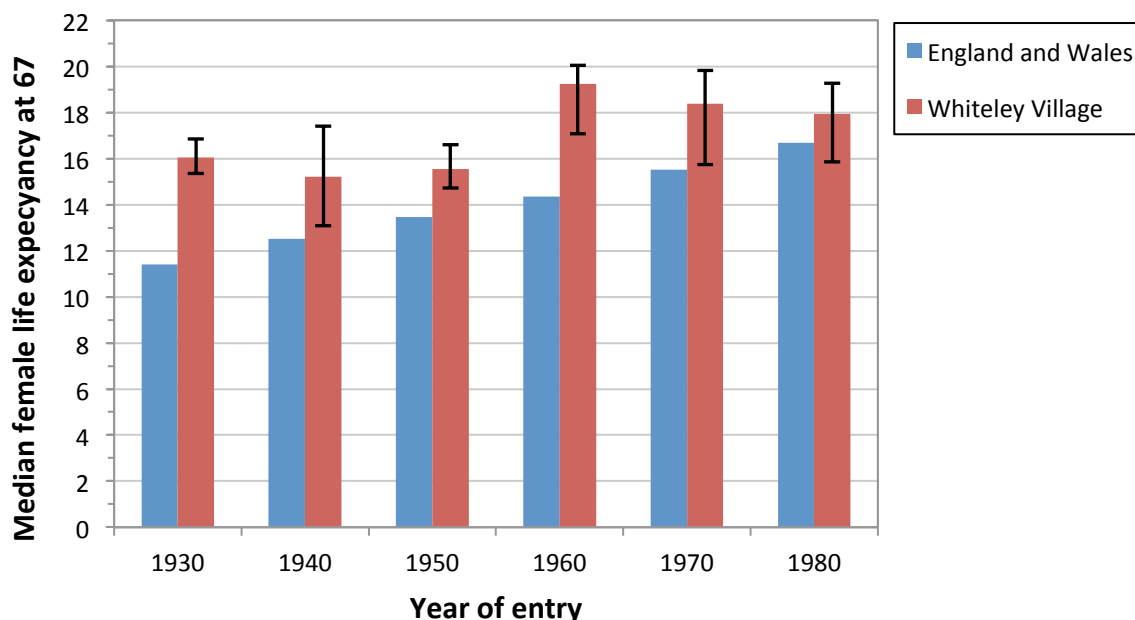


Figure 15: Median female duration of life aged 67 in the E&W and Whiteley populations with bars showing 90% confidence intervals ³

7.3 Comparison of life expectancies

Figure 16 compares the survival curves of female Villagers and the female England & Wales population for the 1960 cohort. The blue line shows the survival curve for England & Wales and the red line shows the survival curve for Villagers. The vertical gap between P and Q shows that approximately 80% of female Villagers survived for at least ten years, whereas only approximately 70% of the general female population survived for the same period.

Let us now consider the horizontal gap between X and Y. This represents the difference in duration reached by a given percentage of the respective populations. It shows that 50% of the general female population survived for at least 14 years, whereas 50% of female Villagers survived for at least 19 years. (Note: These values correspond to the median durations. The precise values are given in Table 9 and are 14.4 and 19.2 years [Columns (D) and (E), 4th row], respectively.)

Figures A1 to A5 in the Appendix compare the survival curves of Villagers and the general population for each cohort. It can be seen that, with the exception of 1980, Village survivorship always exceeds survivorship in the general population at every age up to age 100.

³ See for example: Altman D.G.(1999) Practical statistics for medical research, Table B11 p535

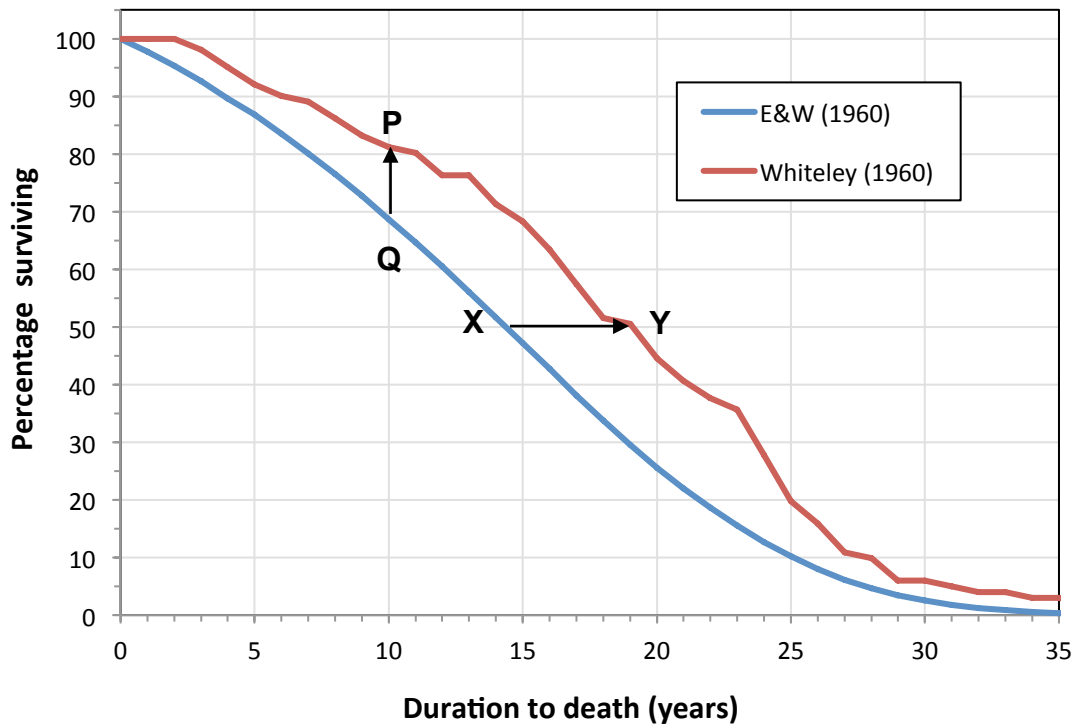


Figure 16: Female survival curves for the 1960 cohorts of E&W and Whiteley

7.4 The Whiteley boost after adjustments for deprivation

Even if life expectancy in the Village had remained at 1960 levels (when it was highest), the gap in life expectancy between Villagers and the general population would still have reduced due to the life expectancy in the wider population increasing. This could falsely lead one to believe that the Whiteley boost has waned over these decades. However, we conjecture that the Whiteley boost has remained intact as the Whiteley Villagers should be compared to the poorest pensioners in the wider population in order to compare like with like.

We consider that the reduction in the gap is largely the result of changes in the relative economic means between the Villagers and the general female population. We know that the decades before 1970 were noted for high levels of pensioner poverty, the effects from which Whiteley residents would have been insulated. Pensioner poverty has since reduced considerably thanks to improved pensions and the wider benefits of home ownership plus a stronger pensioner safety net.⁴ However, the poorest pensioners from which the Whiteley residents are drawn have not benefited to the same extent as the average pensioner (e.g. they would not be homeowners).

Using data from Villegas and Haberman (2014), mortality data for socio-economic subpopulations defined on the basis of a deprivation index are split into quintiles ranging from the 20% least deprived members of the population (Q1) to the 20% most deprived (Q5) in which Q3 corresponds

⁴ For the more recent period please refer to "An analysis of the income distribution 1994/95 – 2013/14 (DWP)". This shows that almost 75% of pensioners now own their own homes and that the percentage of pensioners on 'Absolute Low Income' has fallen from 39% in 1998/99 to 16% in 2013/14.

to the median or average quintile. Table 10 shows the cohort life expectancy and median duration of life for a woman aged 67 in England & Wales based on this demographic split.

Row A shows a 1.8 year gap between the median duration of life between Q5, the poorest, and Q3, the median quintile ($17.0 - 15.2 = 1.8$ years). Therefore, if Whiteley provided no longevity boost, we would expect female Whiteley Villagers to live 1.8 years fewer than the average member of the England & Wales population.

If we now consider the results for Whiteley in row C, we find that, compared to the median duration for Q3, Whiteley Villagers have a 0.9 years ($17.9 - 17.0 = 0.9$ years) increase in median life expectancy. However, if we compare the median durations for Q5 with the female Whiteley population, we see that the difference is 2.7 years ($17.9 - 15.2 = 2.7$ years). That is to say that, when compared to their socio-economic equivalents in the wider population, the truer boost from living in Whiteley was 2.7 years. This is made up of the hidden boost of 1.8 years which takes into account the difference between the Q5 and Q3 median life expectancies and the observable 0.9 year gain that Whiteley Villagers have when compared to the typical (Q3) pensioner. As the lower bound of the 90% confidence interval is 15.8 years, we can be confident that there was a genuine longevity boost compared to the Q5 population. This result is more pronounced if we include the three additional Whiteley residents as this would give a median duration of 18.5 years and a lower confidence bound of 16.2 years.

In fact, when we compare Whiteley with Q1, we find that the median durations are very similar (18.1 years for Q1 vs 17.9 or 18.5 years for female Whiteley residents). In other words, not only has living in Whiteley ameliorated the effect of being from a low socio-economic group, but may in fact have transported the female Whiteley population to a life expectancy experienced by an individual from a much higher socio-economic group. However, we should note the small sample size whilst making the latter conclusion.

Measure (females)		Q1	Q2	Q3	Q4	Q5
A	1981 median cohort duration at 67 (years)	18.1	17.4	17.0	16.4	15.2
B	1981 cohort life expectancy at 67 (years)	17.8	17.1	16.8	16.3	15.4

Whiteley		Value	
C	1980 median duration at 67 (years)		17.9
D	1980 average duration at 67 (years)		17.3
E	Modified 1980 median duration at 67 (years)		18.5
F	Modified 1980 average duration at 67 (years)		17.7
ONS (E&W)			
G	1980 median duration at 67 (years)		16.7
H	1980 average duration at 67 (years)		16.4

Table 10: Cohort mean and median life expectancies for females age 67, split by socio-economic class

Notes for Table 10: Rows A and B taken from Villegas and Haberman (2014); Rows C and D from Whiteley data; Rows E and F from Whiteley data adjusted to include the three additional Villagers; Rows G and H from ONS

7.5 Conclusions regarding longevity

Our findings show that female Villagers have enjoyed a considerable increase in life expectancy compared to the general female population of between 1.3 and 4.9 years based on the median duration of future lifetime (with an increase of between 0.9 and 4.0 years based on the mean). This result is even more remarkable once the lower financial means of Villagers, relative to the general population, is taken into account.

A possible concern is the decrease in life expectancy witnessed in the 1970 and 1980 Whiteley cohorts. However, we believe that this is due to the reduction in capacity in the nursing care in Whiteley House and the refurbishment of the cottages. This commenced in the mid-1990s and led to a temporary decrease in the number of residents (see Figure 10). As explained in Section 7.2, this meant that some of the longer-lived residents of the 1970 and 1980 cohorts may have been excluded from our analysis.

This effect was supported by: (a) the drop in the sample sizes which can only be partly explained by the reduction in the percentage of entrants between the ages 65 and 69; and (b) after 1990, the observed number of deaths of people aged over 80 reduced considerably (see Figure 13). The result is that the calculated mean and median durations are lower than they would have been had these residents been able to move into the residential and nursing care facility in the Village, as previous cohorts would have done.

Our results also show that Whiteley's advantage may be lessening relative to the England & Wales general female population. For example, between the 1960 and 1980 cohorts, the additional years have reduced from 4.9 to 1.3 years (or 1.9 if the three additional lives are included) based on median life expectancy. However, we know that this does not tell the whole story since, relative to Whiteley, the financial and social conditions of the average pensioner has improved markedly in this time. As Villagers must be on low means in order to qualify for entry, a better comparison therefore would be with people of similar background with whom we would expect Whiteley's historical advantage to have been maintained.⁵

We therefore investigated the difference in median duration of a female Whiteley resident compared to that of a female in Q5 of the England & Wales population for the 1980 cohort and found a statistically significant boost of between 2.7 and 3.3 years. This boost equates to a resident having their life expectancy increased from that of a female in Q5 to that of a female in Q1 (with the higher estimate of median duration) or between Q1 and Q2 (with the lower estimate).

In summary, we believe that the longevity boost provided to female residents living in Whiteley Village, when compared to female pensioners in the general population of similarly low means, remains at a significant level. However, this boost has been partly masked by improvements in the health and financial well-being (and the associated increase in life expectancy) of the average pensioner when compared to a typical Whiteley resident.

The undoubted lesson of Whiteley is that it is possible to create a socially stimulating and safe environment in which older people can enjoy a longer retirement in peace and comfort than would have been experienced by similar individuals in the general population. It further suggests that this type of lifestyle in retirement is capable of combating the negative effects on health and social well-being of low economic means and isolation.

⁵ In 'Poverty in the United Kingdom' (1979) Peter Townsend examined relative deprivation covering a wide range of aspects of living standards, both material and social. He noted that, although the problem of poverty among the elderly has been recognised socially for at least 100 years, it has resisted the attempts of successive governments to alleviate or eliminate it.

8. Key findings

- Our analysis has shown that there is statistically strong evidence that female residents entering Whiteley Village between ages 65 and 69 have received a substantial boost to their longevity when compared to the wider population.
- In particular, living in Whiteley Village appears to have significantly improved the probability that a female resident survives beyond the median age of death of the wider population.
- The extent of Whiteley's longevity advantage has changed through time. It reached its highest level of 4.9 years in the 1960 cohort based on the median age to death for a woman entering the Village aged 67 when compared with a woman of the same age in England & Wales.
- In 1970 and 1980 this advantage lessened, mainly due to the increase in life expectancy of the general population. However, this fails to take into account that Whiteley only accepts poorer pensioners who have shorter life expectancy on average, and who may not have had such substantial increases in life expectancy.
- In fact, the median duration of a female entrant at age 67 in the 1980 cohort in Whiteley was between 2.7 and 3.3 years higher when compared to the poorest 20% of female 67 year olds in the wider population.
- Furthermore, Whiteley appears to confer a longevity advantage on female residents equivalent to them coming from quintile 1 or 2 when we would have expected a life expectancy consistent with quintile 5.
- While we were unable to find sufficient statistical evidence that the male residents of Whiteley outlive their counterparts in the wider population, there was certainly evidence that the majority lived at least as long on average. In other words, being a resident in Whiteley seems to nullify the usual higher mortality rates experienced by members of the lower socio-economic classes.
- The only exception to the improvements in the expected mortality rates was for the shortest-lived males. However, we postulate that such males had made lifestyle choices (e.g. smoking) that had led to underlying health impairments which could not be fully mitigated by the benefits achieved through the social interaction and on-site health support provided by Whiteley.
- Our conclusion is that retirement villages (or their equivalents) could help in the Government's aim to reduce mortality inequalities experienced in lower socio-economic groups.

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APPENDIX: Survivorship curves for Whiteley and E&W cohorts

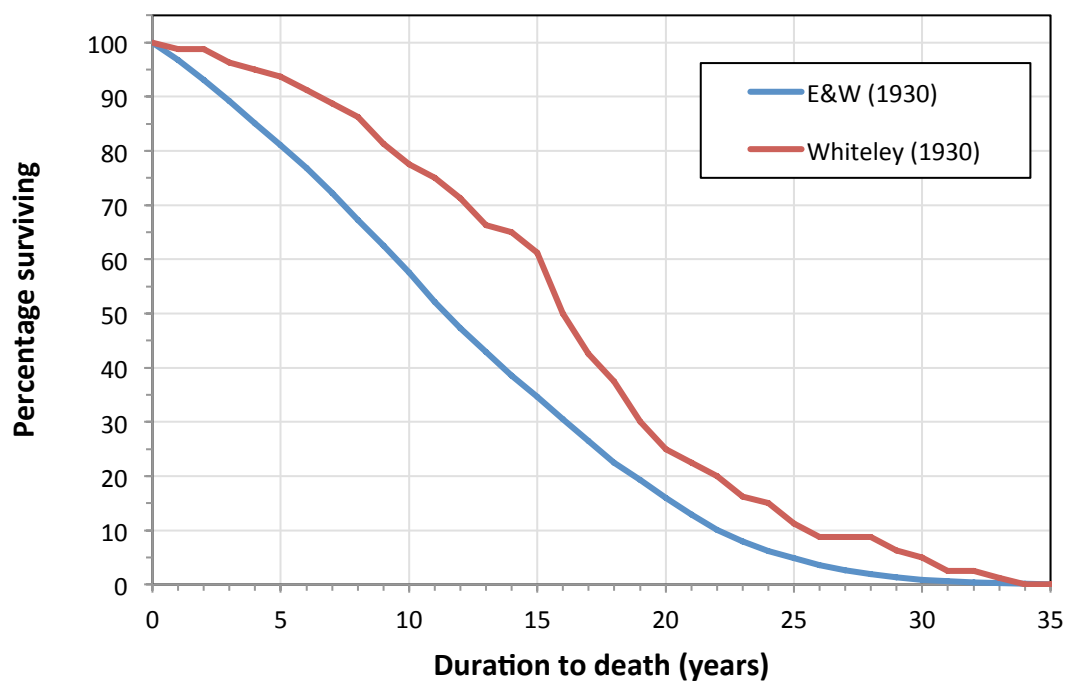


Figure A1: Female survival curves for the 1930 cohorts of E&W and Whiteley

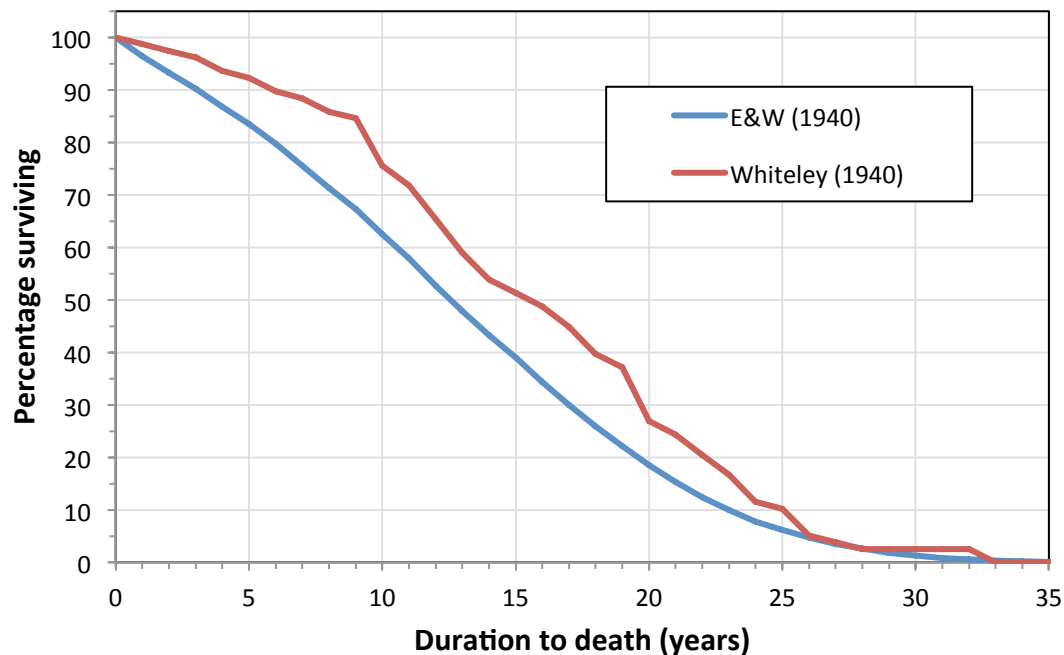


Figure A2: Female survival curves for the 1940 cohorts of E&W and Whiteley

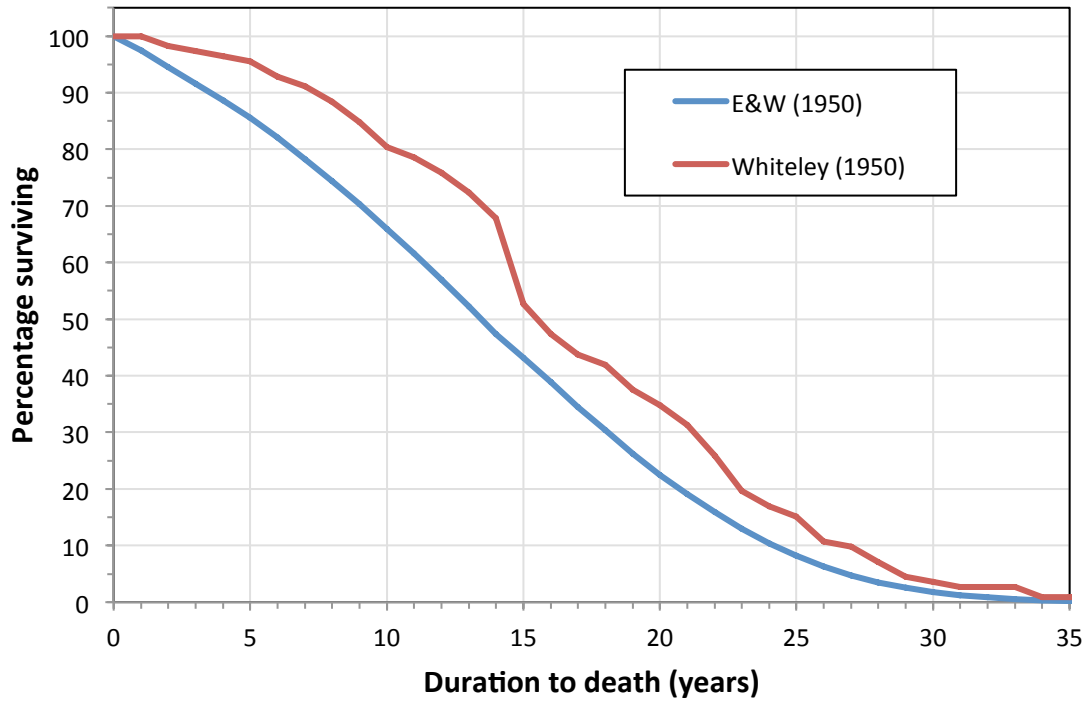


Figure A3: Female survival curves for the 1950 cohorts of E&W and Whiteley

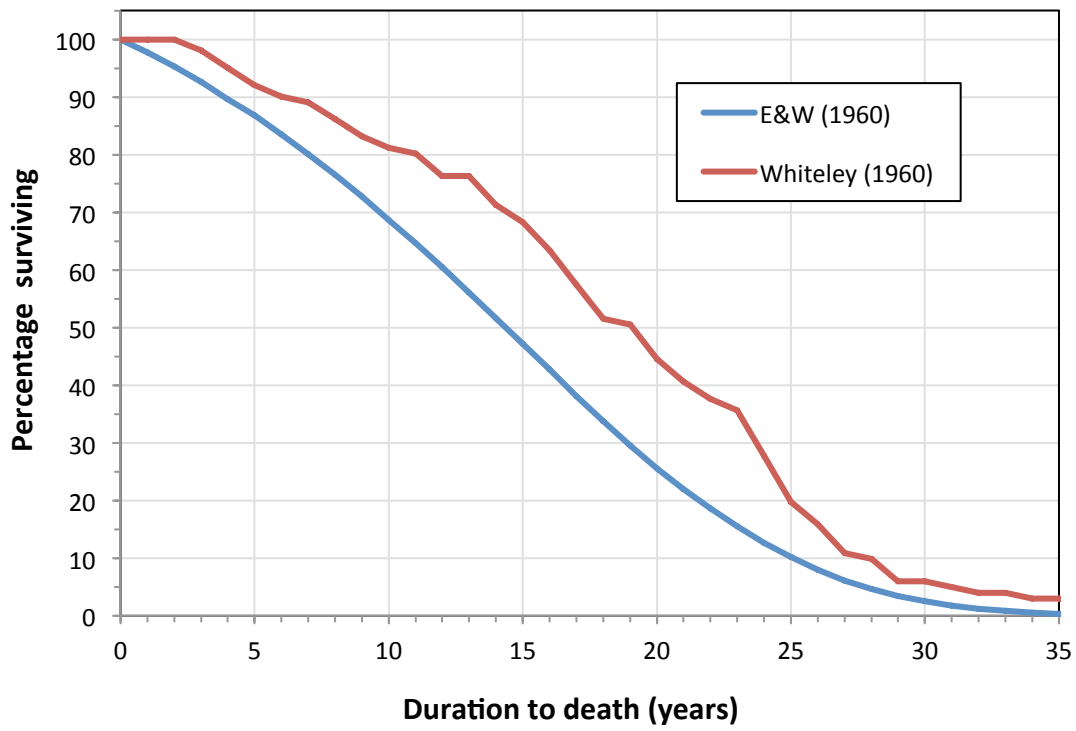


Figure A4: Female survival curves for the 1960 cohorts of E&W and Whiteley

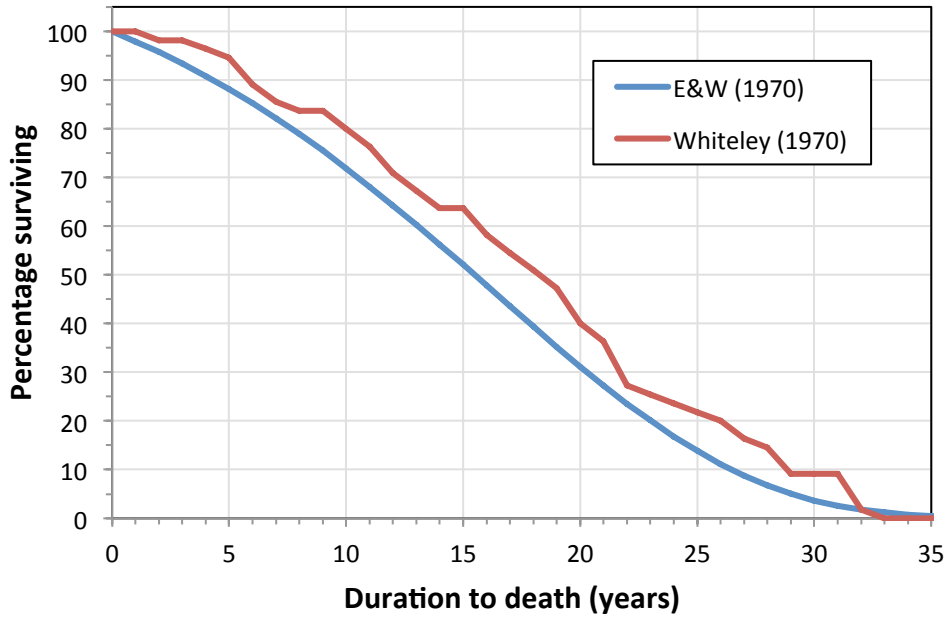


Figure A5: Female survival curves for the 1970 cohorts of E&W and Whiteley

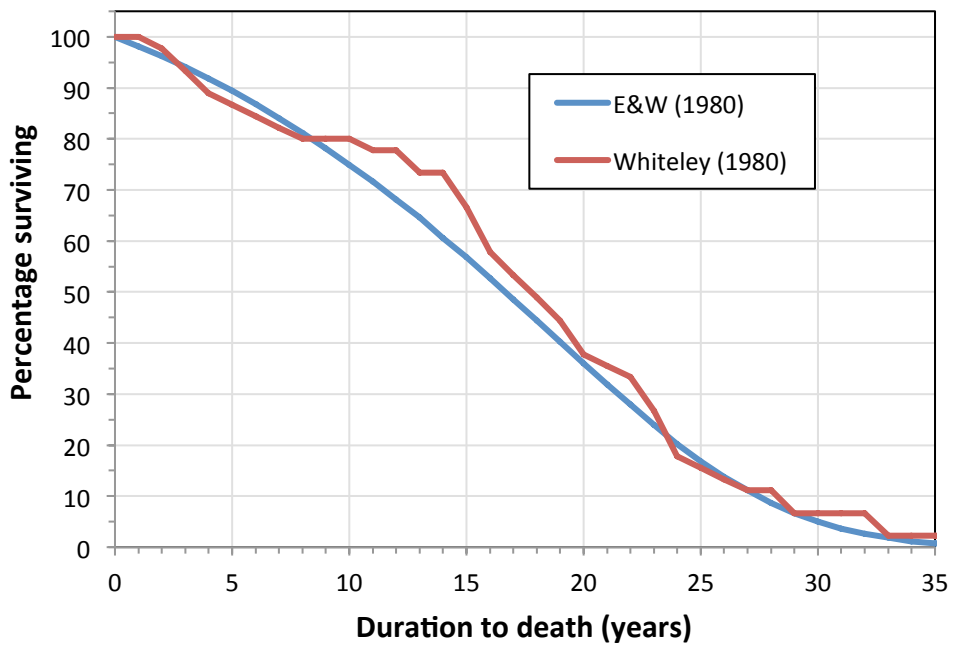
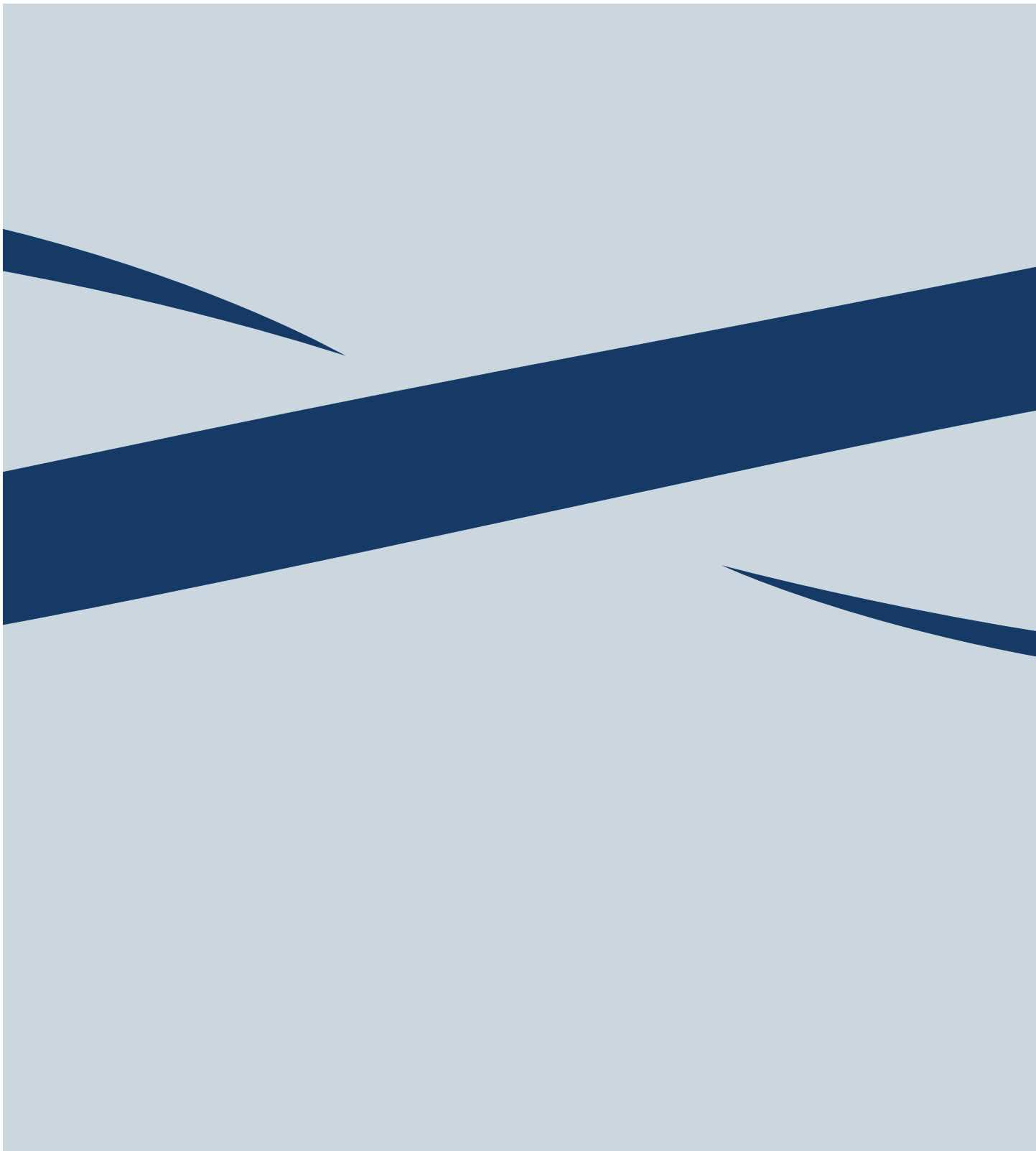


Figure A6: Female survival curves for the 1980 cohorts of E&W and Whiteley



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