Representative Clinical Studies

Associating Telomere Length with Disease & Wellness

Shorter Telomere Length and Disease

Blood leukocyte telomere length and its impact on human health has been researched for over 20 years with consistent clinical findings from multiple studies. Average telomere length (ATL) offers insights into individuals’ overall health as well as several chronic and age-related diseases. A select list of studies are profiled here and more are available at www.teloyears.com.

Telomere length & MORTALITY


This study assessed the association between blood leukocyte average telomere length and mortality in 143 normal unrelated individuals over the age of 60 years. Individuals with shorter telomeres had poorer survival, attributable in part to a 3.18-fold higher mortality rate from heart disease (95% CI 1.36-7.45, p=0.0079), and an 8.54-fold higher mortality rate from infectious disease (1.52-47.9, p=0.015). These results support that telomere shortening in human beings contributes to mortality in many age-related diseases.


This study examined the association between leukocyte telomere length and mortality in US adults aged 50–84. (n=3,091). A decrease of 1 kilobase pair in telomere length at baseline was marginally associated with a 10% increased hazard of all-cause mortality (HR: 1.1, 95% CI: 0.9, 1.4) and a 30% increased hazard of death due to diseases other than cardiovascular disease or cancer (HR: 1.3, 95% CI: 0.9, 1.9).

Telomere length & DIABETES


Health ABC study, a community-based cohort of 3,075 healthy, well-functioning, men and women aged 70–79 years. Average Telomere Length, as measured by Q-PCR, was assessed to see if those with the shortest ATL have poorer survival, shorter life span, and fewer years of healthy life (YHL).

Longer telomere length was associated with more years of healthy living. Longer ATL was positively associated with longer years of healthy life (p = 0.05). Findings suggest that ATL may be an informative biomarker of healthy aging.


In meta-analysis of 5,759 cases and 6,518 controls in nine cohorts, shortened telomere length was significantly associated with type two diabetes mellitus (OR: 1.291; P:0.001) with heterogeneity (I² = 71.6%). When three cohorts responsible for the heterogeneity were excluded, the pooled OR for the remaining cohorts indicated a significant association remained (OR: 1.117; P = 0.045).
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**Telomere length & CARDIOVASCULAR DISEASE**


In a meta-analysis of twenty four studies involving 43,725 participants and 8,400 patients with cardiovascular disease (5,566 with coronary heart disease and 2,834 with cerebrovascular disease), in a comparison of the shortest versus longest third of leukocyte telomere length, the pooled relative risk for coronary heart disease was 1.54. Available observational data show an inverse association between leukocyte telomere length and risk of coronary heart disease independent of conventional vascular risk factors.

**Telomere length & ALZHEIMER’S**


Our data show a significant telomere shortening in PBMC from AD versus controls (P=0.04). Telomere length of T cells, correlated with AD disease status, measured by Mini Mental Status Exam (MMSE) scores (P=0.025). T cell telomere length also inversely correlated with serum levels of the proinflammatory cytokine TNFalpha (a clinical marker of disease status), with the proportion of CD8+ T cells lacking expression of the CD28 costimulatory molecule, and with apoptosis. These findings suggest an immune involvement in AD pathogenesis.

**Telomere length & OBESITY**


In a cross-sectional sample of 309 non-Hispanic white participants aged 8 to 80 yr (52% female), average telomere length was negatively correlated with age (r = -0.32, P < 0.0001) and had numerous significant correlations with established cardiovascular disease risk factors including waist circumference (r = -0.33), apolipoprotein B (r = -0.26), systolic blood pressure (r = -0.28), and fasting serum glucose (r = -0.15); all P < 0.0025. In backward selection linear regression models of telomere length, adiposity measures were consistently retained in the best models; BMI, waist circumference, hip circumference, total body fat, and visceral adipose tissue volume were all inversely associated with average telomere length at the nominal P < 0.05 level or lower, independent of age, sex, systolic blood pressure, and fasting serum lipid, lipoprotein, and glucose concentrations. Individuals with higher total and abdominal adiposity have lower average telomere length, a marker of cellular senescence, suggesting obesity may hasten the aging process.

**Telomere length & MOOD DISORDERS**


Accelerated telomere shortening may reflect stress-related oxidative damage to cells and accelerated aging, and severe psychosocial stress has been linked to telomere shortening. Telomere length was measured by Southern Blot Analysis in 44 individuals with chronic mood disorders and 44 nonpsychiatrically ill age-matched control subjects. Telomere length was significantly shorter in those with mood disorders, representing as much as 10 years of accelerated aging. These results provide preliminary evidence that mood disorders are associated with accelerated aging and may suggest a novel mechanism for mood disorder-associated morbidity and mortality.

**Preliminary Support for a Chronic Stress Model of Accelerated Aging**


In thirty-eight studies (n=34,347), Depression severity significantly associated with telomere length (p=0.03). The association remained highly significant after accounting for publication bias. Subgroup analysis revealed depression assessment tools, telomere measurement techniques, source tissue and comorbid medical conditions significantly affected the relationship.
Interventions to Increase Telomere Length and Improve Health

Blood leukocyte telomere length can be increased by making adjustments to several lifestyle factors, of which diet, exercise, and stress reduction have been shown to return positive results.

**Telomere length & LIFESTYLE**


After previously finding an association between 3 months of comprehensive lifestyle changes and increased telomerase activity in human immune-system cells, the authors followed up participants to investigate long-term effects (ten men and 25 external controls who had biopsy-proven low-risk prostate cancer and had chosen to undergo active surveillance). Men in the intervention group followed a program of comprehensive lifestyle changes (diet, activity, stress management, and social support), and the men in the control group underwent active surveillance alone. Relative telomere length increased from baseline by a median of 0.06 telomere to single-copy gene ratio (T/S) units (IQR –0.05 to 0.11) in the lifestyle intervention group, but decreased in the control group (–0.03 T/S units, –0.05 to 0.03, difference p=0.03). When data from the two groups were combined, adherence to lifestyle changes was significantly associated with relative telomere length after adjustment for age and the length of follow-up (for each percentage point increase in lifestyle adherence score, T/S units increased by 0.07, p=0.005).

**Telomere length & PHYSICAL ACTIVITY**


The authors tested the hypothesis that physical activity level in leisure time (over the past 12 months) is associated with leukocyte telomere length (LTL) in 2,401 white twin volunteers. Leukocyte telomere length was positively associated with increasing physical activity level in leisure time (P<.001); this association remained significant after adjustment for age, sex, body mass index, smoking, socioeconomic status, and physical activity at work. The LTLs of the most active subjects were 200 nucleotides longer than those of the least active subjects (7.1 and 6.9 kilobases, respectively; P=.006). This finding was confirmed in a small group of twin pairs discordant for physical activity level (on average, the LTL of more active twins was 88 nucleotides longer than that of less active twins; P=.03). Conclusions: A sedentary lifestyle (in addition to smoking, high body mass index, and low socioeconomic status) has an effect on LTL and may accelerate the aging process. This provides a powerful message that could be used by clinicians to promote the potentially antiaging effect of regular exercise.

**Telomere length & DIET**


The study examined whether adherence to the Mediterranean diet was associated with longer telomere length. Studied were 4,676 disease-free women from nested case-control studies within the Nurses’ Health Study with telomere length measured who also completed food frequency questionnaires. Greater adherence to the Mediterranean diet was associated with longer telomeres after adjustment for potential confounders. Least squares mean telomere length z scores were −0.038 (SE 0.035) for the lowest Mediterranean diet score groups and 0.072 (0.030) for the highest group (P for trend=0.004). In this large study, greater adherence to the Mediterranean diet was associated with longer telomeres. These results further support the benefits of adherence to the Mediterranean diet for promoting health and longevity.
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