National Institute on Aging

BALTIMORE LONGITUDINAL STUDY OF AGING
1958-1998

Selected Findings from 1978-1998

Heart and Arteries

The Brain and Memory

Personality

The Prostate

The Senses

Diet and Metabolism

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Introduction

The Baltimore Longitudinal Study of Aging (BLSA) celebrates its 40th anniversary in 1998. In commemoration of this event, scientists in the BLSA have selected findings from the past 40 years of research that give a brief glimpse into the study. These findings barely scratch the surface of a study such as the BLSA, which has published over 800 scientific papers since 1958. The findings serve as an introduction to the wealth of information the BLSA has given us.

1958-1978: Early Findings - The First 20 Years of the BLSA

Understanding and Characterizing Aging

By the time the BLSA was 20 years old, an overview of the first 20 years of findings, "Normal Human Aging", was written. The authors discussed what was known then about individual differences among people. This led BLSA scientists to describe what does and does not change and how much change there is with age.

Another important BLSA contribution at the time involved disentangling the effects of disease and illness from the aging process. Many declines associated with age are not due to aging but to illnesses associated with age. Aging is distinct from disease, and the respective effects of disease and aging are also distinct and specific.

By 1978, the contributions of the BLSA to our understanding of human aging were so numerous that "Normal Human Aging" is only a starting point toward comprehending what the first 20 years of this study contributed to our understanding of aging and the field of gerontology.

Shock NW., Greulich RC., Andres RA., Arenberg D., Costa P.T., Jr., Lakatta EW., and Tobin J.D. Normal Human Aging: The Baltimore Longitudinal Study of Aging. Bethesda, MD: NIH Pub No 84-2450; 1984.

Since 1978, our understanding of human aging has continued to grow, thanks in part to the BLSA and its many volunteer subjects. Here are some selected findings from 1978-1998:

Heart and Arteries

1. Normal Aging of the Human Heart and Arteries is a Risk Factor for Cardiovascular Disease at Older Ages

BLSA scientists discovered that stiffening of the arteries, which occurs with aging, is associated with a modest thickening of the heart wall and lack of resiliency in other blood vessels that make up the plumbing system for blood in the body. This stiffening, which was observed in BLSA participants with normal blood pressure, is similar to changes seen in mild hypertension, or high blood pressure.

Gerstenblith, G, Frederiksen, J, Yin, FCP, Fortuin, NJ, Lakatta, EG, and Weisfeldt, ML. Echocardiographic assessment of a normal adult aging population. Circulation 1977:56:273-278. Click here for abstract

2. Life Style and Medications Could Help Slow the Decline in Heart Function of Older People

BLSA Laboratory of Cardiovascular Sciences studies have determined that declines in the ability to perform aerobic exercises and increases in arterial stiffness can be markedly improved by vigorous physical conditioning. Improvements were seen when comparing endurance-exercise-trained participants with sedentary participants. Medications under development by the Cardiovascular lab that dilate, or expand, blood vessels, may help boost heart function. However, a significant decline in the ability of the heart to pump blood to the lungs occurs with advancing age in some BLSA participants, and can discourage participation in leisure time exercise and activities by older people.

Vaitkevicius, PV, Fleg, JL, Engel, JH, O'Connor, FC, Wright, JG, Lakatta, LE, Yin, FCP, and Lakatta, EG. Effects of age and aerobic capacity on arterial stiffness in healthy adults. Circulation 1993:88 [part 1]: 1456-1462. Click here for abstract

3. Cholesterol Continues to be a Risk Factor for Heart Disease in Elderly Men

The traditional risk factors that lead to the development of disease in mid-life are still important in late life. In a study of over 1,000 men age 28 to 97, researchers found that high cholesterol is a risk factor for heart disease even in very old men. The fact that blood cholesterol concentration is a definite risk factor even in individuals 75 to 97 years of age points to the necessity of continuing a healthful life-style into very old age.

Sorkin JD, Andres R, Muller DC, Baldwin HL, and Fleg JL. Cholesterol as a risk factor for coronary heart disease in elderly men: The BLSA Annals of Epidemiology 1992:2: 59-67. Click here for abstract

The Brain and Memory

4. Dementia and Cognitive Declines May Be Predicted as Many as 20 Years before Symptoms are Observed

Early signs of dementia may be detectable as long as 6 to 15 years before noticeable declines are confirmed by extensive mental status tests. By observing changes in memory over a six year period, BLSA investigators found that immediate visual recall tests (remembering a picture or design very shortly after having first seen it) also predicted cognitive performance up to 22 years later, even after taking into account age and other factors. These results provide evidence that change in immediate visual memory has long-term significance in predicting future mental changes and may also signal the onset of diseases such as Alzheimer's.

Zonderman AB, Giambra LM, Arenberg D, Resnick SM, and Costa PT. Changes in immediate visual memory predict cognitive impairment. Archives of Clinical Neuropsychology 1995:10:111-123. Click here for abstract

5. Short-term Visual Memory Declines over Time, but Vocabulary Increases Until People are in Their 80's

Compared to people in their 20s, 30s and 40s, people 60 years and older make increasingly more errors in tests that examine their ability to remember figures and shapes for a short-term period of time. In contrast, vocabulary test scores increase over time at all ages until the 80s, after which vocabulary declines only slightly. Based on memory and vocabulary tests administered in the BLSA over the past 35 years, not all cognitive functions decline over time. These findings suggest the need to recognize that cognitive aging is a complex process.

Giambra LM, Arenberg D, Kawas CH, Zonderman AB, and Costa PT. Adult life span changes in immediate visual memory and verbal intelligence. Psychology of Aging 1995:10:123-39. Click here for abstract

6. Estrogen Replacement Therapy May Have a Beneficial Effect in Preventing Alzheimer's Disease and Cognitive Declines in Post-menopausal Women

Recent evidence has suggested that there are protective factors as well as risk factors for Alzheimer's disease and cognitive decline. Scientists in the Laboratory of Personality and Cognition found that estrogen replacement therapy (ERT) in women may have a protective effect on their risk of developing Alzheimer's disease. By looking at use of estrogen replacement therapy over a period from 1978 to 1994, it was shown that women who began estrogen replacement maintained stable memory or recall whereas women who did not take estrogen replacement therapy showed

decreases in memory with age. These findings demonstrate the possible beneficial role of estrogen on cognitive functioning in normal aging women, but confirmation by controlled clinical trials must be done before any firm recommendations can be made.

Kawas CH, Resnick SM, Morrison A, Brookmeyer R, Corrada M, Zonderman AB, Bacall C, Lingle D, and Metter EJ. A prospective study of estrogen replacement therapy and the risk of developing Alzheimer's disease: The Baltimore Longitudinal Study of Aging. Neurology 1997:48:1517-1521. Click here for abstract

Resnick SM, Metter EJ, and Zonderman AB. Estrogen replacement therapy and longitudinal decline in visual memory: A possible protective effect? Neurology 1997:49: 1491-1497. Click here for abstract

7. Non-steroidal Anti-inflammatory Drugs Such as Ibuprofen May Reduce the Risk for Alzheimer's Disease

Use of non-steroidal anti-inflammatory drugs, such as ibuprofen, was associated with reduced risk for Alzheimer's disease. These medications, which are frequently used by older Americans, may eventually be shown to protect against the development of dementia. The findings suggest that inflammation may play a role in the development of Alzheimer's and perhaps anti-inflammatory agents could play a role in its treatment. Only with the completion of controlled clinical trials that are currently in the planning stages will we know if these drugs will truly be helpful.

Stewart WF, Kawas C, Corrada M, and Metter EJ. Risk of Alzheimer's disease and duration of NSAID use. Neurology 1997:48:626-632. Click here for abstract

Personality

8. Stability of Personality in Adulthood and Older Years

Personality traits have been measured using different methods and questionnaires over a period of 30 years. Analyses of long-term data show that adults as a whole change little after age 30. People who are cheerful and assertive at age 30 are likely to be cheerful and assertive at age 80. These findings show that stereotypes that depict older people as depressed, withdrawn, and rigid are myths. They also imply that marked changes in personality are not due to normal aging, but instead may be signs of disease or dementia.

Costa, PT, Metter, EJ, and McCrae, RR. Personality stability and its contribution to successful aging. Journal of Geriatric Psychiatry 1994:27:41-59. Click here for abstract

9. Older People Cope More Effectively with Stress than Young Adults

It was once widely believed that older people became rigid and lost the ability to cope at just that period of life when they faced the most serious stress. Research at the BLSA calls this view into question. Older people have to face more challenges, particularly from poor health, but in other respects they experience less stress than younger adults (who must juggle work, marriage, and children). When surveyed on a series of ways of coping, there are few age differences in the ways people handle stress; younger adults appear to use

some less effective methods (like hostile reactions to others and escapist fantasies) more than older adults. The ability to cope does not normally decline with age. Most older adults appear to be able to handle stress well.

McCrae, RR. Age differences and changes in the use of coping mechanisms. Journal of Gerontology: Psychological Sciences 1989:44: P161-169. Click here for abstract

10. Happiness is More Predictable from a Person's Disposition than from the Special Events He or She Encounters

People usually assume that happiness depends on special events or circumstances—getting a raise, staying healthy, taking a dream vacation. But analyses of BLSA measurements of psychological well-being show that in the long run, the most important determinants of happiness are personality traits. People quickly adapt to both good and bad circumstances, so the impact of special events can be fleeting; but people who are sociable, generous, goal-oriented, and emotionally stable consistently report higher levels of happiness and lower levels of depression than others. Measures of these particular personality traits can predict happiness years in advance.

Costa, PT, Jr. and McCrae, RR. Mood and personality in adulthood. In: Malatesta-Magai and McFadden (Eds.), Handbook of emotion, aging and the lifecourse. Orlando, FL: Academic Press, 1996.

The Prostate

11. Rate of Change in Prostate Specific Antigen (PSA) is a More Sensitive Method of Detecting Prostate Cancer than Using a Fixed Cutoff Value.

Scientists in the BLSA looked at the time it took for PSA readings to double in three groups of men with different prostate conditions, and found that rapid increases in PSA were better predictors of prostate cancer than fixed values. The PSA values for the men were looked at for a period of up to 26 years using blood that had been stored in BLSA freezers. Changes seen in PSA values over time were predictive not only of prostate cancer, but also of other prostate diseases such as benign prostatic hyperplasia, or enlargement of the prostate. The investigators were able to differentiate between various conditions based on the rate of change of PSA values over time.

Carter HB, Pearson JD, Metter EJ, Brant LJ, Chan DW, Andres R, Fozard JL, and Walsh PC. Longitudinal elevation of prostate specific antigen levels in men with and without prostate disease. JAMA 1992:267:2215-2220. Click here for abstract

12. Examining the Ratio of Free PSA to Total PSA Helps Reduce Incorrect Diagnoses of Prostate Cancer

Many studies have shown that use of a test to determine a man's serum level of PSA is a valid way of diagnosing prostate cancer. However, the majority of men with high PSA levels do not have cancer, and therefore routine testing can lead to many unnecessary tests to rule

out the presence of cancer. Further research into how best to interpret PSA readings led BLSA investigators to determine that a ratio might be useful. The ratio of free (the amount floating loosely in the blood rather than bound to other serum proteins) to total PSA is one of the earlier and better ways of predicting prostate cancer later in life. Measurement of the free to total PSA ratio reduces positive test results among men who, in reality, do not have prostate cancer.

Pearson JD, Luderer AA, Metter EJ, Partin AW, Chan DW, Fozard JL, and Carter HB. Longitudinal analysis of serial measurements of free and total PSA among men with and without prostate cancer. Urology 1996:48(6A):4-9. Click here for abstract

13. Percentage of Free PSA in the Blood Predicts Aggressiveness of Prostate Cancer a Decade Before Diagnosis

One dilemma that many cancer specialists face is determining which men with prostate cancer have aggressive forms of the disease and will benefit from treatment, and which have less aggressive disease and do not need treatment. This BLSA study evaluated the percentage of free PSA as a marker of cancer aggressiveness. Often no difference between total PSA levels is seen when comparing aggressive and non-aggressive cancers. But instead there is a statistically significant difference in free PSA levels. This suggests that knowing the percentage of free PSA may be helpful to a doctor in determining treatment strategy in men who are diagnosed with prostate cancer. It also means that men whose cancer is unlikely to be aggressive can be identified and the possible side effects of radical treatment (e.g., impotence, incontinence) avoided.

Carter HB, Partin AW, Luderer AA, Metter EJ, Landis P, Chan DW, Fozard JL, and Pearson JD. Percentage of free prostate specific antigen in sera predicts aggressiveness of prostate cancer a decade before diagnosis. Urology 1997:49:379-384. Click here for abstract

The Senses

14. Hearing Loss is Greatest at High Frequencies and in Lower Frequency Speech (Conversation) in Older Men

Hearing loss at high frequencies (presbycusis) has long been recognized by physicians and scientists. BLSA findings show that the rate of hearing loss is more rapid in the perception of certain lower frequencies related to everyday speech than in some higher, often non-spoken frequencies. By measuring hearing loss for a 15-year period over a wide range of audio frequencies for each of 7 different age groups, BLSA scientists found a widespread pattern of hearing loss. Researchers found that hearing loss was mild in the 60s and loss accelerated and became severe in the 80s.

Brant LJ, and Fozard JL. Age changes in pure-tone hearing thresholds in a longitudinal study of normal human aging. Journal of the Acoustical Society of America 1990:88:813-820. Click here for abstract

15. Taste Perception Shows Some Declines with Age

A group of 91 men and 79 women between the ages of 23 and 88 years old were given liquid solutions that represented the four basic taste qualities — sweet, sour, salty and bitter. The oldest age group was the only one that showed some loss of taste intensity perception (they needed more salt in the solution to taste salt, for example), while reliability of judgments about specific tastes declined with age for some taste qualities (the ability to accurately decipher all of the flavors inherent in a particular solution).

Weiffenbach JM, Cowart BJ, and Baum BJ. Taste intensity perception in aging. Journal of Gerontology 1986:41:460-468. Click here for abstract

Diet and Metabolism

16. Age Effects on Alcohol Metabolism, or, How Does a Three-Martini Lunch Affect Younger Versus Older People?

Fifty BLSA male participants, age 21 to 81, were given the equivalent of three martinis intravenously over a period of one hour. Contrary to expectations, the older men metabolized the alcohol just as effectively as the younger men. How quickly alcohol was eliminated from the body was also not affected by age. Changes in age-related factors such as body-composition (i.e., lower lean body mass in older men) contributed to higher peak alcohol concentration for the same dose of alcohol for older as compared to younger BLSA men. Additionally, older men showed greater alcohol-related impairment in reaction-time and intellectual functioning than younger men for equal doses of alcohol.

Vestal RE, McGuire, EA, Tobin, JD, Andres, R, Norris, AH, and Mezey, E. Aging and ethanol metabolism. Clinical Pharmacology and Therapeutics 1977:21:343-354. Click here for abstract

17. Effects of Age on Body Fat Distribution

Obesity is a risk factor for the development of many age-related diseases. With aging, there is a shift in the pattern of deposition of fat in the body from the safer peripheral areas, such as the hips and thighs, to the core of the body—the dangerous abdominal area around the waist. BLSA researchers examined 547 men and women over a period of 5 years and observed their weight changes. The scientists found that in men, changes in waist size predominated while women showed about equal changes in waist and hip measurements. Even though women carry more total body fat than men, men develop a more dangerous fat distribution pattern, and this may play a role in the higher incidence of many diseases in men and in their shorter life span.

Shimokata H, Tobin JD, Muller DC, Elahi D, Coon PJ, and Andres R. Studies in the distribution of body fat. I Effects of age, sex and obesity. Journal of Gerontology 1989:44:M66-73. Click here for abstract

18. Diet Trends from the 1960s to the 1980s.

One of the myths of aging is that old people cannot, or will not, change their lifestyles. Starting in the late 1960's, dietary practices of Americans became healthier. Changes in nutrition have been just as great in the old and very old segments of the population as in young and middle-aged adults. By examining dietary diaries of BLSA participants age 27 to 88, researchers found that diets improved over the decades. In particular, fat and cholesterol consumption declined while consumption of fiber increased. Older people are as flexible to change as younger people and can benefit as much as younger people from healthy lifestyle recommendations.

Hallfrish J, Muller D, Drinkwater D, Tobin J, and Andres R. Continuing Diet Trends in Men: The Baltimore Longitudinal Study of Aging (1961-1987). Journal of Gerontology 1990:45:M186-191. Click here for abstract

19. Predictors of the Rate of Development of Diabetes

The rate of development of diabetes increases progressively throughout adult life. While genetic factors play a role, a number of other factors are of great importance: increasing obesity, deposition of fat in the waist region, and decreasing physical fitness. Maintaining a healthy life style can be expected to decrease the incidence of diabetes in later life.

Edelstein, SL, Knowler WC, Bain RP, Andres R, Barrett-Connor EL, Dowse GK, Haffner SM, Pettit DJ, Sorkin JD, Muller DC, Collins VR, Hamman RF. Predictors of progression from impaired glucose tolerance to NIDDM. Diabetes 1997:46:701-710. Click here for abstract

20. Effects of Age on Kidney Function

The difference between an effective or a toxic dose of a medicine may be determined by how well the body gets rid of the medicine. Kidneys play an important role in drug uptake and elimination. BLSA scientists have found that kidney function declines by some 30 percent from age 30 to 50. This decline is not caused by kidney disease, but instead occurs with normal aging. Loss of function does not influence survival as surplus function in early adult life permits a decline to occur without harm. However this loss of function must be considered in decisions concerning appropriate dosage of many of the drugs used in the treatment of older individuals.

Rowe JW, Andres R, Tobin JD, Norris AH, and Shock NW. The effect of age on creatinine clearance in men: A cross-sectional and longitudinal study. Journal of Gerontology 1976:31: 155-163. Click here for abstract

The selection, paring, and editing of over 800 findings for inclusion in this document required the efforts of many of the BLSA scientists and staff, particularly Dr. Paul T. Costa, who helped write and compile the initial drafts. Everyone's help is greatly appreciated.

Participants and others often ask how the BLSA fits into the United States Government's overall health effort. The BLSA is funded by tax dollars. Government employees, who are scientists, doctors, nurses, technicians, and secretaries, staff the BLSA. They work for the National Institute on Aging (NIA), one of the 18 institutes at the National Institutes of Health (NIH), the Federal Government's biomedical research agency. Most of NIH's funding supports research at universities, medical institutions, and hospitals around the country and the world. However, each institute at NIH has a government staffed laboratory facility as well. The Gerontology Research Center (GRC) in Baltimore is where most of the National Institute on Aging laboratories are located and where the BLSA is conducted.