



REPORT  
**2021**

# WHO WANTS TO LIVE **FOREVER?**



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# Executive Summary

Who wants to live forever? How might that be achieved? And is it realistic in our lifespan? These are the questions that this report sets out to address. This is a deep topic and we can only scratch the surface here. Each possible route to longer life is an industry in itself, replete with issues of ethics and economics, science and politics. But we can start your journey. And we can make some predictions: how long might we live by the middle of this century? And how might this change all our lives.



## Introduction

How long will we live in the future? How long do we want to live? And if so many people want to live forever, why are so few of us doing anything about it?

The science - and the mysticism - of life extension have been around at least since antiquity, and likely much longer. The Greeks dreamed of the Philosopher's Stone giving them greater longevity. In medieval times there was the story of the Holy Grail and its power to heal or grant immortality. And more recently, we have had so much fiction about eternal life, from Highlander, to vampires, to the Lazarus Pits of Batman villain Ra's al Ghul.

Today though, our understanding of the human body is beginning to advance on science fiction and we can safely dismiss most of the mysticism. Knowing what we do now, how realistic is life extension? What sacrifices do we have to make to live longer, healthier lives? And given those sacrifices, what will we choose to do?

Let's start by looking at where we are. Because the statistics show that we are a long way from optimising lifespans globally, even with our current understanding.



# The 200 year rise in life expectancy

In the last two centuries, global life expectancy has doubled<sup>1</sup>. As our understanding of the human body has improved and global wealth has increased, we have dramatically slashed infant mortality and minimised many of the risks that used to take people's lives. This dramatic rise has not been even across the population though, either nationally or internationally. Huge inequalities have opened up. Today someone in the UK can expect to live on average twenty years longer than their peers in South Africa. And someone in the wealthiest parts of the UK can expect to live almost ten years longer than someone in the poorest parts<sup>2</sup>.

So, what can we expect for the years ahead? Life expectancy in the UK<sup>3</sup> is currently forecast to rise above 90 for boys and 92 for girls born in 2043. But this projection is significantly lower than the forecasts made in 2016. And the 2016 forecasts were significantly lower than those made in 2014. What is happening?

There are two factors at work here. First, we have a new wave of health crises affecting our longevity. Having made huge strides in reducing levels of smoking, we now face an obesity epidemic. Second, it appears we may be bumping up against some hard limits in our potential lifespan. Some scientists are increasingly sceptical about how much further we may be able to extend our lives, even while others remain hopeful and excited about new technologies.

<sup>1</sup><https://ourworldindata.org/life-expectancy>

<sup>2</sup><https://www.bmj.com/content/364/bmj.11492#:~:text=The%20Office%20for%20National%20Statistics,a%20gap%20of%209.3%20years.>

<sup>3</sup><https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/lifeexpectancies/bulletins/pastandprojecteddatafromtheperiodandcohortlifetables/1981to2068>

# Modern health crises

Worldwide, obesity has nearly tripled since 1975 according to the World Health Organisation<sup>4</sup>. One in four UK adults (26% of men and 29% of women) and 1 in 5 children are obese. 67% of the population are at least overweight<sup>5</sup>. And this is having an effect. Obesity reduces life expectancy, stripping us of up to 8 years<sup>6</sup>. Naturally, it also reduces our chances of living out our years in good health, increasing the risks of cancer, cardiovascular disease and even depression<sup>7</sup>. So what is causing this rise?

The answer is pretty boring, at least if you are looking for a quick fix: we eat too much of the wrong things and move too little<sup>8</sup>. It's more complicated than that at an individual level. But at a population level, the story is pretty clear.

## Eating In and Working Out

Our diets have changed significantly over the period in which life spans have expanded so dramatically. We have gone from many people having access to too few calories each day, to many consuming more than is healthy relative to the activity inherent in their lifestyle. Just looking at the last sixty years, average calorie intake in industrialised countries has increased ten percent<sup>9</sup>. And the nature of what we eat has changed as food production has become increasingly industrialised.

Today, we eat a large variety of 'ultra processed' foods, concocted to appeal to our base desires for sugar, salt and fat and made from low-cost bulk ingredients. In the US, a child is more likely to eat an artificially sweetened product than any fruit or vegetable each day<sup>10</sup>. Contrary to the popular myth, modern fruit has not been bred to include more sugar (though some bitter flavours may have been bred out)<sup>11</sup>. The fashion for more plant-based diets has only accelerated this trend towards processed food, with many meat alternatives and 'fake meats' naturally requiring a lot of production in order to create appealing textures and flavours.

You would think that with all these extra calories we would need to exercise more. But there is some debate about the relationship between activity and calorie utilisation. One study showed that modern, sedentary adults burn similar numbers of calories to ancient hunter gatherers<sup>12</sup>. Nonetheless, exercise is hugely important to maintaining physical and mental health. In the UK, only 67% of adults are considered active (per government guidelines) and just 47% of children. Inactivity in wealthy countries is rising, not falling<sup>13</sup>. Participation in team sports has declined by 12% in recent years<sup>14</sup>, as more of us turn to more solitary forms of exercise - something that the evolutionary scientist Daniel Lieberman says does not come naturally to us<sup>15</sup>.

Between our developing diets and declining activity levels, the prospects of continuing our rise in life expectancy are not good. Will the next set of projections be even more pessimistic? Or can science intervene?

<sup>4</sup><https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight>

<sup>5</sup><https://digital.nhs.uk/data-and-information/publications/statistical/statistics-on-obesity-physical-activity-and-diet/england-2020>

<sup>6</sup><https://www.bbc.co.uk/news/health-30327777>

<sup>8</sup><https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight> [https://www.who.int/nutrition/topics/3\\_foodconsumption/en/](https://www.who.int/nutrition/topics/3_foodconsumption/en/)

<sup>9</sup>[https://www.who.int/nutrition/topics/3\\_foodconsumption/en/](https://www.who.int/nutrition/topics/3_foodconsumption/en/)

<sup>10</sup><https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5033729/>

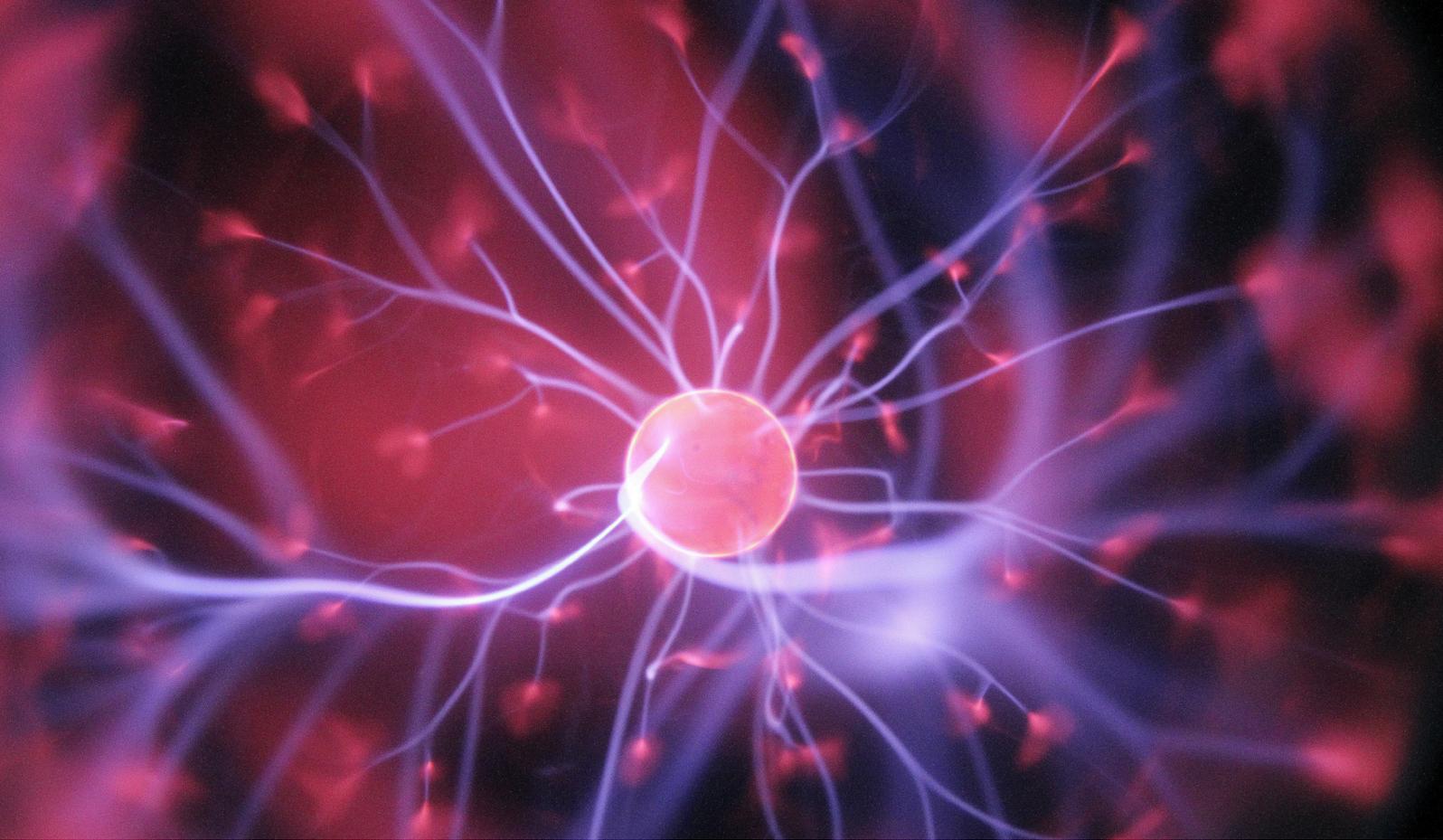
<sup>11</sup><https://www.acsh.org/news/2019/08/26/fruit-much-higher-sugar-it-used-be-14243>

<sup>12</sup><https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0040503>

<sup>13</sup>[https://www.thelancet.com/journals/langlo/article/PIIS2214-109X\(18\)30357-7/fulltext](https://www.thelancet.com/journals/langlo/article/PIIS2214-109X(18)30357-7/fulltext)

<sup>14</sup><https://www.statista.com/statistics/934775/team-sport-participation-uk/>

<sup>15</sup><https://www.penguin.co.uk/books/305/305451/exercised/9780141986364.html>



# The Science of Life Extension

What drove the dramatic rise in life expectancy over the last two centuries? It was to modern eyes, some fairly rudimentary changes. Food supply became more plentiful. We built sewers and fresh water supplies. We began to understand the human body, addressing bacteria with antibiotics and learning to treat viruses. Childbirth became a much less risky proposition. More recently, we began to tackle levels of smoking and learned to address cardiovascular diseases. Health and safety laws began to protect us from accidents.

These changes brought us a long way. But how do we take the next steps?

## Life Extension Tech

Billions have been poured into finding ways to extend our lives, from trimming telomeres, to tweaking our genes, to injecting the blood of younger people (seriously). If none of that appeals, you could always freeze your head at the point of death and wait for the day you can be revived.

Could any of these technologies work? And what about the supplements we are sold today: are they realistic life-extenders, or simply a scam?

## Supplements

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Take a pill to extend your life? Sounds wonderful, right? The reality is a little less clear cut. Many nutritional supplements are marketed to help you extend your life, though the evidence is pretty hazy around most.

Take Coenzyme Q10 (CoQ10) for example. This is an antioxidant produced by your body that according to the Mayo Clinic<sup>16</sup> is used by your cells for "growth and maintenance." There is evidence that levels of CoQ10 are lower in people with certain diseases, so there is speculation that supplements may be helpful in preventing or treating those diseases. But so far the evidence is weak. According to the US National Center for Complementary and Integrative Health<sup>17</sup>, it may help reduce the risk of complications of heart surgery, or damage from a certain chemotherapy drug. But beyond that there's no evidence it helps.

So, how about other supplements? Obviously one isn't going to be the panacea. Melatonin, Magnesium, Omega 3 oils, Shilajit, Turmeric. All have some potential uses and benefits, at least in theory or backed by some limited research. But none will help you to live forever and the benefit of taking all of them is questionable. Especially since most have some potential side effects as well. Taken under medical advice to address specific issues or compliment other treatments, many supplements have potential. But that potential is largely unproven, there are risks involved, and then there's the question of cost. You might be paying up to £1 per capsule for some of these supplements. That money might be better spent improving your diet.

## Telomere Lengthening

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Telomeres sit at each end of your chromosomes. Every time the cell divides, some telomeric DNA is lost and so the telomere shortens. This acts like a clock on the life of the cell. When the telomeres get too short, the cell dies or worse, can mutate towards becoming cancerous. This has led many researchers to look at telomere length both as an indicator of health and as a possible treatment for ageing.

Again though, it is not as simple as just adding some more DNA back into your telomeres. For a start, every human is unique. There is huge variability in telomere length. Researchers in Sweden showed that predictions of age based on telomere length were typically out by 22 years<sup>18</sup>. How long should your telomeres be? It's unclear, though that doesn't stop companies selling you a package of targeted supplements based on testing their length.

If you do want to try lengthening your telomeres despite this, one company does sell a supplement that it claims activates the enzyme telomerase that in theory, can do just this. But as Carol Greider, co-recipient of a Nobel Prize for her work on telomeres said to Nature<sup>19</sup>, a compound that could lengthen telomeres would be hugely beneficial to patients dying of a variety of diseases. "I don't think a company would be selling it on the side as a nutraceutical."

<sup>16</sup><https://www.mayoclinic.org/drugs-supplements-coenzyme-q10/art-20362602>

<sup>17</sup><https://www.nccih.nih.gov/health/coenzyme-q10>

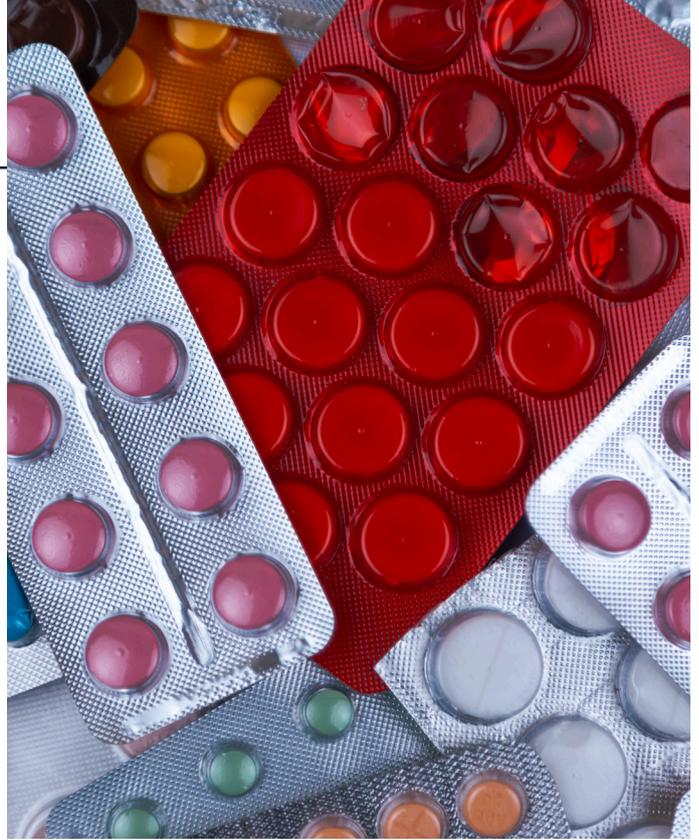
<sup>18</sup><https://www.sciencedirect.com/science/article/abs/pii/S1875176808001819>

<sup>19</sup><https://www.nature.com/articles/488018a>

## Caloric Restriction

If there isn't a magic pill for life extension, what about doing things the hard way? One of the best evidenced approaches to living a longer, healthier life is simply to eat less. In a 2011 review of some of the studies to date, Leanne M. Redman and Eric Ravussin<sup>20</sup> suggested reducing your calorie intake by 20 or 30% has few negative effects but some clear benefits. They suggest based on rodent studies that reducing your caloric intake by 20% from the age of 25 for the next 52 years might give you nearly an extra five years of life.

The question is, how many ice creams and beers are you willing to give up in return for those extra five years?



## Genomic medicine

It's twenty years since The Human Genome Project published its work: a mapping of the majority of the roughly 20,500 genes that make us, us. Francis Collins, then director of the National Human Genome Research Institute, described the output like this: "It's a history book - a narrative of the journey of our species through time. It's a shop manual, with an incredibly detailed blueprint for building every human cell. And it's a transformative textbook of medicine, with insights that will give health care providers immense new powers to treat, prevent and cure disease."

Given the promise, how far have we come in applying our understanding of not just the human genome, but every individual's unique collection of DNA, to improving health? So far, progress has been limited. This shouldn't be unexpected: it typically takes a couple of decades for original research to make it into practice. After all, we want to be sure that new treatments and tests are effective and safe. But some people are understandably disappointed that the biggest success stories so far are mostly inaccurate ancestry tests<sup>21</sup>.

<sup>20</sup><https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3014770/>

<sup>21</sup><https://www.scientificamerican.com/article/how-accurate-are-online-dna-tests/>

## Blood transfusions

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We all know the stories of eternal vampires. But were they on to something?

Stories of wealthy people paying for transfusions of young blood have been an internet staple for the past few years. And there is some truth in them. Scientists have been experimenting with 'heterochronic parabiosis' - connecting the circulatory systems of two subjects of different ages - since the 19th century. And there has been some, if limited, evidence that it can be effective in treating particular diseases - at least in mice.

Based on this, a few...non-traditional...operators have been offering human transfusions to the super-wealthy. Want some young blood? That will set you back somewhere between \$8,000 and \$285,000. Given the paucity of the evidence to date, it's not surprising that the US Food and Drug Administration issued a statement highlighting the lack of proven effectiveness.

And yet, some of the most recent research suggests the snake oil salesmen could be on to something - at least in theory. Studies such as one at the University of Washington have shown that there are components in the blood of young people that can revitalise older subjects - again, only so far proven in mice. In the case of this study, the target was an enzyme called eNampt (extracellular nicotinamide phosphoribosyltransferase). Boosting levels "significantly improves wheel-running activity and extends lifespan."<sup>22</sup>

So, if you're finding it harder and harder to keep running on that wheel, there may be hope.

## Rewriting our code

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Perhaps the most extreme biological option for extending our lives is to start to rewrite the very code at the heart of our cells. If we can reprogram our cells, surely we can live longer? The 2012 Nobel prize in Physiology or Medicine was awarded in part to Shinya Yamanaka for what have become known as the Yamanaka Factors. These four proteins in mice cells proved to be the key to reversing the age of that cell. Yamanaka's discovery has been applied by Juan Carlos Izpisua Belmonte at California's Salk institute to rejuvenate aged mice<sup>23</sup>.

This discovery is a long way from a reliable treatment for humans though. The effects of the treatment don't always have such miraculous results. You're not going to be sipping at some scientific elixir of life any time soon.

Even if we can rewrite our cell's code, it may be very difficult to completely overcome our in-built ageing processes. One recent study<sup>24</sup> cast doubt on whether any biological intervention could seriously extend our lives. It looked at the rate of ageing across multiple species and found that while we can tackle levels of mortality in earlier years, ultimately we will still age at the same rate.

So perhaps if we want to live forever, we need to look beyond the biological...

<sup>22</sup><https://profiles.wustl.edu/en/publications/extracellular-vesicle-contained-enampt-delays-aging-and-extends-l>

<sup>23</sup><https://www.technologyreview.com/2019/08/08/65461/scientist-fountain-of-youth-epigenome/>

<sup>24</sup><https://www.nature.com/articles/s41467-021-23894-3>

## Artificial organs and robot bodies

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Death generally occurs when your organs stop functioning. So could we build organs that will run forever? We can already replace many joints, and organs, albeit some options are limited to the 'extra corporeal' – i.e. outside of your body because of their size and power requirements.

Unfortunately, the survival figures for those with transplanted organs are not perfect. While they offer a great chance to those in need of a replacement, they don't look like great options for everyone. And electromechanical options are rarely as efficient or compact as the real thing.

This opens up questions about quality of life, especially when you consider which aspects of our body start to fail as we age. It's unlikely we could have, or might want, artificial skin, nerves, or blood vessels, all of which degrade as we age.

The ultimate body replacement of course would be the brain in a robot body. That might extend your life somewhat, but it would be a very different life. The human body is not just a vehicle for your brain. Your very experience of the world is bound up in the senses and chemicals of your body. There's a good question as to whether you would be the same person if your brain was transplanted, unless your new robot body could perfectly simulate your missing biology.

Ultimately though, the brain too is an organ that ages. And so we get into the truly digital realms: can you transplant consciousness into a computer?

## The living computer

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What does it mean to be alive? Is it possible to capture every aspect of our consciousness and port it to another platform – like a computer? These are subjects explored by philosophy and science fiction for centuries, and now, by science. What we seem to know now is that you can't just extract someone's consciousness from their brain: everything is filtered through the lens of our bodies. So any virtual environment would have to replicate those as well if we were to be a true version of ourselves in this new digital environment. But what would that environment be? It would be pretty jarring to interact with the physical world if you were no longer embodied. A face on a screen doesn't seem like a very appealing existence.

The alternative is that we live out our eternal lives in a virtual reality landscape, as explored in Neal Stephenson's novel, 'Reamde'. The challenge is that the computing power required to keep all these eternal souls running would rise with every physical death. That might put quite the strain on our energy grid, and the environment. So maybe we would need to think bigger about how to overcome the engineering challenge. Like a Dyson Sphere, encasing a star in solar collectors to consume all of its output.

There is a lo-fi version of digital eternity of course. Microsoft has patented the idea of capturing a sense of your self from your social media interactions and using this to train an AI that can act as you – even if you are long gone<sup>25</sup>. But with current technology, it won't be anything like conscious.

<sup>25</sup><https://www.washingtonpost.com/technology/2021/02/04/chat-bots-reincarnation-dead/>



## Resurrection

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If we don't have the science today to help you live forever, and it seems unlikely we will have it in the next thirty years, is there a way to hang around until we make some breakthroughs? For many years now, some wealthy people have been having their heads or whole bodies frozen and stored at super-low temperatures with the hope that in the future they can be resurrected.

The science of freezing people is fairly well advanced. Preservative chemicals replace the body's fluids to avoid damage in the freezing process, and the body or brain is cooled to a chilly minus two hundred degrees. Inspections of frozen corpses suggests that the bodies have remained fairly well preserved.

The problem comes with the thawing: we simply don't have the technology to bring icy dead people back to life. And even if we could, we have no idea what will remain of their identities. This is not to say that future science could not find a way. But right now, many scientists are sceptical. As neuroscientist Michael Hendricks of Canada's McGill University told *Technology Review*<sup>26</sup>, "Reanimation or simulation is an abjectly false hope that is beyond the promise of technology and is certainly impossible with the frozen, dead tissue offered by the 'cryonics' industry."

<sup>26</sup><https://www.technologyreview.com/2015/09/15/109906/the-false-science-of-cryonics/>



# Survey: Who wants to live forever?

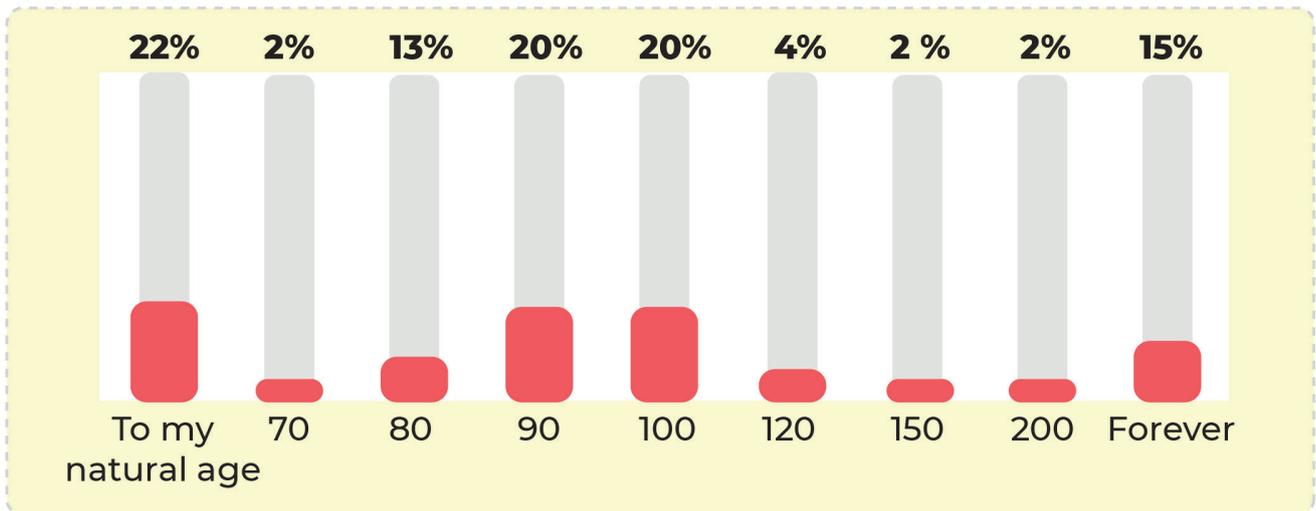
The prospects of eternal life are not promising in the short term then. But do we even want to live forever? I commissioned Opinium Research to survey the British public on their attitudes towards life extension. They asked three questions to a nationally representative cross section of 2,001 adults between the 9th and 13th of July 2021.

## 1. If you could live in good health to any age, how long would you want to live?

Not surprisingly, most people want to live longer. Of those who gave a specific target age (63%), the average respondent said they would want to live to 97. Men are keen to live a bit longer than women, targeting 100 years to women's 95. And those in the North West (101.6) and South East (101.6) are keen to live significantly longer than their counterparts in the West Midlands, who would like to live to 93.1.

A fifth (22%) of UK adults say that they would want to live to their natural age, even if they had the choice to live longer. At 24%, women are significantly more keen on this option than men (20%).

The smallest proportion of respondents (15%) said they would want to live forever. Interestingly, men were more likely to report this than their female counterparts (18% compared to 13% respectively). Those aged 35-54 are the most keen to live forever at 18% vs 12% of over 55s and 16% of under 35s. People in the North East are almost twice as likely to want to live forever (20%) as their counterparts in Wales and Scotland (both at 11%).



On average people want to live to **97.4**.  
 Just **15%** want to live forever.

## 2. What actions have you taken to extend your life?

Four out of five (79%) UK adults have taken some form of action to extend their life. The most common action is not smoking (48%). This is particularly prevalent in the over 55s (57%), compared to 18-34s (42%) and 35-54s (44%).

Other generational differences include going vegan, with 10% of 18-34s dropping meat and dairy versus just 5% of 35-54s and 2% of over 55s. And choosing to move to a less polluted area - something more younger people (16%) have chosen to do, compared to 12% of 35-54s and 9% of over 55s. Reducing stress is something that becomes more popular with age. One in ten (30%) over 55s said they've done this to extend their life, compared with 28% of 35-54s and 26% of 18-34s.

Women are more likely to take supplements (29%) than men (24%). Women are also more likely to avoid alcohol (28% vs 22% of men). While men are marginally more likely to have regular exercise (47% vs 44%).

There are quite significant regional differences in the actions people have taken to extend their lives. Those in Northern Ireland are the most likely to have moved to a less polluted area (18%), while those in Wales and the East Midlands (7%) are the least likely. The East Midlands is however a hotspot for abstinence, with 32% saying they don't drink, similar to London and the South West.

Just 18% of Scots say they don't drink, by contrast. But they also don't consume something else: supplements. Just 17% of Scots say they take supplements, 10% lower than the rest of the country.

Yorkshire and Humber is where the fewest people have taken action to reduce stress, at just 23% versus a national average of 28%. While those in the South West are clearly aware of the power of relaxation, with 34% taking action to reduce stress.

London is where people are most focused on a healthy diet, with 48% saying they have taken action to improve theirs. This falls to just 34% in the East Midlands.

Over half of Londoners (54%) and those in the South West take (52%) regular exercise. But this falls to 39% for those in the North West and West Midlands.

Meanwhile smoking is least popular in the South West where 55% don't smoke. The South East and Yorkshire and Humber follow closely behind with 54%. While in the West Midlands, just 39% say they don't smoke.

Looking at those who have taken no action from our list to extend their lives, this accounts for over a fifth of the population (21%). This rises to 26% in Scotland and 25% in the East of England. Londoners are the most likely to be taking action to extend their lives and perhaps not surprisingly, this is where you will also find the greatest proportion of vegans (12%).



**48%**

Not smoking



**45%**

Taking regular exercise



**42%**

Improving your diet



**28%**

Reducing stress



**26%**

Taking supplements



**25%**

Not drinking alcohol



**12%**

Moving to a less polluted area



**05%**

Going Vegan



**21%**

Not taken any action to extend my life



Londoners have taken the most action to extend their lives. **10%** of **18-34s** say they are vegan.

### 3. If these technologies were available and affordable in the future, which ones would you use to extend your life?

When asked which technologies they'd be willing to use to extend their life if they were available and affordable in the future, 28% said they'd replace their organs with artificial ones. This was closely followed by weekly injections (27%) and blood transfusions from younger people (20%).

UK adults were least likely to say they would be willing to use more radical technologies such as transplanting their brain to a robot body and living forever in virtual reality (both 16%) or copying their mind into a computer and freezing their brain until science can resurrect them (both 15%).

Interestingly, respondents become slightly more willing to partake in more radical technologies if it means they can extend their life for longer periods, as illustrated in the chart below.

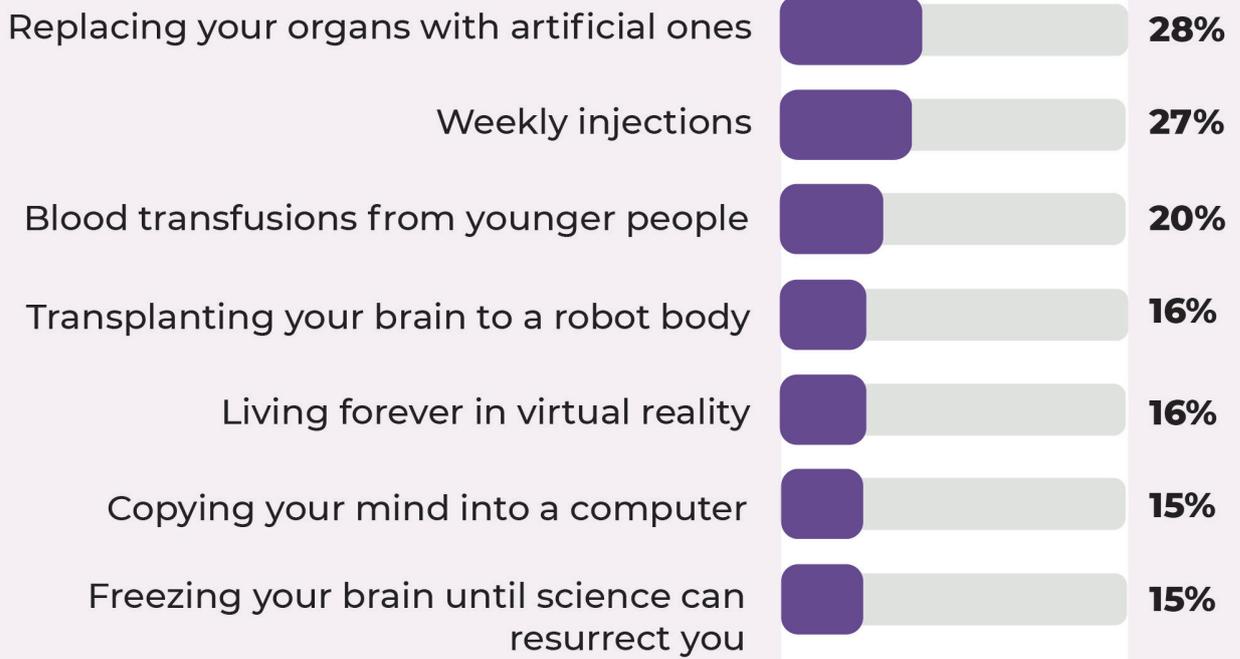
Across the board, men are more keen on life extension technologies than women. Twice as many men as women would consider copying their minds into a computer (22% vs 9%), living forever in virtual reality (22% vs 11%), or transplanting their brains into a robot body (24% vs 9%). And almost twice as many would replace their organs with artificial alternatives (37% vs 19%). While 80% of women said they wouldn't consider any of these technologies, that was only true of 66% of men.

The young are the most open minded about life extension technologies, with 41% of 18-34 year olds open to one or more, compared to just 13% of over 55s. The over 55s were particularly against blood transfusions from the young (9% willing) and living forever in virtual reality (6%) when compared to the rest of the population (27% and 19% respectively). But their least favourite option was having their brain's frozen (5% willing).

Among 18-34s, artificial organs were an option for 40% and blood transfusions for 33%. Over a quarter were open to some sort of digital life extension, as a robot (29%), computer (27%), or in virtual reality (28%). 35-54s were open to weekly injections (30%) or artificial organs (29%) but less keen on all the other options.

Looking across the UK, the North East is the home to the greatest life extension sceptics. Just 17% of people here would accept any form of life extension technology, compared to 39% of Londoners. Those in Scotland (20%) and Wales (21%) were also sceptical.

Those in Yorkshire and Humberside were most accepting of artificial organs (38%). While those in London and Northern Ireland were the most likely to accept blood transfusions from younger people (28%). London was also where forms of digital immortality found the greatest acceptance.



say they would accept **blood transfusions** from younger people if it would extend their life.



say they would want their **brain transplanted** into a robot body.



## US vs UK: Who wants to live longer?

Scientists at the University of Texas asked a panel of 900 Americans of varying ages about the prospect of immortality. This gives us an interesting comparison point between the cultures on each side of the Atlantic. The researchers, Michael D. Barnetta and Jessica H. Helphrey were interested in whether interest in life extension varied by age. They asked people whether they would take a pill to extend their lives forever, as well as the youngest and oldest age at which they would wish to live forever.

More than twice as many Americans as Brits said they would want to live forever at 33%. 42% said they would not take the pill and 25% were undecided. As in the UK, men were more enthusiastic about immortality than women.

The hypothetical immortality pill used in this study would freeze your age at a particular point. The youngest group of people surveyed, ranging from 18-28, said they would be eternally somewhere between 23 and 42 years old. While one of the older cohorts, with an average age of 72 would stop somewhere between 44 and 69. The oldest cohort suggested they would freeze their age between 52 and 77. If nothing else, this suggests that all of us under 77 still have things to look forward to - maybe the best years of our lives!

# Asking Twitter: Would you want to live forever?

Alongside the formal survey, I asked Twitter: would you want to live forever? These were some of the most interesting responses:

- **@overthewire:**  
"Compound interest would work well for you — but you'd be utterly alone and even good friendships would appear to be fleeting. You'd have to invent new ways of staying interested in being alive."
- **@ohblkenob:**  
"If I can periodically have my memory erased in certain areas (my Netflix memories for example) and have people join me (I never want to outlive my children). Although when the sun burns out and the world ends would I be left floating in space?"
- **@NigelSarbutts:**  
"No, it would send you mad by destroying the urge to accomplish anything."
- **@ppbrannon:**  
"No. Living in the moment and being a grateful, mindful person is tricky enough amidst a busy life. If experiences were infinite it would be exceptionally challenging to ever truly appreciate anything."
- **@elovuk:**  
"Life is fun – and I've had dark times before and I'm still here – so why not stay a bit longer :)  
#allthingshallpass"
- **@zaphodzissou:**  
"Yes, because I'd like to be able to enjoy life without the pressure of deadlines."
- **@SeeCaroline:**  
"Queen said it right. Because it would get boring (even as an immortal from the planet Zeist)"
- **@mancinthehat:**  
"I'm going to assume peak physical condition because the alternative is becoming sentient dust. I want to see the future. I'm hoping for the singularity in my lifetime. The future is bright and the present is much better than the past."

I invited a few of those who gave the best responses to expand on the question. You can read their full comments in the appendix.

# The billionaires investing to live longer

It may be that life extension technologies are only attractive to a small proportion of the population. But the extraordinarily wealthy seem to be over-represented in that group.

## Peter Thiel



Perhaps most famous is Peter Thiel, co-founder of PayPal and now investor in a wide range of businesses, including many in biotech. Thiel reportedly takes growth hormone daily<sup>27</sup> and has funded Dr Aubrey de Grey's Methuselah Foundation<sup>28</sup>, whose stated aim is "To make 90 the new 50 by 2030." Thiel is a member of Alcor<sup>29</sup>, meaning he can have his body cryogenically frozen at the point of death.

## Robert Miller



Less well known is the very private Canadian electronics billionaire Robert Miller, another member of Alcor planning to have his remains preserved. Miller is a prolific philanthropist, giving much of his company's profits away with a particular focus on addressing life threatening diseases.

## Sergey Brin



Google co-founder Brin drove the creation of Calico<sup>30</sup>, a company under the Google parent Alphabet's umbrella dedicated to understanding and addressing ageing. Somewhere between a research group and a biotech company, Calico is testing a number of different approaches to extending life.

## Mark Zuckerberg



Alongside Sergey Brin, Facebook founder Mark Zuckerberg is one of the funders of the Breakthrough Prize for life sciences, an annual series of awards for those who have made discoveries that expand our knowledge of life and our ability to extend it.

## Jeff Bezos



The Amazon founder is reportedly one of the investors in Altos Labs, a US start-up looking at genetic reprogramming as a route to reversing ageing. The company, funded by a number of tech billionaires, is pursuing the research of Nobel prize winner Shinya Yamanaka into a set of proteins that can be used to return cells to a more youthful state.

## Larry Ellison



Oracle founder Larry Ellison has a stated goal of immortality, and through his Ellison Medical Foundation has invested more than \$400 million to make it a reality, making him one of the most prolific investors in life extension.

<sup>27</sup><https://www.businessinsider.com/billionaires-who-want-to-live-forever-2015-9?r=US&IR=T#peter-thiel-1>

<sup>28</sup><https://www.mfoundation.org/>

<sup>29</sup><https://www.alcor.org/>

<sup>30</sup><https://www.calicolabs.com/>



# Looking to the future: Life Expectancy 2050

Having gathered information about the science of life extension and the challenges to life on earth in the next century, I mapped one against the other using the Intersections process. This looks for the connections between the pressures we face and the incoming trends to find the most likely outcomes. The result gave me five key predictions for the future of life extension between now and 2050.

## 1. We will find ways to extend human life...but not forever

Despite the scepticism of scientists based on the 'invariant ageing theory', I believe that we will eke out small extensions in healthy life in the next thirty years through new understanding of the ways our bodies decline with age. These will be therapeutic treatments in later life. In addition to the preventative treatments and supplements that wealthy people in later life already consume, we will slowly introduce a range of additional life-extending options for those that can afford it. By 2050, I suspect the average lifespan for those in wealthy countries would have exceeded 92 for men and 95 for women but for issues attached to climate change and inequality.

However, no-one will have found immortality in any real sense by 2050. There will be no biological options for extreme life extension beyond 120, even for the wealthiest individuals. And any digital uploads of consciousness will be incredibly flawed, incapable of replicating the human experience.

<https://ourworldindata.org/life-expectancy>

<https://www.bmj.com/content/364/bmj.11492#:-:text=The%20Office%20for%20National%20Statistics,a%20gap%20of%209.3%20years.>



## 2. Rising lifespan inequality

Inequality is already a visible factor in global life expectancy. And it is likely to get worse.

First, climate change is likely to increase mortality rates in both young and old in those areas poorly equipped to compensate for higher temperatures, water levels, and crop impacts.

Second, in those countries with state healthcare, the cost of novel treatments for an ageing population is likely to be incredibly high – especially since the tax base of working age people is likely to start to shrink in the second half of the century. The state may have to be very selective about what it pays for. For those in countries with insurance based healthcare systems, particularly in the US, the challenges may be even greater, as premiums rise further in line with potential lifespans.

The result will be an increase in the margin between highest and lowest life expectancies, both between countries, and between individuals within countries. Already in the UK, this gap is almost 10 years. By 2050<sup>31</sup> I suspect it will have widened to 12 or even 15.

## 3. The age race

Motivated by their ageing populations, many countries around the world will be investing more and more to drive their people to be healthier, later in life. We will see more campaigns on processed food, higher taxes on alcohol, and exhortations to exercise, even if we don't see huge investment in the facilities that might encourage such exercise. That costs real money that will likely be in short supply for governments in the near future, without radical changes in policy.

These campaigns combined with trends towards plant-based food, alcohol abstinence, and a continuing focus on body image, will start to tackle levels of obesity by 2050. But our efforts might be put to shame by those in other countries.

Instead of pursuing the old Western diets and lifestyles as they become wealthier, many countries will leapfrog us just as they have with technology. Bypassing the last thirty years of high calorie, processed and fast foods, these countries will adopt the latest thinking around diet and climate consciousness. Expect to see rapid increases in fitness levels and lifespans in the wealthier parts of India and China, and likely in capital and larger cities in countries in Africa and South America.

<sup>31</sup><https://www.thesun.co.uk/tech/5587710/how-to-live-forever/>



## 4. The health crunch

As the NHS approaches 100 in 2048, so might many more people. How will services cope with this ageing population? Unless we can address issues of obesity and inactivity, the answer will be 'not well'.

In the 60 years following the founding of the NHS, spending rose more than 13 times when adjusted for inflation, from £11.4bn to £152.9bn. This works out at an average annual increase of 3.9%. Following this trend out to 2048, we would see NHS spending rise almost three-fold to nearly £450bn, before any special provisions, such as the additional £60bn allocated to address COVID-19 in 2020/21.

To pay for our longer lives, we will almost certainly have to work longer. The state retirement age in the UK is rising to 67 in 2028 and by 2050, I predict it will be over 70 – maybe even rising towards 75. Though this is unlikely to address issues with poverty in old age<sup>32</sup>.

At the same time, we might find ourselves facing shortages of skilled workers in the health sector. Forecasts suggest that the number of people over 85 will have doubled to more than three million<sup>33</sup>. And there will be a 30% increase in the number of people of pensionable age, while the number of people of working age will not increase anywhere near as quickly – particularly if the effects of Brexit see lower overall immigration.

## 5. Digital Ghosts

While I don't expect we will be able to recreate human consciousness in a machine by 2050, this won't stop people from trying. By this time there will have been many experiments of differing levels of sophistication and ethics. We will have many 'ghosts in the machine' – digital personalities which though not fully conscious, can sometimes present a believable facsimile of a dead person. Continuing where the trend for resurrecting dead celebrities for posthumous albums and holographic concerts left off, we will find ourselves interacting frequently with the digital echoes of the long dead.

This raises all sorts of issues, around rights (who says if you can be digitally resurrected), laws (who is responsible if your digital ghost goes rogue and starts slandering people?), and costs – not least in carbon. All those extended lives will require an awful lot of storage, processing power and bandwidth, and that means energy and heat.

<sup>32</sup><https://www.wired.co.uk/article/pension-age-state-raise-uk>

<sup>33</sup><https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/bulletins/nationalpopulationprojections/2018based>

# Predictions

## 1. We will find ways to extend human life...but not forever



Expect small extensions in healthy lifespans in the next thirty years through new treatments. But there will be no biological options for life extension beyond 120, even for the wealthiest individuals. Any digital uploads of consciousness will be flawed, incapable of replicating the human experience.

## 2. Rising lifespan inequality

Climate change will increase mortality rates in poorer areas around the world. States will not be able to afford novel life extension treatments, so these will be the preserve of the wealthy. The result will be a growing gap between highest and lowest life expectancies, between countries, and between individuals within them - widening in the UK to 12 or even 15 years.



## 3. The age race



Countries around the world are in a race to address their ageing populations. Expect major health campaigns and rising taxes on alcohol, sugar and other contributors to ill health. In the UK we will start to tackle obesity but we might be overtaken by developing countries who adapt faster - just as they have to new technologies.

## 4. The health crunch

As the NHS approaches 100 in 2048, so might many more people. Unless we can address issues of obesity and inactivity, costs will spiral. NHS spending could rise almost three-fold to nearly £450bn. To pay for our longer lives, we need to raise taxes or work longer, with the state retirement age climbing towards 75.



## 5. Digital Ghosts



Though we won't be able to recreate consciousness in a machine by 2050, this won't stop people trying. By this time we will find ourselves interacting frequently with the digital echoes of the long dead. This raises all sorts of issues, around rights, responsibilities, and costs – not least in carbon.

# Index

# Appendix 1:

## Extended responses

I followed up a poll on Twitter asking people if they would like to live forever, to ask those with some of the most interesting answers to expand on what they said.

**Caroline White (@SeeCaroline)**

### Initial response:

*"Queen said it right. Because it would get boring (even as an immortal from the planet Zeist)"*

### So, would you truly not want to live forever?

It sounds great doesn't it? Endless time, eternally plump cheeks and flowing hormones..all aligned with the wisdom of age. Not seeing buds turn to brown leaf that depresses us so. However- I'm not sure anyone is thinking this through. All the sci fi premises that look at this (Torchwood Miracle Day, the excellent French Ad Vitam, Highlander, Zardoz, Interview with a Vampire and every zombie/vampire film ever) we see two things:

(a) Cynical ennui ridden characters who are all so terribly bored of it all, locked in a past time and unable to really be present with the new youth or world around them. Unable to reproduce, most of the time, or to engage in life- they become sad echoey tribes wandering around the world who seem to have lost the meaning of life..

(b) A population issue with a serious divide between the older and younger. Would nobody dying mean that nobody new could be born? What about children and procreation? What would there be to learn? How would an older class of non ageing people mix with younger generations? Would these generations feel robbed of 'their' time in the same way that millennials blame boomers for robbing resources, hogging high culture and leaving them as the impoverished cleaner-uppers?

(c) Sean Connery running around in leather pretending to be Spanish or travelling through space in giant rocks..

I think we spend the first half of our lives as charming ego driven creatures growing and taking, and the second half of our lives slowly dying and giving. That pattern is in nature- it's everywhere. I see it in the plants I grow, the seasons, children, people, insects and birds. That sounds awfully depressing doesn't it?.. but it isn't. A life chasing eternal youth may not necessarily be a happy one. In this century- We've seen the birth of real childhood, the concept of a teenager and in my generation (I'm 43), the eternal teenager (I know many of these). My generation might be the first where we have had the option to do what we want to as long as we like. Many of my friends haven't had families and kids because they wanted to stay in that 20's/30's era forever. We can still go to festivals and buy silly guitars and dresses until we look too old for them (and somebody tells us to put it away).

However, the happiest people I know aren't doing this. They are giving back. Whether that be to younger people or their community, they still do what they love but in a quieter way and it isn't all about them. I think we are meant to move on from our narcissism and be more than raging egos pursuing our own happiness, and this sad decaying process is part of that humility. No harm if you want to do this with your electric ukelele, if it makes you happy.

## Would you really get bored?

Yes, I think so. I'm already bored of things I did in my 30's. Whether it's your body changing or a 'moving on' from chasing the same 'buzz', ageing is a nudge that you are passing through a different phase of the journey. Just like all the other phases. What would it do to us as humans if the party never stopped? Is any party really THAT good? Are we wise enough yet? Have we proven our generosity to the planet? Ahem... I don't think so.

Would I get bored? I know we all think we want eternal youth, but without the journey and the change and the learning- what would it be? I know ageing is cruel and nobody wants to succumb to the loss it brings. But if there is a purpose in life, I don't think it's to serve ourselves endlessly and live on this earth forever like parasites..

## How long would be an ideal life do you think?

To be a mayfly or a tree? (Trees have a good lifespan, don't you think?)

Question: are we assuming we have the same time for childhood and adolescence and a prolonged middle bit? Or would an extended life just be 100 years being old, which, let's face it, really wouldn't be all that good.

Ideally, I'd like to live twice as long- Maybe twice what we have now. Same length of childhood and adolescence with a mega long 20's and 30's (for 50 years) and then a 30 year old age- dying at about 65 before it gets too wrinkly and uncomfortable. For women, the cut off for reproduction is a tough one, so I'd extend that for sure. Culturally, women are so defined by their youth (STILL!) that there are clear plusses in staying young in this world. That makes me sad that older women have little respect in society beyond youth, beauty and reproduction.

## Anthony Rose (@mancinthehat)

### Initial response:

***"I'm going to assume peak physical condition because the alternative is becoming sentient dust. I want to see the future. I'm hoping for the singularity in my lifetime. The future is bright and the present is much better than the past."***

Let's break this down bit by bit.

When I initially replied 'peak physical condition' I was thinking that if I was to continue to decay then at some point, I just become dust. I think that much is self evident but giving it further thought I would also require physical fitness appropriate to the time along with intelligence for the time. If not then given a couple of million years I would be the equivalent of a primate to them.

Singularity in my lifetime is unlikely. I don't know how true this stat is, but when 'automatons are going to take over' is the story in the media, the average time given is 15 years away. As are flying cars, robot butlers etc. And these have been 15 years away since the times of Jules Verne. However over a long enough time frame and without catastrophe, singularity is inevitable.

The present is better than the past. As a race humans are now more likely to die from obesity related disease than malnutrition. Whilst there are questions over life spans increasing infant mortality is definitely down. We are significantly less likely to die a violent death than we have been at any point in history. We are working less and have more ways of spending our leisure time. I think this trend will continue.

Wealth would be much easier to accumulate over long time lines. I could age whisky over 50 years and get to taste the result.

Technology has been accelerating at a phenomenal rate. I am interested to see the benefits this will bring. Star Trek style utopias with replicators?

Looking at the risks. Top risks that might wipe out the human race and why, if I'm living forever, I don't mind them.

### **Climate change.**

This is unlikely to kill off the human race totally. Pockets will survive in even the worst case scenarios. As the planet heals these survivors will reemerge. Hopefully with lessons learnt and new strategies.

### **AI gets us.**

Well I'm immortal so it's not getting me. I also have an infinite timeline to learn how to communicate with it and/or see what lifeforms evolve next. AI might even help me become AI. At some point in the future, AI will need to leave this solar system. The likely route for that is as informational light. I'm now traveling the universe as sentient light. How cool would that be!

### **Nuclear waste land.**

That will pass over a long enough time line.

### **A meteor gets us,**

or some other planet destroyer. This is the worst case for me and the only one that is guaranteed to happen. If a meteor doesn't get us an expanding sun will. I'm now floating around space with no means of propulsion until the cold death of the universe. Well in this case I'll just go mad.

The mind is very flexible. I could probably retreat into an imaginary universe. I've no evidence I already haven't.

PS: I forgot the 10,000 hours rule. Imagine all the skills I could procrastinate over and fail to achieve over an infinite timeline!

## **Camilo Hurtado (@camilohurtob)**

### **Initial response:**

***"Sounds better than the alternative."***

Uncertainty about the afterlife is obviously terrifying. Since our certain fate will deprive us from all senses, even our sense of ourselves It doesn't look good for us. As Steve Jobs said it better: "Even people who want to go to heaven, don't want to die to get there". Living forever would give you perspective beyond even our universe's rules and give us a real chance to see what existence is about.

So when it comes to the simple pros and cons, even going to heaven is outweighed by the chance to rationally understand our meaning and place in this infinite space. If the alternative was present, I'd choose to live forever.

I would dedicate myself to explore our meaning as humans and our intricacies in relation to our universe beyond planet earth. Food as an example, as pedestrian as it sounds, might have a different meaning in the light of other galaxies. What place does predation have in the universe? Are we special for doing so, or barbaric? We could prosper on another planets, giving other species their best habitat possible for them to evolve. And those who want to dedicate themselves to this mission, should have the choice to live forever. Maybe someday they will achieve our status and explore existence beyond the human race. That idea fascinates me.

## Judit Petho (@JuditPetho)

### Initial response:

***"I'd love a longer (healthy) lifespan than humans can currently expect, and I'd love to see various points in the future, maybe even live then if it's a good life, but living forever. no, definitely no"***

I've always found the future exciting. So much possibility for development as humans, but also for our technologies and societies. I remain optimistic about the long-term future of humanity and would love to be able to see ahead, even 'pop in' at different times in the distant future. Who knows, maybe I'd decide to stick around a few hundred or thousand years from now, provided I am compatible with the new society and environment. And if I can get the physical and neural enhancements they have – otherwise it would be very hard to adapt.

Jumping ahead in time is quite a different concept though to living forever. Human life as we know it is a journey, with a beginning – and an end. That is what we are used to, how our societies evolved. Dealing with death is a very important part of all cultures. Being on an open-ended, never-ending road feels not so much scary as against our cultural norms. Against our instincts.

I am not worried about having to retrain and reorient ourselves many times through life, we already have to adapt that mindset now. Even in 2021, having the same job or same profession for 50–60 years feels way too long. We are already actively switching during mid-life or create flexible portfolio careers. And that is for a life expectancy around 100 years.

Having unlimited tries for new careers and hobbies doesn't sound bad at all. It's the moral questions of immortality that are interesting. Can you even keep track of or have a meaningful relationship with all your descendants? A forever life would require regular recalibration and adaptation to something new as technologies and societies evolve, driven by each new generation. How long can you keep that up and stay sane?

Our moral codes, cultural norms, and behaviours would be upended. Can you transgress freely because whatever the punishment you have plenty of time to start again? Or quite the opposite, punishments can go on forever? Does everything just become a blip on a never-ending timeline and do significant moments even lose their significance? Human relationships would need to be rethought completely as 'they lived happily ever after' or 'love you forever' would take on a whole new meaning if forever means literally forever (again, we are already recalibrating romantic relationships).

My mind can easily process a stretched-out lifespan of about 300 years. You could take more time to achieve certain things, have several careers and hobbies, learn more, do more and create more. I could probably even add an extra few hundred years. But forever? That just sounds really long to have to find meaningful things to do, even if aided by a mental shift from being on a journey to just being.

# About the Author



## **Tom Cheesewright**

is the Applied Futurist, helping people and organisations around the world to see the future more clearly, share their vision, and respond with innovation. An accomplished speaker and broadcaster, he specialises in connecting tomorrow's world to today's experience, making sense of what's happening next, and why. Using a unique set of tools that he developed, and now teaches and licenses to others, Tom finds the critical intersections between today's macro trends and the existing stresses facing organisations and individuals. These are the points at which the greatest change will take place.