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Marathon or sprint?

Do elite-level athletes live longer than average?

Note on the authors

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Professor Les Mayhew is Head of Global Research at ILC and Professor of Statistics in the Faculty of Actuarial Science and Insurance at Bayes Business School, the business school of City, University of London (formerly known as Cass Business School). He is an Honorary Fellow of the Faculty of Actuaries and a former senior civil servant, having worked for the Department of Health and Social Security, Department of Social Security and the Treasury. He was also a Director at the Office for National Statistics. He loves sport but his only ever notable success was winning the Civil Service tennis mixed doubles – an achievement which now seems like a distant memory. His interest in statistics was kindled by keeping scores for his dad's cricket team at a very young age. He says that if this study brings more people into sport, then he'll be happy.

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Acknowledgements

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3

Contents

Executive summary

We know that playing sport has many advantages. Aside from its health benefits, it can have a positive influence on younger participants, encouraging leadership qualities; it can lead to greater career success, and offer a route out of poverty if played to a high enough level. What we don't know is whether it adds years to your life, as well as life to your years.

The ILC previously posed this question in *The longevity of sporting legends* (2021), which investigated the longevity of leading male sports stars across seven sports, ranging from football to horseracing. The results showed that sports such as tennis and golf tended to provide the biggest boost to longevity, in part because they could be played into old age.

The Commonwealth Games are an important global force. Since the 2006 Games in Melbourne, the event's estimated global audience has remained steady at approximately 1.5 billion people – or around six out of ten people across the Commonwealth nations. Last summer England celebrated the success of the Commonwealth Games held in Birmingham. 1.5 million tickets were sold – a record for the Games– while the BBC TV audience was a record 28.6 million, making this one of the most successful Games ever.

Like all established sporting events, the Games keep meticulous records of competing athletes, and especially medal winners. In this report, we use this information on medal winners, and much more, to investigate whether medallists live longer lives than the general public.

We cover as many sports as possible with the information available, across a range of categories: track and field, indoor and contact sports, aquatics and cycling. But not all sports have been represented in every Games and so there are gaps. In addition, we disregard team sports such as basketball, cricket and rugby sevens, whose inclusion in the Games has been sporadic and for which the historical record is much harder to investigate.

For men, we find that track, indoor and aquatics boost longevity the most — with aquatics connected to an increase (compared to the general male population) of 29%, track events 25%, and indoor sports 24%. This translates into between 4.5 and 5.3 extra years of life — an advantage that remains relatively constant over time despite general improvements in life expectancy.

We didn't have enough information to assess the life span of female athletes by sport, so we were forced to aggregate the results from all event categories. This is because women started competing in the Games later than men, and originally in fewer categories (although they now compete for more medals than men). We found that across all sports categories, their longevity is boosted 22%, equating to 3.9 extra years of life.

Further findings show that the longevity of long distance runners is marginally higher than for those who run other distances; that wrestlers live longer than boxers; but that there's no difference within field events. Neither do we find any evidence that gold medal winners live longer than silver or bronze medallists — so excelling in your chosen sport is enough!

Cycling was the only exception. This is a relatively dangerous sport at a competitive level, involving a higher incidence of death and injury than for non-competitors. Longevity was only 90% compared with the general male population, although improved safety is changing this.

You don't have to be in your physical prime to win either. The 2022 Games produced the event's oldest-ever gold medallist: George Miller of Scotland (born 1946) triumphed in the Para-Lawn Bowls Mixed Pairs aged 75, alongside his visually impaired countrywoman Melanie Innes (born 1964).

The overwhelming message is that sport adds years to your life, as long as it's not a dangerous one. While generally you can't take part in sports at the highest level throughout your life, the benefits evidently stay with you long after your hang up your spikes or your swimming goggles!

Playing sport boosts life span

A significant body of research shows that sport and physical activity leads to improvements in physical and mental health. However, what hadn't previously been covered was whether playing sport increases longevity — and in particular, whether elite-level athletes live longer than the general population. This was the subject of the ILC report, *The longevity of sporting legends* (2021), which investigated the longevity of leading male sports stars across seven sports that ranged from football to horseracing.

This report returns to that subject, but covers a wider range of sports over a longer time period. The obvious subjects were the Olympics and the Commonwealth Games, which are both long- established and international in scope. We use the Commonwealth Games as our test bed to explore the life spans of elite athletes by type of event, and whether these have changed over time.

A key difference from our previous research is that the competitors studied are both male and female, and from all over the world, allowing us to determine whether the longevity benefits identified extend to other sports, and to people of all backgrounds. We also speculate whether these advantages transfer to the wider population and not simply sporting elites.

The Commonwealth Games have a long, rich history. This event's history and development shaped the way we undertook our analysis, our choice of events, how we categorised those events, and the robustness of our conclusions.

History of the Commonwealth Games

The Commonwealth Games have become increasingly popular over time. The 2022 Games held in Birmingham, UK, generated a BBC TV audience of 28.6 million and sold more tickets than any previous Games, making that event one of the most successful Games ever.[1]

Known originally as the British Empire Games, the event was designed to bring Commonwealth nations and territories together every four years in what was called a "pan-Britannic festival of culture and sport."[2] The inaugural Games were hosted by Hamilton in Ontario, Canada, in 1930. From 1954, the event became known as the British Empire and Commonwealth Games, with the current name being bestowed in 1978.

The Commonwealth began as a group of eight nations in 1949; now it comprises 56 independent countries from across Africa, Asia, the

Americas, Europe, and the Pacific – with a combined population of 2.5 billion people. Commonwealth member countries were originally part of the British Empire, but this changed with the admission of Mozambique in 1995, and Gabon and Togo in 2022.

Of the 72 teams that entered the 2022 Games, 54 were countries and 18 were territories, such as Jersey, Gibraltar and the Isle of Man. The Games allow island nations such as Niue, a tiny country in the South Pacific Ocean with a population of only 1,784 at the last census, to compete against a country like India, with a population of 1.3 billion.

The key points for our study are that the Commonwealth covers a huge percentage of the world's population, and that the Commonwealth Games are long established, with an unrivalled public record of competitors and medal winners.

The Games have taken place consistently since 1930, with the exception of 1942 and 1946 during the Second World War. An increasing number of Commonwealth regions have taken part over the years, and the event has added many more sports and athletes.

Figure 1: Evolution of the Commonwealth Games
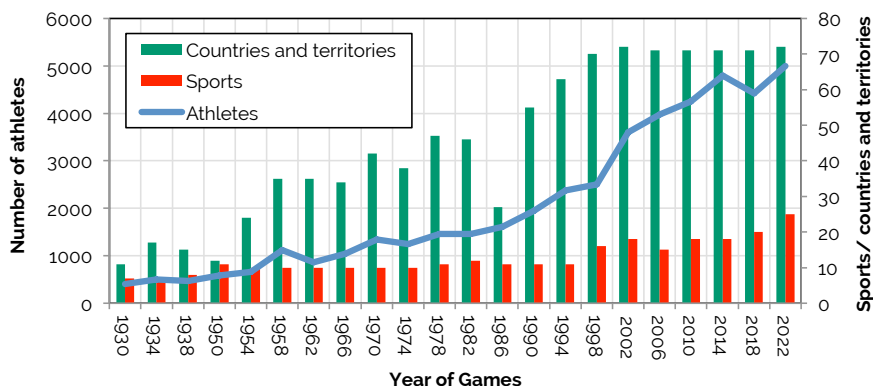
Figure 1 shows how the number of teams entered, by countries and territories, sports and athletes, has grown since 1930. The number of teams participating has grown to 70+ since the 1998 Games in Kuala Lumpur, with 72 competing in the 2022 Games: 5,000 athletes competing across 19 officially recognised sporting categories.

For the first 40 years of the event's history, the Games used the imperial measurement system of feet, yards and miles. Swimmers would compete

over 100 to 1,500-yard events while track events were based on yards and miles. The metric system wasn't used until the 1970 Games in Edinburgh.

A select few athletes competed under both the imperial and metric systems – and won medals in both. For example, Percy Williams (born 1909) won the inaugural 1930 100-yard sprint in a time of 9.9 seconds, which converts to 91.4 metres. Williams went into the 1930 Games as the reigning Olympic 100 and 200-metre Olympic champion.

Global significance of the Games

Since the 2006 Games in Melbourne, the event's global audience has remained steady at an estimated 1.5 billion people – that's around six of every ten citizens across the Commonwealth. In 2019 the Commonwealth Games Federation commissioned PricewaterhouseCoopers (PwC), who were also corporate sponsors, to evaluate the impact of the Games. PwC found that since 2002, hosting the Games would boost GDP for the host city/region by anywhere from £0.8 billion to £1.2 billion (2018 prices).

As the Commonwealth Games increase in size and global reach, each host country can rely on them to boost its political, economic, and social impact. The 1966 Games in Kingston, Jamaica were momentous because it was the first time that the event had been held outside of high-income and predominantly white countries.

However, the Games aren't free from controversy. In recent years, the cost to host cities has been approximately £176 million, but the 2010 Games in Delhi were a significant exception, costing an extraordinary £8 billion (2018 prices). That was around 37 times more than the original estimate. In contrast, the 2022 Games in Birmingham were delivered for £778 million (approximately £690 million at 2018 prices).

The 1986 Games in Edinburgh were an example of sport and politics colliding: 32 countries boycotted the event due to the UK Government's policy, under Margaret Thatcher, of keeping Britain's sporting links with apartheid South Africa. The 'Boycott Games', as they became known, involved just 27 nations, with the teams that withdrew including predominantly African, Asian, and Caribbean states; the event also saw a significant funding shortfall. Since this time, inclusivity has been a driving theme.

Inclusivity to the fore

The early Games could be characterised as involving predominantly 'rich and white' nations. Exceptions were India, which sent a team to the 1934

Games for the first time along with Jamaica. In one defining moment, at the 1954 Vancouver Games Emmanuel Ifeajuna (born 1935) became the first black African to win a gold medal at an international sports event, achieving a leap of six feet and eight inches in the high jump. He became a hero, not just in his native Nigeria, but across the entire African continent. Sadly, after entering politics he met an untimely death when he was executed in 1967 following a failed military coup.

In another example of black sporting success, weightlifter Marcus Stephen (born 1969) represented the Central Pacific Island nation of Nauru at four Commonwealth Games, from 1990 to the 2002 Games in Manchester. Nauru has one of the world's smallest populations: around 10,000 at their last census, but Stephen won a total of 12 Commonwealth medals, including seven golds. Following his sporting retirement, he entered politics and was elected Nauru's president - a position he held for almost four years, until November 2011.

Women have competed in all 22 Commonwealth Games, although their presence was sometimes restricted. Of the seven sports included at the inaugural Hamilton Games – athletics, boxing, diving, lawn bowls, rowing, swimming and wrestling – women competed only for swimming and diving medals. Of the 400 athletes, very few were women. New Zealand, for example, sent only Gladys Pidgeon (born 1906), a breaststroke swimmer, whose presence was conditional on her mother chaperoning her. Pidgeon enjoyed a long life of almost 96 years.

In the 1950 Games, women only competed in nine track and field events – and were restricted to distances of 880 yards (804 metres) – but by the 1974 Games in Christchurch, they were fully involved in throwing events such as shot put, javelin and discus, and ran distances up to 1500 metres. They weren't allowed to compete in the 26-mile marathon until 1986, because of concerns that it was too long, and potentially hazardous. The first time women were admitted to compete in this event, at the Edinburgh Games of that year, it was won by Australia's Lisa Martin (born 1960).

Women achieved medal parity in 2018; and they now compete in sports such as boxing and wrestling. The most decorated athlete in Commonwealth Games history is prolific Australian swimmer Emma McKeon (born 1994). She has won 20 medals, 14 gold, across three Games, starting at Glasgow in 2014.

In terms of age, the 2022 Games saw 75-year-old George Miller (born 1946) become its oldest gold medallist in the Para Lawn Bowls mixed

pairs, alongside Melanie Innes (born 1964). That year also saw the Game's oldest female gold medallist, Rosemary Lenton (born 1949), win the Para Lawn Bowls women's pairs at 72. Whether by coincidence or not, all three competitors played for Scotland.

A distinctive feature of the Commonwealth Games is that para-sports are now fully integrated, at both scheduling and team levels. This didn't take place until the 2002 Games in Manchester. Before that, there was a separate event called the Commonwealth Paraplegic Games. The 2022 Games had the largest para-sport programme in the Games' history, with 42 events across eight sports. They included aquatics (Swimming Para), Athletics (Para), Lawn Bowls (Para) and Powerlifting (Para).

Is longevity boosted or not?

One of the longest-living Commonwealth Games medallists is the remarkable diver, Edna Child (born 1922). Now aged 100, she was born in the East End of London. She spent much of her childhood in and out of hospitals with empyema, a condition that attacks the lungs and chest cavity, and was advised not to over-exert herself. She ignored this to take up swimming, later switching to diving where she excelled, winning two gold medals at the 1950 Games in Auckland for the 3-metre springboard and 10-metre platform. Her medals were stolen in a 2013 burglary, but her records and legacy remain secure.

Edna Child is only one of many such examples: the research question is how we determine whether her longevity is abnormal or more generally representative of elite athletes. To obtain a clear picture we need to disentangle several competing factors: one is the event or sport in which athletes compete; another is gender (as women tend to live longer than men in the general population). Thirdly, and possibly the most important, is the year of birth; average life expectancy has improved over time.

Is the nature of the sport a factor?

Our core question is whether elite athletes live longer than the general public; our secondary one is whether certain sports boost longevity more than others. Only a small number of core sports feature in every Games, while others may be included optionally, depending on popularity, at the discretion of the host country. There are 16 core sports: those with the largest number of competitors are athletics and aquatics (mainly swimming and diving).

Some team games like netball, field hockey and rugby sevens are also core sports – but we can't include these as they've only featured in the Games since 1998, and not every time. Multiple team members are also much harder to trace.

Some sports may feature only a few events, limited to a small number of athletes from a subset of countries. There are also discontinued sports such as tennis, water polo and synchronised swimming. However, this doesn't rule them all out entirely, as we include fencing, which is a discontinued sport.

To cover all of these variations, we group a total of 4,082 medallists into six representative categories, consisting of 2,688 men and 1,394 women. The sports categories with the largest number of competitors are track events (such as running), aquatic sports (such as swimming and diving) and field

events (such as throwing and jumping). Contact sports (such as wrestling) also form a large category. Also included are indoor sports (like gymnastics or weightlifting) and cycling. We've grouped rowing with aquatics, and placed shooting and lawn bowls with field sports as they don't have enough medallists to justify separate categories.

List of sports categories and disciplines, with number of medallists: men

Athletics (track): short, middle and long distance running events, including hurdles, steeplechase, walking and marathon **(578 medallists)**

Athletics (field): decathlon [a mix of track and field events]; discus; high jump; javelin; long jump; pole vault; shot put; triple jump; plus shooting and lawn bowls **(405 medallists)**

Aquatics: diving; swimming (backstroke, breaststroke, butterfly, freestyle, medley); plus rowing (single sculls) **(436 medallists)**

Contact sports: boxing, judo, and wrestling (including weight categories that have been in all Games) plus fencing (epée, foil and sabre) **(726 medallists)**

Indoor: gymnastics (all-around, rings, floor, vault, horizontal bar, parallel bars, pommel horse); racquet sports (badminton, squash, table tennis); weightlifting (all included weight categories) **(323 medallists)**

Cycling: road; mountain/cross country; and track **(220 medallists)**

List of sports categories and disciplines with number of medallists: women

Athletics (track): short, middle and long distance running events, including hurdles, steeplechase, walking and marathon **(357 medallists)**

Athletics (field): heptathlon [a mix of seven track and field events, previously called pentathlon with five events]; discus; high jump; javelin; long jump; pole vault; shot put; triple jump; plus shooting and lawn bowls (**251 medallists**)

Aquatics: diving; swimming (backstroke, breaststroke, butterfly, freestyle, medley); plus rowing (single sculls) **(451 medallists)**

Contact sports: boxing; judo; and wrestling (including weight categories that have been in all Games); plus fencing (foil) **(81 medallists)**

Indoor: gymnastics (all-around, asymmetric bars, hoop, beam, rope, ball, vault, floor, rhythmic all-around); racquet sports (badminton, squash, table tennis); weightlifting (all included weight categories) **(171 medallists)**

Cycling: road; mountain/cross country; and track **(83 medallists)**

Making calculations

To demonstrate whether athletes live longer than the general population, we take the average of the percentiles at which each athlete's death occurs, and express it as an index of what the average percentile would have been had they been members of the general population. If the index is 1, playing that sport doesn't affect the athlete's longevity compared to that of the general population. If the value is higher than 1, it does – but if it's lower than 1, the sport category would appear to reduce life span: a value of 1.2 would indicate a 20% advantage, while 0.9 would indicate a 10% disadvantage.

We're interested in all deceased competitors, but concerned not to introduce longevity bias. A competitor in the 1954 Games born on or before 1930 would be 92 years old in 2022, with a relatively small chance of being alive, but a competitor in the 1974 Games born in 1950 would be only 72 years old in 2022. To avoid mixing younger deceased competitors from more recent Games with those who are still alive, we therefore include only people born before 1931 for this part of the analysis. We identified a tiny number of medallists who were born before 1900 but as we're unsure of their birthdays, we've excluded them.

Figure 2: Relative longevity of male Commonwealth medallists by sporting category
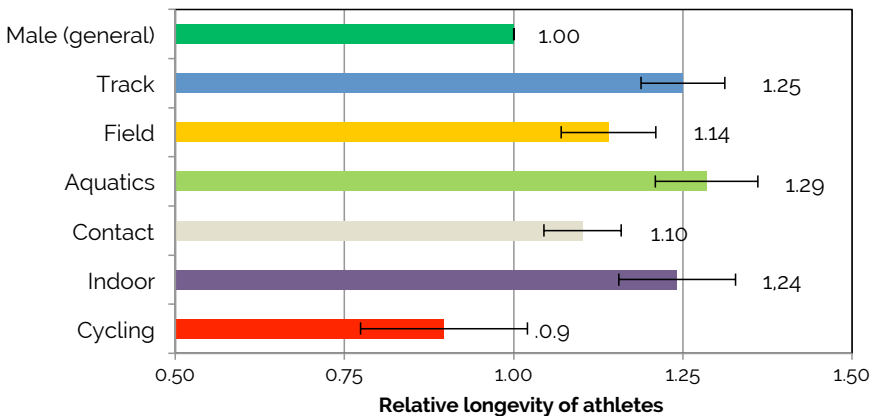

Figure 2 summarises the relative longevity of deceased medallists from different sport categories. Since we're dealing with samples, we've included confidence intervals, or error bars (indicated by the horizontal black lines), to show statistical significance by indicating whether the index is definitely greater or less than 1. The confidence bandwidth is based on one standard deviation.

The value for each bar shows the comparative longevity advantage or disadvantage of each category. The width of the error bars depends on the sample size, so for a category like cycling with only a small sample size, the width is greater than for other categories. The expected value for cycling is 0.9 (-10%), below the average for the general male population, with a confidence interval from 0.8 to 1.02.

Which sports boost longevity the most?

The chart shows that the aquatics and track categories offer the biggest longevity boost, increasing life span by a multiple of 1.29 +/- 0.08 and 1.25 +/- 0.06 respectively. While other categories show a smaller increase of between 10 and 20%, only cycling offers a decrease of 10%. We can conclude that being a medallist in the Commonwealth Games is connected with an increase in longevity for all sports categories except cycling.

For women, we can only say that competing in any of these six categories is connected with an average increase of 22%, as we've grouped all the sporting categories together.

Can we show the longevity increase in years?

The advantage in years will depend on the year of birth. If the prospective median age of death of a man aged 20 born in 1930 is 78 years, a track medallist would receive a 5-year boost; a swimmer 5.3 years, and a field athlete 2.6 years, while a cyclist would see this reduced by 2 years. For a woman, the prospective median age of death at age 20 would be 82 years; in their case, they would receive a 3.9-year boost. Those born after 1930 have higher expectations of a long life thanks to general improvements in health, but the boost for athletes appears to be roughly constant in terms of years, rather than being proportionate to the equivalent average life span.

How do our results match up with other work?

We can compare our results with existing literature on the longevity of elite athletes, although the methodologies differ in some respects. The athletes in those studies aren't an exact match to ours, as our pool is broader in terms of countries, sports, and time scale. But the literature also reports substantial longevity boosts; some studies attribute these to reduced risk of heart disease, cancer and stroke. The boost varies from 2.8 years (in a study of Olympic medallists from nine countries by Clarke et al, 2012),[2] to five years (in a study involving US male Olympic athletes by Antero et al, 2021),[3] to 6.5 years (in a study of French Olympic rowers by Antero, 2014).[4]

Figure 3: Male survival advantage by event category (current value and average from 1960 to present)
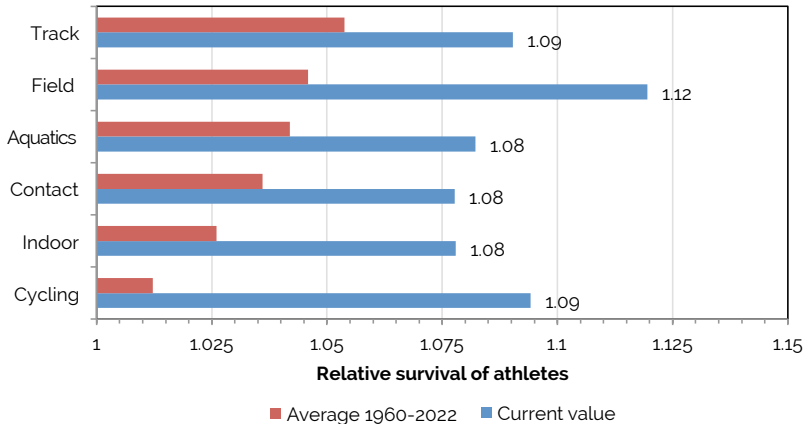
Do the benefits change with age?

When we break our results down in further detail we find that the longevity benefits vary across the life span. For example, track athletes benefit from lower mortality compared with the general population (and other sporting categories). In the Appendix, we compare the percentages that die before the 10th, 25th, 50th, 75th, 95th and 99th percentile of the general population. If fewer are deceased, it means that our athletes do better – providing any difference is statistically significant

For this, we test the null hypothesis that there's no difference between the underlying probabilities of a male athlete and a member of the general male population dying in a specified percentile range. If the probability of occurrence is less than 0.05, we reject the null hypothesis and accept the alternative hypothesis that the athletes die later. The results shown in Table 1 and in the Appendix overwhelmingly shows that male athletes do better than the general population in all event categories except for cycling.

Table 1: Statistical probability of an athlete dying by the given percentile compared with the general male population, by event category

Percentile range	Track	Field	Aquatics	Contact	Indoor	Cycling
0-10						
10-25	*		*	*	*	
25-50	***	*	**	**	**	
50-75	***	**	***		*	
75-95	***	**		*		
95-99	***	**				

(*p=0.05, **p=0.01, ***p=0.001)

Asterisks in this table denote the level of probability of the observed results occurring by chance (one asterisk indicates that p=0.05, two asterisks that p=0.01 and three that p=0.001).

In conclusion

Our athletes' survival advantage isn't spread evenly across the categories and doesn't apply to all percentiles. Track, aquatics and field have the best results, with contact and indoor events also doing well. The advantage only extends to the 50th percentile for aquatics and indoor events; but for track and field, it extends to the 99th percentile. Cycling shows no statistical difference, but the results in the Appendix suggest there's a higher probability of a cyclist dying by the 10th percentile (the youngest category).

In focus: track athletics

Track athletics can be traced back to the Olympics in ancient Greece, where stadium 'footraces' were held in honour of Zeus. Track athletics is categorised as a core mandatory sport at the Commonwealth Games, featuring in all 22 Games. It includes sprint, middle-distance and long-distance events. The range of athletic track events has remained remarkably consistent since the 1930 inaugural games, although there was a significant change when measurement switched from the imperial to the metric system in 1970.

The events included in this category for this study are listed in **Is longevity boosted or not?** (pages 12 and 13).

Until 1970 athletes competed in events such as the 100-yard sprint and one mile. In 1930, Percy Williams (born 1909), the Canadian sprinter and reigning 1928 Olympic champion, won the inaugural 100-yard sprint in 9.9 seconds. 1954, saw the 'miracle mile' in Vancouver, when the English athlete Sir Roger Bannister (born 1929, died 2018, aged 88) and John Landy of Australia (born 1930, died 2022, aged 92) broke the 4-minute barrier. The 100-yard sprint became 100 metres, while the one mile distance was shortened to 1,500 metres.

Although technically a road race, the marathon is included under the track category. It takes its name from the legend of Philippides who ran from the battlefield of Marathon to Athens in 490 BC, carrying urgent news of the Persian invaders. Although there's some dispute about the distance he ran, the modern marathon has featured the same distance across all Games: 26.21 miles (42.19 kilometres). The inaugural 1930 marathon was won by the Scottish athlete Dunky Wright (born 1896, died 1976, aged 79) in two hours and 44 minutes. It also featured one of the study's longest-living athletes, the appropriately-named Johnny Miles (from Canada, born 1905, died 2003, aged 97), who took a bronze medal at the 1930 Games.

The intensive training regimes for track events mean a high level of exposure to muscular injury, especially to the hamstrings and calves, but these will often be short-term in nature and so unlikely to have a negative effect on long-term health and longevity.

There are 578 medallists in our track sample, of whom 161 have died; of these 111 were born before 1931. Of those, there's one centenarian: Godfrey Rampling (born 1909), who died in 2009. He was an English sprinter who won two golds, in the 440-yard and 4 x 440-yard relay events at the 1934 Games in London.

Eight of the 10 longest-lived deceased athletes competed in long distance events (3,200 metres or two miles).

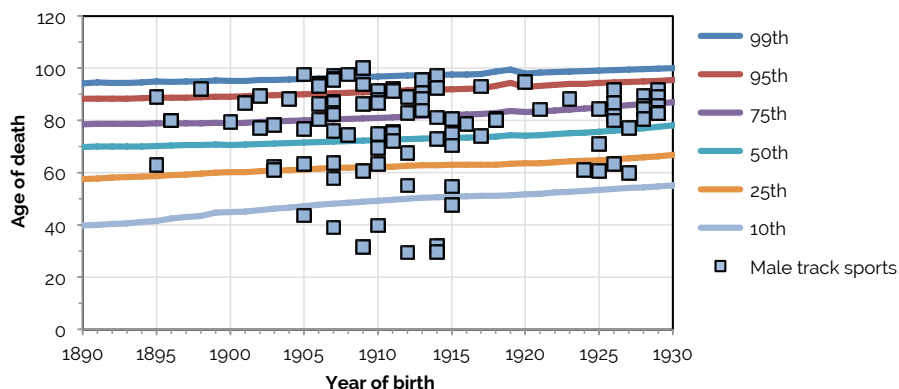**Figure 4: Deaths of medallists compared with the general male population**

Figure 4 shows the ages of death of 102 male track athletes, born between 1890 and 1930, in birth order. The lines show survivorship in the general male population by year of birth: the six divisions range from the 10th to the 99th percentile. The upward slope from left to right reflects that survival is improving over time. One example in the 95th percentile is marathon runner Albert Norris of England (born 1898) who won a silver medal in the 1938 Sydney Games. Norris died in 1990 aged 92.

Over 64% of these deaths exceeded the 50th percentile compared with the general male population; the average percentile age of death was 64%. Four athletes lived beyond the 99th percentile, one of whom was Geoffrey Rampling (born 1909), the only centenarian in this group. A few medallists died before the age of 40. One of these was Reg Thomas (born 1907), a Welsh athlete and squadron leader in the Second World War, who was killed piloting an Avro Lancaster bomber in 1946 at 39.

Figure 5: Cumulative % of deaths compared with the general male population
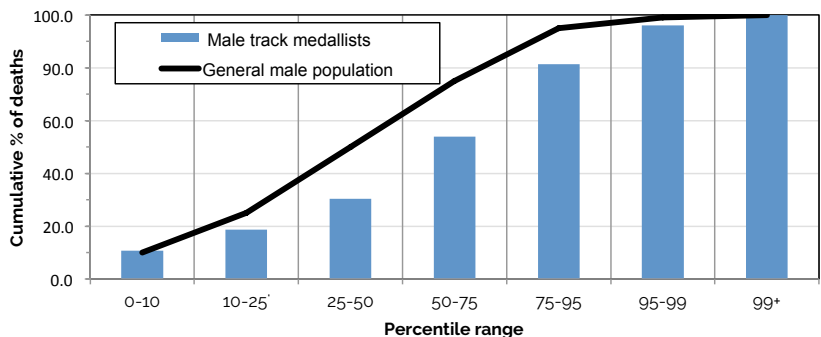
The longevity advantage of track athletes is also clearly seen in Figure 5, which shows the cumulative percentage of deaths compared with the general male population (shown by the black line). This is especially noticeable up to and including the 95-99th percentile as seen by the wide, statistically significant, gap ($p<0.05$) between the blue column and the black line.

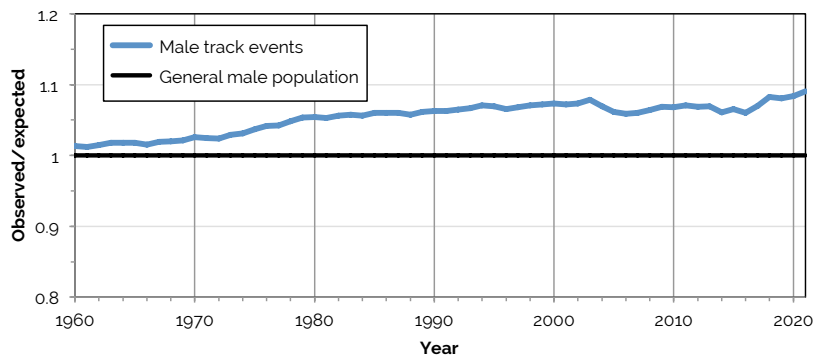**Figure 6: Index for observed versus expected number alive**

Figure 6 confirms that the proportion of athletes alive at any time is higher than the equivalent proportion of the general population. It also shows survivorship gradually increasing, so that by 2021, the ratio indicates a survival advantage of 10% compared with the general male population.

Of the track champions alive in 2022, the oldest is the Australian William De Gruchy (born 1930), aged 92, who took silver in the 100 yards at the 1950 Games in Auckland. And many other alive today made history: Allan Wells, a Scottish sprinter now 70 years old, was the last white male athlete without African ancestry to win the 100 metres at the Olympics.

Spotlight: Allan Wells

Allan Wells (born 1952) is a Scottish former track and field sprinter who was dominant at the 1978 Edmonton and 1982 Brisbane Games. Initially a triple and high jumper, he switched to sprint events and just four years later won 200 metre gold in Edmonton. Wells went into the 1982 Brisbane Games as the Olympic 100 metre champion and achieved a clean sweep of both the 100 and 200-metre events. He won six Commonwealth Games medals in total and following his retirement coached the British Bobsleigh team.

Allan Wells at the final of 1986 Commonwealth Games. Credit PA/Alamy Stock Photo

Marathon or sprint? Do elite-level athletes live longer than average?

21

In focus: field athletics

Field athletics can also be traced back to the ancient Greek Olympics. The javelin evolved from the everyday use of the spear in hunting and warfare, while Homer's Iliad referred to the discus in its description of Patroclus's funeral around 800BC. Events include the discus, shot put, long jump, high jump, pole vault and triple jump.

The events included in this category for this study are listed in **Is longevity boosted or not?** (pages 12 and 13). We've allocated lawn bowls and shooting to this category for completeness and convenience.

Field events have featured as core sports since the inception of the Games in 1930. Canada and South Africa dominated the field in this case. The 1966 Games in Kingston introduced the 10-event decathlon, which was won by Roy Williams from New Zealand (born 1934). More recent competitors include Kenyan javelin thrower Julius Yego (born 1989) who took gold in the 2014 Games in Glasgow. He learned to throw the javelin by watching YouTube videos, which is why he's known as Mr YouTube.

Exposure to injury in field athletics depends on the event. Discus, javelin, hammer and shot put all require the use of a kinetic chain that generates power from the lower to the upper body. This means that injuries can occur in the ankles and knees as well as the upper body. Athletes in jumping events such as pole vault, long, and triple jump tend to have lower body injuries, especially to the ankles. These injuries are often short-term and so should not influence long-term healthy longevity.

There are 405 in our sample of field medallists, 114 of whom have died.

Figure 7: Deaths of medallists compared with the general male population
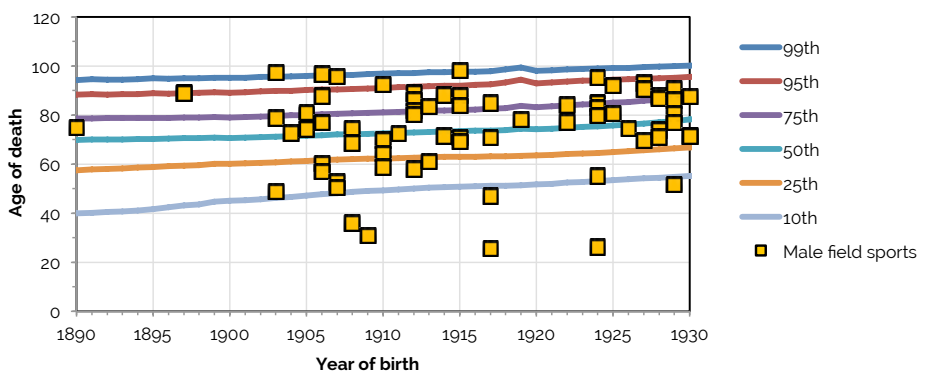
Figure 7 shows the ages of death of 78 medallists born before 1931; the youngest would be 92 years old if he were alive today. The great majority of medallists were born after 1900, but there are a few exceptions such as the Canadian bronze hammer thrower John Cameron (born 1886), who was already relatively old at the time of the 1930 Games. Of the deceased, 61% lived beyond the 50th percentile compared with the general male population: a boost of 11%. A few survived beyond the 95th percentile.

Four athletes seen in the 99th percentile in Figure 7 competed in the 1930 and 1938 Games. The eldest was John Dickinson (born 1915), an Australian jump specialist, who died in 2013 at the age of 98. Close behind him was Victor Pickard (born 1903), a Canadian who took gold in the pole vault in 1930, who died aged 97 in 2001.

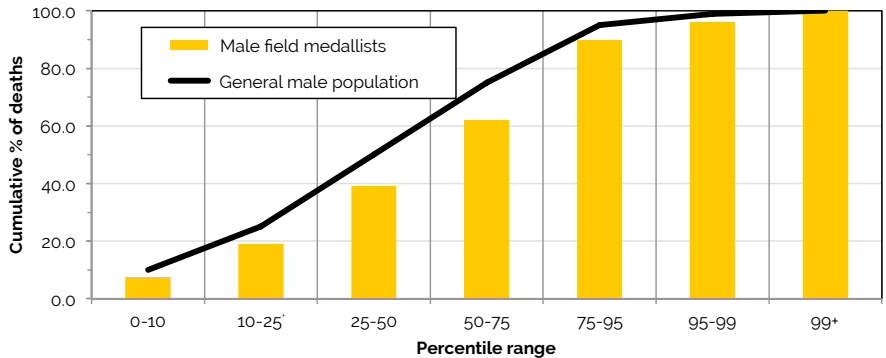**Figure 8: Cumulative % of deaths compared with the general male population**

Figure 8 shows the longevity advantage of field athletes extending to the 75th percentile of all male deaths (p<0.05).

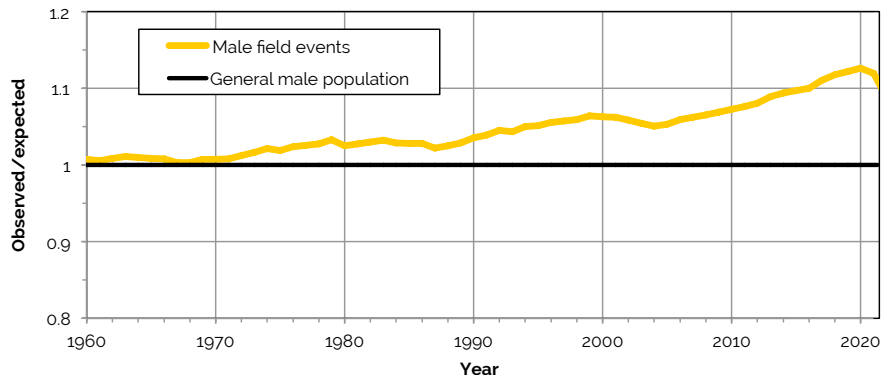**Figure 9: Index of observed versus expected number alive**

Figure 9 shows that survival rates are higher than the equivalent in the general population, with the difference rising to over 12% in 2020 – slightly higher than the equivalent figure for track events.

One of the oldest living field athletes is Muhammad Iqbal from Pakistan (born 1927), a gold-winning hammer thrower at the Games in 1954 who was 95 as of 2022. Other household names include Lynn Davies CBE (born 1942) who represented Wales in the Games and Great Britain in the Olympics, in several track and field events; he excelled in the long jump, earning the nickname Lynn the Leap. As the reigning Olympic long jump champion during the Games of 1966, he secured gold with a leap of 7.99 metres. Four years later, he took a second long jump gold at the Edinburgh Games. Another is Geoff Capes, now aged 73, an English two-time gold-winning shot putter who also won the World's Strongest Man competition twice.

Spotlight: Geoff Capes

Geoff Capes (born 1949) is one of England and Great Britain's most prolific field athletes. Competing for England, Capes took part in three Commonwealth Games winning back-to-back golds in the shot put at the 1974 Games in Christchurch, New Zealand, and the 1978 Games in Edmonton, Canada. After retiring from athletics, Capes twice won the World's Strongest Man title in 1983 and 1985, making him a household name. Capes was a policeman; one of his hobbies is breeding budgerigars.

Geoff Capes competing at the 1974 British Commonwealth Games.
Credit Lincolnshire Free Press

In focus: aquatics

The events included in this category for this study are listed in **Is longevity boosted or not?** (pages 12 and 13)**.** To swimming and diving, we have added rowing. Although optional, diving has featured at all Games so far since the inaugural event in 1930. England is one of the top diving nations: current stars include Tom Daley and Andrea Spendolini-Sirieux..

Rowing has featured at seven games, ending at the 1986 Games. In 1992 a separate competition, known as the Commonwealth Rowing Championships, began. The most celebrated rowing medallist ever is England's Steve Redgrave, who won triple gold at the 1986 Games and five golds in five Olympics. Technically, these were won in combination with others, in events like coxless pairs, but he qualifies for our analysis because he also won an individual gold in the single sculls at the 1986 Games.

Other optional sports, which aren't included here, are synchronised swimming, which has appeared in six games; and water polo, which only appeared once in 1950.

Swimming is widely regarded as being low risk and good for one's health. As one might expect, shoulder injuries are common among elite swimmers, but these are no threat to longer lives. Participation risk is greater in diving, especially from a 10-metre board, where rotational forces and water impact can lead to long-term spinal damage, especially to the lower spine.

Swimming events are organised by distance and stroke, such as front crawl, breast or butterfly. Freestyle has become synonymous with front crawl, as it's the fastest and most often used. Among the oldest freestyle exponents alive in 2022 is 96-year-old Australian Frank O'Neill (born 1926), who won a 110-yard silver in the 1950 Games.

Of the 436 medallists in this category, most got their medals in swimming. 83 have died, whom 53 were born on or before 1930.

Notably long-lived medallists include George Larson of Canada (born 1912), a 100-yard freestyle silver medallist in the 1934 Games who lived to 96, and Bill Trippett of England (born 1909), who took gold in the 100-yard backstroke at the 1930 Games and lived to 93. Perhaps the most famous medal-winning swimmer is Australian Ian Thorpe, known as the Thorpedo, who was born in 1982, and so is still relatively young. He won 11 medals in the Games – 10 gold – and nine Olympic golds.

Analysis shows that these medallists tend to live to ages well above the general male average. Figure 10 shows that relatively few die young, with only two below the 10th percentile, and none dying before the age of 40. Figure 11 shows the cumulative mortality of aquatics medallists to be way below that of the general male population, up to and including the 50-75th percentile giving swimmers, especially, a clear longevity advantage. Figure 12 shows that the index of those alive is 8% higher than that of the general population in 2022.

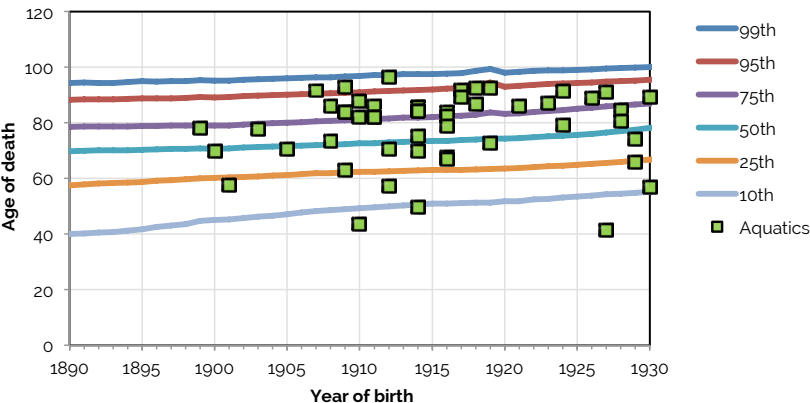**Figure 10: Deaths of medallists compared with the general male population**

Figure 11: Cumulative % of deaths compared with the general male population
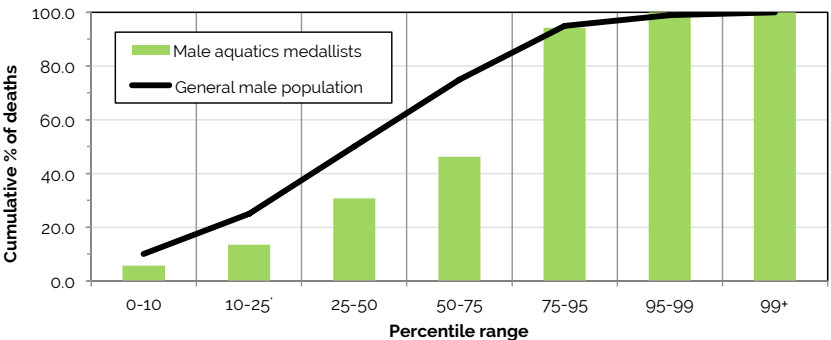
Figure 12: Index for the observed versus expected number alive
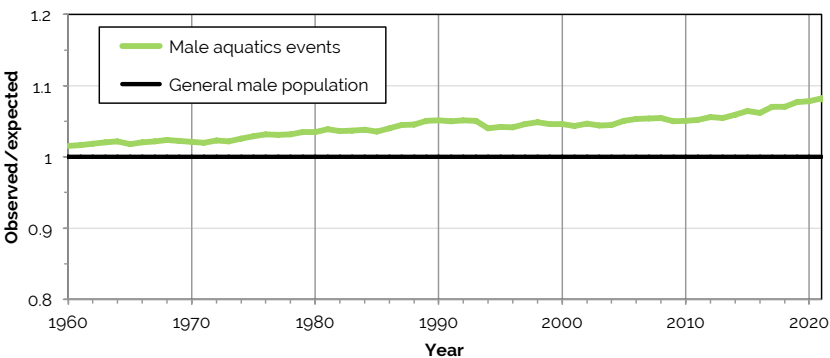
Spotlight: George Larson

George Larson (born 1912) represented Canada as a freestyle swimmer at the 1934 Games, where he won gold at the 100-yard freestyle event. He was also a talented American football player and professional wrestler, fighting under the pseudonym the 'Irish Tom Collins.' In later life he became a police officer. Larson died aged 96 in 2008 in Hamilton, Ontario, which is where the first Commonwealth Games (then known as the British Empire Games) took place.

George Larson at the 1934 British Empire Games. Credit Slam Wrestling

In focus: contact sports

Contact sports include boxing, wrestling, judo and fencing.

The events included in this category for this study are listed in **Is longevity boosted or not?** (pages 12 and 13), although we don't include a list of individual weight categories, as they're numerous and have changed over time. Boxing and wrestling account for over 80% of our medallist sample.

Boxing is a core sport at the Commonwealth Games; it has consistently featured since the inaugural Games in 1930. Wrestling was also featured in 1930. Both boxing and wrestling are centuries old. The forerunner of modern boxing was the 1867 introduction of the Marquess of Queensberry Rules. In amateur boxing, each bout, or match, comprises three rounds of three minutes. There are two major branches of wrestling: freestyle and Greco-Roman. All Commonwealth Games competitions feature freestyle, except in 2010, when a Greco-Roman event was also contested.

Judo is now recognised as a core sport, having previously been optional. It's a Japanese martial art created in 1882 by Kanō Jigorō; its name means "gentle way". Fencing, an optional non-core sport, also features in this category and was included between 1950 and 1970.

There's an obvious risk of serious injury in any contact sport. Judokas and wrestlers are prone to back and knee injuries. In boxing, the most common injuries are to the head, neck and face as this is where the majority of the punches are directed. In an attempt to reduce head injuries, headguards were introduced for the 1982 Games in Brisbane. However, this proved ineffective and so the rule was rescinded for the Games in 2014. Two possible reasons for the failure of headguards is that the boxer's head becomes a larger target and peripheral vision is impaired.

Of the 726 medallists in our sample, 188 have died and of these 112 were born before 1931. The data strongly suggest that boxers have a shorter lifespan than proponents of other contact sports, including wrestling. One reason for the difference is that boxing medallists are more likely to turn professional, after which the dangers tend to be magnified, but we haven't researched this possibility in detail. Looking at the list of longest-living boxers and wrestlers, it's interesting that most are wrestlers, with boxers in a small minority.

There are notable examples of longevity, such as Reg Priestly-Barcham of Canada who took wrestling gold in the inaugural 1930 Games and died aged 96 in 2002. His compatriot, Georges Pouliot (born 1923), a bronze-winning fencer at the 1950 Games, also lived to 96. Notable survivors are English wrestler Arnold Parsons (born 1926 and aged 95 in 2022), who won bronze in the 1950 Games, and South African wrestler Louis Baise (born 1927, aged 95 in 2022) who won gold in the 1954 Games.

Several former medallists tragically died during the Second World War. Arthur Heeney (born 1916), who died at age 25 when his ship hit a mine, won boxing silver for New Zealand at the 1938 Games. Lord David Douglas-Hamilton (born 1912), took a boxing heavyweight bronze for Scotland at the 1934 Games and died at age 31 when his Spitfire crashed. Albert Love (born 1911), a Welsh-born athlete who took a boxing bronze for England at the 1930 Games, died at age 32 in a Japanese prisoner-of-war camp.

Another tragic death was Jamie Nicolson (born 1971), an Australian boxer who won bronze at the 1990 Games, who died with his 10-year-old brother in a car crash on their way to a training session.

Figure 13 shows the pattern of deaths by age of death and year of birth for all those born before 1931. It reveals that there were 29 deaths by the 25th percentile and that 61.6% survived beyond the 50th percentile, collectively living longer than the general male population. Figure 14 shows cumulative mortality compared with the general male population, with a longevity advantage up to the 25-50th percentile. Figure 15 shows that contact sports competitors have a survival ratio of 1.08 compared with the general population, with that position improving over time.

Figure 13: Deaths of medallists compared with the general male population

Figure 14: Cumulative % of deaths compared with the general male population
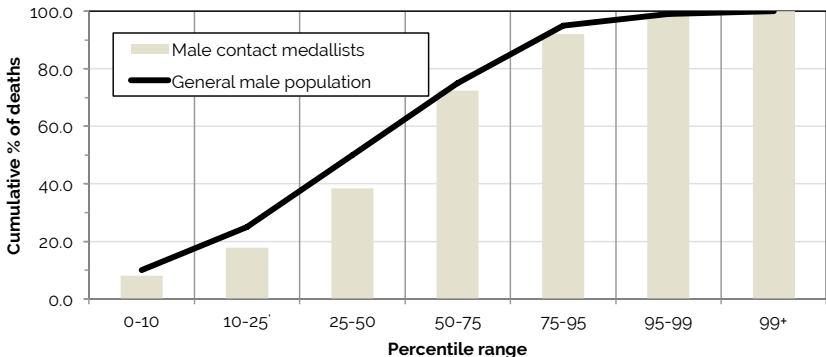
Figure 15: Index for the observed versus expected number alive
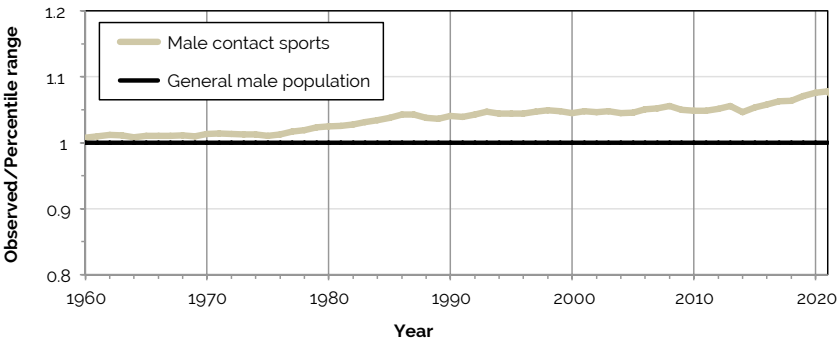
Spotlight: Rashid Anwar

Rashid Anwar (born 1910) has a special place in India's sporting history: he won the country's first ever Commonwealth Games medal when he secured bronze in wrestling at the 1934 British Empire Games. Remarkably, India sent just six athletes, with Anwar as the sole wrestler. He died in London in 1983 at the age of 73.

Rashid Anwar (left) competing at the 1934 British Empire Games. Credit: Wikipedia

In focus: indoor sports

The indoor sports category features five main sports: the events included in this category for this study are listed in **Is longevity boosted or not?** (pages 12 and 13).

They're all relatively new to the Commonwealth Games: weightlifting (introduced in 1950), badminton (1966), gymnastics (1978), squash (1998) and table tennis (2002). This means that our sample for this category is much smaller compared with others. For example, 70% of the medallists are weightlifters. Within each sport, there are various sub-categories. In weightlifting there are eight weight divisions, while in gymnastics there are six individual disciplines, plus one all-around medal.

Across this category, there's a low to moderate risk of injury. Musculoskeletal injuries are common in several including weightlifting, due to the explosive nature of the activity, and impact forces. For example, it's not unusual for gymnasts to withdraw due to ankle injuries during the vault programme. Weightlifters often experience injuries to the lower back, knees and shoulders. Although these injuries can be chronic and sometimes life-limiting, we haven't identified any negative effect on longevity.

Of the total sample of 323 medallists, 52 have died, of whom 23 were born before 1931.

Star performers include Precious McKenzie. Born in 1936, he won four consecutive gold medals for weightlifting between 1966 and 1978, first representing England and then later New Zealand. He won his fourth gold aged 42 years old, at the 1978 Games. Among the longest-lived is Canadian Jules Sylvain (born 1925; not to be confused with the Swedish composer of the same name), who won silver in the weightlifting featherweight class in 1954 and died, aged 91, in 2016. Maurice Megennis (born 1929), English gold winner in 1954 in the bantamweight class, died aged 90 in 2020. Reg Gaffley of South Africa, born in 1929, won gold in the bantamweight class in 1958. However, pride of place must go to Thong Saw Pak, who is spotlighted below.

Because these sports are relative newcomers, sample sizes are small and so Figure 16 shows only a sparse number of deaths. Of these 17 (74%) exceed the 50th percentile for the general male population, indicating a 24% longevity boost. The longevity advantage is also seen in Figure 17 up to the 50-75% percentile range. Meanwhile, the longevity index in Figure 18 steadily increases over time: the advantage is 8% in 2021 and likely to rise further.

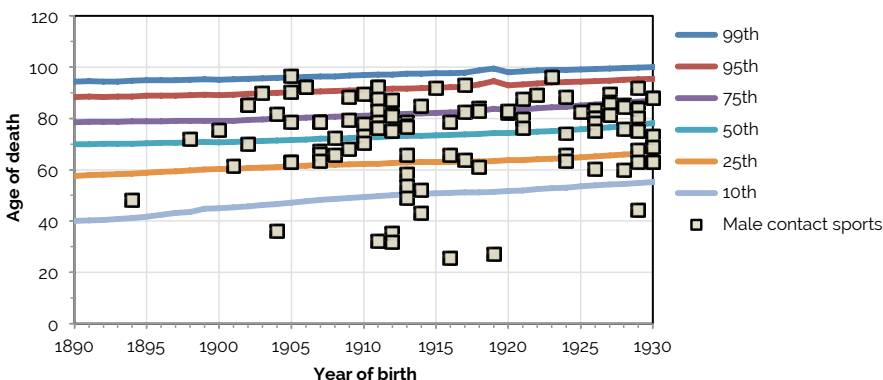## Figure 16: Deaths of medallists compared with the general male population
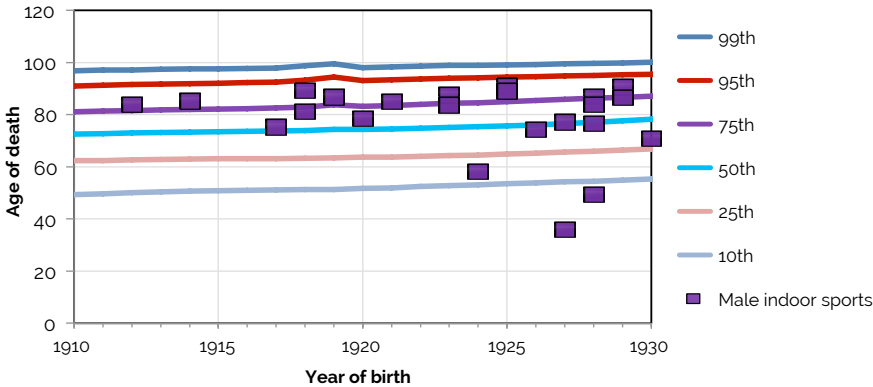
## Figure 17: Cumulative % of deaths compared with the general male population
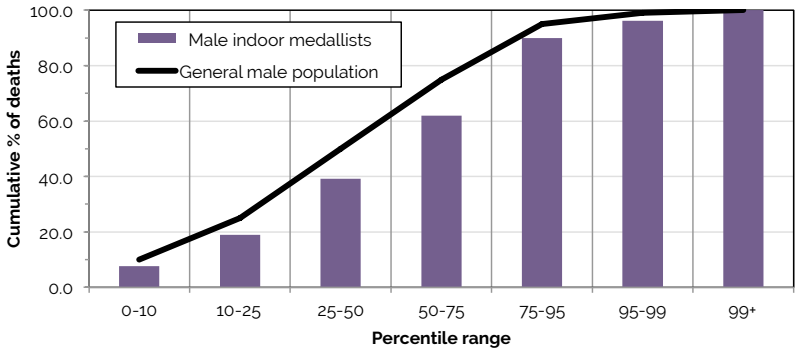
Figure 18: Index for the observed versus expected number alive
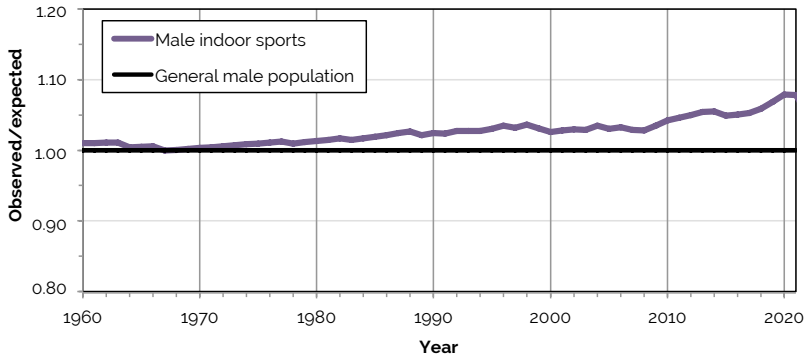
Spotlight: Thong Saw Pak

Thong Saw Pak (born 1924) represented Malaya (now Malaysia) as a weightlifter when he won silver at the 1950 Games. Following his successful weightlifting career, he became a Professor of Physics at the University of Malaya from November 1959 until his retirement. As of 2022 he is aged 98.

Thong Saw Pak at the 1950 British Empire Games.
Credit: Arthur Chidlovski

In focus: cycling

Although it's considered an optional sport, cycling has featured in all Games since London in 1934. As a category, it stands on its own, so our analysis doesn't include any connected sports. Disciplines include road, mountain and track, within which there are many different events and distances. Some track events have unusual names like Keirin, in which cyclists sprint for victory following a speed-controlled start behind a motorised pacer.

The events included in this category for this study are listed in **Is longevity boosted or not?** (pages 12 and 13).

Australia has dominated cycling at the Commonwealth Games since Dunc Gray (born 1906 and died 1996, aged 90) won the inaugural 1,000-metre time trial at the 1934 Games. They have won 232 of the 607 medals (38%) awarded to cyclists over 19 Games, not including Birmingham 2022.

Among the different events, data show that cycling has a chequered history in terms of longevity. There's a moderate to high participation risk, which has been well documented since the 1890s. Cycling combines a unique combination of physical and environmental challenges which can lead to serious injury and death. Speed is the first factor: riders can reach speeds of 70 kilometres per hour in short sprints. Equipment failure or a collision would be very serious at such speeds, especially as pileups involving two or more competitors are not uncommon. Professional cyclists can typically spend 24,000 – 32,000 kilometres per year training and competing. This exposes them to musculoskeletal injury, as well as heat stress and road traffic accidents. Cycling has also had to contend with a long-established doping culture which is now thankfully on the decline, but the Games appear not to have been affected.

As this sport is in a category of its own, it gives us the smallest sample of medallists – 220. 43 of those competitors have died, of whom 24 were born before 1931.

Figure 19: Deaths of medallists compared with the general male population
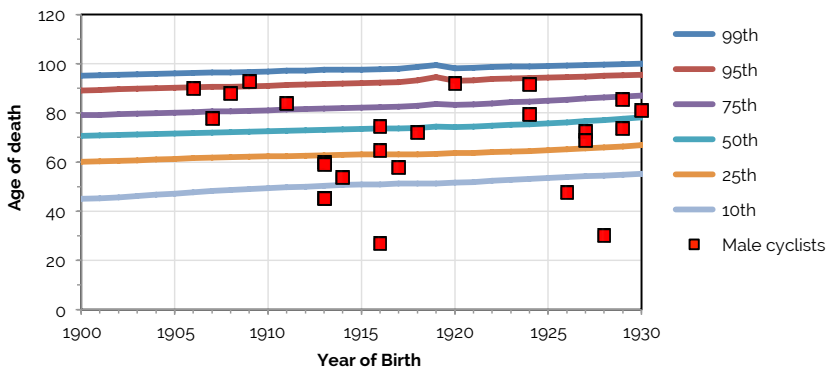
**Figure 20: Cumulative percentage of deaths compared with the general male population**
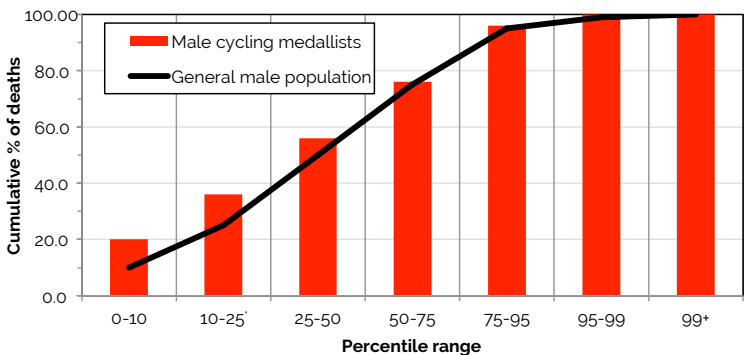
Of these, 14 or 56% died before the 50th percentile as is seen in Figure 19, indicating higher levels of mortality in this data segment compared with the general population. This can also be seen in the cumulative mortality figures of Figure 20, in which we see that column heights exceed expected mortality in the general population. Among all deaths, including those born after 1930, at least six died by the age of 30 from various causes, including unconnected accidents.

Although only a small sample, the number of injuries and fatalities is striking. Peter Buckley (born 1944), representing the Isle of Man, died in 1969 aged just 24 after crashing into a dog during training. Australian Russell Mockridge (born 1928), a three times Commonwealth Games winner of two gold and one silver medal, died in 1958 aged 30, following a collision with a bus. Tom Simpson (born 1937), a British 1965 road race world champion, died at just 29 during the 1967 Tour de France, of heart failure caused by heat exhaustion.

However, quite a few cyclists lived into their 90s, including Tommy Godwin of England (born 1920) who won bronze in the 1000 metres time trial in the 1950 Games and died aged 91. Horace Pethybridge of Australia (born 1909) won the 1000-yard sprint in 1934 and also died at 92. The current longest-living medallist is Ian Browne of Australia (born 1931 and aged 91 as of 2022).

Figure 21: Index for the observed versus expected number alive
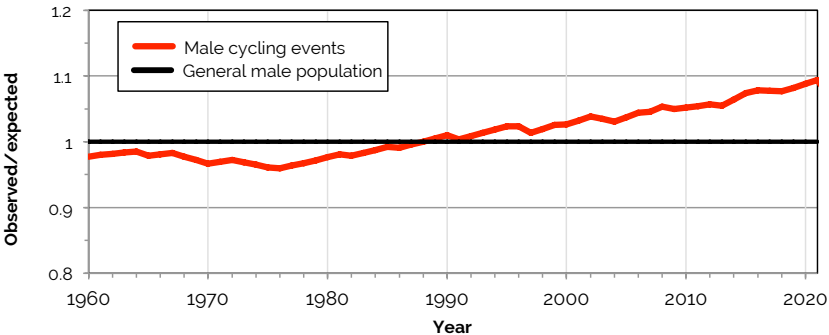
Figure 21 shows that up to 1989, the index of the number alive at any time is less than the equivalent number in the general population. As time passes and medal winners' age, survivorship increases, so that by 2021 we see a survival advantage which then climbs to nearly 10% by 2020. The improvement is due in part to improvements in safety and training regimes and greater regulation in general.

Spotlight: Horace Pethybridge

Horace Pethybridge (born 1909) competed as a cyclist at the 1934 Games, where he represented Australia. He took silver in the 1,000-yard sprint. His was one of 14 medals won by the Australian team that year, placing them third in the final medals table. Living to the age of 92 means he holds the record for having the longest life for a male Commonwealth Games cyclist.

Horace Pethybridge at the 1934 British Empire Games. Credit: National Library of Australia

In focus: female athletes — all categories

While women did compete in the first Games held in 1930, they only took part in aquatic events such as swimming and diving. Since then women have been admitted to more sports, with more medal events open to women than men by the time of the 2022 Games in Birmingham.

The events included in this category for this study are listed in **Is longevity boosted or not?** (pages 12 and 13).

There are some obvious differences to the men's events, especially in gymnastics. The rhythmic section is a women-only event where entrants compete for hoop, beam, ball, ribbon, club and all-round medals, while the pommel horse and rings are unique to men.

Female competitors are relative latecomers to the Games in many events; we therefore lack a big enough sample size to make general judgements about their longevity over the required time period by individual category. For analytical purposes, we decided to group all female athletes together rather than breaking the sample down by category.

Overall there are 1,364 women medallists in this sample, of whom 111 are deceased; of these, 78 were born before 1931.

Figure 22: Deaths of medallists compared with the general female population
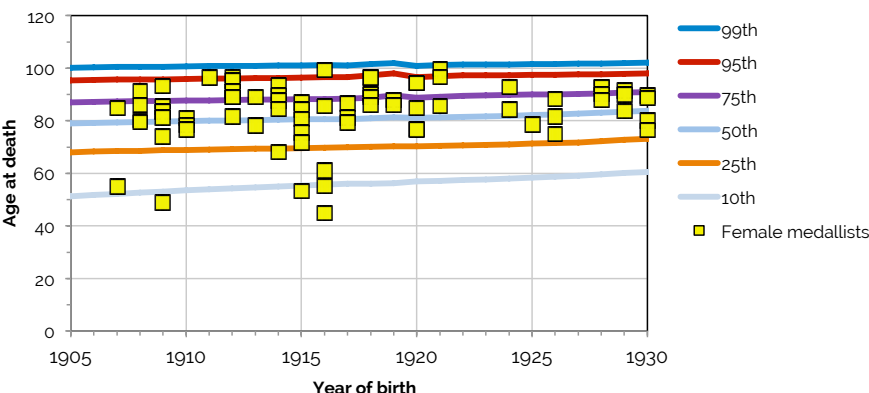
Figure 22 compares the ages of death of the 78 deceased medallists born on or before 1930 with longevity in the general female population. Since adult women have a natural longevity advantage over men, all the percentile figures are slightly higher. For example, the 99th percentile for

women has been 100 years for decades but for men the 99th percentile is less than 100 in every category, although this is now changing as men catch up in the longevity stakes.

Figure 23: Cumulative percentage of deaths compared with the general female population
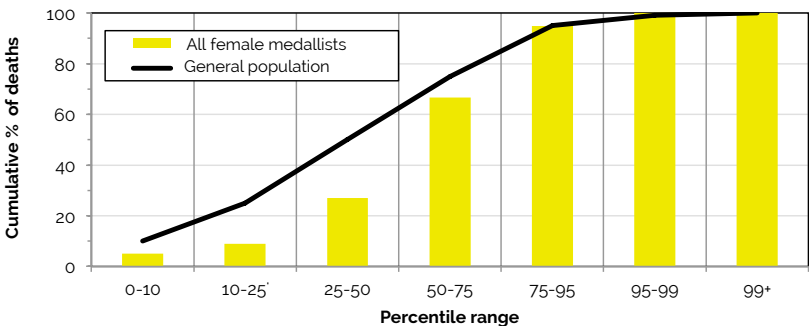
Of the 78 deaths, only 7 (or 9%) occurred before the 25th percentile whereas 44 (or 57%) occurred above the 50th percentile. The longevity advantage is confirmed in Figure 23, which shows that cumulative mortality is less than in the general female population, up to and including the 50-75th percentile.

Figure 24: Index of female observed versus expected number alive
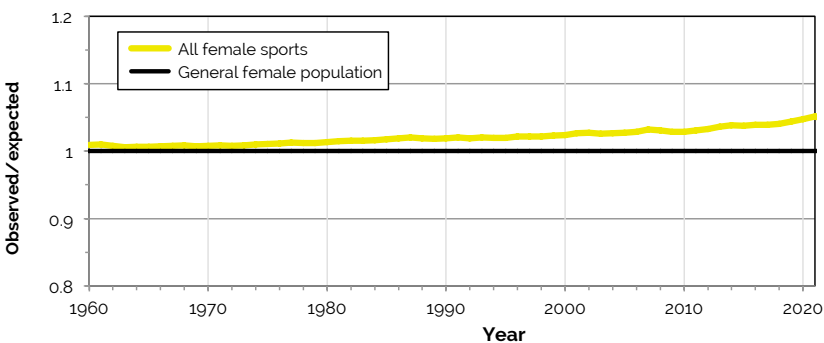
Figure 24 shows that survivorship among female athletes is higher than in the general female population, but that the advantage isn't as great as for men. This could be because they started competing in the Games more recently than men and so their longevity advantage still has further to go – something that will take a few more years to confirm.

Among the deceased, the longest-lived was English swimmer Helen Yate,

who was born in 1921. She won three medals (one silver and two bronze) in the 1950 Games. Helen died in 2020, a few months before her 100th birthday, at a nursing home in Southwest England. Of those alive in 2022, Edna Child (born 1922), who was 100 in October 2022, is the longest-lived. She too competed in the 1950 Games, dominating the diving event with gold medals in the 3-metre springboard and 10-metre platform.

Women have provided many of the most memorable stories of the Games. Meg Ritchie (born 1952) competed in the 1978 shot put but won gold in the 1982 Games – and the British record she set with a throw of 67.48 metres in 1981 has yet to be beaten. Dawn Fraser (born 1937) is one of Australia's most well-known and successful medal winners: we spotlight her below. Fraser dominated the 1958 and 1962 Games, winning six golds and one silver in swimming.

Another notable competitor is sprinter Cathy Freeman (born 1973) who became the first indigenous Australian to become a Commonwealth Games gold medallist, aged just 16, at the 1990 Games. There are many others to choose from, but a special mention also goes to Elizabeth McColgan-Nuttall MBE (known most widely as Liz McColgan).

Spotlight: Dawn Fraser

The youngest of eight, Fraser dominated the 1958 and 1962 Games, winning six golds and one silver in swimming. She was named Australian of the Year after winning Olympic gold in 1964 at in Tokyo. Fraser has received many honours: she was named Australian Female Athlete of the Century by the Sport Australia Hall of Fame in 1985, and in 1999 the International Olympic Committee named her the World's Greatest Living Female Water Sports Champion.

Dawn Fraser — Seven times medallist at the 1958 and 1962 British Empire and Commonwealth Games. Credit: PA/Alamy Stock Photo

Spotlight: Liz McColgan

Elizabeth McColgan-Nuttall (née Lynch, formerly McColgan, born 1964) is a former Scottish middle and long distance track and road-running athlete. She dominated the 10,000 metres event at the 1986 Games in Edinburgh. Four years later in Auckland, she repeated her gold-winning performance in the same event. Remarkably, her daughter Eilish McColgan (born 1990) is also a successful athlete; she's just been crowned champion in the same event as her mother at the 2022 Birmingham Games while also setting a new Games record.

Liz McColgan at the 1986 Commonwealth Games.
Credit: PA/Alamy Stock Photo

Conclusion

We already know that sport is good for your physical health, but our study seeks to discover whether it also increases longevity.

There are practical difficulties in addressing this question, because it requires significant amounts of data collected over the course of many peoples' lives. We need to know when a person was born, their sex, the type and amount of physical exercise undertaken and if it was harmful – in fact, the more information the better!

In our previous study *The Longevity of Sporting Legends*, which analysed the life spans of athletes taking football, cricket, rugby, tennis, golf, boxing and horse racing to the highest level, we found clear differences in longevity: some sports, like tennis, showed a much greater effect than others. In this study of the Commonwealth Games, our focus has been on a range of other sports. Without the advent of the Games, it would have been impossible to collect this data as, firstly, they're minority sports and secondly, the historical record is incomplete.

Our main findings are that elite athletes see a boost in longevity. For men, we find that track, indoor and aquatics events boost longevity the most — with aquatics connected to an increase of 29%, track events 25%, and indoor sports 24%. This translates into between 4.5 and 5.3 extra years of life — an advantage that remains relatively constant over time despite general improvements in life expectancy.

Although women started competing more widely in the Games relatively later on, they now compete for more medals than men. However, we didn't have enough information to assess the life span of female athletes by sport, so we were forced to aggregate the results of all event categories. We found that their longevity is boosted 22%, equating to 3.9 extra years of life.

The only sport that we saw associated with a shorter than average lifespan is cycling, since male cyclists' mortality is worse than the general average. But this doesn't necessarily mean that recreational cyclists are exposed to the same risks; indeed, there's general agreement that cycling is healthy.

We compared our findings with our previous research (which featured a different range of sports): our present categories of track, field, and aquatics show the most favourable longevity boost, while field and contact sports are on a par with golf and tennis (physical exertion and the ability to play to late age may be the common factor here). Cycling appears to be comparable to horse racing, while boxing, with the least favourable

mortality figures, brings up the rear. These results are consistent with other published studies, which mainly involve Olympians from selected countries, but deliver more granularity in terms of types of sports.

Although our information on individual sports is sparse, we can confirm that, in the contact sports category, medal-winning wrestlers live longer than boxers. Drilling down further into individual categories where sample sizes are sufficient, we also observe that competing in long distance races (over 3km) boosts longevity more than for shorter distances. In the field category, where we might find differences between events such as jumping and throwing, because the physical demands are very different, further investigation finds no significant differences.

Because of sampling limitations, we've resisted the temptation to compare individual sports beyond these few examples. This is an area for potential further research using a much larger data set – such as the Olympic Games. This would also allow more granular research into women's sports.

Finally, we find no evidence that gold medal winners live longer than silver or bronze medallists – competing at an elite level is clearly enough to influence your life span. While we can't all play sports at such high levels, we can all take advantage of the more modest health benefits associated with being more active – and have fun too.

About ILC's work on healthy ageing and prevention

While the health benefits of physical activity are well known, more than one in four adults around the world don't exercise enough[2] - and in the UK, this figure is even higher.

People face myriad challenges that may prevent them exercising – from time and cost to geographical and motivational barriers. But it's an important part of a preventative approach to healthy ageing. From our work, including our upcoming Healthy Ageing and Prevention programme, we know that to support greater uptake of physical activity, we need to:

- Invest more in physical activity at the local and national level

- Address access inequalities by democratising access to exercise, which includes:

    o Targeting specific and at-risk communities at the local level with initiatives

    o Making sport easily accessible as part of people's everyday lives

    o Reducing costs and other barriers

- Better use the extended health workforce to communicate the benefits of exercise and help people integrate exercise into their daily lives

- Make the most of technology to widen access to, and engagement, with sport

Find out more about Healthy Ageing and Prevention at: https://ilcuk.org.uk/healthy-ageing-and-prevention-index/.

Appendix

Methodology

Our first question is whether elite athletes live longer than the general public; our second is whether certain sports boost longevity more than others.

We first need to define what we mean by 'athlete' and who will be included in the investigation. Some sports in the Commonwealth Games feature only a few events, which are limited to a small number of athletes from a subset of countries. We therefore grouped medallists into six representative sporting categories. Note that athletes that win more than one medal are only counted once for the purposes of this analysis.

The largest categories, as measured by the number of medals awarded, are **track events** such as running, **aquatic sports** such as swimming, and **field events** which involve throwing, jumping etc. Contact sports was also among the largest by medals awarded, including boxing and wrestling, which have been core events in every Games from the outset.

The most heterogeneous category is **indoor sports,** which mixes events such as weightlifting and gymnastics with racket sports like badminton and squash. Except for weightlifting, which is a core sport, most are newer to the Games or haven't been featured consistently. Rather than omit them we decided to group them together. **Cycling** has no obvious sporting comparators so is in a category on its own.

However, our biggest decision was to bracket all **female medallists** into a single category. The chief reason is that in many of the Games women featured in relatively few events (swimming and diving being an exception). Pooling them, therefore, gave us a reasonable sample to work with.

We undertook detailed searches of multiple sources and databases to collect the required demographic data for all medallists. The sources were hosted or compiled by different bodies and organisations, including the Commonwealth Games Federation, World Athletics and the Olympian database. Some sources give only the medallist's name but not the date of birth or death. Online searches and sites such as Wikipedia were invaluable for finding these dates and for cross-checking.

Some athletes won medals at more than one games, or took medals in more than one discipline. After removing duplicates, our sample consisted of 2,688 unique male medallists, of whom 2,047 were still alive

at the start of 2022. There were 1,364 female medallists, of whom 1,253 are still alive. This gave us a combined total of 4,052 individual medallists, of whom 752 have died.

We analysed the data on deceased and living athletes separately, using an approach discussed in more detail below. Where precise dates of birth and death are missing, exact ages of death are unknown, but we can be accurate in around 75% of cases by subtracting year of birth from year of death.

Deceased athletes

Whether we call someone 'old' is not straightforward. A competitor in the 1954 Games born on or before 1930 would be 92 years old in 2022, with a relatively small chance of being alive, but a competitor in the 1974 Games born in 1950 would be only 72 years old in 2022. And of course the average longevity figures vary between men and women. Comparing longevity is not therefore a simple matter of averaging ages of death. For example, in the 19th century, if someone died aged 65, they might be considered to be old, whereas someone dying at that age in the 21st century might not be.

We use the Office for National Statistics (ONS) cohort life tables for England and Wales. These track men and women born from 1841 onwards and consider future mortality trends. We measure life expectancy from age 20 (rather than from birth) and compute our expected life spans by adding 20 years to this figure. We then compare that figure with the actual age of death of an individual born in the same year. To deal with shifting longevity, we use a relative measure of age, based on the percentile of the population living to a given age versus the actual percentile of a given individual, based on their age of death and birth year.

Marathon or sprint? Do elite-level athletes live longer than average?

45

Figure A1: Measuring the longevity of individuals compared with the general population
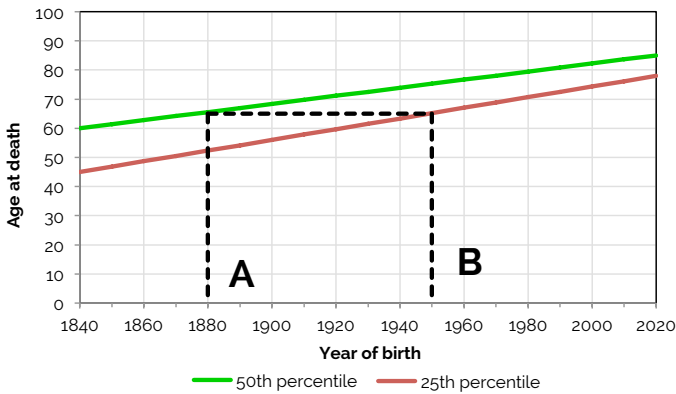
How this works is explained in Figure A1. Consider two hypothetical males who both die aged 65, one born in 1880 (A) and the other in 1950 (B). For person A, dying at the age of 65 would have been considered 'normal', since 50% of the population born in that year would also be dead by that age. But for person B this would have been considered a relatively young age to die, as only 25% of the population would have died (half as much as in 1880).

As longevity has increased, the range of ages in which people die has narrowed, so those percentiles tend to converge over time – demographers often refer to this as the 'compression of mortality'. We compare longevity by checking whether the number of deaths in any given percentile range is higher or lower than expected. If the number of athletes in a given sporting category living to the 95th percentile of the general population is unusually high, we have decided to accept that there's a difference if the probability of that result is <0.05. We do this test at five different percentile ranges: 0-10, 10-25, 50-75, 75-95, 95-99 and 99+.

As a final step, we aggregate the results to produce a single overall measure of longevity, which we express as an index. If the index for a particular sporting category is 1.2, this equates to a 20% longevity advantage over the general population; if the index is 1.1, there's a 10% advantage, and so on. A simple way to think about this is as follows: if 50% of the general population is dead for any given birth year while only 40% of sporting legends are dead, leading sportsmen have a longevity

advantage of (100-40)/50 = 1.2, which equates to a 20% advantage. This enables us to rank the sporting categories in this study against each other.

Living athletes

Mortality measures look backwards in time: our athletes don't appear on charts such as Figure A1 until they have died. In effect we're studying people born 70+ years ago, even though they would have been at the peak of their athletic prowess in their 20s or 30s. How many are still alive today will depend on how long they live on average, their birth year and the time frame – if they were born any time before 1920, they will almost certainly have died.

The test in this case is more complicated. The question is how many athletes are there, born in the same year and alive today, compared with the number predicted to be alive based on survivorship in the general population. We test whether this number is higher than expected by applying cohort life tables to extract the probability of each being alive. This probability is then summed over all birth years and expressed as a ratio of the actual number alive in any given year. If the ratio is greater than one, more are alive than would be expected; if it's less than one, then fewer are alive.

There are many reasons why this ratio might fluctuate over time. They could include improvements in safety, e.g. new rules and regulations that have the gradual effect of extending lives. Boxing and cycling are good examples of sports in which safety issues are important considerations; their survival ratios are lower as a result. When values are consistently higher than one, this generally indicates consistently greater survivorship and longer lives than the general population.

In each of our six categories we observe that the survivorship is not only generally positive but also still increasing, up to and including 2021. But since the Commonwealth Games has only been around since 1930, the ages of our living athletes are not yet representative. There's still some way to go before we reach a steady state. For example, a ratio of 1.1 would indicate 10% greater survivorship but in the long run that could easily climb to 20% or more.

As shown in Figure A2, the index hovered around one for much of the early period of the Games, but since 1960 it has been increasing, indicating a survival advantage between 8% and 10%. In another 20 years or so it is likely to be much higher.

Figure A2: Survival advantage by event category (current value and average from 1960 to present)

Relative survival of athletes

■ Average 1960-2022　■ Current value
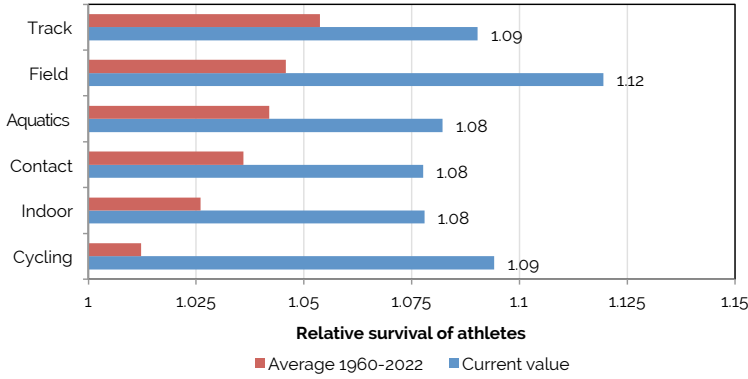
1. Extracting the age of death for a given percentile of survivors

Our life tables are based on a single year of age. To compare survivorship based on year of birth, we require the age x_p, to which a given percentile of the population survives l_P. This is given by interpolation as:

$$x_P = \frac{l_x - l_P}{l_x - l_{x+1}} + x \qquad\qquad l_x > l_P > l_{x+1}$$

Where x is age and l_x is the number surviving to x, and $l_{x=1}$ is the number surviving to age $x + 1$.

2. Survivorship or expected percentile (analogy with life expectancy)

$$e_P = \frac{1}{l_0} \sum_P l_P$$

Where l_0 is the radix – usually 100,000 or 100 – and l_P is the number surviving to a given percentile or percentile range.

3. Mortality

Here we test whether mortality among our athletes is less than expected in comparison with the general male population.

For each percentile considered, we construct a one-tailed test, which is formally defined as follows:

Case A

H_0: There is no difference between the underlying probability of an athlete dying in a specified percentile range and a member of the general male population.

H_1: The probability of an athlete dying in a specified percentile range is *less* than the probability of a member of the general male population dying in the same range.

With a test statistic of:

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

where $\hat{p}$ is the observed proportion of deaths at the specified percentile cut-off in this case 0.1, 0.25, 0.5, 0.75, 0.95, 0.99.

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

Case B

We can also reverse the question and ask whether mortality among sporting legends is greater than expected when compared with the general population. We do this by reversing the sign of z and finding its position on the normal distribution. In this case, the hypotheses are:

H_0: There is no difference between the underlying probability of an athlete dying in a specified percentile range and a member of the general male population.

H_1: The probability of an athlete dying in a specified percentile range is *greater* than the probability of a member of the general male population dying in the same range.

The results for each sporting category and hypothesis are given below (including three measures of statistical significance).

Our decision rule of whether to accept or reject H_0 is based on the probability of its occurrence. If p is 0.05 or less, we reject H_0 and accept the alternative hypothesis.

Significance levels: Case A	Probability of null hypothesis being correct
*	0.05
**	0.01
***	0.001

Significance levels: Case B	Probability of null hypothesis being correct
†	0.05
††	0.01
†††	0.001

(a) Cumulative % of deaths

Percentile range	Field	Aquatics	Track	Contact	Indoor	Cycling	General male population
0-10	7.6	5.8	10.8	8.0	8.7	20.0	10.0
10-25	19.0	13.5	18.6	17.9	13.0	36.0	25.0
25-50	39.2	30.8	30.4	38.4	26.1	56.0	50.0
50-75	62.0	46.2	53.9	72.3	56.5	76.0	75.0
75-95	89.9	94.2	81.4	92.0	100.0	96.0	95.0
95-99	96.2	100.0	96.1	99.1	100.0	100.0	99.0
99+	100.0	100.0	100.0	100.0	100.0	100.0	100.0

(b) z scores

Percentile range	Field	Aquatics	Track	Contact	Indoor	Cycling	General male population
0-10	-0.71	-1.02	0.26	-0.69	-0.21	1.67	0.00
10-25	-1.23	-1.92	-1.49	-1.75	-1.32	1.27	0.00
25-50	-1.91	-2.77	-3.96	-2.46	-2.29	0.60	0.00
50-75	-2.66	-4.80	-4.92	-0.65	-2.05	0.12	0.00
75-95	-2.09	-0.25	-6.31	-1.47	1.10	0.23	0.00
95-99	-2.50	0.72	-2.97	0.11	0.48	0.50	0.00

(c) p-values (case A)

p-one-sided	Field	Aquatics	Track	Contact	Indoor	Cycling	General male population
0-10	0.12	0.08	0.30	0.12	0.21	0.48	0.25
10-25	0.05	0.01	0.03	0.02	0.05	0.45	0.25
25-50	0.01	0.00	0.00	0.00	0.01	0.36	0.25
50-75	0.00	0.00	0.00	0.13	0.01	0.27	0.25
75-95	0.01	0.20	0.00	0.04	0.43	0.30	0.25
95-99	0.00	0.38	0.00	0.27	0.34	0.35	0.25

(d) p-level

p-one-sided	Field	Aquatics	Track	Contact	Indoor	Cycling	General male population
0-10							
10-25	*	*	*	*	*		
25-50	*	**	***	**	**		
50-75	**	***	***		*		
75-95	**		***	*			
95-99	**		***				

(e) p-value (case B)

percentile range	Field	Aquatics	Track	Contact	Indoor	Cycling	General male population
0-10	0.38	0.42	0.20	0.38	0.29	0.02	0.25
10-25	0.45	0.49	0.47	0.48	0.45	0.05	0.25
25-50	0.49	0.50	0.50	0.50	0.49	0.14	0.25
50-75	0.50	0.50	0.50	0.37	0.49	0.23	0.25
75-95	0.49	0.30	0.50	0.46	0.07	0.20	0.25
95-99	0.50	0.12	0.50	0.23	0.16	0.15	0.25

(f) p-level

p-one-sided	Field	Aquatics	Track	Contact	Indoor	Cycling	General male population
0-10						†	
10-25							
25-50							
50-75							
75-95							
95-99							

References

[1] https://www.gov.uk/government/publications/birmingham-2022-commonwealth-games-the-highlights/birmingham-2022-commonwealth-games-the-highlights#wellbeing

[2] Clarke, P. M., Walter, S. J., Hayen, A., Mallon, W. J., Heijmans, J., & Studdert, D. M. (2012). "Survival of the fittest: Retrospective cohort study of the longevity of Olympic medallists in the modern era." *BMJ*, *345*.

[3] Antero J., Tanaka H., De Larochelambert Q., *et al* "Female and male US Olympic athletes live 5 years longer than their general population counterparts: a study of 8124 former US Olympians" *British Journal of Sports Medicine* 2021;55**:**206-212.

[4] Antero J., Desgorces F.D., Dor F., Sedeaud A., Haïda A., et al. (2014) "Row for Your Life: A Century of Mortality Follow-Up of French Olympic Rowers." PLOS ONE 9(11): e113362.

About ILC

The International Longevity Centre UK (ILC) is the UK's specialist think tank on the impact of longevity on society. The ILC was established in 1997, as one of the founder members of the International Longevity Centre Global Alliance, an international network on longevity. We have unrivalled expertise in demographic change, ageing and longevity. We use this expertise to highlight the impact of ageing on society, working with experts, policy makers and practitioners to provoke conversations and pioneer solutions for a society where everyone can thrive, regardless of age.

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