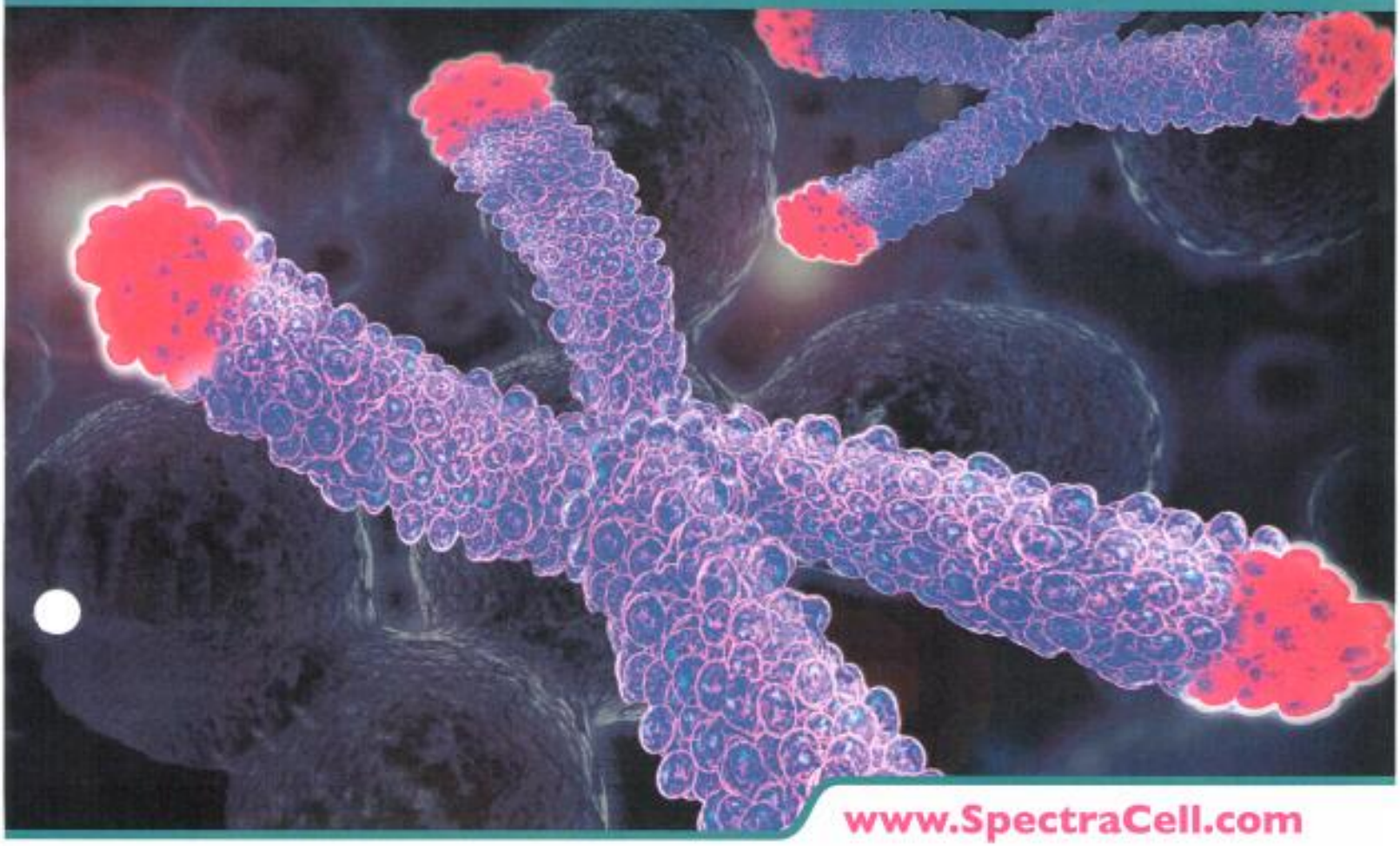
TELOMERE TESTING

A New Foundation for Age Management



www.SpectraCell.com

Telomeres are sections of genetic material at the end of each chromosome whose primary function is to prevent chromosomal "fraying" when a cell replicates. As a cell ages, its telomeres become shorter. Eventually, the telomeres become too short to allow cell replication, the cell stops dividing and will ultimately die - a normal biological process. SpectraCell's Telomere Test can determine the length of a patient's telomeres in relation to the patient's age.

Telomere length can be affected by:

- Age
- Paternal age at birth
- Gender
- Elevated levels of oxidative stress and inflammation
- Menopausal status
- Low levels of physical activity

SPECTRACELL LABORATORIES
ADVANCED CLINICAL TESTING

10401 Town Park Drive
Houston, Texas 77072
800.227.LABS (5227)

The ONLY commercially available telomere analysis in the United States.

A window to your patient's cellular age.

What does Telomere Testing measure?

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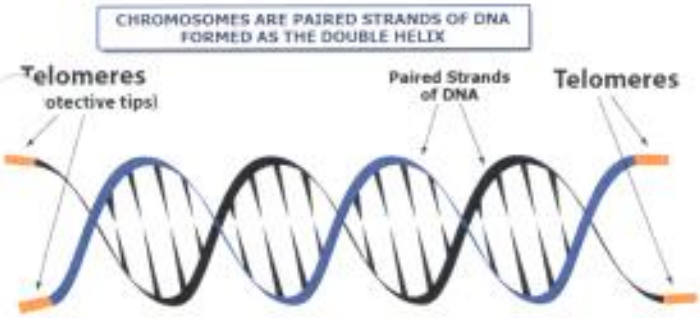
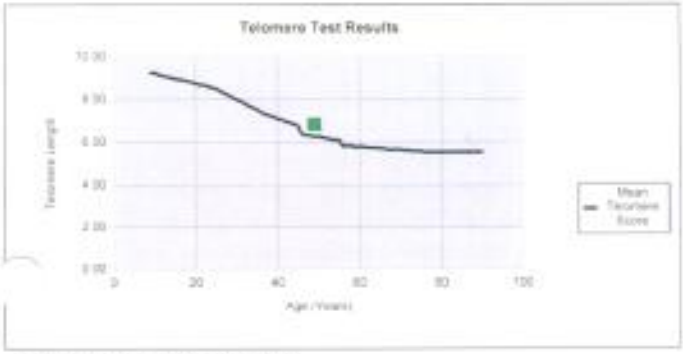


How are the results reported?

The Patient Telomere Score is calculated based on the patient's telomere length on white blood cells (T-lymphocytes). This is the average compared to telomere length on lymphocytes from a sample of the American population in the same age range. The higher the telomere score, the "younger" the cells. A Telomere Score that is above the average line is desirable.



Patient Telomere Score: 6.85
Percentile relative to patient's age population: 74%

What do the results mean to the patient and the doctor?

Age adjusted telomere length is the best method to date to assess biological age using structural analysis of chromosomal change in the telomere. Serial evaluation of telomere length is an indicator of how rapidly one ages relative to a normal population. Therapies directed at slowing the loss of telomere length may slow aging and age-related diseases.

What are the nutritional implications on telomere length and repair?

An inflammatory diet, or one that increases oxidative stress, will shorten telomeres faster. This includes refined carbohydrates, fast foods, processed foods, sodas, artificial sweeteners, trans fats and saturated fats. A diet with a large amount and variety of antioxidants that improves oxidative defense and reduces oxidative stress will slow telomere shortening. Consumption of 10 servings of fresh and relatively uncooked fruits and vegetables, mixed fiber, monounsaturated fats, omega-3 fatty acids, cold water fish, and high quality vegetable proteins will help preserve telomere length. In addition, it is advised to reduce total daily caloric intake and implement an exercise program. Fasting for 12 hours each night at least 4 days per week is recommended.

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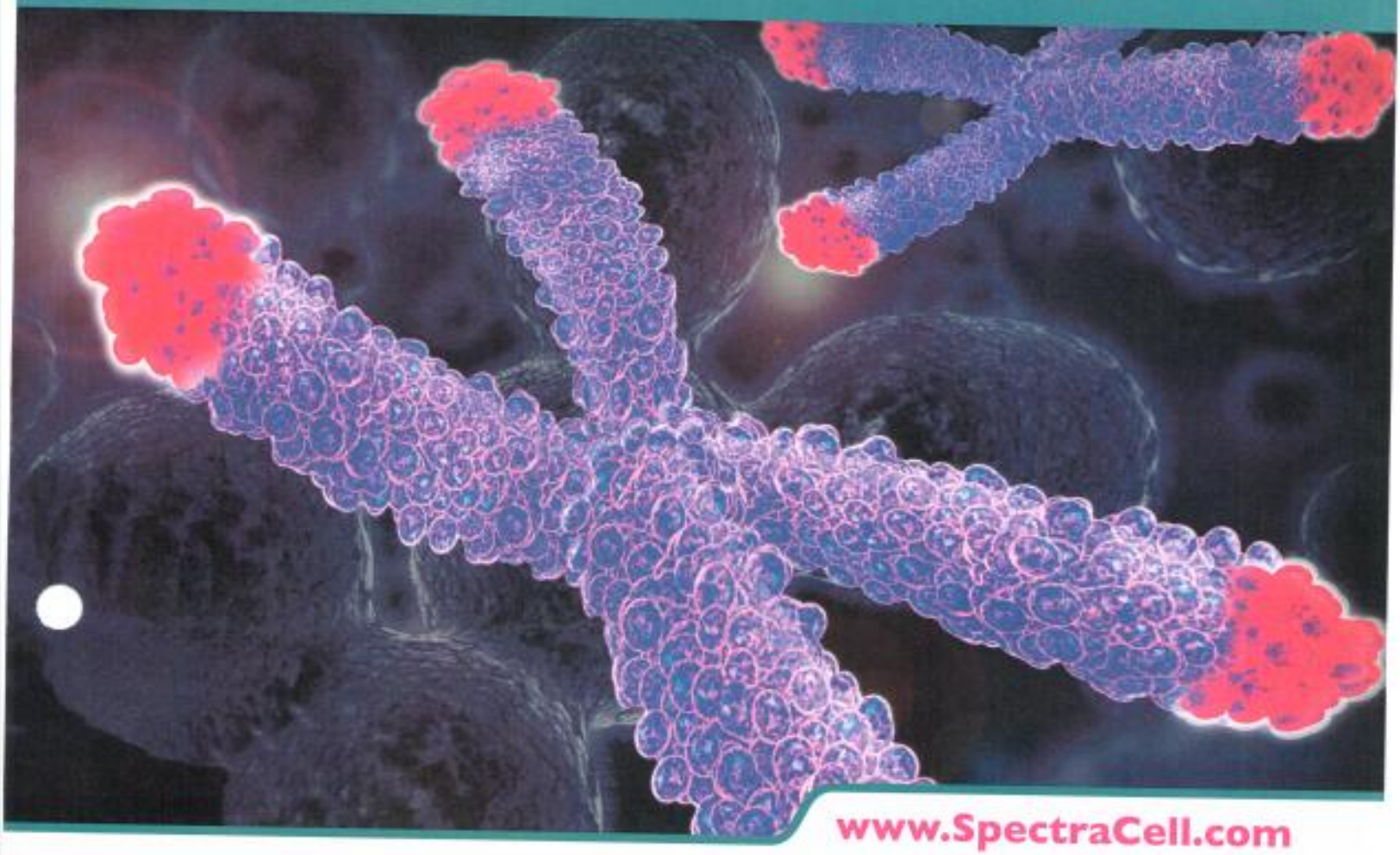

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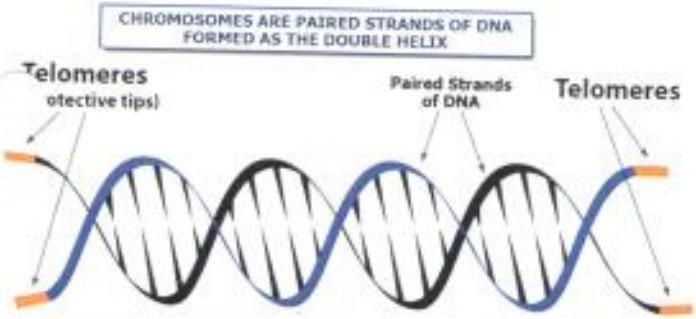

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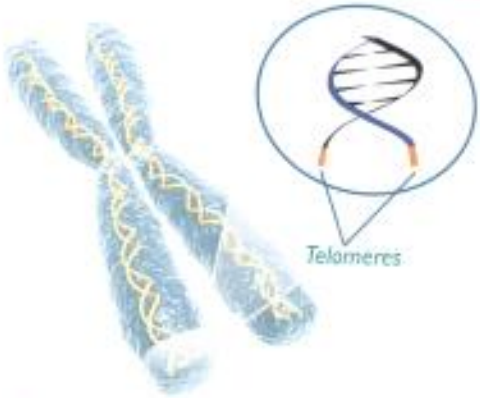

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What lifestyle modifications are likely to be helpful?

One should achieve ideal body weight and body composition with low body fat (less than 22 % for women and less than 16 % for men). Decreasing visceral fat is very important. Regular aerobic and resistance exercise for at least one hour per day, sleeping for at least 8 hours per night, stress reduction, discontinuation of all tobacco products are strongly recommended. Bioidentical hormone replacement therapy may decrease the rate of telomere loss.

When should retesting be considered?

Testing should be done once per year to evaluate the rate of aging and make adjustments in nutrition, nutritional supplements, weight management, exercise and other lifestyle modifications known to influence telomere length.

What role will nutritional supplements play in slowing telomere shortening?

Oxidative stress will shorten telomere length and cause aging in cellular tissue. Antioxidant supplements can potentially reduce oxidative stress very effectively, which will ultimately improve oxidative defenses, mitochondrial function, reduce inflammation and slow vascular aging. Targeted supplementation is key, as antioxidants work synergistically and must be balanced to work most effectively and avoid inducing a pro-oxidant effect. Increasing antioxidant capacity at the cellular level is critical to maintaining telomere length.

Recent evidence suggests that a high quality and balanced multivitamin will also help maintain telomere length. Specifically, studies have linked longer telomeres with levels of vitamin E, vitamin C, vitamin D, omega-3 fatty acids and the antioxidant resveratrol. In addition, homocysteine levels have been inversely associated with telomere length, suggesting that reducing homocysteine levels via folate and vitamin B supplementation may decrease the rate of telomere loss. Similarly, conditions such as cardiovascular disease, insulin resistance, diabetes, hypertension, atherosclerosis and even dementia affect telomere length. Correcting subclinical nutritional deficiencies that may contribute to such diseases is crucial for telomere maintenance.

What pharmacologic treatments are known to slow telomere aging?

- Angiotensin converting enzyme inhibitors (ACEI)
- Angiotensin receptor blockers (ARB)
- Renin Inhibitors
- Statins
- Possibly Calcium channel blockers
- Possibly Serum aldosterone receptor antagonists
- Possibly metformin
- Aspirin
- Bioidentical Hormone Replacement Therapy

Control all known coronary heart disease risk factors to optimal levels.

- Reduce LDL cholesterol to about 70 mg %, decrease LDL particle number and increase LDL particle size.
- Reduce oxidized LDL.
- Increase HDL to over 40 mg % in men and over 50 mg % in women and increase HDL 2 subfraction. Reduce inflammatory HDL and increase protective HDL.
- Reduce fasting blood glucose to less than 90 mg % and 2 hour post prandial or 2 hour GTT to less than 110 mg %. Keep Hemoglobin A1C to about 5.0% and keep insulin levels low.
- Reduce blood pressure to about 120/ 80 mm Hg
- Reduce homocysteine to less than 8 um/L
- Reduce HS-CRP to less than 1.0
- Maintain ideal body weight and composition.
- Stop smoking.
- Treat insulin resistance and metabolic syndrome.

Overall recommendations to maintain telomere length.

Some clinicians have recommended reducing all known coronary risk factors, inflammation, oxidative stress, ADMA levels and angiotensin II levels or its action. At the same time, therapy should increase nitric oxide levels and nitric oxide bioavailability, increase arginine, increase endothelial progenitor cells, improve mitochondrial function and increase oxidative defenses. In addition, one should optimize hormone levels, exercise, sleep, nutrition and nutritional supplements. Fasting and caloric restriction should be part of the regimen as well.

Resetting Your Biological Clock: How to Slow the Aging Process and Live Longer

by Mark Houston, MD, MS, ABAAM, PCCP, FAHA

Youth has no age

Pablo Picasso (1881–1973)

We all desire to live long and healthy lives. None of us wants to deal with the declining health or chronic diseases commonly associated with aging. Given a choice, wouldn't we all like to life full, active, healthy lives and then, when the time comes, make the quick exit? I call this model of life the "Square Life Curve," as opposed to the "Declining Life Curve."

We *can* age successfully. There are ways to control the diseases that cause declining health as we age. We can't *stop* aging, but with myriad lifestyle changes, we can certainly experience a more successful aging process. To age successfully, you must have a healthy mind, body, and spirit.

What Is Aging?

Aging is when the body shifts from a constructive (anabolic) to a destructive (catabolic) state. Anabolism is the replenishing of the body's systems with new and stronger tissue, a rejuvenating or building mode. Catabolism is the breaking down of the body's physiological systems. Physiological function peaks in the 20s, plateaus in the 30s, and then begins a sharp descent in the 40s. In the US the "decade of vulnerability" occurs at the age of 40 to 50 years. During this time, the male ages 15.2 years and the female ages 18.6 years.

What Can You Expect to Happen As You Age

Individuals age at variable rates due to genetic and environmental factors such as nutrition, exercise, stress, smoking, and alcohol and various diseases such as obesity, high blood pressure, high cholesterol, and diabetes mellitus.

Regardless of the rate, however, these are the facts:

- The brain shrinks and there is loss of cognitive function, focus, and memory;
- vision worsens, with cataracts and loss of visual acuity, darkness adaptation, and color perception;
- hearing is impaired, especially for higher tones;
- the skin loses elasticity and collagen, begins to wrinkle and thin, heals slower, and bruises more easily;
- smell and taste decrease, hair thins, and fat increases as lean muscle mass and bone mass decrease, resulting in decreased strength, osteoporosis, and fatigue;
- the kidneys decrease in size and function and the bladder losses its elasticity and capacity, resulting in incontinence;
- the heart has contracted about 2 billion times by age 50, and the incidences of heart attack and heart failure increase;
- the lungs lose elasticity and breathing capacity is reduced by over 20%;
- the pancreas produces less insulin, and diabetes mellitus is more common. In addition, men lose testosterone starting at age 30 and women have reductions in progesterone and estrogen after menopause in their 40s and 50s.

How Old Are You, Really? Biological Versus Chronological Age

Before you can figure out how to slow down your own aging clock, you need to find out where it's currently set. You need to determine your *biological* age versus your *chronological* age. The chronological age is today's year minus your birth year. The biological age is every individual's unique physiological rate of aging. The most accurate means to determine your biological age is the Telomere Test offered by Spectracell Laboratories in Houston, Texas (800-227-5227 or www.spectracell.com). Telomeres on the end of our chromosomes will determine present biological age and also correlate with the rate of aging. There are many methods to slow telomere attrition rate that I will discuss in this article.

Taking the Telomere Test is a first step, along with a thorough intensive physical examination combined with a series of functional and anatomic diagnostic tests including all the biomarkers of aging such as: circulating levels of vitamins, minerals and antioxidants, antioxidant defense, hormone levels, cardiovascular status, vascular health, cardiovascular risk factors, pulmonary status, bone health, speed of nerve conduction, body composition, musculoskeletal health, sensory responses, balance, coordination, reaction time, neuropsychological status, and cognitive function. Please see the list of recommended tests for a complete evaluation.

Tips to Slow Aging

Nutrition

Eat an anti-inflammatory diet. One should consume 10 servings of relatively uncooked fresh fruits and vegetables per day (6 vegetables and 4 fruits of multiple colors, especially a variety of dark berries and grapes). Reduce the refined carbohydrates and foods that contain a high glycemic load or index, and increase complex carbohydrates and fiber. Reduce saturated fats, reduce inflammatory omega-6 fats, and eliminate trans fats; but increase omega-3 fatty acids, in foods such as cold-water fish and nuts, and omega-9 fatty acids, found in olive products and nuts. Use more high-quality protein such as that in cold-water fish, wild game, and grass- or range-fed meat. Avoid caffeine and all sodas, diet or otherwise. Eat less refined, processed, and fast food. Avoid high-fructose corn syrup.

Special consideration: Caloric restriction as been shown to increase the lifespan in primates and rodents by 40% or more. One would need to reduce total caloric intake by 30% to 40%. Caloric restriction with a diminished energy intake forces an optimization of the metabolism and may alter entire genetic programs. It reduces cellular damage and disrupts certain hormonal levels. Another practical method is to fast for 12 hours after 5 p.m. each day for 3 to 4 days per week, combined with increased energy expenditure via resistance and aerobic exercise 4 day per week. This achieves caloric restriction and increases growth hormone and male and female sex hormones, but reduces insulin and cortisol levels and may alter calorie-induced modification of aging genes.

Water

Consume at least 100 ounces of filtered or bottled water (from glass, not plastic) each day. Add some fresh lemon or lime to each glass.

Smoking

Avoid all tobacco use – active or passive.

Exercise

Exercise for at least one hour per day, at least 4 days per week, including a combination of aerobics, resistance training, and flexibility and agility exercises. The aerobic exercises should be interval training at near maximum heart rate for about 30 seconds, followed by 90 seconds at about 60% of maximum heart rate (220 – age). This is repeated for 20 minutes and adjusted as one achieves better cardiovascular conditioning. Resistance training is 40 minutes and should be rotated among different muscle groups. The hour per day does not have to be continuous, but can be divided into 15- or 30-minute segments to achieve the full hour. Remember also that any exercise that you do will help. Start slow, with fewer minutes and less-strenuous exercises, and increase the duration and intensity of exercise over the next several months. Exercise your mind as well with reading, crossword puzzles, math, memory tests, and other mental exercises.

Weight and Body Composition

Ideal body weight, waist circumference, waist/hip ratio, and body composition are important. The ideal body weight is based on body mass index. The percentage of body fat in men should be less than 18% and in women less than 22%. Increases in percent lean muscle mass will improve insulin sensitivity and other hormonal and physiological functions. The waist circumference should be less than 36 inches in men and less than 31 inches in women. The waist/hip ratio should be less than 1.0 in both genders.

Relaxation, Spirituality, and Religious Commitment

All of these modalities that reduce stress and provide inner peace will improve overall health and slow aging. Reductions in stress hormones such as cortisol and adrenalin levels help to reduce blood pressure and heart rate, and improve immune and brain function. Maintain an optimistic attitude and be a positive thinker. Be adaptable and forgiving. Have a lot of love in your life and maintain social, family, and intellectual connections. Consider having a pet in the home. Practice safe and frequent sex with your mate.

Alcohol

Consumption of small amounts of alcohol per day may increase lifespan and reduce the incidence of cardiovascular disease. Although any alcohol may be effective, red wines, especially those with high resveratrol content such as Pinot Noir, Cabernet, and Merlot, may be the most effective. About 20 grams per week is optimal, equivalent to about a 6 ounce glass of red wine per day. More is not better and has detrimental health consequences.

Nutraceuticals, Vitamins, Anti-oxidants, and Minerals

Although there is no definitive proof in humans that specific nutraceuticals, vitamins, antioxidants, and minerals extend life expectancy, there are data in animal models showing that certain supplements are effective in extending lifespan. Coenzyme Q10, R-lipoic acid, acetyl-L-carnitine, phosphatidyl serine, glycerophosphocholine, N-acetyl-cysteine, EGCG (epigallocatechin gallate), trans-resveratrol, grape seed extract, polyphenols, vitamin C, vitamin D, B vitamins, selenium, zinc, lycopene, lutein, vitamin K2 MK-7, gamma- and delta-tocopherols and tocotrienols, and omega-3 fatty acids increase lifespan and cognitive function in rats. Other supplements are being evaluated as well. The best-quality sources for these nutrients are VasculoSirt, EFASirt Supreme, and Resveratrol HP from Biotics Research at 800-231-5777 or biotics@bioticsresearch.com.

Do not take a multivitamin with beta-carotene or only d- or dl-alpha-tocopherol (vitamin E). Males should avoid supplemental iron. Women and men need 2000 IU or more of vitamin D per day to achieve a blood level of vitamin D at 80 ng/ml. Women

need 1500 mg calcium with other bone minerals. Use ginger, turmeric, curcumin, and other natural anti-inflammatory agents.

Recent studies have shown that increasing blood levels of the powerful intracellular antioxidant glutathione and maintaining enzymes that produce it or reduce its destruction will decrease heart attack, stroke, high blood pressure, cardiovascular and vascular diseases, and cancer. Many foods and nutritional supplements will increase intracellular levels of glutathione, such as R-lipoic acid, N-acetylcysteine, selenium, vitamins C and E, whey protein, and broccoli.

According to Greek mythology, the hapless mortal Tithonus mistakenly asked the goddess Eos to confer eternal life rather than eternal youth. He thus found himself condemned to immortal decrepitude. A new report suggests that if Tithonus had cut a deal with Dionysus, the god of wine, he might have fared much better. This may be due to the resveratrol and other polyphenols in red wine

Resveratrol shows the most promise as an anti-aging nutrient. It is found in red wine, the skin of young unripe red grapes, grape seeds, and purple grape juice, and in smaller amounts in peanuts, the roots of the Chinese medicinal herb *Polygonum cuspidatum*, and a South American shrub – *Senna quinquangulata* – that activates a group of genes called sirtuins (silent information regulator proteins), specifically SIRT1 and Sir2 genes in human cells. Activation of SIRT1 will extend lifespan and can be particularly effective in conjunction with caloric restriction. SIRT1 blocks tumor growth and cell death, and protects human cells from gamma radiation. Sir2 increases DNA stability, speeds cellular repair, and increases total lifespan.

The power of resveratrol in various studies is impressive. In yeast, resveratrol extends life by 80%. In mice, rats, fish, and other animal models, resveratrol demonstrates anti-aging, promotes weight loss, and simulates the anti-aging effects of caloric restriction without actually restricting calories. Resveratrol has also demonstrated antioxidant, anti-inflammatory, anticancer, anti-platelet, and cholesterol-lowering activities. Resveratrol increases insulin sensitivity, reduces insulin-like growth factor 1 (IGF-1), activates the PPAR-gamma system, increases mitochondrial number and energy expenditure, and improves motor function.

Recent studies also suggest that resveratrol reduces the risk of colorectal cancer and slows the progression of Alzheimer's disease. One liter (bottle) of red wine contains only about 1 to 2 mg of resveratrol (range of 0.2 to 5.8 mg per liter) The dose needed in humans to achieve an anti-aging effect is not known, but based on the doses that have been shown to be effective in animals and other metabolic and lifespan considerations, a human would need about 250 mg per day of trans-resveratrol. No short- or long-term adverse effects have been noted to date.

Pharmacologic Agents

Angiotensin Converting Enzyme Inhibitors (ACEIs) and Angiotensive Converting Enzyme Inhibitors (ARBs). These drugs are used to treat high blood pressure and heart failure, reduce stroke and heart attack, improve kidney function and reduce urinary protein, improve vascular function, and reduce the incidence of diabetes mellitus. They also have potent antioxidant, anti-growth, anti-inflammatory, and other protective characteristics that increase life expectancy in rats and mice. The exact mechanisms are unclear, but increases in nitric oxide levels and inhibition of the toxic actions of angiotensin II appear to be at play.

Statins. These drugs are used to treat high cholesterol and reduce heart disease and stroke. They also have pleiotrophic effects that are antioxidant, anti-inflammatory, and anti-growth; increase endothelial progenitor cells (stem cells for vascular function); and induce expression of telomere repeat binding factor, which protects telomeres via a "capping" mechanism, reducing senescence. They improve telomere life and thus extend life expectancy in animal models.

Metformin. This drug is used to treat diabetes mellitus and insulin resistance. Its effects on improving glucose and AGE (advanced glycosylation end) products as well as many other biological effects may improve life expectancy in animals.

AGE Cross-Link Breakers. These drugs act by catalytically breaking AGE cross-links. Studies have shown improvement in blood pressure, pulse pressure, and arterial elasticity.

Conclusion

The potential lifespan of the human could be as high as 129 years! Achieving an optimal combination of both quantity and quality of life are important goals for future studies. Many animal studies have demonstrated a wide variety of modalities to increase lifespan. Although definitive studies in humans are lacking, it would seem prudent to consider many of the treatments that are safe as outlined in this article if you are seeking that youthful and healthy life. To age successfully, you must have a healthy mind, body, and spirit. And remember, it is never too late to start.

Mark Houston, MD, MS, ABAAM, FACP, FAHA, is associate clinical professor of medicine at Vanderbilt University School of Medicine, director of the Hypertension Institute and Vascular Biology, director of the Life Extension Institute and Human Nutrition at Saint Thomas Medical Group and Saint Thomas Hospital in Nashville, Tennessee.

Telomere Testing

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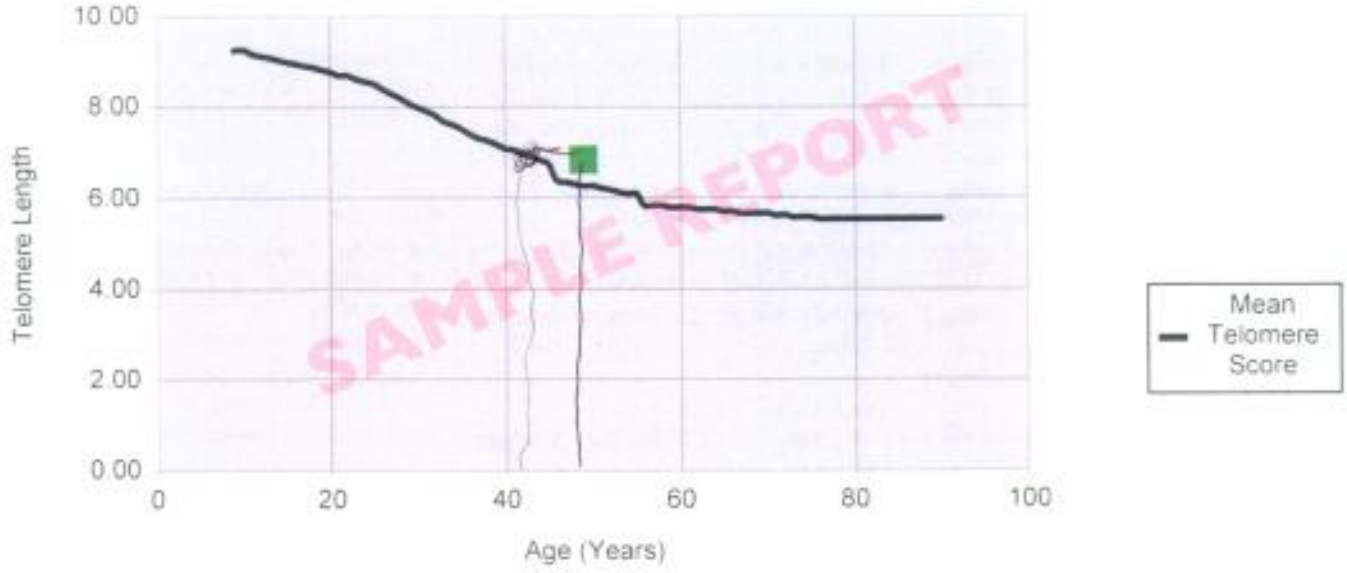
Account Number:	Patient:	Accession Number:
	Gender:	Requisition Number:
	DOB:	Date Received:
		Date Reported:

Telomere Test Results



Patient Telomere Score: 6.85

Percentile relative to patient age and population: 74%

The Patient Telomere Score is a calculation of the patient telomere length derived from nucleated white blood cells obtained from whole blood. This result is graphed relative to the average telomere length of a sample population in the same age range. The higher the telomere score, the "younger" the cells.

A Patient Telomere Score that is above the black line (green box) is an above average Telomere score.

A Patient Telomere Score that is below the black line (red box) is a below average Telomere score.

If patient age was not provided, a horizontal red/green line will be shown which represents the patient Telomere score across all age groups.

J.F. Crawford, Ph.D., Laboratory Director

CLIA# 45D0710715

All tests performed at SPECTRACELL LABORATORIES * 10401 Town Park Drive, Houston, Texas 77072
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Function:

Telomeres are sections of DNA at the end of each chromosome that serve as a cap to the genetic material. Their purpose is critical to the life of the cell in that they serve as protective buffers that keep the ends of the chromosomes from becoming attached to each other or rearranging. If cells divided without telomeres, they would lose the necessary information at the end of each chromosome. In this way, telomeres prevent chromosomal fraying.

Every time a cell replicates, its telomere will become shorter, eventually causing cell death once the telomere attrition has reached a critical length. It is estimated that human telomeres lose about 100 base pairs from their telomeric DNA during each mitosis (cell division). At this rate, after approximately 125 mitotic divisions, the telomeres would be completely gone, which is why normal cells will eventually die after healthy division. Shorter telomeres imply a shorter life span for a cell, essentially giving it a finite lifespan, depending on the number of cell divisions left within each telomere.

Cells can maintain the length of their telomeres with an enzyme called telomerase, which adds genetic material at the end of the DNA strand, thus lengthening the number of times it can replicate, which ultimately prolongs the life of the cell. It is not active in most cells, but is active in stem cells, germ cells, hair follicles and most cancer cells.

Reporting:

Telomere length is determined using a ratio of the genetic material contained in a nucleated white blood cell telomere relative to the length of a single copy gene of known size to calculate an approximate telomere score. This ratio is then compared to a population of people with similar chronological age.

Clinical Application:

Shorter telomeres have been associated with metabolic abnormalities, obesity and several degenerative diseases including cancer, dementia and cardiovascular disease. In vitro studies have shown that telomeres are highly susceptible to oxidative stress, which will shorten telomere length and enhance cellular aging.

Minimizing associated risk factors that are linked to shortened telomere activity is recommended:

- Reduce oxidative stress
- Correct micronutrient deficiencies, in particular, vitamin C, D and E
- Change sedentary lifestyle by increasing physical activity
- Avoid weight gain or obesity
- Correct insulin resistance

Clinical Update

Multivitamins linked to younger 'biological age': Study

The cells of multivitamin users may have a younger biological age than cells from non-users, according to new research from the US.

(American Journal of Clinical Nutrition, June 2009)

Researchers led by Honglei Chen, MD, PhD from National Institute of Environmental Health Sciences looked at the length of telomeres, DNA sequences at the end of chromosomes that shorten as cells replicate and age.

The ageing and lifespan of normal, healthy cells are linked to the so-called telomerase shortening mechanism, which limits cells to a fixed number of divisions. During cell replication, the telomeres function by ensuring the cell's chromosomes do not fuse with each other or rearrange, which can lead to cancer. Elizabeth Blackburn, a telomere pioneer at the University of California San Francisco, likened telomeres to the ends of shoelaces, without which the lace would unravel.

With each replication the telomeres shorten, and when the telomeres are totally consumed, the cells are destroyed (apoptosis). Previous studies have also reported that telomeres are highly susceptible to oxidative stress.

Dr Chen and his co-workers noted that telomere length may therefore be a marker of biological ageing, and that multivitamins may beneficially affect telomere length via modulation of oxidative stress and chronic inflammation. According to results published in the new issue of the American Journal of Clinical Nutrition, the telomeres of daily multivitamin users may be on average 5.1% longer than in non-users.

According to a National Institutes of Health (NIH) State-of-the-Science Panel, half of the American population routinely use dietary supplements, with their annual spend estimated at over $20 billion. Recent results of the National Health and Nutrition Examination Survey showed that 35% of the US adult population regularly consumes one or more types of multivitamin product (Am. J. Epidemiol., 2004, Vol. 160, Pages 339-349).

New study

Dr Chen and his co-workers analysed multivitamin use and nutrient intakes, as well as telomere length of 586 women aged between 35 and 74 in the Sister Study. A 146-item food-frequency questionnaire was used to determine multivitamin use and nutrient intakes.

Compared to non-multivitamin users, the researchers noted that that telomeres were on average 5.1 per cent longer for daily multivitamin users.

In an attempt to identify specific nutrients that could be behind the observations, a positive relationship between telomere length and intakes of vitamins C and E from foods was observed.

Being the first study to report such an association, Dr Chen and his co-workers emphasized that the evidence is only preliminary and that additional epidemiologic studies are required to further explore the association. The implications of the findings in terms of ageing and the etiology of chronic diseases should be carefully evaluated.

Source: www.nutraingredients.com

Abstract

Am J Clin Nutr. 2007 Nov;86(5):1420-1425.

Higher serum vitamin D concentrations are associated with longer leukocyte telomere length in women

Richards JB, Valdes AM, Gardner JP, Paximadas D, Kimura M, Nessa A, Lu X, Surdulescu GL, Swaminathan R, Spector TD, Aviv A.

From Twin Research and Genetic Epidemiology, St Thomas' Hospital, King's College, London School of Medicine, London, United Kingdom.

BACKGROUND: Vitamin D is a potent inhibitor of the proinflammatory response and thereby diminishes turnover of leukocytes. Leukocyte telomere length (LTL) is a predictor of aging-related disease and decreases with each cell cycle and increased inflammation.

OBJECTIVE: The objective of the study was to examine whether vitamin D concentrations would attenuate the rate of telomere attrition in leukocytes, such that higher vitamin D concentrations would be associated with longer LTL.

DESIGN: Serum vitamin D concentrations were measured in 2160 women aged 18-79 y (mean age: 49.4) from a large population-based cohort of twins. LTL was measured by using the Southern blot method.

RESULTS: Age was negatively correlated with LTL ($r = -0.40$, $P < 0.0001$). Serum vitamin D concentrations were positively associated with LTL ($r = 0.07$, $P = 0.0010$), and this relation persisted after adjustment for age ($r = 0.09$, $P < 0.0001$) and other covariates (age, season of vitamin D measurement, menopausal status, use of hormone replacement therapy, and physical activity; P for trend across tertiles = 0.003). The difference in LTL between the highest and lowest tertiles of vitamin D was 107 base pairs ($P = 0.0009$), which is equivalent to 5.0 y of telomeric aging. This difference was further accentuated by increased concentrations of C-reactive protein, which is a measure of systemic inflammation.

CONCLUSION: Our findings suggest that higher vitamin D concentrations, which are easily modifiable through nutritional supplementation, are associated with longer LTL, which underscores the potentially beneficial effects of this hormone on aging and age-related diseases.

PMID: 17991655

Abstract

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Telomere length and risk of incident cancer and cancer mortality.

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CONTEXT: Telomeres are essential to preserve the integrity of the genome. Critically short telomeres lead to replicative cell senescence and chromosomal instability and may thereby increase cancer risk.

OBJECTIVE: To determine the association between baseline telomere length and incident cancer and cancer mortality.

DESIGN, SETTING, AND PARTICIPANTS: Leukocyte telomere length was measured by quantitative polymerase chain reaction in 787 participants free of cancer at baseline in 1995 from the prospective, population-based Bruneck Study in Italy.

MAIN OUTCOME MEASURES: Incident cancer and cancer mortality over a follow-up period of 10 years (1995-2005 with a follow-up rate of 100%).

RESULTS: A total of 92 of 787 participants (11.7%) developed cancer (incidence rate, 13.3 per 1000 person-years). Short telomere length at baseline was associated with incident cancer independently of standard cancer risk factors (multivariable hazard ratio [HR] per 1-SD decrease in log(e)-transformed telomere length, 1.60; 95% confidence interval [CI], 1.30-1.98; P < .001). Compared with participants in the longest telomere length group, the multivariable HR for incident cancer was 2.15 (95% CI, 1.12-4.14) in the middle length group and 3.11 (95% CI, 1.65-5.84) in the shortest length group (P < .001). Incidence rates were 5.1 (95% CI, 2.9-8.7) per 1000 person-years in the longest telomere length group, 14.2 (95% CI, 10.0-20.1) per 1000 person-years in the middle length group, and 22.5 (95% CI, 16.9-29.9) per 1000 person-years in the shortest length group. The association equally applied to men and women and emerged as robust under a variety of circumstances. Furthermore, short telomere length was associated with cancer mortality (multivariable HR per 1-SD decrease in log(e)-transformed telomere length, 2.13; 95% CI, 1.58-2.86; P < .001) and individual cancer subtypes with a high fatality rate.

CONCLUSION: In this study population, there was a statistically significant inverse relationship between telomere length and both cancer incidence and mortality.

PMID: 20606151

*****FOR IMMEDIATE RELEASE – **July 21, 2011*****

SpectraCell's Telomere Testing Goes Mainstream

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Houston, TX- July 21, 2011. America's #1 rated morning news program, *The Today Show*, featured a story highlighting SpectraCell's Telomere Test, a blood test that measures cellular aging. The segment entitled *How to Live to 100* showcased SpectraCell's Telomere Test as a tool for those interested in monitoring their health with biomarkers specific to longevity and aging. The Telomere Test measures a person's biological age in comparison to their chronological age, giving a person an overall picture of how well they are aging.

SpectraCell was the first company to commercially offer telomere analysis to patients when it introduced its Telomere Test in June 2009. Before that, telomere testing was only available to researchers and university scientists. SpectraCell's telomere testing was also recently featured in the New York Times (May 18, 2011). The *Today Show*, which has over five million viewers, aired the story on July 13, 2011. (http://today.msnbc.msn.com/id/26184891/vp/43737929#43737929)

Telomeres are sections of DNA at the end of chromosomes that cap genetic material and serve as protective buffers that prevent chromosomes from becoming attached to each other or rearranging. They are often compared to the caps at the ends of shoelaces. Every time a cell replicates, its telomere gets shorter, eventually causing cell death once the telomere attrition has reach its maximum. Measuring telomere length in human lymphocytes is an indicator of cellular aging, and research demonstrates that shortened telomeres are responsible for many of the normal processes of aging.

"SpectraCell Laboratories has always been on the cutting edge of diagnostic testing and Telomere Testing is no exception. We commercialized this test in direct response to interest from our physician clients, who saw it as a natural complement to our micronutrient testing," says Otto Schaefer, Vice President of Sales and Marketing for SpectraCell. "The landscape of healthcare is really changing, with people taking charge of their own personal health information."

Human chromosome

The most common question asked by people who get the telomere test is "What do I do if I have a low telomere score?" Basic lifestyle changes are the first step – these include smoking cessation, moderate daily exercise and maintaining a healthy weight. For those who have already made these choices but still have a low telomere score, a comprehensive nutritional assessment is recommended.

Deficiencies in nutrients such as folate and vitamins C and D can shorten telomeres, so it is imperative to correct such deficiencies. Oxidative stress is another major culprit in telomere shortening so reducing inflammation and shoring up the body's antioxidant defenses is critical for telomere maintenance. A person's ability to combat free radicals, which cause oxidative stress, can be improved by correcting deficiencies in specific antioxidant nutrients, such as vitamin E, selenium and glutathione.

Telomere length is affected by many factors: age, genetics, lifestyle, disease and pharmaceuticals. Chronic diseases such as cardiovascular disease, hypertension, diabetes, obesity and dementia have strong associations with shorter telomeres. But telomere attrition can be mitigated significantly with aggressive lifestyle therapies as well as certain medications.

SpectraCell's test measures a person's telomere length. A control gene is also measured and compared to the telomere length, and then results are stated as a ratio. A higher ratio means a longer telomere, and younger biological age. The Telomere Score is also compared to other individuals in the same chronological age group.

This automated test is based on Quantitative Real Time PCR (polymerase chain reaction) technology and only requires 1 mL of whole blood. When a sample is received at SpectraCell's Houston laboratory, the white blood cells are broken apart, the DNA is extracted and the telomeric DNA is amplified into a measurable signal. This signal is compared to a control gene of known length and a Telomere Score is generated. The price of the Telomere Test is $290. Testing once each year starting around age 25 is suggested to monitor the rate of telomere loss. More information at www.spectracell.com.

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About SpectraCell Laboratories – SpectraCell is a CLIA accredited laboratory servicing healthcare providers nationwide by providing advanced clinical tests that measure nutritional status, cardiovascular risk, and cellular aging.

SpectraCell's micronutrient tests measure the function of over 32 vitamins, minerals, amino acids and antioxidants in white blood cells, specifically taking into consideration personal differences in metabolism, age, genetics, health, prescription drug usage, absorption rate and other factors.

SpectraCell's Telomere test measures how well a person's body is aging internally. Many factors – both genetic and environmental – affect the rate of telomere loss, and this test provides an overall window into aging at the cellular level.

SpectraCell's Lipoprotein Particle Profile™ is the most advanced lipoprotein particle test available, providing an accurate and in-depth assessment of cardiovascular risk.

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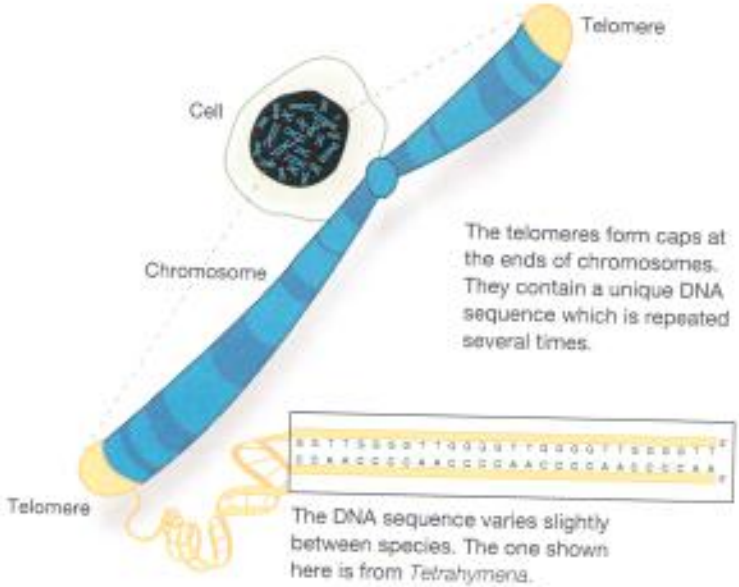
The Telomere
– Function and Synthesis



The telomeres form caps at the ends of chromosomes. They contain a unique DNA sequence which is repeated several times.

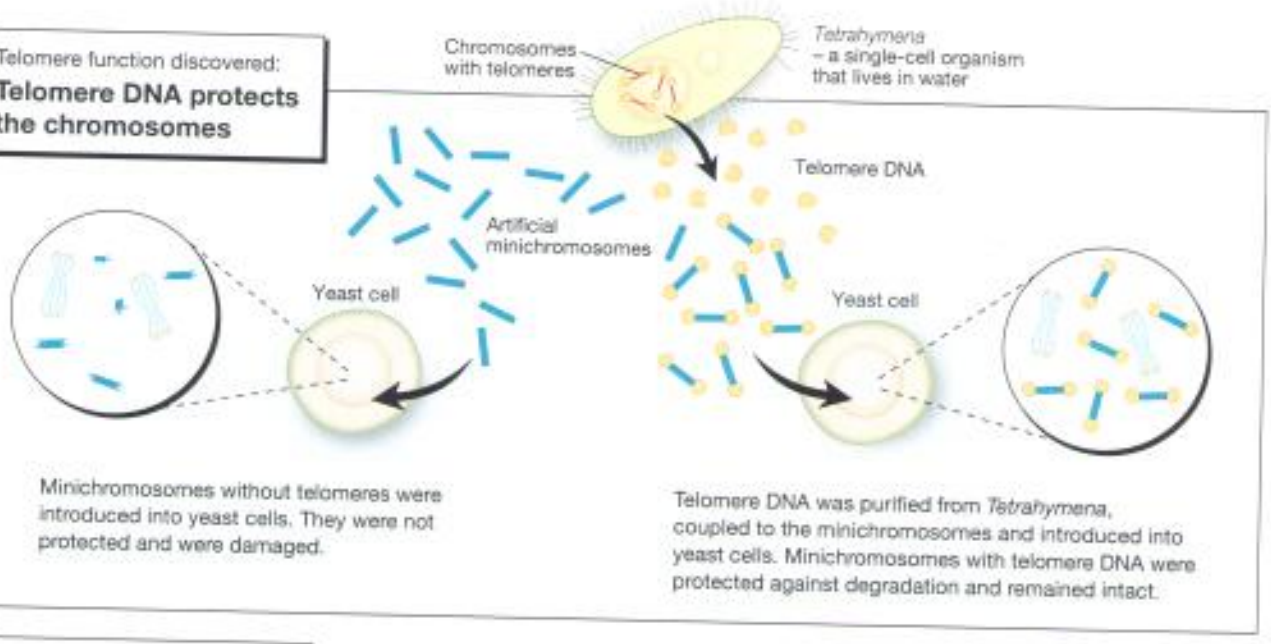
1. The mysterious telomere

The telomeres appear to protect the chromosomes from damage. But how?

Telomere = Greek for "end" *(telos)* and "part" *(meros)*

The DNA sequence varies slightly between species. The one shown here is from *Tetrahymena*.

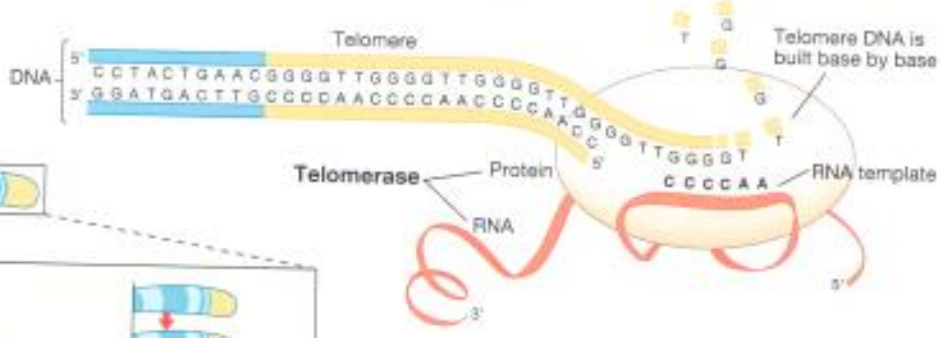
2. Telomere function discovered: Telomere DNA protects the chromosomes



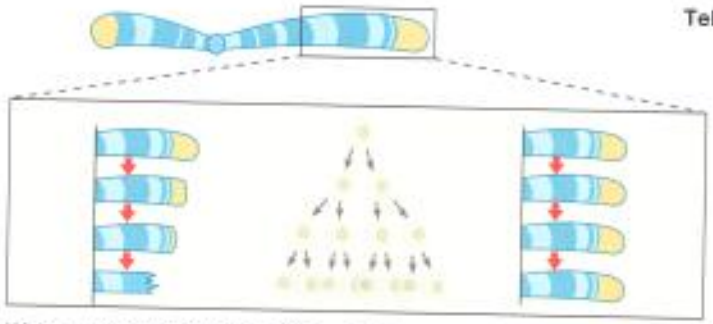
Minichromosomes without telomeres were introduced into yeast cells. They were not protected and were damaged.

Telomere DNA was purified from *Tetrahymena*, coupled to the minichromosomes and introduced into yeast cells. Minichromosomes with telomere DNA were protected against degradation and remained intact.

3. Telomere synthesis elucidated: Telomerase builds telomere DNA



Telomerase operates at the end of the chromosome. It is an enzyme consisting of a protein and an RNA sequence. The RNA serves as a template for synthesizing telomere DNA.



Without telomerase present, the chromosome is shortened each time the cell divides. Finally the telomere DNA is eroded and the chromosome is damaged.

Telomerase maintains the telomeres at the ends of the DNA thread. This makes it possible to copy the entire chromosome to its very end each time the cell divides.

TELOMERE TESTING •