Telomere Analysis Technology®

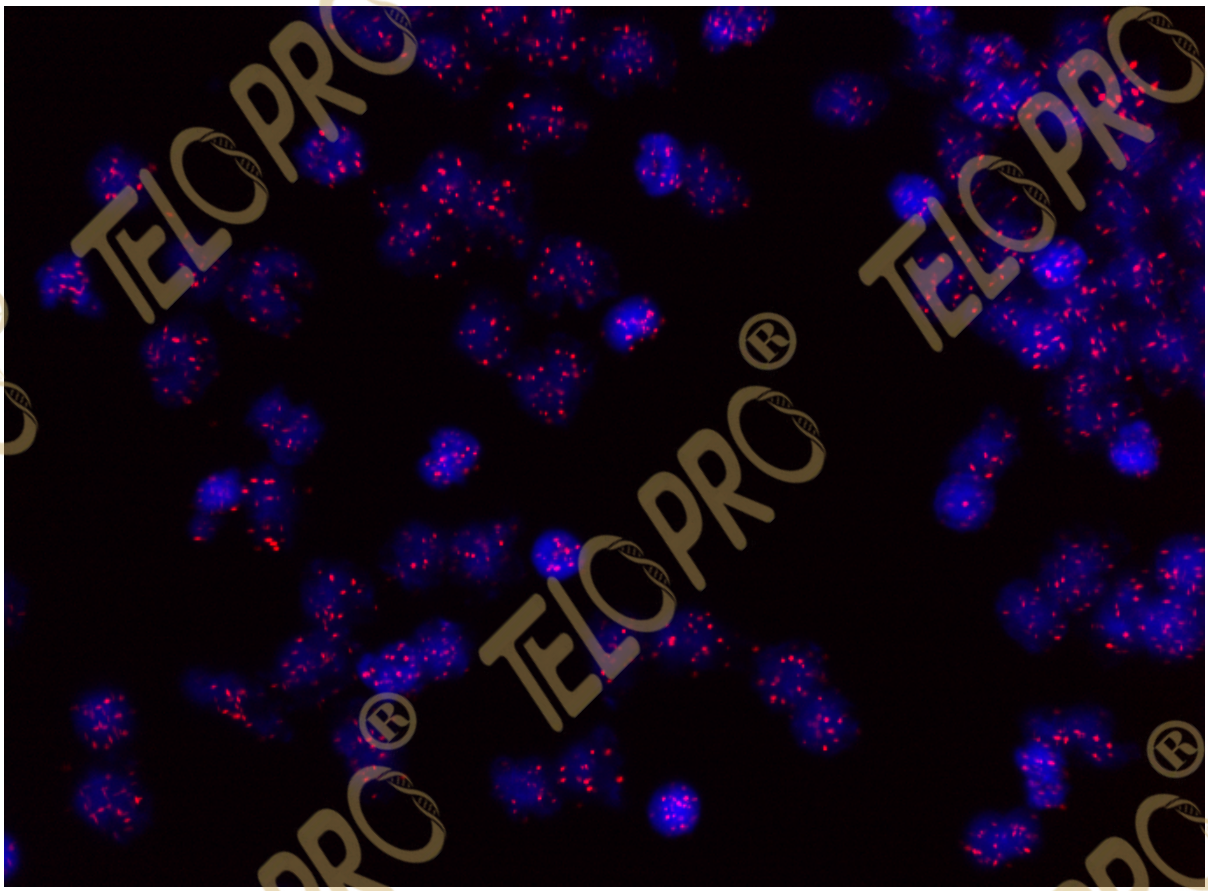
Results Report

SAMPLE CODE: [redacted]1037
Report issue date: 09-02-2017

LIFE LENGTH

Life Length, S.L. | www.lifelength.com | info@lifelength.com | Calle Faraday 7 Madrid, 28049, Spain

Your unique telomeres



This is an image of your own telomeres, unique to you. These come from your blood sample, which was analyzed and measured using Life Length's state-of-the-art equipment, which allows us to capture and process images on a sub-cellular level.

The image shows the nuclei of some of the cells from your blood samples (in blue) and your telomeres (pink dots). A higher intensity of fluorescence in the pink dots indicates greater telomere length and a lower percentage of short telomeres.

Definitions

The following short definitions will help you better understand this report.

Average: The sum of a group of numbers divided by the number of values. For example, the average of the following numbers below is 140/7 or 20.

1 2 3 5 6 **20** 103

Biological age: A snapshot of your true age based on testing results. Depending upon your results, your biological age may be higher, equal or lower than your chronological age. One goal of making lifestyle and health improvements is to reduce the rate of telomere attrition, thereby slowing the aging process.

Kb: Stands for kilobase, a measurement of DNA length used in genetics.

Leukocytes: The white blood cells in your blood sample. Unlike red blood cells, these cells contain DNA which can be used to evaluate your telomeres.

Median: This is the middle number in a sorted list of numbers. For example the median in the numbers below is 5.

1 2 3 **5** 6 20 103

The median number is more representative of telomere health than the mean and is used frequently throughout the report.

MTL: Stands for the median telomere length. This is expressed in Kb or kilobases. If we lined up all your telomeres by size, the MTL would be the middle value in terms of length.

Telomeres: Are the endcaps of your chromosomes, the structures in your cells that carry genetic material and are responsible for cell division. Over time, as your cells continue to divide, these endcaps shorten. Once telomeres reach a certain length, the cell can no replicate and dies. You will find much more about telomeres later in this report.

Telomerase: Is an enzyme at the end of the chromosomes. Its role is to extend the length of the telomere, slowing down the rate of shortening.

20% Percentile: The TAT quantifies the number of short telomeres in your sample. To do this, we closely examine the bottom 20% of your telomeres to determine how many of them are short.

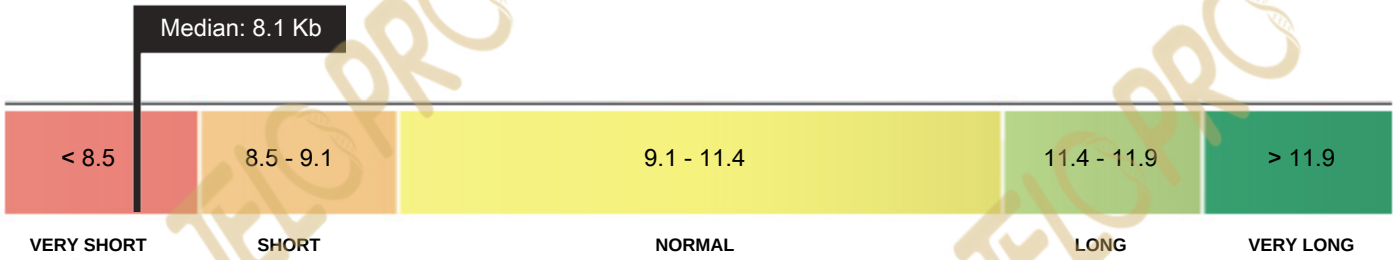
Questions?
Contact your physician for further interpretation.

Please record your report code for future measurements. Code: [redacted]1037

1. Your telomere length

Median Telomere Length: 8.1 Kb

Your median telomere length is estimated to be very short compared to Life Length's database population.

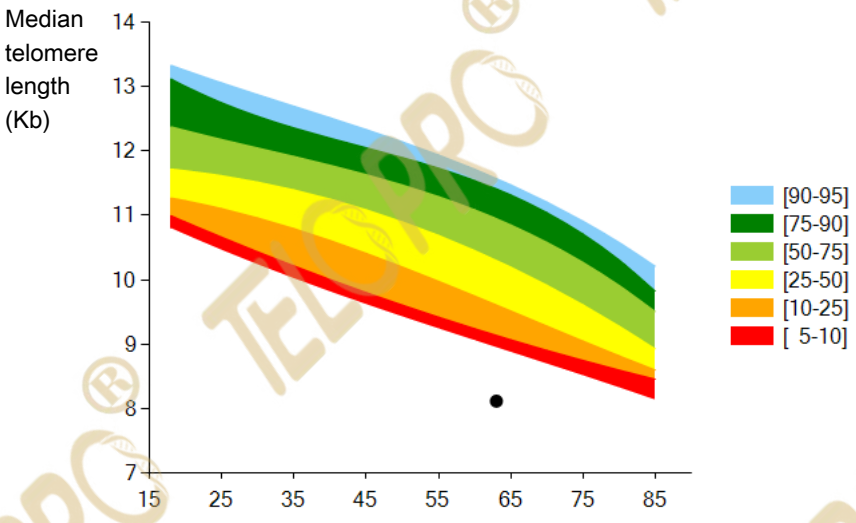


Median Telomere Length (MTL) = 8.1 ± 0.3 Kb

Average Telomere Length = 10.3 Kb

The ranges on this graph are dynamic and based on your age.

2. Median telomere length – Comparison by age band and percentiles



Chronological age (years)

The black dot above shows your result.

This graph shows how your median telomere length compares with other people your age.

Each color band represents a range of percentiles of the control database. It is therefore best if your result falls into one of the upper bands.

According to your result, you fall into the <1 percentile, meaning that <1% of people your age have a shorter median telomere length.

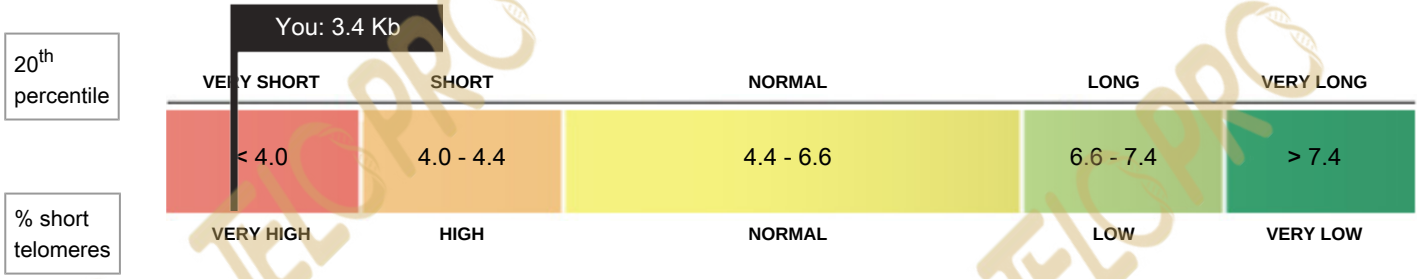
3. Your estimated biological age

Estimated Biological Age: >71.4 years old
Chronological Age: 63.3 years old
(Out of range data is indicated by < or >)

Your 20th percentile / short telomeres

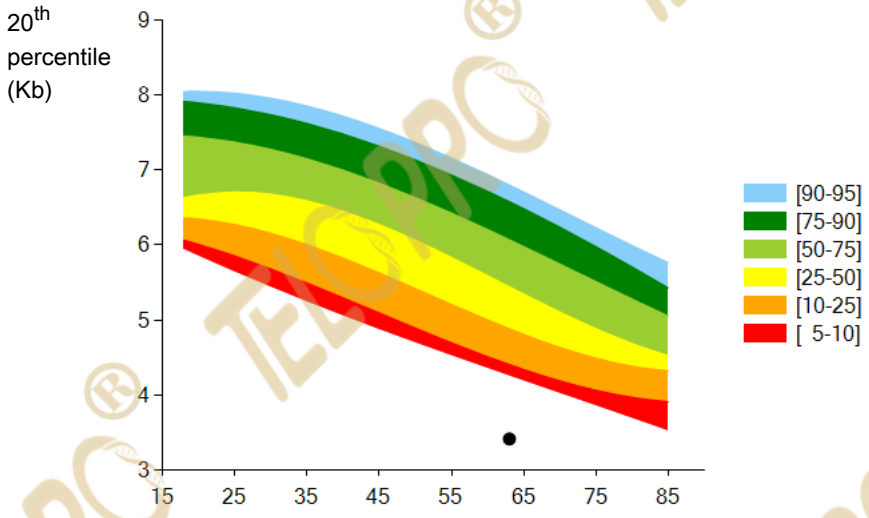
20th percentile: 3.4 Kb

Your 20th percentile is estimated to be very short compared to Life Length's database population.



The ranges on this graph are dynamic and based on your age.

20th percentile / short telomeres – Comparison by age band and percentiles



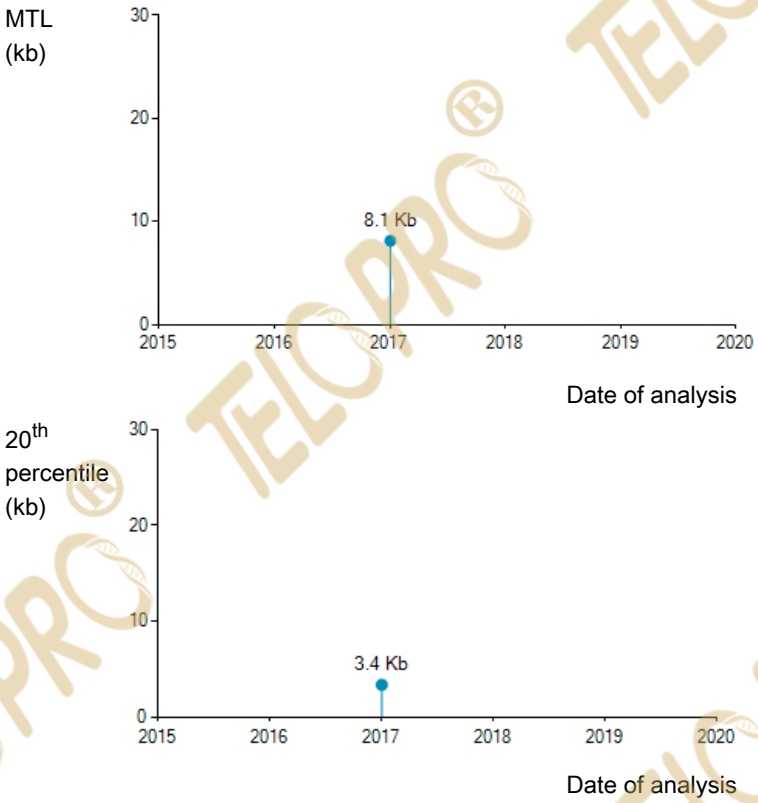
The black dot above shows your result.

This graph shows your 20th percentile value (which represents your shortest telomeres) compared with the control database.

Each color band represents a range of percentiles of the control database. It is therefore best if your result falls into one of the upper bands.

According to your result, you fall into the <1 percentile, meaning that <1% of people your age have shorter telomeres than you and, consequently, a higher degree of cellular aging.

Longitudinal analysis – MTL and 20th percentile

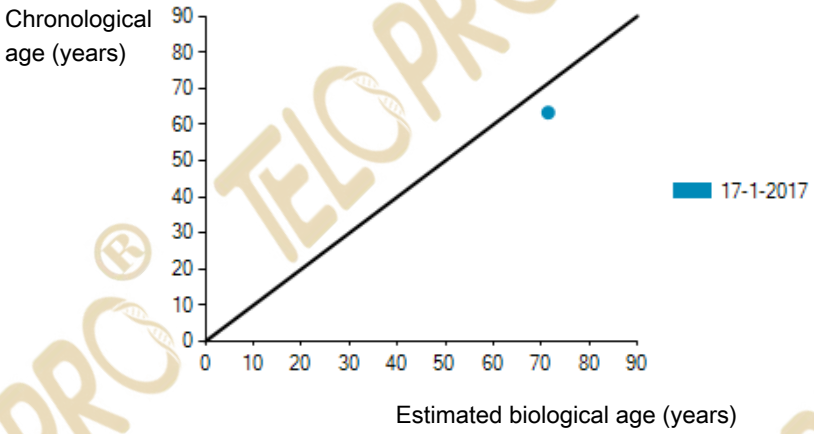


This graph show the longitudinal evolution of your results. Each value represents an analysis that you have had.

The slope between the values indicates the rate of telomere variation over time.

We encourage you to re-test annually to closely monitor your telomere dynamics and cellular aging.

Longitudinal analysis - Chronological age vs. biological age



This graph shows the longitudinal evolution of your biological age vs. your chronological age. Each plotted value represents an analysis you have had.

Values above the line correspond to an estimated biological age lower than your chronological age.

Values below the line correspond to an estimated biological age higher than your chronological age.

According to the U.S. National Institutes of Health, there are more than 25,000 published scientific studies on telomeres. And this is in the U.S. alone. The Nobel Prize was awarded for pioneering work in telomeres. As scientific interest and observation increases, so too does our knowledge of the importance of telomere health. Telomeres have shown strong links to cardiovascular disease, osteoarthritis, and osteoporosis, vascular dementia, pulmonary fibrosis, major depressive disorders and some cancers as well as infertility, type 2 diabetes and CNS diseases, among others. Telomere shortening is also associated with other lifestyle related behaviors such as smoking, obesity, stress and sedentary habits. Studies have shown that individuals who have been subject to violence exhibit significantly shorter mean telomere length. Many studies are now showing that positive health practices can impact the rate of telomere shortening. Among these positive activities are omega-3 fish oils, exercise, mindfulness meditation, stress resilience, and healthy diets.

Below, we have listed several peer-reviewed scientific publications. This list is not intended to be exhaustive or exclusive but covers some of the many conditions for which robust scientific validity appears to have been established. You may wish to share these studies with your physician.

If you authorized that your anonymous questionnaire responses be shared with your physician, then the report highlights in blue those factors, whether good or bad, that affect you and the title of the publications which show the role of this factor in telomere biology. Please note that it is your physician who will aid you in the interpretation of these factors which may or may not play a role in your personal case.

Please also note that if you opted not to take the questionnaire or did not authorize Life Length to share your anonymous questionnaire responses with your physician, then the list appears without any highlighting.

FACTORS	LINKS TO STUDIES Title of Study
ALCOHOL	• Association between alcohol consumption in healthy midlife and telomere length in older men: the Helsinki Businessmen Study • Shortened telomeres in individuals with abuse in alcohol consumption
ATHEROSCLEROSIS	• Telomere shortening in atherosclerosis • Short telomeres are associated with increased carotid atherosclerosis in hypertensive subjects • Biological ageing and cardiovascular disease
CANCER	• Are short telomeres predictive of advanced cancer? • Telomere length and risk of incident cancer and cancer mortality • Telomere shortening is an early somatic DNA alteration in human prostate tumorigenesis
CARDIOVASCULAR	• Telomeres and cardiovascular disease risk: an update 2013 • The roles of senescence and telomere shortening in cardiovascular disease • Leucocyte telomere length and risk of cardiovascular disease: systematic review and meta-analysis

FACTORS	LINKS TO STUDIES Title of Study
CYTOMEGALOVIRUS	• Cytomegalovirus infection reduces telomere length of the circulating T-cell pool
DRUG CONSUMPTION	• Drug addiction is associated with leukocyte telomere length
EXERCISE	• Longer leukocyte telomeres are associated with ultra-endurance exercise independent of cardiovascular risk factors • The power of exercise: buffering the effect of chronic stress on telomere length • Telomeres and lifestyle factors: roles in cellular aging
HEPATITIS	• Telomere reduction in human liver tissues with age and chronic inflammation • Telomere length in hepatitis C
HIGH BLOOD PRESSURE	• Association of leukocyte telomere length with circulating biomarkers of the renin-angiotensin-aldosterone system: the Framingham Heart Study • Leukocyte telomere length, hypertension, and atherosclerosis: are there potential mechanistic explanations? • Telomere length, risk of coronary heart disease, and statin treatment in the West of Scotland Primary Prevention Study: a nested case-control study
HIGH GLUCOSE - DIABETES	• White blood cells telomere length is shorter in males with type 2 diabetes and microalbuminuria • Accelerated aging as evidenced by increased telomere shortening and mitochondrial DNA depletion in patients with type 2 diabetes • Shortened telomere length in white blood cells of patients with IDDM
INSOMNIA	• Associations between rotating night shifts, sleep duration, and telomere length in women • Short sleep duration is associated with shorter telomere length in healthy men: findings from the Whitehall II Cohort Study
LUPUS ERYTHEMATOSUS	• Shortened telomere length in patients with systemic lupus erythematosus
NEURODEGENERATIVE DISORDERS	• Accelerated cell aging in female APOE-e4 carriers: implications for hormone therapy use • Association of shorter leukocyte telomere repeat length with dementia and mortality
OBESITY	• Obesity, cigarette smoking, and telomere length in women • Inverse association between adiposity and telomere length: the Fels Longitudinal Study • Is obesity linked to aging?” Adipose tissue and the role of telomeres

FACTORS	LINKS TO STUDIES Title of Study
OSTEOPOROSIS	• Telomere length in leukocytes correlates with bone mineral density and is shorter in women with osteoporosis • The effect of telomere length, a marker of biological aging, on bone mineral density in elderly population
PULMONARY FIBROSIS	• Telomerase mutations in families with idiopathic pulmonary fibrosis
RHEUMATOID ARTHRITIS	• Premature telomeric loss in rheumatoid arthritis is genetically determined and involves both myeloid and lymphoid cell lineages • Reduced telomere length in rheumatoid arthritis is independent of disease activity and duration • Defective proliferative capacity and accelerated telomeric loss of hematopoietic progenitor cells in rheumatoid arthritis
SCHIZOPHRENIA	• Rapid telomere erosion in schizophrenia
SMOKING	• Telomere shortening in smokers with and without COPD • Obesity, cigarette smoking, and telomere length in women
STRESS	• Accelerated telomere shortening in response to life stress • Telomere length and early severe social deprivation: linking early adversity and cellular aging
VITAMINS AND ANTIOXIDANTS	• Mediterranean diet, telomere maintenance and health status among elderly • Higher serum vitamin D concentrations are associated with longer leukocyte telomere length in women • Association of marine omega-3 fatty acid levels with telomeric aging in patients with coronary heart disease

About telomeres in general

What are chromosomes?

Chromosomes are highly condensed rods of Deoxyribonucleic Acid (DNA), the genetic material which contains the building blocks of life. DNA carries a specific code that gives instructions to our body on how to grow, develop and function. The instructions are organized into units called genes. Chromosomes serve as the storage for this important material, periodically dividing along with cells and replicating to make copies of the DNA they contain. Chromosomes are also very important in sexual reproduction, as they allow an organism to pass genetic material on to descendants. In organisms with cell nuclei, known as eukaryotes, chromosomes are found inside the nucleus. Most of these organisms have a set of chromosomes which come in pairs. In structural cells, each cell retains a complete set of chromosomes, in what is known as diploid form, referring to the fact the chromosomes contain two copies of each gene. In cells for sexual reproduction like eggs or sperm, each cell only has half of the parent organism's genetic material, stored in haploid form, ensuring that each parent passes down one copy of its genes.

What are telomeres?

Telomeres are the ends of chromosomes, which have an essential role in protecting their integrity in the process of cellular replication. One common analogy is that they are like the plastic caps at the end of shoelaces which keep the laces from unraveling. Telomeres are formed by repeats of a DNA sequence, along with associated proteins. The function of telomeres is to protect chromosome ends from chromosome fusions and degradation, therefore, ensuring the proper functionality and viability of cells.

What is telomerase?

Telomerase is an enzyme which is able to elongate telomeres and repair short telomeres by re-elongating them. To this end, telomerase adds telomeric repeats to the chromosome ends. In non-pathological conditions telomerase is expressed in early stages of embryo development as well as in certain adult stem cell compartments. Telomerase is also highly expressed in pathological conditions, such as cancer, where it sustains the immortal growth of cancer cells. Healthy cells usually produce little or no telomerase and, as a consequence of this, they progressively shorten their telomeres associated with successive cycles of cell division, until they reach a critically short length which triggers cell death or an irreversible cell arrest known as replicative senescence (also known as the Hayflick limit).

Why are telomeres important?

Cells stop duplicating when telomeres become too short. Therefore telomere length is considered to be an excellent biomarker of tissue renewal capacity and, consequently, of organismal aging. Telomeres progressively shorten with increasing age as a consequence of cumulative cycles of cell division that are required for tissue repair and regeneration. This occurs both in differentiated cells as well as in stem cells. Telomere shortening has been demonstrated to impair the ability of stem cells to regenerate tissues when needed. Animal studies have shown that an accumulation of critically short telomeres causes more rapid aging. Interventions that decrease the rate of telomere shortening with age, such as enhancing telomerase, can delay aging and increase longevity. Thus, therapeutic strategies based on telomerase activation are envisioned as potentially important for intervening in age-related problems.

Why does Life Length emphasize the median telomere length rather than the average (mean) value?

Telomere length varies within each single cell, such that each chromosome end has a different length of telomeric repeats (there are 2 telomeres per chromosome and 23 pairs of chromosomes per cell). Average telomere length is the mean length of all telomeres considered together, usually within a population of cells (not even per individual cell). However, as the telomere length distribution of the cells is not symmetrical, the median telomere length is more representative of this distribution rather than the mean.

What is the difference between median telomere length and the 20th percentile and why is this important?

The median telomere length represents the 50th percentile in the distribution of cell telomere lengths. In contrast, the 20th percentile indicates the telomere length below which 20% of the observed telomeres fall. As such it is an estimator of the percentage of short telomeres in the cells. This is important because mounting scientific evidence shows that it is the short telomeres that are responsible for causing aging and the collateral effects of aging. This is because critically short telomeres inflict permanent and deleterious damage to the cell, unless they are repaired by telomerase. Therefore, to be able to evaluate whether telomeres are prematurely short for a given chronological age it is necessary to use techniques that allow quantification of the abundance of short telomeres. Just measuring average or median telomere length of a population of cells is not sufficient to identify premature telomere shortening. The superiority of the technology commercialized by Life Length is based on our ability to precisely measure telomeres individually, allowing for the quantification of short telomeres.

What is the relationship between biological age and chronological age that we can learn from our telomeres?

Not all individuals age at the same rate even though they may have the same chronological age. Therefore, it is important to identify molecular markers (other than chronological age) that can estimate the degree of aging of an organism. This information is useful for health professionals and individuals alike to anticipate premature development of age-related issues and to try to consider changes in lifestyle (for instance, obesity and smoking have been shown to accelerate telomere attrition while exercise and good nutrition slow it), to follow more closely our telomere dynamics over the years, or to benefit from potential telomerase activators. Mounting evidence suggests that the length of telomeres is a good indicator of the degree of aging of an organism.

What are the factors that affect the length of my telomeres?

Genetics and lifestyle are fundamental factors that affect telomere length and the rate at which they shorten. Certain life habits have been significantly associated with having longer or shorter telomeres. For example, smoking, obesity and psychological stress increase oxidative stress and inflammation which, in turn, contribute to higher rates of telomere attrition throughout life. Other factors such as diet, exercise, sleep are also believed to impact biological aging. Current therapies are being developed based on telomerase activation to rejuvenate telomeres. Measuring telomere length will be necessary to determine whether these therapies are effectively improving telomere length.

Why do I need to know my biological age?

Firstly, it is an excellent indicator of an individual overall general health status. Secondly, knowing our biological age, it permits us to obtain a better understanding of the lifestyle habits that impact aging and affords us the opportunity to make appropriate changes and by periodic re-testing, measure the results. Thirdly, Life Length's Telomere Analysis Technology (TAT), will allow for more personalized medicine as doctors treat patients increasingly taking into consideration their biological age.

How is this calculated?

Life Length calculates biological age using a mathematical formula which takes into consideration the individual's chronological age group which is then weighted by their telomere length results.

How often should I get my telomeres measured?

We recommend that individuals interested in monitoring their telomere length repeat the measurement annually, although periods of six months may be considered for individuals making significant lifestyle changes.

What is the purpose of the health questionnaire?

To provide you with increasingly robust information around how your lifestyle habits and other factors influence the aging process, you may have completed our anonymous online questionnaire. If provided, this informaton is used to personalize your report according to your self-reported responses.

How is my information kept anonymous and confidential?

Your blood sample is submitted using a numeric bar coded label and your questionnaire is completed using a unique login and password provided by your physician. Life Length never receives your name. Reports are delivered to your doctor using this identifying code.

What if I get a "bad" result? What can I do?

Our report provides detailed information about your entire telomere length distribution including your 20th percentile as well as a statistically estimated biological age. Knowing that you have a lower than average 20th percentile is like knowing that you have high cholesterol or other conditions which are influenced by certain lifestyle choices. We always recommend you to follow professional medical advice to make those changes that may allow you to reduce your rate of telomere attrition and potentially to even lengthen telomeres and thereby slow down biological aging.
For individuals with unusually low telomere length values, the result could have been influenced by a recent traumatic event, sickness or other stressful occurrence that could have temporarily affected the length of your telomeres as reflected by the blood cells we measure. Such individuals may wish to consider repeating the measurement in six months instead of annually.

Want to continue to be informed about telomere biology and Life Length?

Please visit our website to see updated news and join us on:

Disclaimer
This Report is not intended to replace medical or other professional advice and services from a physician or other qualified healthcare professional. The information contained in the Report does not constitute medical advice or a medical consultation. By no means is the Report intended to suggest the start of any kind of medical treatment, nor should it be considered a substitute for the independent opinion of a physician with regard to any health-related issue. Life Length accepts no responsibility whatsoever for the use or utilization of the Report and its results. It is the physician's responsibility to communicate and interpret the findings with their patient for any treatment or diagnosis.